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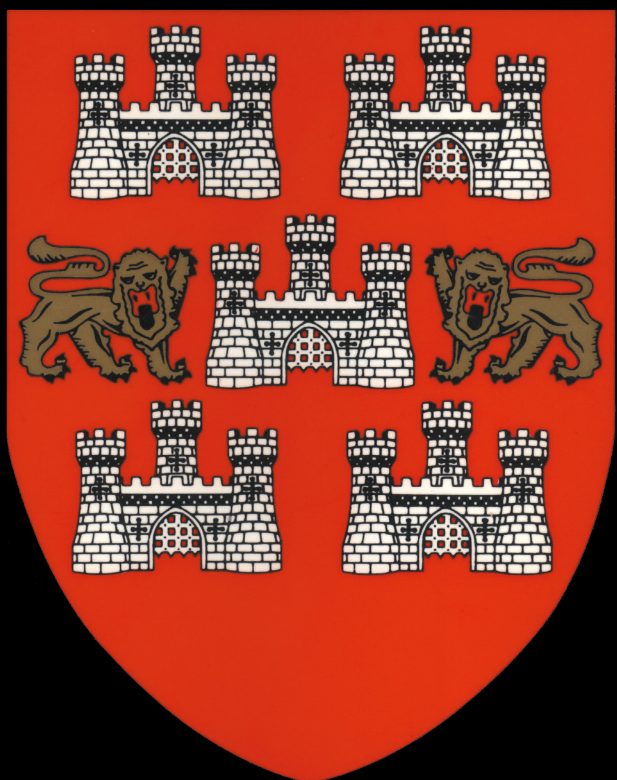
General Editor: Martin Biddle

The People of Early Winchester



EDITED BY

CAROLINE M. STUCKERT

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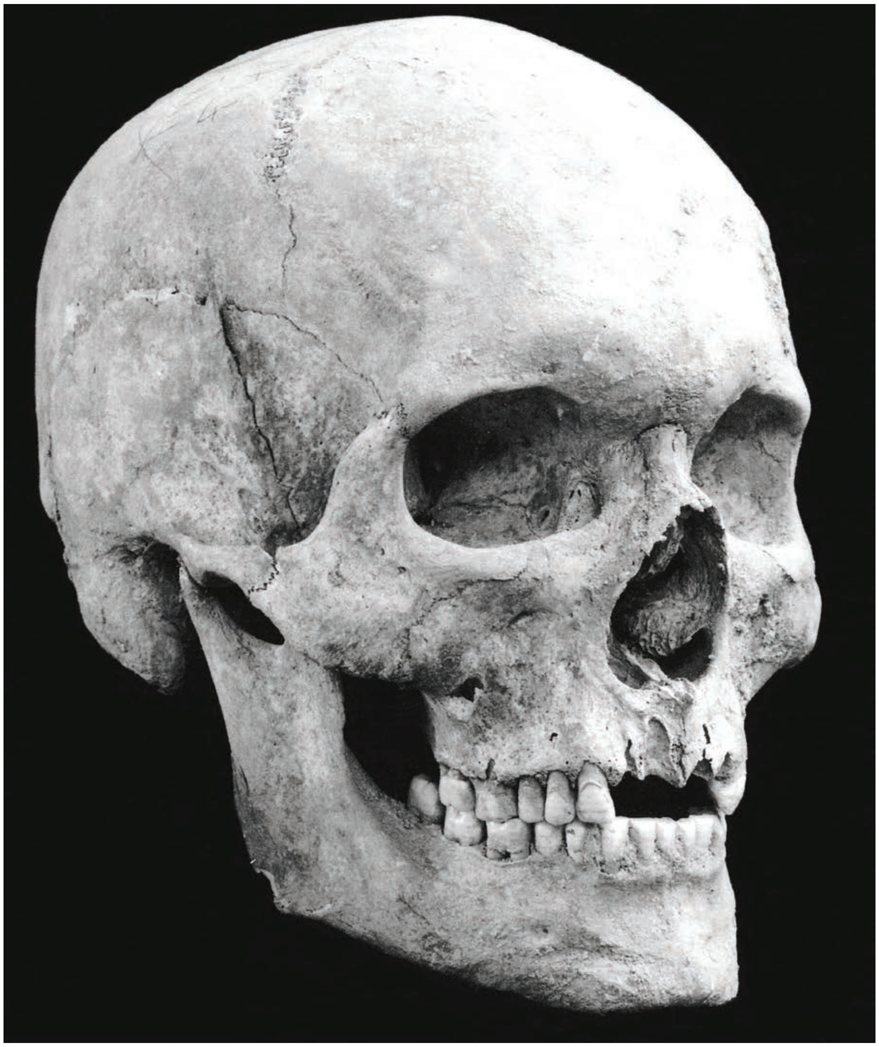

A citizen of medieval Winchester. The skull of a robust adult male from a medieval earth grave in the cemetery of Winchester Cathedral.
(CG 1965, MG 688, Final phase 78–80, mid 14th to 15th cent.)

WINCHESTER STUDIES 9.i

THE PEOPLE OF EARLY WINCHESTER

Edited by
CAROLINE M. STUCKERT

With contributions by
Caroline M. Stuckert (Parts 2, 3, and 5),
Martin Biddle and †Birthe Kjølbye-Biddle (Part 1),
and Theya Molleson, †John Price, Rosemary Powers, and Pauline Sheppard (Part 4)

and additional contributions by
Sue Browne, J. L. Macdonald, and Katie Tucker

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General Editor's Preface to the Reprinted and Open Access Edition

Since 2021, volumes in the *Winchester Studies* series have been made available in facsimile of the original out-of-print editions. Developments in digital technologies now enable academic publishing to reach wider audiences with options to read online or print on demand. From the earliest days of the development of technology to enable online publication, we have been exploring options for digitising our volumes, while maintaining close attention to the quality of reproduction, especially of our large scale and complex illustrations. Those familiar with our volumes will understand and appreciate the care that has been taken with the illustrations. The team at Archaeopress have ensured important facets like scale and pagination are maintained throughout each volume. It is only through the expertise, dedication, and enthusiasm of Archaeopress and their team that this attention to detail and accuracy in digital reproduction has been achieved, and for that we are very grateful.

Martin Biddle
March 2023

GENERAL EDITOR'S PREFACE

The Winchester excavations of 1961–71 began in a wholly *ad hoc* manner in July 1961 in response to the impending construction of a new hotel on the site of the Cathedral Car Park. There was then no statutory protection for the buried remains of the urban past, and it was entirely due to the efforts of Roger Quirk CB, whose study of the Old and New Minsters had led him to the view that the site of the hotel lay within the New Minster Precinct and might even include the site of the minster church itself, that arrangements were made for an excavation which lasted from July until the end of the year, and beyond during the early stages of construction.

Everything had to be improvised. When a cemetery of tenth- to eleventh-century date was uncovered, it was to Don Brothwell, then one of Dr Jack C. Trevor's group located in the Duckworth Laboratory in the Department of Archaeology and Anthropology at Cambridge (where I had graduated that summer) that I naturally turned for study of the physical anthropology of the burials.

As the excavations continued over the following decade, on many sites and on an ever increasing scale, Don Brothwell, who had by then moved to the Department of Anthropology at the British Museum (Natural History), now the Natural History Museum, took the lead role in dealing with the vast quantities of human remains recovered from excavations on the Cathedral Green notably, indeed nobly, assisted by his colleagues, Theya Molleson and Rosemary Powers.

Outside Cambridge, Manchester, and London there were then no major centres for the study of buried human remains in this country, and few people qualified to do the work. The excavation of the Lankhills Roman cemetery in 1967–72 highlighted the problem: no-one could be found to carry out a comprehensive study of the Romano-British skeletons and we were fortunate to obtain the help of Miss Mary Harman to provide the initial aging and sexing of the bodies, essential for the production of the report.

The Department of Anthropology at the University of Pennsylvania in Philadephia is one of the most distinguished centres for the study of ancient human remains. As recorded in Part 1 (pp. 1–6) it was in 1974 that Connie Stuckert from the Penn department visited Winchester to discuss a possible subject for a doctoral dissertation. In the course of time, in addition to continuing work on her dissertation, she agreed to prepare a full report on the Lankhills skeletons, and eventually took on the editing of this present volume.

Today, with the introduction of fully-funded archaeological investigation of sites threatened by development, a vibrant tradition of palaeoanthropology has developed in this country, resulting in the appearance of an already considerable and constantly increasing number of outstanding publications. The work at Winchester stood on the cusp between the older, amateur tradition by which local doctors were recruited to report on skeletal material and the new world of a highly professional discipline.

Winchester was fortunate from the start in securing the advice and active involvement of Professor Don Brothwell and his colleagues at the Natural History Museum and most fortunate again at a later stage to secure the crucial contribution of Dr Connie Stuckert who has brought to conclusion this study of the human remains of over 3000 people covering some 1300 years of the population history of an English city, an achievement apparently hitherto unparalleled.

I am particularly grateful to members of the Winchester Research Unit office in Oxford, Katherine Barclay, Clare Chapman, and Francis Morris for their unstinting help in seeing this volume through the press.

Martin Biddle

Encaenia
25 June 2015

Note: the appearance of a volume on human osteology in a series devoted so far mainly to archaeology and history suggested the need for a Glossary, which appears here as Appendix D (pp. 442–56).

EDITOR'S PREFACE

A LONG journey began when I first walked into Martin Biddle's office in the summer of 1974. I could not have foreseen that 40 years later the end result would be this volume. Trained as both an archaeologist and physical anthropologist, at the time I was a young graduate student hunting a research topic that would permit me to use skeletal data as a resource in addressing cultural dynamics. Specifically, I was interested in the seemingly rapid and radical transition from the lifestyle and cultural patterns of a Roman province to that of Anglo-Saxon England. By the early 1970s emerging archaeological data was beginning to present a picture of this culture change that was at variance with aspects of the rather meagre historical record, and infinitely more complex, but no one, at that time, had looked at the composition of the populations involved. Was there truly massive population replacement? Or did the population remain essentially unchanged, indicating far more complex cultural processes at work?

I decided to tackle this question in one region of England, using a variety of statistical techniques and collecting the largest sample of both Roman period and Early Anglo-Saxon skeletons possible at that time in a circumscribed geographic area. Hampshire quickly became the logical place to look. Ultimately I was able to obtain data from over 770 skeletons from nine separate sites, two Romano-British and seven Early Anglo-Saxon. The results of that research, partially funded by grants from the National Science Foundation and the University of Pennsylvania, constitute Part 3 of this volume.

Many people helped along the way, and I am deeply indebted to all of them, named and unnamed. Sadly, some are no longer with us.

Special thanks goes to the General Editor of Winchester Studies, Martin Biddle, and the late Birthe Kjølbye-Biddle for unfailing guidance, assistance, and support over four decades and two continents, even when our opinions differed. It has been an incredible collaboration. The project would not have been possible without access to the skeletons themselves, and for this I am grateful to a small army of people including Giles Clarke, Kenneth Qualmann, Sonia Hawkes, Alison Cook, Vera Evison, Audrey Meaney, John Musty, Don Brothwell, Rosemary Powers, Adrien Rance, Fred Aldsworth, Robin Harvey, Leslie Webster, David Rudkin, and Graham Johnson. My assistant in England in 1976–77, Sylvia Meacock, with her combination of manual dexterity and training as a nurse, proved invaluable in sticking skulls back together. Later, after Martin Biddle had invited me to publish the Lankhills bones as part of this volume, I returned to Winchester several times to investigate the skeletal pathology of the Lankhills sample, now presented here in Part 2, which had not been part of my original project. Michael Zimmerman M.D., Ph.D. and Morrie Kricun M.D. both provided essential diagnostic assistance and information, although I must accept any errors as mine alone. Thanks also go to the University of Southampton, Einstein Medical Center in Philadelphia, and to Dr David Wilson, St Luke's Hospital, Oxford, for the many radiographs needed for this study. A trans-Atlantic project of this sort would not have been possible without the unflagging support of the Anthropology Department, University of Pennsylvania as well as my doctoral dissertation committee, and also many individuals at both the Winchester Research Unit and the then City Archaeologist's Office, Winchester. My thanks to all of them.

Work on the Cathedral Green Anglo-Saxon and medieval skeletons proceeded along a completely different track, involving a separate group of researchers initially led by Don Brothwell and subsequently brought to completion by Theya Molleson. An overview of the history of this project is given in Part 1.

Delays in publishing a project of this magnitude are perhaps inevitable, but also create issues that must be addressed. It would be incorrect to assume that because work started 40 years ago, all the data accumulated and methodology employed are both 40 years old and also outdated. This project has been a work in progress, sometimes moving forward, sometimes on hold, for many years. It is true that if we were to design a comprehensive study of this nature today, it would be done somewhat differently, would stress greater consistency in methodology, and would take greater advantage of scientific advances not available until recently. That said, many of the techniques employed in this study are still in use today, and are still valid. As, we believe, are the results.

One of the most significant challenges we have faced is the potential impact on our findings of data from more recent excavations, especially those at Lankhills in 2000–5 and at the other Romano-British cemeteries in Winchester. As new information has become available, we have evaluated and incorporated it as appropriate, and an extended discussion will be found in Part 2. Another challenge has lain in the increasing use of DNA analyses to address questions of population movements in general, and the Romano-British/Anglo-Saxon transition in particular. In England, most of this work has been done in parts of the country other than Hampshire, and has been done using modern populations as the sample, not skeletal material from the period. It of course raises the question of whether conclusions based on older statistical techniques continue to be valid. Part 3 discusses this question in some detail. At present, DNA studies do not appear to contradict our results.

Long delays in publication have also opened up new opportunities to include important work in this volume that would not have been possible ten or twenty years ago. Katie Tucker has stepped forward with a new and greatly improved forensic analysis of the Lankhills decapitations. Jock Macdonald has provided an updated and revised interpretation of the ritual involved, which has been able to incorporate all the decapitations from Lankhills, including those from the later excavations, and has also been able to take advantage of the data provided by physical anthropology.

When I agreed in 2008 to edit the entire volume, I realized that a very large task lay before me. It could not have been accomplished without the help of Theya Molleson in bringing Part 4 into final form, for which I am most thankful indeed. Dr Janet Monge, Department of Anthropology, University of Pennsylvania, and Dr Hans-Chr. Petersen, Department of Statistics, University of Southern Denmark, provided timely assistance on several occasions. I also owe thanks to Helen Rees of the Winchester City Museums for all sorts of assistance, and most especially to Katherine Barclay of the Winchester Research Unit. She was a remarkable source of information and advice, a problem-solver extraordinaire, and she saved my sanity more than once. To these, and the many other research and excavation teams, staff, and volunteers who all touched this project at one time or another, my deepest thanks.

Caroline M. Stuckert

Newtown Square, Pennsylvania
5 June 2014

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Photographs and radiographs by courtesy of Martin Biddle, Einstein Medical Center (Philadelphia), Jay Erwin, Morrie Kricun, Natural History Museum (London), St Luke's Hospital (Oxford), Caroline M. Stuckert, Katie Tucker, and the University of Southampton.

Line drawings by Simon Hayfield, Rosemary Powers, and Mark Redknap.

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LIST OF ABBREVIATIONS

Arch J	*Archaeological Journal*
Am J Phys Anthropol	*American Journal of Physical Anthropology*
Am Antiq	*American Antiquity*
Ann Eugen	*Annals of Eugenics*
Antiq J	*Antiquaries Journal*
A-P	Anterior–posterior: used e.g. to define shaft diameter of long bones
ASC skull	Anglo-Saxon Charnel skull from Cathedral Green
ASG	Anglo-Saxon Grave: designation for Anglo-Saxon burials at Cathedral Green
BABAO	British Association for Biological Anthropology and Osteoarchaeology
BAR	British Archaeological Reports
Brit Dent J	*British Dental Journal*
Brit J Radiol	*British Journal of Radiology*
CACP	Cathedral Car Park: site code used for burials found at excavations at this site in Winchester in 1961
Caries Res	*Caries Research*
CBA	Council for British Archaeology
CG	Cathedral Green: site code used for the Anglo-Saxon and medieval cemeteries of the Old Minster, New Minster, and the Norman and later cathedral in Winchester in 1962–70
CI	Cranial Index
Clin Radiol	*Clinical Radiology*
CPR	Crude Prevalence Rate
DCN	Data Code Number: used by the British Museum (Natural History) team to reference records of their work on individual bodies from the Anglo-Saxon and post-Conquest cemeteries on the Cathedral Green, Winchester
Dent Rec	*Dental Record*
DF	Degrees of freedom
DI	Dimorphism Index (stature)
DISH	Diffuse Idiopathic Skeletal Hyperostosis
dm	deciduous molar: lower case indicates immature dentition (Scheuer and Black, 2004, 149)
DNH	Dorset Natural History and Archaeological Society
Drug Develop Res	*Drug Development Research*
EHR	*Economic History Review*

Genet Epidemiol	*Genetic Epidemiology*
HB	*Human Biology*
HFC	Hampshire Field Club and Archaeological Society
I1	Incisor 1
I2	Incisor 2
Indet.	Indeterminate
Intl J Osteoarchaeol	*International Journal of Osteoarchaeology*
Intl J Paleopath	*International Journal of Paleopathology*
Israel J Med Sci	*Israel Journal of Medical Sciences*
JAMA	*Journal of the American Medical Association*
J Am Acad Orthop Surj	*Journal of the American Academy of Orthopaedic Surgeons*
J Am Dent Assn	*Journal of the American Dental Association*
J Anat	*Journal of Anatomy*
J Archaeol Sci	*Journal of Archaeological Science*
J Epidemiol Commun H	*Journal of Epidemiology and Community Health*
J Forensic Sci	*Journal of Forensic Sciences*
J Hum Evol	*Journal of Human Evolution*
J Int Assoc Dent Child	*Journal of the International Association of Dentistry for Children*
J Roy Anthrop Inst	*Journal of the Royal Anthropological Institute*
LEH	Linear enamel hypoplasia
LH	Lankhills: site code used to designate graves from the 1967–72 excavations
M^1	'upper' (i.e. maxilliary) Molar 1. Superscript is used similarly for the other upper teeth
M_1	'lower' (i.e. mandibular) Molar 1. Subscript is used similarly for the other lower teeth
MASCA	Museum Applied Science Center for Archaeology (University of Pennsylvania)
MG	Medieval Grave: designation for medieval burials at Cathedral Green. Grave numbers 1 to 499 are cist graves; numbers from 500 are earth graves.
MoLAS	Museum of London Archaeological Service (now MOLA)
Mol Biol Evol	*Molecular Biology and Evolution*
na	Not available
N, n	Number in population *or* number in sample or 'set' under consideration
n/N	Number of cases noted (n) in a larger set (N)
NM	New Minster, Winchester
No.	Number
nr	Not recorded
NS or ns	Not significant

OA	Osteoarthritis when discussing pathology; also, Oxford Archaeology when used to designate graves from the Lankhills 2000–5 excavations
OM	Old Minster, Winchester
P	Probability of statistical significance
PM1	Pre-molar 1, sometimes called PM3
PM2	Pre-molar 2, sometimes called PM4
PPA	Paleopathology Association
Proc Hants FC	*Proceedings of the Hampshire Field Club and Natural History Society*
Proc Roy Irish Acad	*Proceedings of the Royal Irish Academy*
Proc Soc Antiq London	*Proceedings of the Society of Antiquaries, London*
SAA	Society for American Archaeology
S.D.	Standard deviation
SHA	Society for Historical Archaeology
t	The *t*-statistic
TPR	True Prevalence Rate
Tr.	Trench
TRAC	Theoretical Roman Archaeology Conference
Trans Birmingham Warwickshire Archaeol Soc	*Transactions of the Birmingham and Warwickshire Archaeological Society*
WANHS	Wiltshire Archaeological and Natural History Society
WHO	World Health Organisation
WS 1	Martin Biddle (ed.), *Winchester in the Early Middle Ages*, Winchester Studies 1 (Oxford, 1976)
WS 2	D. J. Keene, *Survey of Medieval Winchester*, Winchester Studies 2, in two parts (Oxford, 1985)
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PART 1
INTRODUCTION

by MARTIN BIDDLE

INTRODUCTION

This is the only account so far published of the skeletal evidence for the population history of a British town and its environs over a span of more than twelve hundred years, from around AD 250 in the Roman period to about 1540 on the eve of the Reformation.

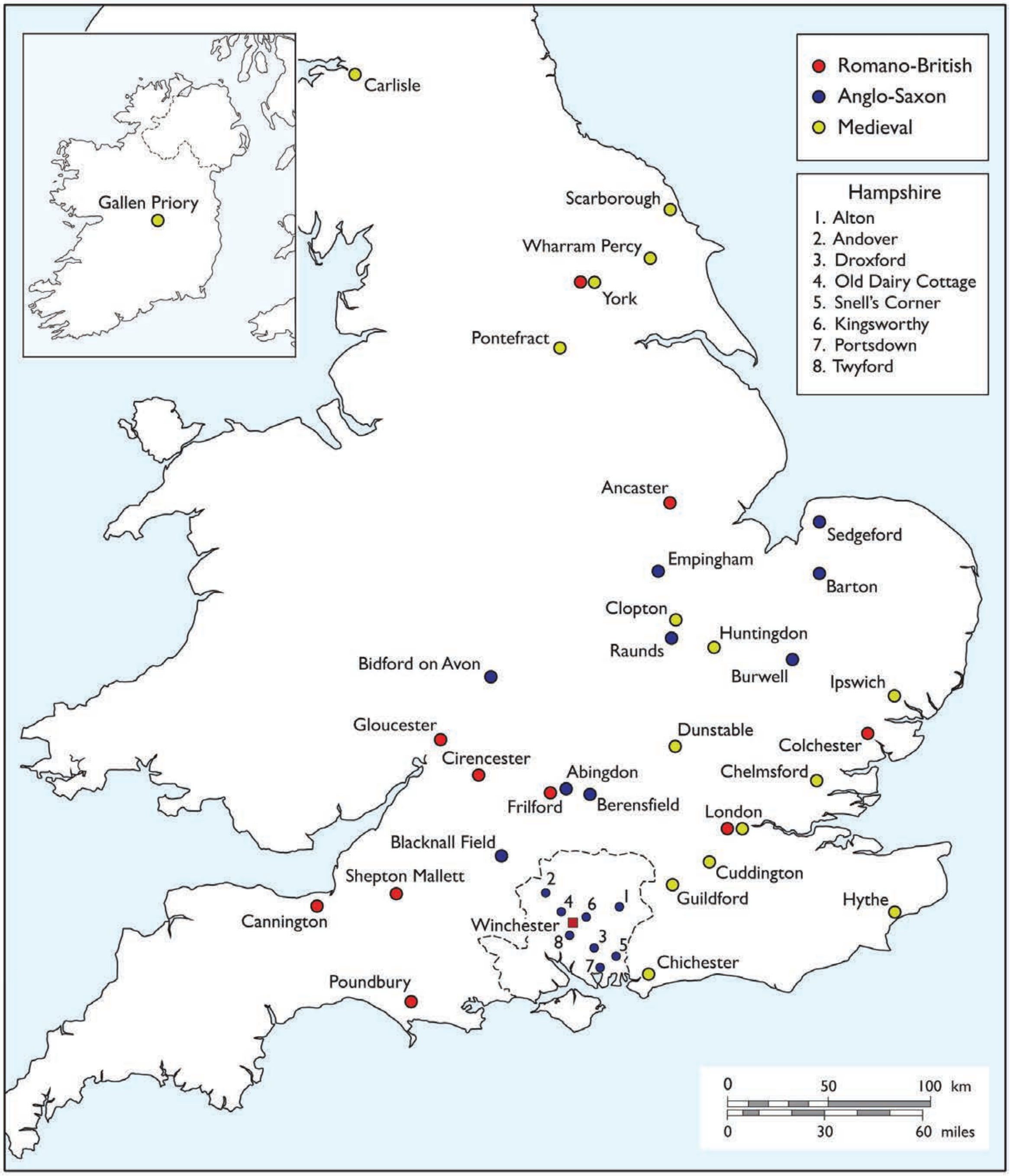
For the two centuries and more between 450 and about 670 no burials are known which might have been those of people living within the walls of the former Roman city.[1] During these years the city appears to have been abandoned, or nearly so, and new settlements grew up in the surrounding countryside, each accompanied by its own burials. These rural, so-called Anglo-Saxon, cemeteries of Hampshire (Illus 1.1) were one part of Dr Stuckert's original doctoral work at the University of Pennsylvania. Her results, presented here for the first time in detail, provide the essential link between the people of Roman *Venta* and their successors in the emerging central place that by the early eighth century was known as *Wintanceaster*.

Between the demolition of the Anglo-Saxon cathedral church known as Old Minster in 1093 and the growth of the new 'Paradise' cemetery over its site from about 1200 onwards, there is a second break of perhaps a century in the burial sequence. During these years burial must have been taking place on an as yet unidentified site somewhere adjacent to the new Norman Cathedral.

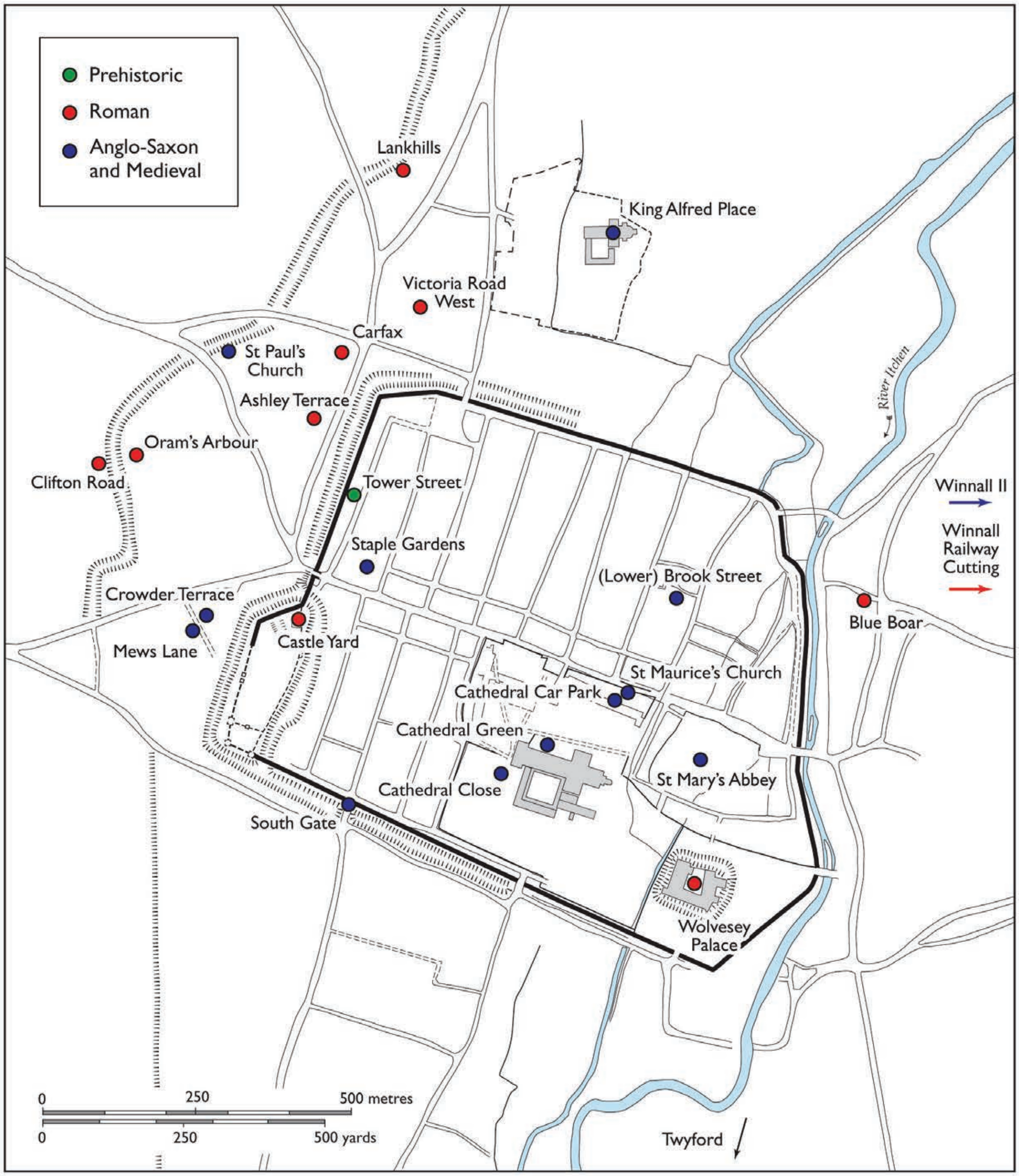
CONCEPT

The title of this book, *The People of Early Winchester*, first emerged in the 1980s in homage to J. Lawrence Angel's *The People of Lerna: Analysis of a Prehistoric Aegean Population* (Princeton, 1971). Larry Angel worked closely with archaeologists in his effort to reconstruct what he called the social biology of archaeological human populations, emphasizing the importance of combining cultural and biological data in interpreting human skeletal samples from past human groups. The title of the present book seeks to stress the essential humanity behind the bones we study.

[1] With the possible exception of two bodies found outside the post-Roman blocking of South Gate: see below, p. 421.



Illus. 1.1. Romano-British, Anglo-Saxon, and medieval burial sites in England and Hampshire referred to in this volume. For sites in Winchester and its suburbs, see Illus. 1.2



Illus. 1.2. Prehistoric, Romano-British, Anglo-Saxon, and medieval burial sites in Winchester and its suburbs referred to in this volume. For sites in England and rest of Hampshire, see Illus. 1.1

THE ORIGIN, GROWTH, AND COMPLETION OF THIS STUDY

The excavation in 1961 of the site of the proposed Wessex Hotel between Market Lane and the north boundary of the north close of the cathedral uncovered, among much else, a hitherto unknown cemetery lying to either side of a north-south street now identified as an element in the Anglo-Saxon street plan of the city.[2] Once thought to be part of the cemetery of New Minster, these burials are now believed to be part of a tenth- to eleventh-century cemetery lying to the south of and probably belonging to the Church of St Maurice.[3]

The excavations of 1961–3 set the programme for the work that was to follow: to use all the available evidence, whether from documents, archaeology, or the natural sciences, to study 'the development of Winchester as a town from its earliest origins to the emergence of the modern city' in the Victorian period.[4] Over the eleven years 1961–71 four sites (Cathedral Green, Lower Brook Street, the Castle, and Wolvesey Palace) were excavated on a large scale over many summer seasons, with smaller investigations on sixteen more sites (Illus. 1.2).[5] In 1968 the Winchester Research Unit was founded to prepare the results for publication in a series of *Winchester Studies* to be published by Oxford University Press, of which the present book is Volume 9.i. The whole project including the proposed *Winchester Studies* was reviewed in the Albert Reckitt Archaeological Trust Lecture to the British Academy on 9 March 1983.

The immediate problem was to find someone to study the human remains already appearing, not only in 1961, but also in the trial excavations north of the cathedral in 1962–3.[6] There were then very few centres or professional posts for the study of ancient human bones in the United Kingdom. An exception was the Duckworth Laboratory in the Department of Archaeology and Anthropology at the University of Cambridge, then under the leadership of Dr J. C. Trevor. In 1959 Don Brothwell was teaching in the department and I was about that summer to excavate Henry VIII's Nonsuch Palace, near Ewell in Surrey. Knowing the Henry had demolished the medieval church of Cuddington village to make way for the inner court of his new palace, I asked Don how many adult skeletons he would need from the Cuddington cemetery to study the population of this medieval village. Don wanted a minimum sample of a hundred adults and this we obtained. Some of his results appear in several of the graphs in this book.[7] It was natural therefore to ask Don Brothwell to look at the skeletal material from the 1961 excavation at Winchester. This he agreed to do.

From 1964 to 1970, with the agreement of the Natural History Museum, Don Brothwell and Rosemary Powers were present on site for part of each season at Cathedral Green to observe and make notes on burials found during the excavation of the Anglo-Saxon Old Minster and of the 'Paradise' cemetery which grew up over its site from about 1200 onwards. The discovery in 1969 of a charnel of over a thousand bodies deposited in a pit from which the foundations of the westwork of Old Minster had been robbed in 1093–4 presented a major problem of recording. This was solved over the winter of 1969–70 by Pauline Sheppard of the Winchester Research Unit, with the help of

[2] Cathedral Car Park (CACP) 1961: Biddle and Quirk 1962, 159–65, Fig. 4. See now WS 4.i forthcoming, Part III, Chapter III.2.viii.

[3] ibid.

[4] Biddle 1964, 188; Biddle 1983, 95–6.

[5] WS 7.ii 1990, Table 1, for a full list of the sites excavated with dates and references; for the ten annual interim reports, see Biddle and Quirk 1962 and Biddle 1964, 1965, 1966, 1967, 1968, 1969, 1970, 1972, and 1975.

[6] Biddle 1964, 202–11, Pls. LIII*b*, LVII, LVIII, Fig. 5.

[7] Illus. 4.20—4.30, 4.48, 4.49.

Rosemary Powers and Theya Molleson, also of the Natural History Museum Paleontology Department.

The overall number of burials encountered was very large: to the 47 bodies recovered from the Cathedral Car park cemetery in 1961, the excavation of Old Minster added 989 Anglo-Saxon graves (ASG numbers), a charnel with the crania of at least 1067 individuals (ASC numbers), and 1069 medieval graves (MG numbers), for a potential total of 3172 individuals.[8] The actual number of individuals available for analysis was considerably smaller, and the count varied depending upon the bone or fragment under consideration, as described in Part 4.[9] By 1968, when the Winchester Studies series was originally proposed to and accepted by the Delegates of Oxford University Press, a single volume devoted to the study of human and animal remains was already envisaged. By 1983 the human part was to be prepared by Don Brothwell, Theya Molleson, and Caroline M. Stuckert.[10]

The situation was changing fast in the late 1960s. Between 1967 and 1972 the excavation of the Roman cemetery at Lankhills outside the north gate of the Roman town by Giles Clarke for the Winchester Schools Archaeological Committee, with the support of the Winchester Excavations Committee and its Research Unit, added 475 graves dating between about 230 and about 410 or later (Illus. 1.2).[11] The problem was to find someone to work on the Lankhills bones. Nobody could be found in the UK to undertake a full study and in order not to delay the publication of Giles Clarke's report, Mary Harman kindly undertook to scan the material for age and sex as a contribution to the published report.[12]

It was clear by 1972 that there was an opportunity to undertake a study of over a thousand years of population change in the Hampshire region if only the evidence of the Early Anglo-Saxon cemeteries of the region could be included to cover the fifth to seventh centuries. A solution emerged in the summer of 1974 when Caroline ('Connie') Stuckert, then at the University of Pennsylvania, visited the Winchester Research Unit in the course of a preliminary tour to identify a possible dissertation topic. That visit led to her decision that year to begin work on a doctoral thesis on the Romano-British and Anglo-Saxon population of Hampshire.[13] This research included analysis of 245 skeletons from seven Early Anglo-Saxon sites surrounding Winchester as well as a total of 525 skeletons from the Winchester Romano-British cemeteries of Lankhills and Victoria Road West. In 1976 while she was living in Winchester doing the basic research for her dissertation, I asked her to undertake the full publication of the Lankhills skeletal material. She started work on the Lankhills pathologies in 1978–9 and 1985 with the result that Lankhills was by then in preliminary draft.

Meanwhile, for career reasons and with the approval of her committee, Connie changed her original dissertation topic to work she had done previously on medieval Czech collections, receiving her doctorate in 1985,[14] and beginning her professional work in consulting and museum administration. With her retirement in 2006, work on Lankhills and other portions of this

[8] The smaller groups of human remains encountered during the excavations of 1961–71 are described in Appendix A (pp. 417–28) with full references to the archaeology of the sites from which they came.

[9] See Table 4.1, p. 279.

[10] Biddle 1983, 132.

[11] Clarke 1979: 7 cremations, a cenotaph, and 411 skeletons available for analysis.

[12] ibid. 123–7.

[13] 'The Romano-British/Anglo-Saxon Transition in Hampshire, 350:700 AD: an Archaeological and Biological Assessment', supervised by Dr Bernard Wailes. Her dissertation committee included Professors Ward Goodenough, Frank Johnston, John deCani, and myself. This research, published fully here, also resulted in several papers presented at professional conferences (Stuckert 1980 a; Stuckert 1980b; Stuckert 1982).

[14] Stuckert 1985.

volume could accelerate in earnest and moved rapidly ahead with her visits to England in 2003, 2008, 2010, and 2011.

By the end of the 1980s work on the medieval populations from the excavation beside the cathedral had slowly come to a halt. The records were all paper based in a pre-digital age. Significant recording and other problems had to be (and were) resolved by the devoted work of Theya Molleson at the Natural History Museum, ably assisted by Rosemary Powers, and by the radiologist the late Dr John Price. Faced with the problem of getting the work finished, I asked Connie Stuckert in 2008 to take on the editorship of the whole volume and this she has done.

In 2000 and 2004–5 a further large area of the Lankhills cemetery was excavated in advance of development under a fully-funded contract let to Oxford Archaeology for excavation and publication.[15] Apart from a small strip to the south, the new area lay immediately adjacent to the north of that excavated in 1967–72. A further area to the east was excavated by Wessex Archaeology in 2007–8.[16] The numbers of graves recorded on these excavations were originally given as:

Clarke 1967–72	411
Oxford 2000, 2004–5	284
Wessex 2007–8	52

After correcting the totals to account for six graves partially excavated by both Clarke and Oxford Archaeology and for other factors, these later excavations nearly doubled to 743 the number of Romano-British skeletons from Lankhills available for study.[17]

The osteological results of the Oxford Archaeology excavations in 2000 and 2004–5, and in particular their comparison with data derived from the skeletons excavated in 1967–72, are compared here with the evidence derived from all the excavated material.

THE OUTCOME: A SUMMARY

This volume is thus able to present under single editorship evidence for the history of Winchester's population over 1200 years. It is based on a sample of at least 1784 skeletons retrieved from 2,645 graves (Romano-British: Lankhills 1967–72, 475 graves and Victoria Road West, 112 graves; Anglo-Saxon and later medieval: Cathedral Green Anglo-Saxon, 989 graves, and Cathedral Green medieval, 1069 graves), plus 1067 cranial and other elements in the Cathedral Green Anglo-Saxon charnel, and is linked together by a study of the population of early Anglo-Saxon Hampshire as represented in an additional 245 skeletons. It is a rigorous study of a very large sample over a very long period. The conclusions reached regarding population continuity and change, demography, and health status also evaluate and include where possible more recent published research on further excavations at Lankhills and other Romano-British cemeteries in Winchester, placing the findings within their historical and cultural context.

[15] Booth et al. 2010. [16] Wessex Archaeology 2009.
[17] For these numbers, see pp. 27–8 and Tables 2.13 and 2.14.

PART 2
ROMANO-BRITISH POPULATIONS FROM LANKHILLS AND OTHER CEMETERIES IN WINCHESTER

by CAROLINE M. STUCKERT

1
INTRODUCTION

I. BACKGROUND OF THE STUDY

This part presents skeletal data from Lankhills Romano-British cemetery, and begins the task of placing it within the context of a larger Romano-British population. Part 3 will investigate the important question of population replacement or continuity through time in the Sub-Roman and Early Anglo-Saxon periods in Winchester and the surrounding region of Hampshire. All the sites used in this study have now been published, which was not the case at the time of original data collection. Thus in this chapter we simply present a brief archaeological overview of the two major Romano-British sites used in the study in order to set the stage for the players, as represented by the skeletal samples described in the following chapters. The Early Anglo-Saxon sites forming part of the larger sample are described more fully in Part 3.

Initial data collection on the 770 skeletons in this study took place over a fifteen-month period in 1976–77, and included all skeletal material available at that time from the county of Hampshire. It was not intended that the study include all of Wessex, as insufficient skeletal material from Wiltshire then existed. Instead, the focus was intentionally kept on a more local area—Winchester and surrounding communities in Hampshire. Romano-British skeletal samples came primarily from Lankhills and Victoria Road West in Winchester, with a few remains from Snell's Corner, Horndean. The Early Anglo-Saxon samples in Hampshire that could be included were the seven sites of Alton Anglo-Saxon cemetery, Droxford Anglo-Saxon cemetery, Worthy Park Anglo-Saxon cemetery at Kingsworthy, Snell's Corner at Horndean, Ports Down, and Winnall II and St Mary's and St Pancras, Winchester (Illus. 1.1). Portway cemetery, Andover, had been excavated, but the skeletons were not available for this project, as they were being studied for publication.

Originally it was intended that the project would result in a doctoral dissertation using univariate and multivariate statistical techniques to address the question of population continuity through time rather than a detailed analysis of Lankhills itself, and the choice of information to be collected reflected that emphasis. For the purpose of making chronological comparisons, the samples were divided into three groups according to the dating and cultural affiliations of the sites, and to a lesser extent, geographical location. Because many of the Early Anglo-Saxon samples were small, it was necessary to pool them to obtain useable groups for quantitative analysis. Those groups were defined as Pooled Roman, Saxon 1, and Saxon 2. They are described more fully in Part 3.

In the field, data were collected initially on age and sex, cranial and postcranial measurements, cranial and postcranial non-metric traits, and dental data related to ante mortem tooth loss, caries, abscesses, dental variants, and M3 agenesis for all nine sites. Tooth measurements were not taken, nor were pathologies systematically recorded. For the original study focusing on the question of population change or continuity through time, it was decided to concentrate on univariate and multivariate analyses of cranial metric and non-metric traits. Initial results were presented at three professional conferences[1] and since then have been cited in other publications.[2] Subsequently the distribution of Romano-British ages at death was tested statistically (Chapter 2), as were cranial indices and stature (Chapter 3). Dental data frequencies are presented in Chapter 4, but have not been tested statistically.

Additional work for brief periods in five summers spread over the next three decades concentrated more directly on Lankhills, especially with regard to identifying pathology, and where possible obtaining radiographs and photographs. Invaluable diagnostic advice and assistance were received from Michael R. Zimmerman, M.D., Ph.D., and Morrie Kricun, M.D. Results of this work are given in Chapter 5.

Inevitably when material has languished for many years it will not be possible to produce the results that could be obtained today, although the data collection standards employed in this project are still in use. However, new morphometric techniques, theoretical approaches, genetic and isotopic analyses, and sophisticated digital techniques not available in the 1970s are all part of the current analytical arsenal and have enriched the interpretative potential of more recent studies. Consequently, it must be understood that this study has the limitations imposed by greatly delayed publication and an expanded purpose. However, it is offered in the hope that it will be found useful, and will encourage further research.[3]

2. ARCHAEOLOGICAL BACKGROUND: THE ROMANO-BRITISH SITES

Original data was collected for two Romano-British sites in Winchester, the Lankhills excavations of 1967–72 and Victoria Road West. The following chapters incorporate, to the extent possible, data from the more recent excavations carried out at Lankhills by Oxford Archaeology (referred to as Lankhills 2000–5),[4] as well as comparative information from the other Romano-British cemeteries in Winchester and elsewhere in Britain (Illus. 1.1).

[1] Stuckert 1980a; 1980b; 1982.

[2] Arnold 1984, 129–30; Stuckert 2010, 111–37; Härke 2011, 17.

[3] The records and finds from the Lankhills 1967–72 excavation, including the human remains, form part of the Winchester Excavations Committee archive now in the care of the Hampshire Cultural Trust, Winchester.

[4] Booth et al. 2010.

Illus. 2.1. Lankhills Romano-British cemetery, looking east, 1971. The dark strip across the middle marks the line of the boundary ditch, F. 12, and shows how later burial extended eastwards over and beyond this boundary.

Lankhills 1967–72

The Roman cemetery at Lankhills was located on the grounds of the Lankhills School, adjacent to the modern Andover Road and approximately 500 m north-east of Winchester's North Gate.[5] Occupying a spur of land between the Itchen Valley to the east, and a small stream, the Fulflood, to the south, the ground occupied by the cemetery sloped from west to east and from north to south.[6] The excavated area of the cemetery was an irregular space extending over a maximum of approximately 85 × 35 m. Within this were excavated 451 graves (Illus. 2.1; see also Illus. 2.3), seven of which were cremations.

Excavation of the Lankhills cemetery took place during a five-year period, from 1967 to 1972. The original impetus came from the discovery of skeletal remains and fourth century objects during construction at the Lankhills School in 1961, and during the years between 1961 and 1972 a series of rescue observations were made as school construction continued.[7] These observations helped define the northern limit of the cemetery, which appeared to be located approximately on the northern edge of the main school building. More recently, between 2000 and 2005, the Oxford Archaeological Unit excavated an additional 313 graves yielding 284 skeletons and 25 cremation burials.[8]

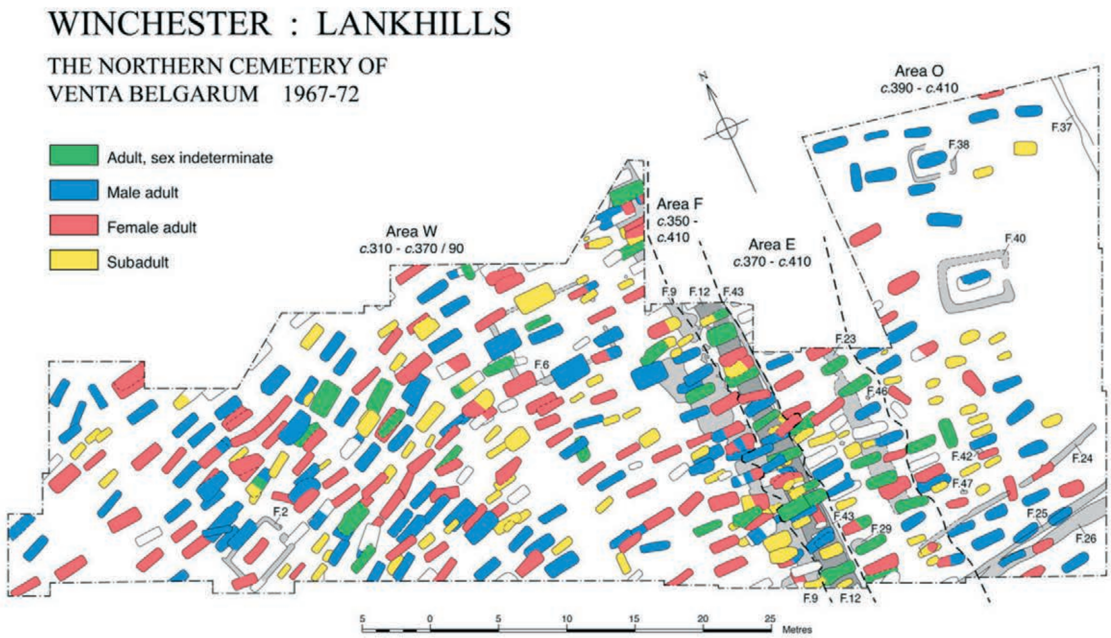
[5] WS 3.ii. [6] ibid. 4. [7] ibid. 1.
[8] Booth et al. 2010, 17; for the figures and the Wessex Archaeology work of 2007–8, see above, p. 6.

Illus. 2.2. Lankhills Romano-British cemetery, 1967–72, selected burials as excavated: (a) left, Grave 308, a triple burial of a male of *c*.45 [LH 308(1)], a female of *c*.30–35 [LH 308 (3)], and a female of *c*.15 [LH 308 (2)], surrounded by stone packing; (b) middle, Grave 291, a male of *c*.30, surrounded by stone packing; (c) right, Grave 250, an unsexed adolescent of 17/19 in an iron-bound coffin.

The earlier excavation itself was unusual in having been conducted almost entirely by schoolchildren. The excavator, Giles Clarke, originated the project while a student at Winchester College, and subsequently students from that school as well as most of the other secondary schools in Winchester provided most of the labour. When the scope of the undertaking became clear, the project affiliated with the Winchester Research Unit, thus providing access to professional assistance and facilitating publication. The excavations and objects were thoroughly documented and discussed in the site report, a major publication which is Vol. 3.ii of the Winchester Studies.[9] It is only necessary to provide a brief summary here.

The portion of the cemetery at Lankhills uncovered by these excavations appeared to have been in use between approximately 310 and 410. The date of first use was based largely on the dating of two features, Feature 9 and Feature 12, relative to their functional history and the dating of the graves within the cemetery. Feature 9, interpreted as a bedding trench for hedges or trees, contained coins of Gallienus (260–268) and was intersected by some of the earliest graves in the cemetery. Immediately adjacent to it, Feature 12 appeared to have been an open boundary ditch of a type known as a ha-ha, intended for keeping cattle out. This was interpreted by Clarke as forming the

[9] WS 3.ii.



Illus. 2.3. Lankhills 1967–72, age and sex distribution of the burials.

eastern boundary of the cemetery, and the early graves intersecting Feature 9 respected it. The graves themselves were dated by a combination of horizontal stratigraphy, vertical stratigraphy, and graves with datable objects, primarily coins and pottery. The terminal use date of 410 was largely based on negative evidence, as there were no objects in the site clearly datable to fifth century contexts, such as quoit brooches. In later excavations by Oxford Archaeology, Clarke's location of the northern and eastern limits of the cemetery was confirmed.[10]

Within the cemetery itself, Clarke divided the area into four sections, areas W, F, E, and O, defined by Features 9, 12, and 43. A rough chronological sequence could be established for these areas based on graves dated by coins, indicating an eastward movement of use through time. In the analyses that follow, area W has been used as the earlier chronological sample, and areas F, E, and O have been combined into a later sample.

The graves excavated at Lankhills were part of the northern cemetery of *Venta Belgarum*. The results of this excavation, and other finds over the years, suggested that the north cemetery occupied a strip approximately 125 m wide and 500 m long adjacent to the eastern edge of the Roman road to Cirencester.[11] The cemetery appeared to have commenced at Winchester's North Gate. Other finds in other locations indicated that portions closer to Winchester were used earlier, and that occupancy from the first to fourth centuries proceeded in a north-westerly direction from the city.[12] A late expansion, possibly from overcrowding, may have been reflected in the area of Lankhills used east of Feature 9 after *c.*350.

Of the 451 excavated graves at Lankhills, there were 439 inhumations in addition to the seven cremations mentioned above. The excavator listed 375 inhumations as intact and fully excavated,

[10] Booth et al. 2010, 456. [11] WS 3.ii, 5–10. [12] ibid. 11.

another 33 as only partially investigated, and 31 as totally destroyed by later burials.[13] Most inhumations contained only a single individual (Illus. 2.2b, 2.2c). However, there were five double burials, one triple burial (Illus 2.2a), a grave pit that contained only part of a body, and four empty grave pits, two of which were probably robbed, and two of which appeared never to have been used. The actual number of skeletons available for study is discussed more fully in Chapter 2.

The seven cremation burials fell into three different types: simple urned cremation burials, loose cremated bones in the topsoil, and cremation burials in an inhumation-sized pit where the body was apparently cremated *in situ.* Clarke made two interesting points about these cremation burials.[14] First, except for the last category, these were all topsoil burials and consequently, due to survival problems, the total number of cremation burials may have been grossly under-represented. Second, the dating of the cremation burials indicated that the practice continued throughout the fourth century. In this respect Lankhills was somewhat unusual, but not unique, as by the fourth century inhumation was the most common, and almost universal, form of burial in Roman Britain.[15] Remains for five of the cremation burials could be located for study in 2011, and are described in Chapter 7, but do not figure further in any analyses.

With regard to cemetery organization, graves appeared to have been marked in at least two ways. Some, probably the majority, were topped by mounds. A few, almost certainly burials of important persons, were surrounded by hedged enclosures, entered from the east.[16] Graves appeared to have been aligned at right angles to topographic features, and the majority of heads were to the west. While some graves were in rows (i.e. side by side), lines of graves (i.e. end to end) may have been a more common arrangement.[17] Although the cemetery gave the impression of crowding, only two burials appeared to have been deliberately placed in close contact. Burials generally were disturbed only in those areas in use for 40 years or more, and not until the later fourth century was it common for those disturbances to be ignored.[18] A small number of step graves appeared to be associated with high-status burials. A group of decapitated burials were associated with graves that were either military, rich, or ritually unusual.[19] These are discussed at length in Chapter 6, while further information on the relationship of cemetery organization to the physical anthropology of the skeletons will be found in Chapter 5.

There were three groups of graves at Lankhills identified as intrusive, or 'foreign'. Of the two groups which had chronological associations the first, containing sixteen graves, was dated to 350–410, while the second, containing six graves, was dated to 390–410. It was argued, based on grave goods, that the first group, which was predominantly male, originated in or near the mid to upper Danube region, and may have been Sarmatians.[20] It was further argued that their graves indicated they were wealthy and powerful, but not necessarily military: the evidence suggested the possibility they were civilian officials of the Empire, whose advent may have been related to the presence of a *gynaeceum* in Winchester which was manufacturing cloth for all troops in Britain.[21] Clarke further argued for their integration into the native population in three generations, based on the increasing adoption of Romano-British materiel, but not ritual.[22] While the exact nature of these groups is not fully resolved, more recent isotopic analysis has established the probability that at least some of these individuals are, indeed, of foreign origin, although probably from several different locations,

13 WS 3.ii, 13. 14 ibid. 129–30. 15 ibid. 350–1. 16 ibid. 183–5. 17 ibid. 185.
18 ibid. 186. 19 ibid. 193. 20 ibid. 384–6. 21 ibid. 386–9. 22 ibid. 389.

and that in many cases there is no direct equivalence between the biological point of origin and the material culture of the burial.[23]

The later group of graves was interpreted as Anglo-Saxon, with Upper Thames affinities, based on individual aspects of funerary rite and occasional objects.[24] Again a military or official role was postulated, possibly associated with Magnus Maximus' attempts to stabilize Britain in his absence.[25]

Although Lankhills was in use at the time Christianity was first introduced into Britain, the preponderance of evidence from the site suggested to the excavator that, unlike Poundbury in Dorset, it represented a primarily non-Christian community. Affinities to Celtic or Classical religious practices were found in the cremations and the nature of the grave furnishings, especially the presence of hobnails, coins, and richly appointed graves, as well as the presence of decapitations and a cenotaph.[26] Attributes which might be explained as Christian, such as unfurnished burials, location respecting other burials, a west-east orientation, and care in burials, could be explained in other ways. For example, west-east alignment was shown to be a general fourth century phenomenon, which may have been related to the influence of an Imperial sun cult rather than to Christianity.[27] Orderly alignment also seemed to have been a general fourth century characteristic.[28] While Lankhills graves were generally carefully constructed until around 390, they did not compare to the plaster and lead coffins found at Poundbury, which was almost certainly Christian.[29]

At the time initial data collection took place, the sample was stored, and work was carried out, at the Guildhall, Winchester. Previous work on the collection had been undertaken by Mary Harmon, then of the Department of the Environment, London,[30] and Robin Watt, then of the Institute of Archaeology, London.[31] The condition of the skeletons and the challenges of working with this collection are discussed more fully in Chapter 2. The final sample totalled 411 individuals, of whom 298 were adults and 113 were subadults.

The Romano-British cemetery at Victoria Road West, Winchester

The Romano-British cemetery at Victoria Road West (NGR SU/480300) was located within the northern city limits of modern Winchester (Illus 1.2). In Roman times the site was located north and slightly west of the North Gate of Roman *Venta*.[32] Excavation took place between 1972 and 1975, with most intensive work occurring in 1972 and 1973. Work was part of an ongoing examination of the northern cemetery and associated residential suburbs conducted by the Winchester City Rescue Archaeologist at the time, Mr. K. Qualmann. The excavations exposed an irregular area which was approximately 985 m^2.

The Victoria Road West cemetery lay on fairly high ground outside the Roman city and on the western side of the Cirencester Road, across from the main area of Winchester's great north cemetery. It may have represented a late extension of that cemetery, as cremations and inhumations, mainly of infants, excavated immediately across the Cirencester Road to the east (Victoria Road East) dated to the first and second centuries, with a small number from the first half of the third century. Land in the western and eastern suburbs of Winchester was also newly taken up for

[23] Evans et al. 2006; Eckardt et al. 2009.
[24] WS 3.ii, 390.
[25] ibid. 399.
[26] Macdonald 1979, 406–21. See also below, pp. 147–72.
[27] WS 3.ii, 425.
[28] ibid. 352.
[29] Macdonald 1979, 426; Farwell and Molleson 1993, 236.
[30] See WS 3.ii, Table 2.
[31] Largely unpublished, but see ibid. 342–4.
[32] Ottaway et al. 2012, 9, Fig. 2.

cemetery use at this time (late third and early fourth centuries), so the expansion of the northern cemetery to the western side of the road to Cirencester appears to be part of a wider trend. The most intensive use of the cemetery occurred, however, after *c.*350.

The northern part of the site contained no graves, and was probably immediately adjacent to the bed of a small stream, the Fulflood. The cemetery boundary to the north-east was formed by the roadside ditch. Boundaries to the south and west are presently unknown, but burials recorded in 1998 on the site of the (then) Eagle Hotel, Andover Road, to the south-west, may represent part of the same cemetery area. In addition to the graves, the road, and its roadside ditch, the remains of timber buildings fronting the road and predating the establishment of the cemetery were located and excavated on the Victoria Road West site.

Although it has now been fully published,[33] the site plans and other records were initially made available for this project in the 1970s through the kind assistance of the City Rescue Archaeologist. The excavation archive and objects are held by the Hampshire Cultural Trust.

The Roman cemetery at Victoria Road West yielded 114 individuals from 112 inhumations for this study, four of which were double graves. In addition, there were bone scatters which may not have been true graves, but may have represented disturbances of other graves. There were five empty graves, and two other features which were empty, but may not have been graves. In addition, there were five sets of cremated remains from four cremation burials.[34]

Three infant burials were stratigraphically earlier than the main use of the cemetery area, and were probably contemporary with the graves reported at Victoria Road East. Apart from that, three phases have been defined based on stratigraphic and spatial relationships. Burial Phase 1 graves were dug parallel to the ditch along the edge of the Cirencester Road, and mainly oriented north-west—south-east with it. Following that, the graves of Burial Phase 2 had two subdivisions which were spatially separated and were both quite strictly laid out in rows and lines. A group to the east consisted of well-made graves oriented generally west–east with supine coffined inhumations. A western group also contained generally west–east oriented supine inhumations, but there was more variation in position, the graves tended to be shallower, and some were uncoffined. This was perhaps related to the inclusion in the western group of infants and children, whereas the eastern group comprised almost all adults. Burial Phase 3 was characterized by shallow, scooped-out graves and hasty burials, a number of which were face down. Although the subdivisions were maintained, cemetery organization was less strict in this phase. At some point during the three burial phases, probably by the end of Burial Phase 1, the roadside ditch was filled and silted up, but its line, the cemetery boundary, was maintained by a stout fence, represented by postholes cut into the backfill of the ditch.

Burial Phase 1 was relatively well provided with furnishing. At least seven out of 19 graves (four inhumations, two empty graves and one cremation) had pots or hobnails or both, and in one grave an infant was accompanied by the skull and hoof of a horse. In Burial Phases 2 and 3 there was a general paucity of grave goods.

At the original time of study in 1976–7, Victoria Road West was tentatively dated by the excavator to the late fourth and early fifth centuries, pending further analysis. Continuation of use well into the fifth century was postulated partly on the basis of horizontal and vertical stratigraphy. For example, G. 39 could be tentatively dated to sometime roughly between 364 and 375 *at the*

[33] Ottaway et al. 2012, 9, Fig. 2. [34] ibid. 127.

earliest on the basis of an associated coin of Valentinian I. It was cut by G. 40, which was in turn cut by G. 41, giving three 'generations' of burials. Using Clarke's assumption that these intersections represented twenty-year intervals,[35] G. 41 could have been cut as late as roughly 420, or indeed later. Further, the site itself may have continued in use substantially beyond this date. More recent analysis has challenged some of these original chronological conclusions, but has not necessarily invalidated them.[36]

The latest phase of Victoria Road West may have reflected transitional elements in late Roman Winchester. The lack of coffins, shallow and poor construction of the graves, paucity of grave goods, and frequent casualness or irregularity of body layout, possibly coupled with a date well into the fifth century, suggested a high degree of economic and social stress acting on those individuals charged with the responsibility of laying the dead to rest. Further, the location of this late cemetery site outside the limits of the great northern Roman cemetery, but close in to the city walls in the same general area, may have reflected a shrunken population both in the immediately adjacent residential suburbs and also in Winchester itself after the early years of the fifth century.

The 114 skeletons which could be examined for this study were stored at the offices of the City Rescue Archaeologist, Winchester, and data collection was carried out there in 1976–7. These skeletons were in better condition than those from any other site in this project. The bone had sustained very little surface erosion or breakage, and a high percentage of adults were complete, or nearly so, although most skulls required at least some reconstruction. This sample had not been subjected to any osteological analysis prior to this study. A preliminary report by this author is on file in Winchester.[37]

The following chapters discuss the demography, physical characteristics, and health of the Romano-British population of Winchester, as reflected primarily in the osteological samples from Lankhills 1967–72 and Victoria Road West. The transition to the Early Anglo-Saxon period, and subsequently through the Anglo-Saxon period to the medieval populations continues in Parts 3, 4 and 5.

[35] WS 3.ii.

[36] See Ottaway et al. 2012. According to their analysis, the dating of Burial Phase 1 has been reasonably well established as late 3rd–early 4th centuries (perhaps 260/270–320/330) from the pottery, grave goods, and cremation urns. Burial Phases 2 and 3 are less easy to date because of the lack of grave goods. However in comparison with Lankhills, other aspects of cemetery layout and burial practice at Victoria Road West may suggest a mid- to late 4th century date for Burial Phase 2, and a late 4th to 5th century date for Burial Phase 3. Some corroboration for this, and the implication that there was a chronological gap between the end of Burial Phase 1 and the beginning of Burial Phase 2, is offered by the stratigraphic sequence affecting Graves 39, 40, and 41 described above.

[37] Toomey 1977.

2
DEMOGRAPHY

i. INTRODUCTION

DEMOGRAPHIC profiles potentially yield some of the most useful information available in gaining fuller understanding of ancient populations. These profiles can reveal patterns of death, survivorship, and reproduction whose causes may be related to economic subsistence patterns, nutrition, disease loads, or cultural practices. The application of demographic techniques to archaeologically derived skeletal samples, however, is fraught with traps for the unwary. High quality results require high quality raw data. Very few archaeological samples, including material from the Lankhills excavations of 1967–72, meet all the necessary criteria in a completely satisfactory fashion. In spite of greater or lesser degrees of inaccuracy in the results, useful demographic information can be obtained nonetheless if the limitations of the data are clearly understood and accounted for, and if the level of demographic analysis is fitted to the sample.

The limitations inherent in the Lankhills 1967–72 material are discussed more fully below. Within the scope of these limitations, this chapter presents the demographic distributions found in Lankhills. The excavations of 1967–72 are first considered as a whole, and then broken into two slightly overlapping chronological sub-units defined by Area W (310–370/90), and Areas F, E, O (350–410).[1] After comparison with data from the subsequent Oxford Archaeology excavations at Lankhills in 2000 and 2004/5,[2] referred to as Lankhills 2000–5 in the remainder of this study, an attempt is made to create an overall demographic profile for the whole site, including a small amount of material from recent excavations at Lankhills by Wessex Archaeology. It is then compared with other available Romano-British material from Winchester, especially the companion site of Victoria Road West, as well as other significant Romano-British burial sites.[3]

Condition and completeness of the skeletons

Table 2.1 presents the data on skeletal preservation by age and sex in the Lankhills burials from the 1967–72 excavations. The condition and completeness information are taken from Clarke's Table 2,[4] but the age and sex data listed in that table have been modified by the findings of the current study. At the time of data collection, skeletal material from twenty-two graves listed as 'destroyed' was found in storage boxes. These are included in Table 2.1 in the category 'X'. Detailed information will be found in Chapter 7, the Catalogue of the Burials. Cremated burials have been omitted from Table 2.1.

The overall condition of the Lankhills skeletons from the 1967–72 excavations was poor, which affected both the quantity and quality of the data that could be collected. Considerable time was spent reconstructing skulls and long bones in order to maximize the information potential, as

[1] WS 3.ii, 118. Fig. 9
[2] Booth et al. 2010.
[3] For burial site locations see Illus. 1.1 and 1.2.
[4] WS 3.ii, 24–95.

TABLE 2.1

Skeletal preservation by age and sex, Lankhills excavations, 1967–72 (column percentages)

State of preservation	Overall frequency		Frequency, males		Frequency, females		Frequency, all adults		Frequency, subadults	
	Number	%	Number	%	Number	%	Number	%	Number	%
A almost perfect	33	8	19	15	9	7	29	10	4	4
B slight decomposition	99	24	40	31	30	24	72	24	27	24
C smaller bones decayed	88	21	32	24	35	28	72	24	16	14
D only major bones left	98	24	31	24	39	31	83	28	15	13
E only skull and legs left	43	10	5	4	10	8	29	10	14	12
F little or nothing left	28	7	1	1	0	0	5	2	23	20
X destroyed grave	22	5	1	1	3	2	8	3	14	12
Total	411	100	129	100	126	100	298	100	113	100

broken and degraded bone was a significant issue. Only 8% of the skeletons were in almost perfect condition 'A', and of these, there were twice as many males (15%) as females (7%). Only 4% of subadults fell into this category. Almost half the skeletons (41%) were scored in conditions 'D', 'E' or 'F', with another 5% coming from destroyed graves (category 'X'). Males generally were better preserved than females. Of the males, 46% scored in conditions 'A' and 'B', whereas only 31% of the females scored this well. The modal score for males was 'B', indicating 'slight decomposition', while for females it was 'D', indicating 'only major bones left'. The modal score for subadults was also 'B'. However, only 28% scored either 'A' or 'B', whereas 32% scored condition 'F' or 'X', indicating there was little left. This is a much higher percentage than either males or females (male 'F' + 'X' = 2%, female 'F' + 'X' = 3%), suggesting that interpretations based on subadult data must be treated with some caution.

A subsequent study by Gowland[5] revised Clarke's figures based on her own ageing and sexing, and essentially validated the conclusions regarding condition reached earlier by us. The 1967–72 Lankhills excavations showed a similar pattern to the Oxford Archaeology Lankhills excavations of Lankhills 2000–5 in that males tended to be better preserved than females, and subadults were much less well preserved.[6] However, overall the Oxford Archaeology Lankhills bones were consistently in better condition than those from the 1967–72 excavations. The reasons for this are unclear.

Structure of the sample

Determining the number of individuals represented in the burials is the most fundamental aspect of creating a demographic profile from excavated cemeteries. The basic unit of analysis is the grave, as defined by the archaeologists. There is then the question, also determined during excavation, of how many individuals are buried in each grave as primary burials. Most graves are single inhumations, but at Lankhills there were also five double burials and one triple burial. Other bones may be found in the grave fill. The question arises as to whether they represent deliberate deposits, disturbed earlier burials that were intentionally backfilled into the new grave at the time of the primary burial, or random, unintended bone scatters from other existing graves located by the archaeologists.

[5] Cited in Clough and Boyle 2010, 344. [6] ibid. 344.

Skeletons from deliberate fill deposits and disturbed earlier burials, when they can be clearly identified at the time of excavation, would be included in the count of individuals from the site, as they represent the remains of actual interments.

Fill bone scatters in a crowded cemetery with frequent intercutting and possibly poorly delineated graves should be treated with great caution. In most cases these scatters should not be counted as separate individuals, especially if only fragments or a few bones are present. The chances are very great that these bones belong to an individual already accounted for elsewhere. The risk of double counting, so that one individual gets counted as two, is very high. In a large site such as Lankhills, where sections of the cemetery are extremely crowded, unintentional double-counting can quickly distort the demographic data.

All these issues were encountered at Clarke's Lankhills. There was a further challenge with this particular skeletal collection. The bones were originally processed and packed post-excavation by relatively untrained volunteers without being numbered individually, although most bones have been numbered in more recent years. In addition, the numbering system used for the skull and bone boxes consisted of Roman numerals with Greek suffixes for double and triple burials. Since the grave numbers went up to 473 (or CCCCLXXIII), and there were approximately one thousand boxes of bone, the chances were great for mislabelling and mixing bones in the wrong boxes. It can be demonstrated that this happened on numerous occasions.[7] As a result, the original excavated context for those bones was lost. While many of those problems were resolved during our work, including renumbering boxes into a more easily understood Arabic numeral system and properly reassociating many skeletal components, and a few other problems have been resolved since,[8] many problems still remain, exacerbated for later researchers by the continuing deterioration of the collection over time. When reexamined in 2010, many fresh breaks, newly eroded surfaces, and additional missing bones were seen. As a result, our findings constitute the fullest and most accurate analysis possible, using a collection that closely mirrored the excavation results on the ground and had not yet suffered many years of post-excavation handling and deterioration.

The grave numbers from the Lankhills 1967–72 excavations run from 1 to 473.[9] However, 22 numbers in this sequence were dropped, leaving 451 graves. Of those 451, seven were cremation burials, there were two cenotaphs, two robbed pits, and there was one partial grave, leaving a total of 439 inhumation graves in varying states of preservation or completeness. Of the 439 inhumation burials, five were double burials and one was a triple burial, leaving 433 single burials. When the ten skeletons from the double burials and three skeletons from the triple burial are added to the single inhumations, the theoretical maximum total number of skeletons represented in this site, and therefore useable in demographic distributions, is 446. It is not possible to obtain a higher count that is reliable.

A theoretical maximum is not always obtainable, however, either due to lost material, or the condition of the bones themselves. At the time of this study, bones could not be located for 49 graves. These are itemized in Chapter 7. However, Table 2 in Clarke includes preliminary work by Mary Harmon that aged and sexed 19 of those 49 graves.[10] That means bones were found at the time of excavation, but by 1976 were missing. Six were adults, nine were children, and four were classified as neonates. Some of the 'bones not located' may have disintegrated beyond recognition in

[7] See p. 20 and Table 2.2.
[8] See Tucker, below, pp. 101–2, 190–1.
[9] WS 3.ii, Table 2.
[10] ibid.

the process of cleaning, packing, and repeated handling. However, most of the rest were probably mislabelled or packed in with other skeletons. Since virtually none of the individual bones had been numbered at the time, mislabelling or mispacking would be an easy mistake to make. Examples of these problems will be found in Table 2.2 and Chapter 7.

In an effort to build the most complete demographic profile possible, it is tempting to include archaeologically derived data either pertaining to the size of the grave (suitable for child or adult), or the grave construction and artefactual contents. Of the graves with 'bones not located', an additional 27 beyond those aged and sexed by Mary Harmon were identified as either 'Infant', 'Infant/Child', 'Child', or 'Adult' by Clarke,[11] based on the size of the grave. However, this is demonstrably an unreliable method of assigning a burial to an age category. In several instances of other graves where skeletal material was found (e.g. LH 156, LH 172, LH 269 and LH 274), the 'infant/child/adult' designation assigned by Clarke was clearly incorrect. Thus, in graves without surviving bone, preliminary assignment to specific age groups on archaeological grounds such as the size of the grave pit should not be used in an attempt to build up a complete demographic profile. Such assignments have a high probability of error.

It might be possible to include those graves lacking bones for which grave goods indicative of age or sex are noted in Clarke's Table 2, as more recent research has shown that certain categories of grave goods are reliable indicators of sex, especially for females, and often can suggest a general age group as well.[12] However, the seven graves for which this archaeologically derived information is consistent with the age categories assigned by Clarke (LH 40, LH 102, LH 268, LH 276, LH 321, LH 329, LH 396) are all female, both children and adults. To include them and omit the other 20 graves (which might be either male or female, child or adult) would inevitably bias the results in the direction of females. Therefore, graves aged and sexed on the basis of grave goods in the absence of skeletal remains should not be included in the counts used in creating a demographic profile for this site.

Taking into consideration the factors outlined above, the maximum number of skeletons that can be included in a demographic profile for the Lankhills 1967–72 excavations based on the bones alone is 411, including both those individuals for whom skeletal material was available and those individuals seen earlier in the preliminary assessment by Mary Harmon, but omitting 'extra' bones and those graves assigned an age category based on the size of the grave only, or assigned no category at all because the grave was empty, destroyed, or bones were missing.

The issue of fill bones and 'extra' bones (Table 2.2)

Clarke enumerated bones found in the fill of 49 graves.[13] Of these, the fill bones from 24 graves could be associated with the burials from which they originated. In 19 cases the fill bones referenced in Clarke's Table 2 could not be specifically identified when the bones were examined, and many—if not most—of them are probably represented, but are unidentified, in the 'extra' bones found in the storage boxes.

'Extra' bones were found commingled in the storage boxes for an additional 57 graves not referenced in Clarke's Table 2. Three of these could be assigned to known graves. A skull in another grave (LH 297) actually belonged with LH 348, although there was also material from a child that

[11] ibid., Table 2. [12] Booth et al. 2010, 307; Gowland 2006. [13] WS 3.ii, Table 2.

TABLE 2.2

Extra bones found in storage boxes, Lankhills excavations, 1967–72

Grave	Bones found
10	tibia 2nd larger adult
25	femur 2nd individual
35	femur 2nd individual
66	fragments of 2 adults, 1 child found, none of which can be associated clearly with this grave
71	skull of 2nd adult, ?female
86	2nd individual, ?female, 15–18
90	sacrum & pelvis of female adult
104	fragments of 2nd skull present
136	very fragmentary postcranial remains of another adult
139	fragments of child, 5–12
141	fragmentary postcranial remains of 2nd individual, labelled 142 except on front of box
142	remains of 2nd individual
153	adult postcranial remains
154	fragmentary adult remains
161	portions of 2nd individual
166	femur of child
167	skull fragment of 2nd individual
170	innominate of 2nd immature individual
179	remains of child, *c.*8 [clearly belongs to LH 189]
183	2nd infant, 0–3 months
185	skull fragments of 2nd child
199	portions of at least 1 younger individual
225	femur of 2nd adult, and femur of child
228	calcaneus of 2nd adult
231	skull of 2nd male, 35–40
233	humeri from 2nd adult and child
255	fragments of 2nd female adult
256	larger fibula from another individual.
278	spinal column of child, 6–8 [may belong w/LH 378]
293	cranial fragments of 2nd individual
295	2 individuals inventoried with this number. Male, 18–20, misnumbered.
297	at least 2 other individuals. Skull of female may belong with LH 348. Older child also present.
302	partially excavated grave from margin of site—decapitation
304	maxilla from 2nd individual
317	remains of adult [from LH 310]
320	fragments at least 1 other individual
328	skull of female *c.*25 mixed in
334	skull of LH 284
342	portions of at least 2 individuals
343	bones of neonate [LH 470] and child 1–3
345	adult skull from F. 12
349	infant tibia
350	tali of 2nd individual
356	humerus of 2nd individual
358	right radius of 2nd individual
368	2nd individual
383	leg bones of smaller child
386	leg bones of LH 368
388	skull of child *c.*7 years
395	talus and calcanei of 2nd individual
402	male innominate from 2nd individual
413	portion of 2nd individual, female 35+
449	very fragmentary remains of several individuals
455	No primary burial. Fragmentary remains from fill present
456	No primary burial. ?female *c.* 40 may belong to LH 421, not certain

did not belong with either the original burial or the LH 348 skull. In addition, there were clearly some unresolved misnumbering problems. At the minimum, these affected graves LH 141, LH 295, and LH 356, all of which contained skeletal material that might have belonged to other graves, but the attribution could not be certain. There were 46 graves as well whose storage boxes contained individual bones or portions of skeletons that did not belong with the primary burial, and had not been recorded by the excavator as being in the fill. Some of these cases may represent fill bones that were missed during recording on site, but it is likely that the great majority represent bones boxed up incorrectly by untrained site volunteers processing a large volume of unnumbered bones, or mispacked during handling in subsequent years. These 'extra' bones almost certainly do not represent additional skeletons missed by the excavators. For that reason, the 'extra' bones from these 46 graves should not be incorporated into any demographic profiles.

ii. METHODS

Determination of age and sex

Sex was determined by osteological criteria alone, with no reference to grave goods. Designation of sex was based primarily on observed morphological characters of the skull and pelvis,[14] and comparisons were made within the collections, rather than against any type of 'objective' standard. In the case of fairly complete skeletons, as many sexually associated traits as possible were observed, although pelvic anatomy, which is usually more diagnostic than skulls,[15] was given greater emphasis. Badly fragmented individuals presented a great problem. Where unambiguous diagnostic pelvic or cranial traits were present, they were used, even if the amount of material available was small. When only portions of long bones were available, overall size and robustness was used occasionally, but only with great caution. Occasionally even fairly complete skeletons were too ambiguous to classify morphologically with any degree of comfort. These were designated 'sex indeterminate', and were included in a larger group of both Roman and Early Anglo-Saxon skeletal material that was sexed using the statistical technique of discriminant analysis. This resulted in greatly enhancing the number of skeletons that could be sexed. A full description of this study will be found in Appendix B.

Evidence from our study has altered the demographic distributions described in the original Lankhills publication,[16] a situation that was anticipated by the original authors. The alteration is reflected primarily in the greatly enlarged numbers of females listed in the present study, and arises from the very different circumstances in which each evaluation took place. Extensive cranial and postcranial skeletal reconstruction was undertaken in this study before age and sex were determined, an advantage not available to the original investigator. As a consequence, a much larger volume of useable material was present, and much of this turned out to be female. Since female skeletal remains are usually smaller and the bones are thinner than those found in males, they often suffer greater destruction. Thus, it is reasonable to expect reconstructive work to restore a number of these individuals who could not be identified as female in a shattered state. However, it is important to note that the original conclusions concerning association of grave goods by sex have not been altered significantly.

[14] Bass 1971, 1995; Brothwell 1972, 1981; Krogman 1962.
[15] Ubelaker 1978.
[16] WS 3.ii.

The different results in the two studies were not due to wide discrepancies between observers. Approximately 160 skeletons were examined by both investigators. Of these, the investigators differed on the sex of six individuals, for a discrepancy rate of slightly less than 4%. Since the rate of inter-observer error for sexing skeletal material can range from zero to 20% for adult skeletons, depending on completeness,[17] the inter-observer differences found in these two studies are well within acceptable margins. Specific discrepancies have been noted in Chapter 7. Divergent findings with regard to age are affected by much the same set of circumstances. In addition, the assessment of age is subject to less precision than the determination of sex, and may have been affected by the application of different standards and techniques.

Designation of age was based on as many criteria as were applicable to any one skeleton. For infants and children, the primary age criterion was the stage of development and eruption of the deciduous and permanent dentition.[18] In the case of very small infants, or in the absence of dentition, long bone shaft length was occasionally used as well.[19] For older children and adults, several techniques were used. These included dental development and eruption, the degree of epiphyseal union of the long bones,[20] and the degree of crown wear on permanent molars.[21] Assessments of age in adult males were also based on pubic symphyseal wear using the standards of McKern and Stewart,[22] and for older males, Todd.[23] Endocranial suture closure was also used as an estimate of age, but only with considerable caution as a last resort, given the limitations on the method caused by great variability in both the sequence and timing of suture fusion.[24] The sutures of all skulls were examined, but the results were not the primary determining criterion of age if other criteria were available.

The age of each individual was calculated as closely as the condition of the skeletal remains, and the application of relevant ageing techniques, would permit. These ages are given in Chapter 7, the Catalogue of the Burials. Often material was so fragmentary that an individual could only be designated 'adult, age indeterminate', or 'child, age indeterminate'. Most commonly, however, it was possible to age children within a one- to three-year range, and to age adults roughly within a five- or ten-year range. A number of individuals were so fragmentary that it was possible to determine only a lower limit for their age, for example, '35+'. This situation, coupled with the fact that accuracy of age determination decreases both with the advancing age of the individual and also with the decreasing degree of completeness of the material available for examination, has undoubtedly caused a bias towards youth to creep into the results. As pointed out by Weiss[25] and numerous other studies, this problem is common in archaeologically derived samples.

Data analysis

Demographic analysis of the Lankhills 1967–72 material concentrates on simple distributional data to examine the proportion of children to adults, males to females, modal ages at death, and mortality patterns. Although the sample is large, a life table was not constructed since the necessary criteria of sample completeness, representativeness, and highly accurate age and sex data could not

17 Krogman 1962, 149.
18 Schour and Massler 1941.
19 Johnston 1962 cited in Bass 1971.
20 Stevenson 1924.
21 Brothwell 1981, 1972.
22 McKern and Stewart 1957.
23 Todd 1920.
24 Cobb 1952; Todd and Lyon 1924.
25 Weiss 1973.

be met.[26] In the case of individuals whose remains were available for the preliminary study of this material, but which could not be found for the present study, Harmon's data is incorporated into the demographic profiles presented here.[27] The individuals so incorporated are marked with an asterisk (*) in Chapter 7. In this way an attempt has been made to provide the most comprehensive demographic profile possible, but data from these individuals were not used in any further analyses in subsequent chapters.

The distributional age and sex data were grouped in intervals specified by Martin and Saller.[28] These intervals are designated 0–6 months, 7 months–6 years, 7–13 years, 14–19 years, 20–29 years, 30–39 years, 40–49 years, 50–59 years, and 60+ years. Individual placement in an age interval was determined by taking the midpoint of the age range specified in Chapter 7, rounding to the nearest whole number, and using the resulting figure in assignment. In the case of individuals for whom only a minimum age could be determined, that figure was used in assigning an age interval. No attempt was made to smooth the data, and this will certainly skew the averages down somewhat.

Statistical tests of the mortality distributions found at Lankhills and at Victoria Road West were made in order to identify significant differences in demographic patterning, as opposed to those variations that might be due to chance factors. The test chosen was Wilcoxon's two sample rank sum statistic for ordered categories,[29] which takes into account the fact that that the age data categories are ranked, and the order is not independent, since individuals must pass through all the age categories prior to the one in which death occurred. A programme was then written to compute the expected values of the tested distributions under the null hypothesis that the samples came from populations having the same distribution.[30] The expected values thus derived were compared with the observed distributions, and Wilcoxon's *t* was calculated based on the rankings. The age distributions for subadults and adults were compared separately, adults being analysed with sexes both separated and pooled. Comparisons were made between different combinations of skeletal samples, and results are presented in Table 2.6.

iii. LANKHILLS EXCAVATIONS OF 1967–1972

Distribution of burials by age and sex

The spatial distribution of adult males, females, and subadults is shown in Illus. 2.3. Of the 411 individuals for whom some skeletal material was available, there were 118 subadults under the age of 20, and 293 adults. These figures represent respectively 28.7% and 71.3% of the sample. The mortality distribution for the Lankhills 1967–72 excavations will be found in Table 2.3 and Illus. 2.4. The graph reveals a bimodal distribution in modal age at death, with a childhood peak occurring in the six-month to six-year interval, and an adult peak occurring in early adulthood, between 20 and 29 years.

On closer examination, only 23 infants, representing 5.6% of the sample, clearly died prior to the age of six months. Of these, two (both in double burials associated with adult females) appeared to

[26] Acsadi and Nemeskeri 1970, 57–8. See also p. 46 for a discussion of the relationship of the sample structure to the overall population structure.

[27] WS 3.ii, Table 2.

[28] Martin and Saller 1957.

[29] Lehmann 1959.

[30] APL program written by the late Dr John S. de Cani, then Chairman, Department of Statistics, University of Pennsylvania.

TABLE 2.3

Mortality distribution, Lankhills excavations, 1967–72 (table percentages)

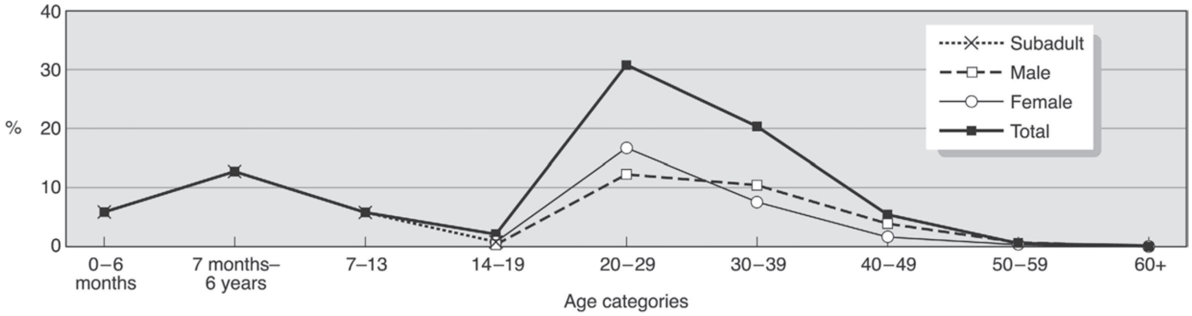
Age	Subadult		Male		Female		Indeterminate		Total	
	N	%	N	%	N	%	N	%	N	%
0–6 months	23	5.6							23	5.6
7 months–6 years	52	12.7							52	12.7
7–13 years	23	5.6							23	5.6
14–19 years	5	1.2	1	0.2	4	1.0			10	2.4
Child	10	2.4	0	0	0	0			10	2.4
TOTAL	**113**	**27.5**	**1**	**0.2**	**4**	**1.0**			**118**	**28.7**
20–29 years			50	12.2	70	17.0	6	1.5	126	30.7
30–39 years			43	10.5	31	7.5	9	2.2	83	20.2
40–49 years			15	3.6	7	1.7	0	0	22	5.4
50–59 years			2	0.5	0	0	0	0	2	0.5
60+ years			1	0.2	0	0	0	0	1	0.2
Adult			17	4.1	14	3.4	28	6.8	59	14.4
TOTAL			**128**	**31.1**	**122**	**29.7**	**43**	**10.5**	**293**	**71.3**
TOTAL SAMPLE	**113**	**26.2**	**129**	**31.4**	**126**	**30.7**	**43**	**10.2**	**411**	**100.0**

have been mid- to late-term fetuses. Fifty-two infants and children, representing 12.7% of the sample, died between six months and six years of age. Thereafter, the proportion of subadult deaths declined steadily, reaching a low point of 2.4% (10 individuals) among adolescents in the 14- to 19-year age interval. Of these 10 subadults, one was male, five were of indeterminate sex, and four were female, suggesting that the precipitous rise in female mortality may have begun during this age interval.

When the childhood age data were examined in increments of one year, certain patterns emerged. Infants were clearly at greatest risk during their first year of life. Thirty-four infants, comprising 8.3% of the sample, died between birth and twelve months. The second through to the fourth years of life, which may represent the weaning and immediate post-weaning period, also manifested comparatively high mortality levels. In the second year 10 children died (2.4%), in the third year eight children (2.0%), and in the fourth year nine children (2.2%). Mortality then dropped sharply in the fifth year when only two children died (0.1%), and rose again to 3% in the sixth year when 12 children died. After the age of six, the mortality rate for each year of age was low, ranging from one to four individuals each year.

Among adults, there were 59 individuals (14.4%) who could not be aged and are not represented in the mortality profile in Illus. 2.4. Of these, 17 were male, 14 were female, and 28 were of indeterminate sex. Overall, the balance of sexes was very nearly equal, with an insignificant predominance of males. There were 128 adult males over the age of 20 (31.1%), and 122 females (29.7%). If the few adolescents who could be sexed are included, the totals rise to 129 males (31.4%) and 126 females (30.7%).

Life expectancy for adults was short. For both sexes the greatest risk of death occurred between the ages of 20 and 29, when 126 individuals (30.7%) expired. Death rates dropped substantially between the ages of 30 and 39, but still remained at fairly high levels, claiming 83 individuals (20.2%). A sharp decline was observed after the age of 40, and only one individual clearly survived



ILLUS. 2.4. Mortality distribution, Lankhills 1967–72.

past the age of 60. Put in other terms, 209 individuals, representing 50.9% of the sample, died between the ages of 20 and 40. Of all individuals in the sample, only 25 (6.3%) clearly survived beyond the age of 40.

Mortality patterns for males and females differed. Although the modal age at death for both sexes occurred during the third decade of life, a much larger number of females died during this age interval (70 females versus 50 males, representing respectively 17.0% and 12.2% of the sample). In the succeeding decade (age 30–39) the number of female deaths declined by more than half, and fell below the male death rate. This pattern continued into old age, with no females at all clearly surviving past 50 years. The male mortality curve peaked very slightly during the twenties, and maintained almost the same levels in the thirties, tailing off more gradually into old age. This pattern suggests that while mortality in young adulthood was high for both sexes, males generally outlived females. It is reasonable to infer that the very high rate of female mortality under the age of 30 may have been related in part to the hazards and complications of childbearing.

Lankhills' demography through time

In order to determine whether any shifts existed in mortality patterns through time, the burials at Lankhills were divided into two partially overlapping groups according to location and chronological relationships as defined by Clarke.[31] The first of these groups consists of 274 burials in Area W dated 310–370/90, while the second group includes 137 burials found in Areas F, E, O, dated from 350–410.

Certain variations in patterns of mortality distribution are immediately evident in the data presented in Tables 2.4 and 2.5, and Illus. 2.4, 2.5 and 2.6. Although the overall subadult figures are still low, the remains of children are better represented in the second half of the fourth century, comprising 32.8% of the sample, as against 26.6% in Area W. Higher percentages of all age classes of children except adolescents are represented in the later time period, the most marked difference appearing in the 0–6 month interval, with a percentage almost three times that found in Area W. As Table 2.6 shows, however, the differences in age distribution are not statistically significant, indicating a basic similarity of patterning in the demographic profile of subadult ages at death.

Differences also exist in the distribution of adults by sex. Females outnumber males in Area W, while the situation is reversed in the later time period. The uneven sex distribution is small in Area W (31.4% male, 33.9% female), but is considerably greater in Areas F, E, O (30.7% male, 21.2% female).

[31] WS 3.ii.

TABLE 2.4

Mortality distribution, Area W (AD 310–370/90), Lankhills excavations, 1967–72 (table percentages)

Age	Subadult		Male		Female		Indeterminate		Total	
	N	%	N	%	N	%	N	%	N	%
0–6 months	10	3.6							10	3.6
7 months–6 years	34	12.4							34	12.4
7–13 years	15	5.5							15	5.5
14–19 years	4	1.5			3	1.1			7	2.6
Child	7	2.6							7	2.6
TOTAL	**70**	**25.5**			**3**	**1.1**			**73**	**26.6**
20–29 years			39	14.2	60	21.9	2	0.7	101	36.9
30–39 years			23	8.4	18	6.6	4	1.5	45	16.4
40–49 years			8	2.9	4	1.5	0	0	12	4.4
50–59 years			1	0.4	0	0	0	0	1	0.4
60+ years			1	0.4	0	0	0	0	1	0.4
Adult			14	5.1	11	4.0	16	5.8	41	15.0
TOTAL			**86**	**31.4**	**93**	**33.9**	**22**	**8.0**	**201**	**73.4**
TOTAL SAMPLE	**70**	**25.5**	**86**	**31.4**	**96**	**35.0**	**22**	**8.0**	**274**	**100.0**

TABLE 2.5

Mortality distribution, Areas F, E, O (AD 350–410), Lankhills excavations, 1967–72 (table percentages)

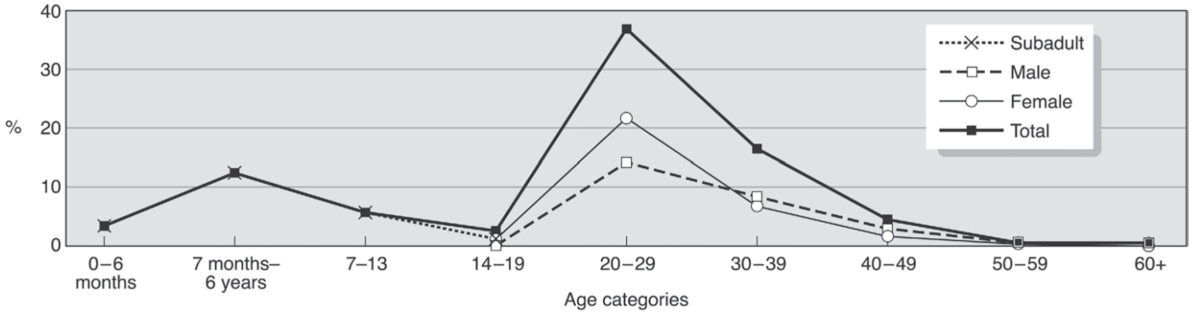
Age	Subadult		Male		Female		Indeterminate		Total	
	N	%	N	%	N	%	N	%	N	%
0–6 months	13	9.5							13	9.5
7 months–6 years	18	13.1							18	13.1
7–13 years	8	5.8							8	5.8
14–19 years	1	0.7	1	0.7	1	0.7			3	2.2
Child	3	2.2							3	2.2
TOTAL	**43**	**31.4**	**1**	**0.7**	**1**	**0.7**			**45**	**32.8**
20–29 years			11	8.0	10	7.3	4	2.9	25	18.2
30–39 years			20	14.6	13	9.5	5	3.6	38	27.7
40–49 years			7	5.1	3	2.2	0	0	10	7.3
50–59 years			1	0.7	0	0	0	0	1	0.7
60+ years			0	0	0	0	0	0	0	0
Adult			3	2.2	3	2.2	12	8.8	18	13.1
TOTAL			**42**	**30.7**	**29**	**21.2**	**21**	**15.3**	**92**	**67.2**
TOTAL SAMPLE	**43**	**31.4**	**43**	**31.4**	**30**	**21.9**	**21**	**15.3**	**137**	**100.0**

TABLE 2.6

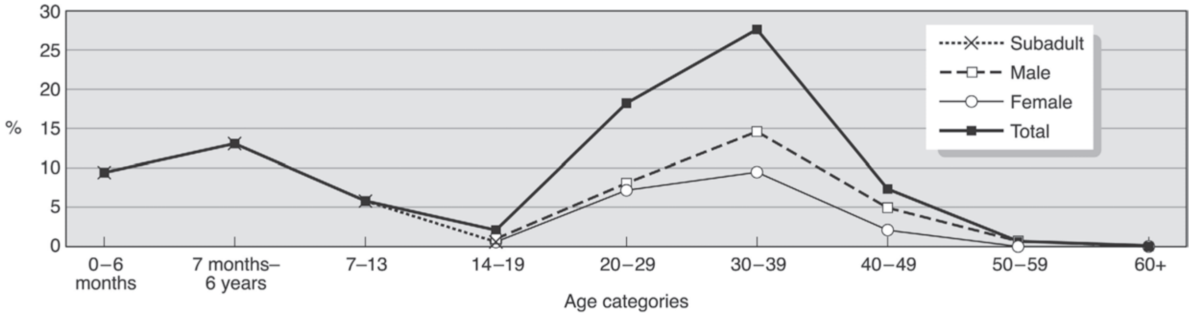
Distribution of ages at death, Lankhills excavations, 1967–72 and Victoria Road West: Wilcoxon's t-test for ordered categories

Tests	Children		Males		Females		Adults	
	/t/	P	/t/	P	/t/	P	/t/	P
LH: Area W v. Areas FEO	1.13	NS	−2.32	<0.05	−2.62	<0.01	−3.76	<0.001
LH: 1967–72 total v. VRW	1.62	NS	−0.60	NS	−0.44	NS	−0.91	NS

LH = Lankhills VRW = Victoria Road West NS = Not significant



Illus. 2.5. Mortality distribution, Lankhills 1967–72, Area W (310–370/90).



Illus. 2.6. Mortality distribution, Lankhills 1967–72, Areas F, E, O (350–410).

Among adults, interesting differences in patterns of age at death also emerge. In the early/mid fourth century (Area W), the modal age at death for both males and females occurred during young adulthood, in the 20–29 year interval, when 36.9% of the sample died. The peak for female deaths was especially sharp. Thereafter, female rates dropped below those found for males, although male death rates also declined steadily. In the late fourth/early fifth century (Areas F, E, O) on the other hand, the modal age at death for both sexes shifted to the 30–39 year interval, and a larger percentage of individuals of both sexes are found in the older age intervals, although none can be identified in the oldest age interval (60+). The rate of female mortality was almost constant between the ages of 20–40, while that of males climbed sharply between the ages of 30–39. The difference in the two age distributions for both sexes is statistically significant (see Table 2.6), although the level of significance is greater for females. The direction of the results indicates a younger mean age at death for both sexes, especially females, in the first half of the fourth century.

iv. LANKHILLS, A DEMOGRAPHIC OVERVIEW

Oxford Archaeology excavations of 2000–5

Between 2000 and 2005, Oxford Archaeology conducted further work at Lankhills in a portion of the site immediately adjacent to Clarke's 1967–72 excavations. The Oxford Archaeology excavations yielded 284 sets of human remains from 281 excavated graves, plus 25 cremation burials.[32] Included

[32] Booth et al. 2010, 17.

in this figure were six graves[33] that had been partially excavated by Clarke, and that were subsequently fully excavated by Oxford Archaeology. In order to determine the overall total number of sets of human remains excavated from Lankhills, one must add the 411 sets of human remains from the 1967–72 excavations, subtract the six graves reported in both studies, and then add the 52 sets of human remains also excavated by Wessex Archaeology, but not yet published.[34] Contra Oxford Archaeology Table 5.13,[35] the correct combined total for discrete excavated sets of human remains at Lankhills is 743, not 817. The correct total figures for Lankhills excluding the Wessex Archaeology excavations is 691 inhumation burials, not the 765 cited.

A reassessment of comparative demographic figures

Clarke's excavations of 1967–72 and the Oxford Archaeology excavations of 2000–5 taken together have greatly enlarged the sample from Winchester's northern Roman cemetery represented by Lankhills. It is important to compare and contrast these two significant excavations, and to understand what they reveal, when combined, about the Roman population of Winchester. The archaeology of Clarke's excavations was fully published,[36] but the osteology was not, although the majority of analyses for the current study were completed prior to 1985. In making demographic comparisons between the two sets of excavations, Oxford Archaeology has not relied on the preliminary assessments made by Mary Harmon in the original publication, nor on data from the current study that was offered to them. Oxford Archaeology has, instead, turned to more recent demographic data from a doctoral thesis by Gowland that focused on age as an aspect of social identity, and that used somewhat different ageing techniques from those used in the current study.[37] Therefore, before making any further comparisons with Oxford Archaeology's data, it is necessary to examine the relationship between Gowland's demographic profiles as stated by Oxford Archaeology[38] and those reported in this study. The tables and figures in Clough and Boyle present data on the size of the skeletal sample, the condition of the bones, and the proportions of males, females, adults of indeterminate age or sex, and subadults. Frequency distributions by age and sex are treated separately.

The total skeletal sample size for Clarke's 1967–72 excavations is quoted variously in Booth et al. as 408? or 488 in Table 2.1, and as 481 in Table 5.11.[39] As we have shown above,[40] the latter two figures are unsustainable numbers that cannot be reached based on the graves themselves. Oxford Archaeology acknowledges in the footnote to their Table 2.1 that '. . . Gowland's (2002) total of 488 individuals must include disarticulated and other material.'[41] The probability is very high, as pointed out earlier, that use of this extra material has resulted in unintentional double-counting or misattribution of individuals, calling the reliability of the entire sample into question. However, Oxford Archaeology has used the figure of 481 in all their further calculations, leading to distortion of sample sizes and proportions.

In order to make comparisons with the 1967–72 excavation age distributions cited in Booth et al., the age groups from our study were reorganized into the ranges used by Gowland.[42] These are

[33] LH 73, LH 99, LH 115, LH 116, LH 228, LH 265.
[34] Clough and Boyle 2010, 347.
[35] ibid. 352.
[36] WS 3.ii.
[37] Gowland 2002.
[38] Clough and Boyle 2010, Tables 5.8, 5.9, 5.11, 5.13, and Illus. 5.8, 5.10, 5.13, 5.15.
[39] Booth et al. 2010, 17, 348.
[40] See above, pp. 18–21.
[41] Booth et al. 2010, 17.
[42] ibid. 348.

TABLE 2.7
Age distributions, Lankhills excavations, 1967–72: Gowland[1] and the current study compared (column percentages)

Age	Gowland		Current study	
	Number of individuals	%	Number of individuals	%
Neonate 0–1	37	11.6	35	10.2
Infant 1–3	23	7.2	25	7.3
Young child 4–7	30	9.4	22	6.4
Older child 8–12	8	2.5	15	4.4
Adolescent 13–17	14	4.4	7	2.0
Young adult 18–24	65	20.4	72	21.1
Prime adult 25–34	63	19.8	99	28.9
Mature adult 35–49	54	17.0	64	18.7
Older adult 50+	24	7.5	3	0.9
Total	**318**		**342**	
Unaged adult	114		59	
Unaged subadult	31		10	
Unaged	18			
Total	**481**		**411**	

Note: unaged adult, unaged subadult, and unaged have been omitted from % calculations.
[1] Clough and Boyle 2010, 348, in Table 5.11.

presented in Table 2.7. The ageing techniques used by Gowland differ in some respects from those used in the current study, and include the use of Bayesian statistics.[43] The resulting age profile places more individuals in the oldest adult age group, and fewer in the younger adult age groups. To what extent are these differences statistically significant, and what would that indicate? The two distributions were tested statistically by Wilcoxon's signed-rank test using a normal distribution with continuity correction.[44] As will be seen from the results presented in Table 2.8, there are no statistically significant differences between subadult, adult, or full samples. Therefore, the ageing methods used by Gowland cannot be presumed to give results that are meaningfully different from the older methods used in this study. Further, whereas the Gowland study aged only 318 individuals, this study was able to age 342 individuals.

The Gowland distributions by sex[45] and the sex distributions used in the current study will be found in Table 2.9. When tested statistically with chi-squares (Table 2.8), the differences were found to be highly statistically significant. Using traditional methods as well as discriminant functions (see Appendix B), this study was able to sex 25 more individuals than were sexed by Gowland, and enough of those were male to alter significantly the ratio of males to females from that given by Gowland. In the Gowland study there is a predominance of females, whereas in this study the numbers of males and females are almost equal, with a slight and insignificant predominance of males. This study also contains 50 fewer individuals of indeterminate sex in addition to the overall larger sexed sample, which affects the results as well.

In sum, the unreliability of the Gowland sample size coupled with the fact that the present study

[43] Gowland 2002, 159–62.
[44] Statistical tests run by Dr Hans Chr. Petersen, University of Southern Denmark.
[45] Clough and Boyle 2010, 346.

TABLE 2.8

Tests of significance, age and sex distributions: Lankhills excavations, 1967–72 Gowland[1] *v. the current study*

AGE DISTRIBUTIONS, Table 2.7			
Wilcoxon's signed-rank test:			
Subadults (ages 0–17)	p = 0.892	not significant	
Adults (ages 18–50+)	p = 0.703	not significant	
Full sample (ages 0–50+)	p = 0.098	not significant	
SEX DISTRIBUTIONS, Table 2.9			
Chi-square test:			
Full sample*	Chi-square = 29.11, df = 4	$p < 0.0001$	highly significant
Combined**	Chi-square = 18.61, df = 2	$p < 0.0001$	highly significant

* = males, ?males, females, ?females, indeterminate
** = males, females, indeterminate
[1] as cited in Clough and Boyle 2010, 348.

TABLE 2.9

Adult sex distributions, Lankhills excavations, 1967–72: Gowland[1] *and the current study compared (column percentages)*

Sex	Gowland		Current study	
	Number of individuals	%	Number of individuals	%
Males	78	24.0	107	35.9
?Males	34	10.5	22	7.4
Females	87	26.8	107	35.9
?Females	32	9.8	19	6.4
Indeterminate	94	28.9	43	14.4
Total	**325**	**100.0**	**298**	**100.0**
COMBINED:				
Males	112	34.5	129	43.3
Females	119	36.6	126	42.3
Indeterminate	94	28.9	43	14.4
Total	**325**	**100.0**	**298**	**100.0**

[1] in Fig. 5.8, Clough and Boyle 2010, 246.

has both aged and sexed a greater proportion of the sample with no significant differences in age distribution, but highly significant differences in sex distribution, indicates that the current study has produced a demographic sample both more comprehensive and likely to be more reflective of the true nature of the site's demographic composition. For that reason, all further comparisons will be limited to the use of the demographic profiles generated in the current study.

The demography of Oxford Archaeology and Clarke's excavations combined

The Oxford Archaeology Lankhills report uses somewhat different age categories from either those used by Gowland, or those used in the current study.[46] In order to facilitate comparisons we have

[46] Clough and Boyle 2010, 348.

TABLE 2.10

Age distributions, Oxford Archaeology excavations at Lankhills, 2000–5: Oxford Archaeology[1] and the current study compared (column percentages)

Age	Oxford Archaeology		Current study	
	Number of individuals	%	Number of individuals	%
Neonate 0–1 month	7	3.3	13	3.8
Infant 1 month–3 years**	23	10.9	47	13.7
Young child 4–7	21	10.0	19	5.6
Older child 8–12	8	3.8	16	4.7
Adolescent 13–17	9	4.3	8	2.3
Young adult 18–25	13	6.2	75	21.9
Prime adult 26–35	28	13.3	96	28.1
Mature adult 36–45	39	18.5	56	16.4
Older adult 45+	48	22.7	11	3.2
Much older adult 60+	15	7.1	1	0.3
Unaged adult	72		59	
Unaged subadult	1		10	
Total	**284**		**411**	

Note: unaged adults and subadults are omitted from per cent calculations. This table uses raw data uncorrected for graves partially excavated by both the Oxford Archaeology and 1967–72 excavations.
* This category is listed as 'Infant 1–3' in Clough and Boyle 2010, 348. We assume this is a typographical error, and should read as given here. Reassignment of the 1967–72 skeletons into these age categories has been made accordingly.

TABLE 2.11

Tests of significance, age and sex distributions, Oxford Archaeology excavations at Lankhills, 2000–5[1] and the current study compared

AGE DISTRIBUTIONS, Table 2.10			
Wilcoxon's signed-rank test:			
Subadults (ages 0–17)	p = 0.157	not significant	
Adults (ages 18–50+)	p = < 0.0001	highly significant	
Full sample (ages 0–50+)	p = < 0.0001	highly significant	
SEX DISTRIBUTIONS, Table 2.12			
Chi-square test:			
Full sample*	Chi-square = 11.37, df = 4	p = 0.023	significant at p = 0.05 level
Combined**	Chi-square = 0.01, df = 2	p = 0.996	not significant

* = males, ?males, females, ?females, indeterminate
** = males, females, indeterminate
[1] Clough and Boyle 2010, 348.

also recast our data into the Oxford Archaeology age categories, as will be seen in Table 2.10. When tested statistically with Wilcoxon's signed-rank test (Table 2.11), there are no significant differences in the age distribution of subadults, but the differences among adults, and consequently the whole sample, are highly significant. These differences are caused by the far greater proportion of older individuals in the Oxford Archaeology sample, as was also noted by Clough and Boyle.[47] The reasons for this disparity, also present with Gowland's work, are not clear. Oxford Archaeology posits there might be some form of zoning within the cemetery, thus concentrating older

[47] ibid. 346–8.

TABLE 2.12
Adult sex distributions: Oxford Archaeology excavations at Lankhills, 2000–5,[1] and the current study compared

Sex	Oxford Archaeology		Current study	
	Number of individuals	%	Number of individuals	%
Males	64	29.1	107	35.9
?Males	30	13.6	22	7.4
Females	68	30.9	107	35.9
?Females	26	11.8	19	6.4
Indeterminate	32	14.5	43	14.4
Total	**220**	**100.0**	**298**	**100.0**
COMBINED:				
Males	94	42.7	129	43.3
Females	94	42.7	126	42.3
Indeterminate	32	14.5	43	14.4
Total	**220**	**100.0**	**298**	**100.0**

Note: this table uses raw data uncorrected for duplications between the Oxford Archaeology 2000–5 and the 1967–72 excavations.
[1] Clough and Boyle 2010, 246.

individuals in the section excavated by Oxford Archaeology.[48] Alternatively, differences in ageing techniques, and the fact that the work was done by several different individuals over a period of years also need to be considered. This issue can be resolved in the future if a single investigator re-ages both collections, so the standards applied are consistent and are not affected by variations in individual perception or technique.

The adult sex distributions for both the 1967–72 and 2000–5 excavations are given in Table 2.12. When the tentatively sexed individuals are separated from those more certainly sexed, the difference between the two samples is statistically significant at a very low level (Table 2.11), primarily because a larger proportion of the Oxford Archaeology males and females were given an uncertain designation. When combined with definitely sexed males and females, there is no significant difference between the two samples in the pattern of sex distribution. This suggests that practices regarding the location of burials by sex were relatively uniform over the larger area of the two excavations combined, with some exceptions noted in small parts of the site.[49]

The combined age distributions from the 1967–72 and 2000–5 excavations, as well as the Wessex Archaeology excavations,[50] are presented in Table 2.13, which is a revision and expansion of Table 5.13 in Clough and Boyle.[51] The total number of burials at Lankhills is reduced, reflecting the correction to Gowland's figures provided for the 1967–72 excavations, while the age categories have been matched to those used by Oxford Archaeology. The current figures place a slightly higher percentage of adults in the 'prime adult' category, and a slightly lower percentage of adults in categories aged 35 and beyond. Combining all three excavations at Lankhills, the sex distribution for the site (Table 2.14) is almost equally balanced, with an insignificantly greater number of females, a difference of less than 1%.

[48] Clough and Boyle 2010, 348.
[49] cf. Ch. 5, pp. 130–4.
[50] Wessex Archaeology preliminary assessment data provided by Jacqueline McKinley, and may be subject to future revision.
[51] Clough and Boyle 2010, 352.

TABLE 2.13

Lankhills age distributions: Lankhills 1967–72, Lankhills 2000–5, Wessex Archaeology and all Lankhills excavations combined

Age	Lankhills 1967–72		Lankhills 2000–5				Wessex Archaeology		Combined	
	Number of individuals	%	Number of individuals	%	Total	%	Number of individuals	%	Total	%
Neonate 0–1 month	13	3.8	7	3.3	20	3.6	2	4.3	22	3.7
Infant 1 month–3 years*	47	13.7	23	10.9	70	12.7	6	12.8	76	12.7
Young child 4–7	19	5.6	21	10.0	40	7.2	2	4.3	42	7.0
Older child 8–12	16	4.7	8	3.8	24	4.3	2	4.3	26	4.3
Adolescent 13–17	8	2.3	9	4.3	17	3.1	1	2.1	18	3.0
Young adult 18–25	75	21.9	13	6.2	88	15.9	6	12.8	94	15.7
Prime adult 26–35	96	28.1	28	13.3	124	22.4	7	14.9	131	21.8
Mature adult 36–45	56	16.4	39	18.5	95	17.2	13	27.7	108	18.0
Older adult 45+	11	3.2	48	22.7	59	10.7	8	17.0	67	11.2
Much older adult 60+	1	0.3	15	7.1	16	2.9	0	0.0	16	2.7
Total	**342**		**211**		**553**		**47**		**600**	
Unaged adult	56		71		127		5		132	
Unaged subadult	10		1		11		0		11	
Total	**408****		**283**		**691**		**52**		**743**	

* see Table 2.10.
** Note: unaged adults and subadults were excluded from percentage calculations. The data have been corrected for burials partially excavated by both Oxford Archaeology and the 1967–72 excavations.

TABLE 2.14

Lankhills sex distributions: Lankhills 1967–72, Lankhills 2000–5, Wessex Archaeology and all Lankhills excavations combined

Sex	Lankhills 1967–72		Lankhills 2000–5				Wessex Archaeology		Combined	
	Number of individuals	%	Number of individuals	%	Total	%	Number of individuals	%	Total	%
Subadult	113	27.7	64	22.6	177	25.6	13	25.0	190	25.6
Males	106	26.0	64	22.6	170	24.6	7	13.5	177	23.8
?Males	22	5.4	30	10.6	52	7.5	8	15.4	60	8.1
Females	107	26.2	68	24.0	175	25.3	15	28.9	190	25.6
?Females	19	4.7	26	9.2	45	6.5	5	9.6	50	6.7
Unsexed adult	41	10.0	31	11.0	72	10.4	4	7.7	76	10.4
Total	**408**		**283**		**691**		**52**		**743**	
COMBINED:										
Subadult	113	27.7	64	22.6	177	25.6	13	25.0	190	25.6
Males	128	31.4	94	33.2	222	32.1	15	28.9	237	31.9
Females	126	30.9	94	33.2	220	31.8	20	38.5	240	32.3
Unsexed adult	41	10.0	31	11.0	72	10.4	4	7.7	76	10.4
Total	**408**		**283**		**691**		**52**		**743**	

Note: the data have been corrected for burials partially excavated by both Oxford Archaeology and the 1967–72 excavations.

When adult ages at death are compared by age and sex combined for the 1967–72 and 2000–5 excavations (Tables 2.15 and 2.16), it will be seen that the same patterns observed by looking at age and sex separately are still present. In both excavated samples, males outlive females, and both sexes appear to live longer in the 2000–5 excavated sample than in the 1967–72 excavated sample. The

TABLE 2.15

Mortality distribution, Lankhills 1967–72 excavations, using Oxford Archaeology age categories (table percentages)

Age	Subadult		Male		Female		Indeterminate		Total	
	N	%	N	%	N	%	N	%	N	%
Neonate 0–1 month	13	3.2							13	3.2
1 month–3 years	47	11.4							47	11.4
4–7 years	19	4.6							19	4.6
8–12 years	16	3.9							16	3.9
13–17 years	5	1.2			3	0.7			8	1.9
Child	10	2.4							10	2.4
TOTAL	**110**	**26.8**			**3**	**0.7**			**113**	**27.5**
18–25 years			24	5.8	45	10.9	6	1.5	75	18.2
26–35 years			49	11.9	40	9.7	7	1.7	96	23.4
36–45 years			29	7.1	22	5.4	5	1.2	56	13.6
45+ years			9	2.2	2	0.5	0	0	11	2.7
60+ years			1	0.2	0	0	0	0	1	0.2
Adult			17	4.1	14	3.4	28	6.8	59	14.4
TOTAL			**129**	**31.4**	**123**	**29.9**	**46**	**11.2**	**298**	**72.5**
TOTAL SAMPLE	**110**	**26.8**	**129**	**31.4**	**126**	**30.7**	**47**	**11.4**	**411**	**100.0**

TABLE 2.16

Mortality distribution, Oxford Archaeology excavations, 2000–5 (table percentages)

Age	Subadult		Male		Female		Indeterminate		Total	
	N	%	N	%	N	%	N	%	N	%
Neonate 0–1 month	7	2.5							7	2.5
1 month–3 years*	23	8.1							23	8.1
4–7 years	21	7.4							21	7.4
8–12 years	8	2.8							8	2.8
13–17 years	4	1.4	1	0.4	4	1.4			9	3.2
Child	1	0.4							1	0.4
TOTAL	**64**	**22.5**	**1**	**0.4**	**4**	**1.4**			**69**	**24.3**
18–25 years			7	2.5	6	2.1	0	0	13	4.6
26–35 years			8	2.8	20	7.0	0	0	28	9.9
36–45 years			23	8.1	16	5.6	0	0	39	13.7
45+ years			30	10.6	15	5.3	3	0.7	48	16.9
60+ years			8	2.8	7	2.5	0	0	15	5.3
Adult			17	6.0	26	9.2	29	10.2	72	25.4
TOTAL			**93**	**32.7**	**90**	**31.7**	**32**	**11.3**	**215**	**75.7**
TOTAL SAMPLE	**64**	**22.5**	**94**	**33.1**	**94**	**33.1**	**32**	**11.3**	**284**	**100.0**

* see Table 2.10
Data extrapolated from Booth et al. (2010) Chapter 3, Grave Catalog; Table 5.10; Figs. 5.7 and 5.14.
The total of 69 subadults and 215 adults is inconsistent with figures of 64 subadults and 220 adults cited in Clough and Boyle 2010, 348, as five of those 'adults' were actually adolescents who could be sexed.

highest percentage of males die in the 26–35 year age group in the 1967–72 excavations, while the highest percentage in the 2000–5 excavations falls in the 45+ age group. In the 1967–72 sample of females, the highest percentage die in the 18–25 year age group, while in the 2000–5 sample the highest percentage of females die in the 26–35 year age group.

TABLE 2.17

Mortality distribution, Lankhills 1967–72 and 2000–5 excavations combined (table percentages)

Age	Subadult		Male		Female		Indeterminate		Total	
	N	%	N	%	N	%	N	%	N	%
Neonate 0–1 month	20	2.9							20	2.9
1 month–3 years	70	10.1							70	10.1
4–7 years	40	5.8							40	5.8
8–12 years	24	3.5							24	3.5
13–17 years	9	1.3	1	0.1	7	1.0			17	2.5
Child	11	1.6							11	1.6
TOTAL	**174**	**25.2**	**1**	**0.1**	**7**	**1.0**			**182**	**26.3**
18–25 years			31	4.5	51	7.4	6	0.9	88	12.7
26–35 years			57	8.2	60	8.7	7	1.0	124	17.9
36–45 years			52	7.5	38	5.5	5	0.7	95	13.7
45+ years			39	5.6	17	2.5	3	0.4	59	8.5
60+ years			9	1.3	7	1.0	0	0	16	2.3
Adult			34	4.9	40	5.8	53	7.7	127	18.4
TOTAL			**222**	**32.1**	**213**	**30.8**	**74**	**10.7**	**509**	**73.7**
TOTAL SAMPLE	**174**	**25.2**	**223**	**32.3**	**220**	**31.8**	**74**	**10.7**	**691**	**100.0**

Note: the data have been corrected for burials partially excavated in both the 1967–72 and 2000–5 excavations.

TABLE 2.18

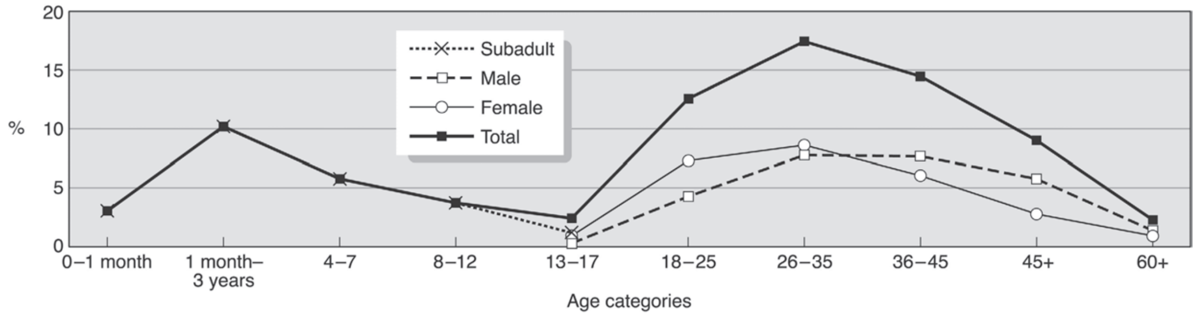
Mortality distribution, Lankhills 1967–72, 2000–5, and Wessex Archaeology excavations combined (table percentages)

Age	Subadult		Male		Female		Indeterminate		Total	
	N	%	N	%	N	%	N	%	N	%
Neonate 0–1 month	22	3.0							22	3.0
1 month–3 years	76	10.2							76	10.2
4–7 years	42	5.7							42	5.7
8–12 years	26	3.5							26	3.5
13–17 years	9	1.2	2	0.3	7	0.9			18	2.4
Child	11	1.5							11	1.5
TOTAL	**186**	**25.0**	**2**	**0.3**	**7**	**0.9**			**195**	**26.2**
18–25 years			32	4.3	55	7.4	7	1.0	94	12.7
26–35 years			59	7.9	65	8.7	7	1.0	131	17.6
36–45 years			57	7.7	45	6.1	6	0.9	108	14.5
45+ years			43	5.8	21	2.8	3	0.4	67	9.0
60+ years			9	1.2	7	0.9	0	0	16	2.2
Adult			36	4.8	40	5.4	56	8.1	132	17.8
TOTAL			**236**	**31.8**	**233**	**31.4**	**79**	**11.4**	**548**	**73.8**
TOTAL SAMPLE	**174**	**25.0**	**238**	**32.0**	**240**	**32.3**	**79**	**11.4**	**743**	**100.0**

Note: the data have been corrected for burials partially excavated in both the 1976–72 and 2000–5 excavations.

Merging the samples from the Oxford Archaeology excavations with the 1967–72 excavations and correcting for duplications in graves excavated alters these patterns in some ways (Table 2.17). As pointed out in Clough and Boyle, when the two samples are combined, the ratio of males to females overall is almost equal,[52] an assertion that has not been changed by the revised numbers

[52] Clough and Boyle 2010, 350.



Illus. 2.7. Mortality distribution, Lankhills 1967–72, and 2000–5, and Wessex Archaeology excavations combined.

used in this study. Males and females each represent approximately 32% of the entire sample, while children, at 26.3% are somewhat under-represented, particularly in the earliest two age categories. In the merged sample, the modal age at death for both males and females occurs in the Prime Adult category (ages 26–35 years), although males lived longer, as shown by their greater representation in the older age groups. Adding in the 52 burials from the Wessex Archaeology excavations (Table 2.18) tips the balance of the sexes insignificantly in favour of females, but otherwise the age/sex distribution is essentially unaltered.

The site as a whole (Illus. 2.7) is characterized by an under-representation of infants, an approximately equal distribution of adult males and females, a modal age at death between 26 and 35 years for both sexes, and a possible under-representation of the oldest age groups. However, since over 10% of the adults could not be aged, it is possible that the older adults are in fact present in the more fragmentary material, but cannot be accounted for.

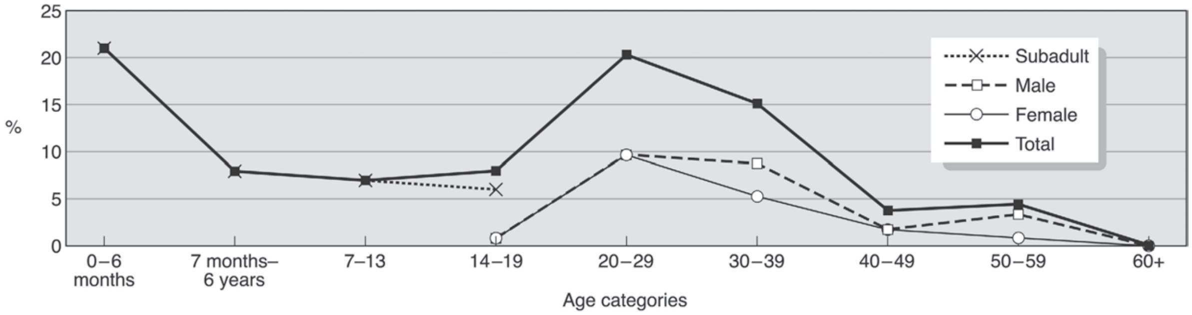
v. LANKHILLS IN ROMANO-BRITISH CONTEXT

Roman Winchester: Victoria Road West

This study includes unpublished data from 114 individuals from the late fourth to the early fifth century site of Victoria Road West examined by this author in 1977, prior to the more recent publication of the site.[53]

The mortality distribution of the 114 individuals excavated from 112 inhumations at Victoria Road West is found in Table 2.19 and Illus. 2.8. It differs from the Lankhills 1967–72 mortality distribution in several respects. The larger number of infant deaths is immediately obvious. Over 21% of the Victoria Road West sample died prior to the age of six months, as opposed to a maximum of 9.5% in the late fourth-/early fifth-century sample at Lankhills (Areas F, E, O). Differential skeletal preservation certainly played a role in the discrepancy between these figures, for on the whole the Victoria Road West skeletons were in a much better state of preservation. If Victoria Road West is in fact slightly later than Lankhills, other explanatory possibilities to consider include larger families, a change in burial practices regarding very small infants, or an altered socioeconomic environment related to changed levels of nutrition or disease. If, on the other hand, Victoria Road West is fully contemporary with Lankhills, the greater number of infants might

[53] Ottaway et al. 2012.



Illus. 2.8. Mortality distribution, Victoria Road West.

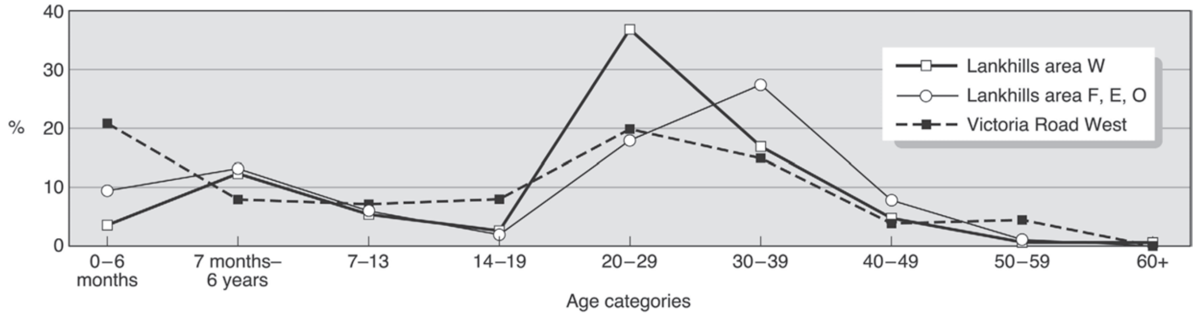
TABLE 2.19
Mortality distribution, Victoria Road West (table percentages)

Age	Subadult		Male		Female		Indeterminate		Total	
	N	%	N	%	N	%	N	%	N	%
0–6 months	24	21.1							24	21.1
7 months–6 years	9	7.9							9	7.9
7–13 years	8	7.0							8	7.0
14–19 years	7	6.1	1	0.9	1	0.9			9	7.9
Child	2	1.8							2	1.8
TOTAL	**50**	**43.9**	**1**	**0.9**	**1**	**0.9**			**52**	**45.6**
20–29 years			11	9.6	11	9.6	1	0.9	23	20.2
30–39 years			10	8.8	6	5.3	1	0.9	17	14.9
40–49 years			2	1.8	2	1.8	0	0	4	3.5
50–59 years			4	3.5	1	0.9	0	0	5	4.4
60+ years			0	0	0	0	0	0	0	0
Adult			2	1.8	6	5.3	5	4.4	13	11.4
TOTAL			**29**	**25.4**	**26**	**22.8**	**7**	**6.1**	**62**	**54.4**
TOTAL SAMPLE	**50**	**43.9**	**30**	**26.3**	**27**	**23.7**	**7**	**6.1**	**114**	**100.0**

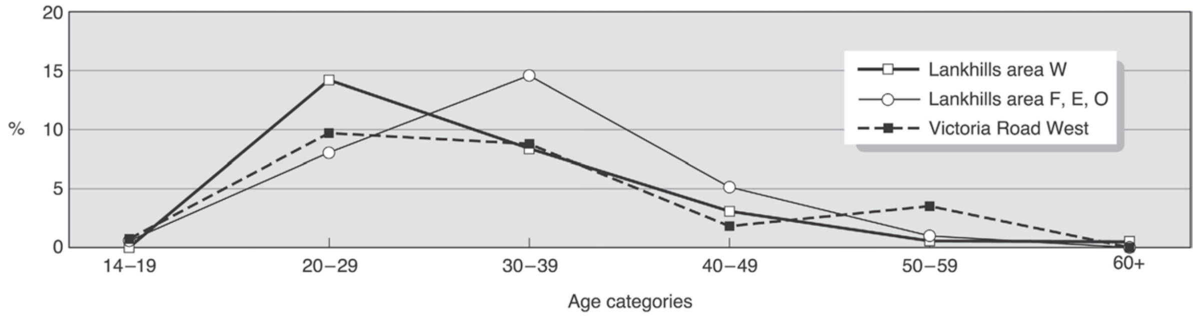
indicate that this site was being used by individuals with different beliefs regarding the disposal of deceased infants. The importance of these differences in mortality patterns should not be overemphasized, however. When the childhood mortality distributions of the two sites were tested statistically, the observed differences between them were not significant (Table 2.6), suggesting an underlying similarity between the sites.

Adults comprise 54.4% of the sample at Victoria Road West. The sexes are almost evenly distributed, with a small preponderance of males, who represent 26.3% of the sample, while females constitute 23.7%. In this respect Victoria Road West is very similar to the overall distributional pattern found at Lankhills, and resembles the late fourth-/early fifth-century subsample (Areas F, E, O) more closely than the early/mid fourth-century subsample (Area W).

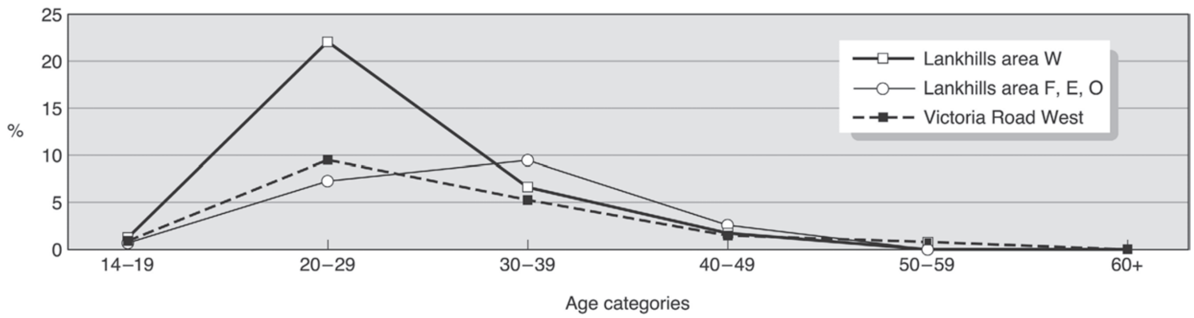
The modal age at death for adults at Victoria Road West, both males and females, occurs between 20 and 29 years. In this regard it resembles both the overall mortality distribution at Lankhills, and also the subsample in Area W. In Illus. 2.9 the young adult (20–29 year interval) curve appears greatly flattened compared to the Lankhills samples. This effect is caused by the greater frequency of infants in



Illus. 2.9. Mortality distribution, Lankhills 1967–72 Area W, Lankhills Areas F, E, O, and Victoria Road West compared.



Illus. 2.10. Mortality distribution, males, Lankhills 1967–72 and Victoria Road West compared.



Illus. 2.11. Mortality distribution, females, Lankhills 1967–72 and Victoria Road West compared.

the overall profile. When the sexes are considered separately (Illus. 2.10 and 2.11), the comparative samples more nearly resemble each other, although certain variations are present.

The mortality rate for males at Victoria Road West (Illus. 2.10) is fairly constant between the ages of 20 and 39, lacking the sharp peaks of the Lankhills samples. Between 40 and 49 the Victoria Road West rate dips below that found in the Lankhills samples, and then rises noticeably in the 50–59 age bracket. The total percentage of all individuals living past 40 is approximately the same in both sites.

The most notable finding of the comparative adult female mortality distributions (Illus. 2.11) is the very high percentage of deaths between the ages of 20 and 29 in the early-/mid fourth-century Lankhills sample (Area W). This age group also contains the modal age at death for Victoria Road West females, but a higher percentage of them survive into older age groups. Statistical testing (Table 2.6) indicates a slightly younger mean age at death for both sexes at Lankhills 1967–72 as

TABLE 2.20

Mortality distribution, Victoria Road West, using Oxford Archaeology age categories (table percentages)

Age	Subadult		Male		Female		Indeterminate		Total	
	N	%	N	%	N	%	N	%	N	%
Neonate 0–1 month	17	14.9							17	14.9
1 month–3 years	14	12.3							14	12.3
4–7 years	5	4.4							5	4.4
8–12 years	4	3.5							4	3.5
13–17 years	7	6.1	1	0.9	1	0.9			9	7.9
Child	2	1.8		0					2	1.8
TOTAL	**49**	**43.0**	**1**	**0.9**	**1**	**0.9**			**51**	**44.7**
18–25 years			6	5.3	10	8.8	1	0.9	17	14.9
26–35 years			9	7.9	4	3.5	1	0.9	14	12.3
36–45 years			7	6.1	5	4.4	0	0	12	10.5
45+ years			5	4.4	2	1.8	0	0	7	6.1
60+ years			0	0	0	0	0	0	0	0
Adult			2	1.8	6	5.3	5	4.4	13	11.4
TOTAL			**29**	**25.4**	**27**	**23.7**	**7**	**6.1**	**63**	**55.3**
TOTAL SAMPLE	**49**	**43.0**	**30**	**26.3**	**28**	**24.6**	**7**	**6.1**	**114**	**100.0**

opposed to Victoria Road West, but the differences are not statistically significant. This suggests overall homogeneity in demographic structure for these two sites. Significant chronological variation is present, as attested by the younger mean ages at death in the early/mid fourth-century Lankhills sample (Area W), but this variation becomes obscured when the Lankhills 1967–72 sample is considered as a whole.

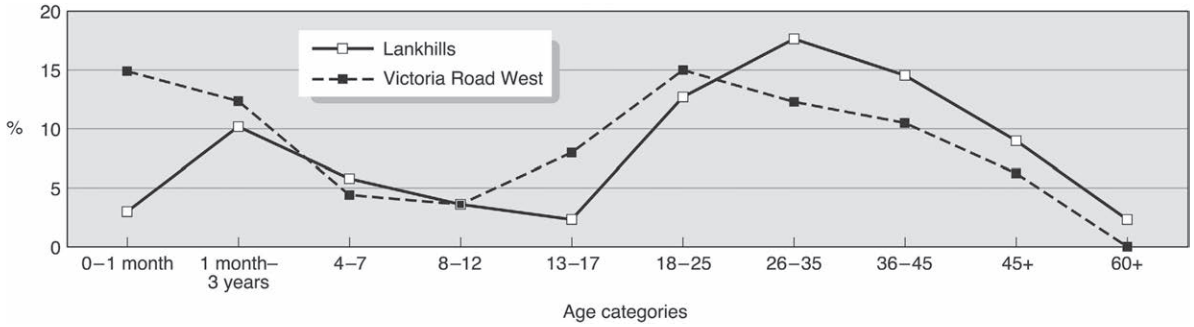
In order to facilitate comparisons with the entire site of Lankhills, including the Oxford Archaeology excavations, the Victoria Road West demographic data are shown using the Oxford Archaeology age categories in Table 2.20. Changing the age categories in this manner reduces the number of subadults by one, with a corresponding increase in the number of adults. However the percentage of subadults to adults changes very little. The Oxford Archaeology age categories reveal that the majority of infants under the age of six months are neonates, or close to that age. Changing the age categories has also created the impression of a slightly older sample, although none of the individual age estimates have been changed. They have simply been allocated differently, testimony to the effect on perceptions that different age category structures can make.

Illus. 2.12 compares the age structure of the entire Lankhills site with Victoria Road West. The two most prominent features of this comparison are first, the greater number of infants at Victoria Road West (although as noted earlier, this is not statistically significant), and second, the older modal age at death in Lankhills. This older modal age at death is being driven by the demographic profile of the Oxford Archaeology excavations.

Lankhills and the northern, western, and eastern Roman cemeteries of Winchester

Exclusive of Lankhills, but including an additional assessment of Victoria Road West, the northern, western, and eastern Roman cemeteries of Winchester are fully described in Ottaway et al. (2012).[54]

[54] Ottaway et al. 2012.



Illus. 2.12. Mortality distribution using Oxford Archaeology age categories, all Lankhills excavations combined, compared to Victoria Road West.

In this report we seek only to place Lankhills within the context of those other sites. The Lankhills excavations constitute merely one part of Roman Winchester's northern cemetery, which was much larger. Commencing with late-first century cremation burials at Victoria Road East in the triangle formed by the Cirencester and Silchester Roads,[55] it spread north along the Cirencester Road as inhumation became a more common burial rite in the third and fourth centuries. In addition to Lankhills and Victoria Road West, smaller excavations touching on portions of the northern cemetery have taken place at nine other locations to date, including Hyde Street, Eagle Hotel, and Hyde Close.[56] Exclusive of Lankhills but including Victoria Road West, these various excavations have produced a sample of 210 individuals.[57] When added to the combined Lankhills excavations, the total sample from the northern cemetery constitutes 953 individuals, by far the largest of any Roman cemetery in Winchester. However, it is still a very small proportion of the entire cemetery, perhaps less than 10%.

Assignment of individuals to age categories in Browne[58] is different from the methods used either in this study or by Oxford Archaeology, limiting the possible comparisons. However, some observations can be made. Exclusive of Lankhills, 77 (37%) subadults and 133 (63%) adults were identified in the northern cemetery sample. This proportion of children is higher than the proportion for the Lankhills excavations combined (26.3%), or for the 1967–72 excavations alone (28.7%), and is being driven by the high proportion of children in Victoria Road West (45.6%). When all the data for the northern cemetery from all excavations are combined, 28.5% of the sample are subadults and 71.5% are adults, a proportion which is almost identical to the Lankhills 1967–72 excavations. In the northern cemetery sample exclusive of Lankhills, 14.3% of the children are 0–2 years, while the modal age at death is 0–3 months.[59] The corresponding age categories at Lankhills (Tables 2.15 and 2.18) extend to three years, so the comparisons cannot match exactly. In the combined excavations at Lankhills 13.3% of the children are in the 0–3 year age groups, while in the 1967–72 excavations 14.6% are included in these age brackets. These numbers are very close to those for the northern cemetery, and suggest a general similarity of results.

Adults in the northern cemetery sample appear to have died at a younger age than at Lankhills. The modal age at death occurs in the 17–25 year age group,[60] although 9% of the sample lived to the age of 45+. The modal age at death for adults in the combined Lankhills excavations (Table 2.18) is

[55] Ottaway et al. 2012, 34. [56] ibid. 211, Table 19. [57] ibid. 217, Table 23
. [58] Browne 2012, 218, Table 24. [59] ibid. [60] ibid.

in the 26–35 year age category, while 11.2% of the sample survived to 45+. In the 1967–72 Lankhills excavations the modal age at death for adults is also in the 26–35 year age category, but only 2.9% are identified as living to 45+. Overall, the percentage of older individuals in the northern cemetery and combined Lankhills samples is quite similar. The difference in the modal age at death for these samples could be due to many factors, ranging from ageing techniques to differential preservation or variations in burial custom.

Browne[61] provides figures of 120 sexed adults and subadults from the northern cemetery, of which 72 (60%) are male and 48 (40%) are female. In all three Lankhills excavations combined, the respective totals are 238 (49.8%) males and 240 (50.2%) females. Taken together, the sexed adults and subadults from the northern cemetery represent 598 individuals, including 310 (51.8%) males and 288 (48.2%) females. This indicates a nearly equal distribution of the sexes. The variation of sex distribution in the individual excavations within the northern cemetery is almost certainly a function of site sampling, especially in the smaller excavations. Both the 1967–72 and 2000–5 Lankhills excavations show a similarity to numbers for the entire northern cemetery, with male/female ratios of 51:49 and 50:50 respectively. However, this does not negate the possibility that within the cemetery as a whole some specific locations reflect burial practices limited to one particular age group or sex.

Because of the differences in age categories used, it is not possible at present to build a demographic profile for all the excavations in the northern cemetery combined. Comparisons between the northern cemetery exclusive of Lankhills and the other Winchester cemeteries have been made by Browne.[62] Therefore this report concentrates on the relationship of Lankhills to the western and eastern cemeteries.

The western cemeteries sample of 82 individuals is derived from excavations at six sites, the largest of which are New Road (23 individuals) and Carfax (38 individuals). The larger eastern cemetery sample is composed of 133 individuals from five sites, including Chester Road (94 individuals) and St Martin's Close, Winnall (34 individuals).[63] The proportion of subadults in the eastern cemetery and the combined sample from the northern cemetery are very similar. This is also true when the eastern cemetery is compared with either the combined Lankhills sample or the 1967–72 excavations. However, the western cemeteries yield a subadult sample of 61%, over double that of the total northern cemetery sample. This may be attributed to the very high proportion of infants under the age of two at the New Road and Carfax sites in the western cemeteries, locations which may have been used specifically for the burial of small children.[64]

The modal age at death for adults is the same in the western cemeteries (25–35 years) as in Lankhills, either when all three Lankhills excavations are considered together, or the 1967–72 Lankhills excavations are taken alone. The percentage of adults living past 45 is also similar in the western cemeteries and the 1967–72 Lankhills excavations (3.7%[65] and 2.9% respectively). However, Lankhills considered as a whole has a higher percentage of older adults (11.2%), reflecting the contribution of the Oxford Archaeology excavations. The eastern cemetery, on the other hand, has a younger modal adult age of death (17–25 years), similar to the northern cemetery with Lankhills excluded. The proportion of individuals living past 45 (6.8%) in the eastern cemetery is intermediate between the western cemeteries (3.7%) and the combined Lankhills excavations (11.2%).

[61] ibid. 219, Table 26.
[62] ibid. 209 ff.
[63] ibid. 211, Table 19.
[64] ibid. 226.
[65] ibid. 218, Table 24.

TABLE 2.21

List of selected Roman and Sub-Roman sites

Site	Date	Sample size	Reference
London East cemetery, London	1st–5th cent.	550	Barber and Bowsher 2000
Fosse Lane, Shepton Mallet, Somerset	2nd–4th cent.	46	Pinter-Bellows 2001
120–122 London Road, Gloucester	3rd–4th cent.	64	Márquez-Grant and Loe 2008
Bath Gate cemetery (north), Cirencester	3rd–4th cent.	45	Wells 1982
Bath Gate cemetery (south), Cirencester	3rd–4th cent.	405	Wells 1982
Trentholme Drive, York	3rd–4th cent.	290	Warwick 1968
Northern cemetery, Winchester	3rd–4th cent.	210	Browne 2012
Eastern cemetery, Winchester	3rd–4th cent.	133	Browne 2012
Western cemeteries, Winchester	3rd–4th cent.	82	Browne 2012
Butt Road (P. 2), Colchester	4th cent.	669	Pinter-Bellows 1993
Poundbury, Dorchester, Dorset	4th cent.	1,074	Molleson 1993
Cannington, Somerset	4th–7th cent.	542	Brothwell and Powers 2000

TABLE 2.22

Percentages of adults and subadults in selected Romano-British sites

Site	N	% Adult	% Subadult
Bath Gate (north), Cirencester	45	97.8	2.2
120–122 London Road, Gloucester	64	85.7	14.3
Trentholme Drive, York	290	84.8	15.2
Bath Gate (south), Cirencester	405	83.5	16.5
London East cemetery	515	75.0	25.0
Lankhills (total 1967–72, OA, WA)	743	73.8	26.2
Lankhills, Area W	274	73.4	26.6
Eastern cemetery, Winchester	133	71.0	27.0
Lankhills (total, 1967–72 excavations)	411	71.3	28.7
Fosse Lane, Shepton Mallet	46	71.1	28.9
Lankhills, Areas F, E, O	137	67.2	32.8
Northern cemetery, Winchester	210	63.0	35.0
Butt Rd (P. 2), Colchester	669	67.0	36.0
Poundbury, Dorset	1,030	63.3	36.7
Cannington, Somerset	393	55.0	45.0
Victoria Road West, Winchester	114	54.4	45.6
Western cemeteries, Winchester	82	39.0	61.0

The sex distribution in the western cemetery is 50/50,[66] virtually identical to that found in the Oxford Archaeology Lankhills excavations, and very similar both to the 1967–72 excavations and the Lankhills excavations combined. The eastern cemetery, on the other hand, reveals a marked predominance of males, who comprise 61.4% of the sexed individuals.[67] The reasons for this finding are not clear, but it may be a function of sampling.

Other Romano-British sites

The published body of useful comparative data from large Roman period cemeteries in England was limited at the time this study was originally undertaken, but has increased greatly in recent years. This report considers a number of other sites (see Table 2.21), but is not intended to be a comprehensive review.

[66] Browne 2012, 219, Table 26. [67] ibid.

Other site comparisons with the Winchester Romano-British samples are constrained by several factors. The age categories employed at different sites are not uniform, there undoubtedly has been inter-observer variation in age and sex standards applied, and the skeletal material itself may have varied considerably from one site to another with regard to state of preservation and completeness of recovery. Keeping these difficulties in mind, certain useful comparisons can be made, however.

Table 2.22 illustrates the range of variation in the percentage of children and adults at a number of Romano-British sites. Where possible, the figures for children include all individuals under the age of 20. However, this is not entirely consistent across all sites. The percentages of children range from a low of 2.2% at Cirencester (North) to a high of 61% in Winchester's western cemeteries. These two extreme outliers may reflect differential burial practices at these sites, or they may be a sampling effect in incompletely excavated sites. The highest percentages of children, varying between 45 and 61%, are found at Cannington, Victoria Road West, and Winchester's western cemeteries. Three other sites (Lankhills Areas F, E, O, Winchester's northern cemetery, and Poundbury) have subadult samples in excess of 32%. Although it cannot be proven conclusively, with the exception of Winchester's western cemeteries, this group may have a ratio of children to adults similar to the living population, with the caveat that neonates and very small infants may be under-represented, and there may be other irregularities in the subadult age distributions. In five other groups (Lankhills total of all three excavations; Lankhills Area W; Winchester's eastern cemetery; Lankhills 1967–72 excavations; Shepton Mallet) the percentage of children ranges from 26.2% to 28.9% and represents a modal clustering of sites. Twenty-nine per cent of this group of sites falls within this range. The Lankhills 1967–72 excavations, with 28.7% subadults, represents the median point in this group, with half the sites listed having lower subadult percentages, and half the sites having higher percentages. At the two Cirencester cemeteries, Gloucester and Trentholme Drive, very few children indeed are found, ranging from only 2.2% at Cirencester (North) to 16.5% at Cirencester (South). While the difference between Cirencester and Winchester's western cemeteries may be meaningful, the differences between the sites in Table 2.22 ranging from Lankhills (1967–72 excavations) down the list to Poundbury, Cannington, and Victoria Road West probably are not, since it has already been demonstrated that Lankhills and Victoria Road West do not differ significantly from each other statistically in spite of the seemingly large variation, and the Poundbury and Cannington percentages fall between the two. This general rough similarity may argue for the presence of a genuinely meaningful demographic distribution in terms of proportions of subadults, as opposed to simple sampling or preservation problems. The low child percentages at Cirencester, Gloucester, and Trentholme Drive do not have an adequate explanation at present, but may be related to either circumstances of excavation, variations in burial practices, or both.

In common with Lankhills and Victoria Road West, the greatest childhood mortality at many sites seems to take place prior to the age of two. At Lankhills the highest mortality is seen in infants under the age of one year, while at Victoria Road West it is found in infants of less than six months. Like Lankhills, at Poundbury the modal age at death among children is under the age of one year,[68] although the percentage of neonates is lower at Lankhills than at Poundbury.[69] At Shepton Mallet

[68] Molleson 1993, 212.

[69] See Clough and Boyle 2010, Tables 5.13 and 5.14 as well as pages 351–2. The assertion that there is a higher percentage of neonates at Lankhills (8.3%) as opposed to Poundbury (6.3%) is based on the use of Gowland's demographic data for the 1967–72 excavations, which has been shown to be questionable (see above, pp. 28–30).

53.9% of the subadults are late term fetuses or perinatal.[70] Children at Cannington have a mortality rate of 10.7% for fetal or neonatal burials, and a total mortality of 26.7% under the age of five.[71] At London East cemetery, in spite of clear under-representation of infants and small children, the modal age at death is two years, by which age 20.7% of the subadults have perished.[72] Data from Cirencester south of the Fosse reveals the highest childhood mortality under the age of two, with a rate of 30.2%. The pattern at Cirencester resembles Victoria Road West in that 16 of the 19 infants under two years are neonates.[73] These figures suggest that infants were at highest risk in the first year or so following birth, rather than during or immediately following the weaning period (unless weaning was accomplished exceptionally early), although mortality levels remain fairly high at almost all sites up to the age of approximately five or six years. Trentholme Drive presents an exception to this pattern, with extremely low childhood mortality rates, rising steadily to a maximum in the 15–20 year age bracket. Gloucester follows the same pattern, but the subadult sample is so small that any findings must be considered inconclusive.[74] Colchester is somewhat similar, in that only six infants under the age of one year are identified, while 60 children die between the ages of five and fifteen, and an additional 27 subadults die between the ages of fifteen and twenty.[75] Overall, these figures may reflect site use patterns and excavation problems rather than a representative demographic distribution.

The distribution of adults and adolescents by sex in these sites is extremely variable, raising the possibility that each site was being affected in different and highly specific ways both by preservation and recovery, and also by other factors such as burial practices or the nature of the communities served. The sexes are approximately evenly distributed in the 1967–72 excavations at Lankhills and at Victoria Road West, with a slight predominance of males overall. In addition, the greater number of females in the early phase of Lankhills should be mentioned. Although the three combined excavations at Lankhills indicate an essentially even sex distribution with a very small predominance of females,[76] when the northern cemetery including Lankhills is considered as a whole, males (310) outnumber females (288) by a small margin. The excavated sample at Shepton Mallet, although small, is also evenly distributed between the sexes.[77] At Poundbury it appears that females outnumber males by approximately 6%, at least in the main cemetery.[78] Females (54.7%) also outnumber males (37.2%) at Cannington.[79] The distribution is reversed at London East cemetery, Colchester, Cirencester, and Trentholme Drive. The London East cemetery has 186 males and 109 females.[80] The Colchester sample contains 170 males and 140 females, but the results must be treated with caution, since 22% of the adult sample could not be sexed, which might change the results.[81] At Cirencester, the sample south of the Fosse includes 207 males and 93 females, while north of the Fosse 38 males and seven females are reported. One possible explanation offered by Wells in this case for such a great imbalance was the function of Cirencester as a home for retired legionaries who may not have had families with them,[82] although others have not accepted this opinion.[83] Males also overwhelmingly predominate at

70 Leach 2001, 266.
71 Brothwell et al. 2000, 143–4.
72 Barber and Bowsher 2000, 278.
73 Wells 1982, 137.
74 Márquez-Grant and Loe 2008, 34.
75 Pinter-Bellows 1993, 63.
76 See Table 2.18.
77 Pinter-Bellows 2001, 265–6.
78 Molleson 1993, 223.
79 Brothwell et al. 2000, 137.
80 Barber and Bowsher 2000, 279.
81 Pinter-Bellows 1993, 62–3.
82 Wells 1982, 135.
83 cf. Simmonds et al. 2008, 141.

Trentholme Drive,[84] representing 80% of the sample that could be aged and sexed, and at 120–2 London Road, Gloucester, where males outnumber females by more than two to one (23:11).[85] These findings may indicate a social reality, or it may reflect problems in excavation and analysis, or both.

Only the most tenuous comparisons can be made with respect to adult ages at death. At 120–2 London Road, Gloucester, the modal age at death for both males and females is found in the young adult category, ages 18–25.[86] The modal adult age at death at Poundbury occurs in the 25–34 year interval with a larger percentage of males living into the next age interval,[87] suggesting a pattern very like Lankhills and Victoria Road West. Similarly, at Cannington males tend to have a higher adult average age at death, with female mortality peaking in the 20–24 age group and male mortality peaking in the 30–34 age group.[88] At Shepton Mallet the modal age at death for both sexes falls in the 30–49.9 age bracket,[89] while at the London East cemetery 41.3% of all adults die between 25 and 45.[90] The modal age at death for all adults at Colchester is in the group defined as 'middle aged', i.e. between 30 and 50. However, males did tend to live longer than females, with greater numbers of females dying in their twenties, and greater numbers of males dying over the age of 50.[91] At Cirencester, the modal age at death for males occurs in the 48–53 year interval, with generally high mortality rates after the age of 38. Female deaths peak between the ages of 28 and 33, indicating a pattern very similar to female mortality patterns at the other sites included here. The peak, however, is very small, and deaths are rather evenly distributed over the adult years.[92] This distribution may also be related to the specialized nature of the site. The modal age at death for all adults at Trentholme Drive appears to have occurred between 30 and 40 years, affecting 40% of the sample.[93]

In summary, Lankhills shares certain demographic characteristics in common with many of the other Romano-British sites reviewed here. These characteristics include proportions of children clustering around roughly 25–36%, high levels of childhood mortality under the age of two, and high female death rates in young adulthood. Modal ages at death tend to group around 30, ± five or ten years. The only real outlier is Cirencester, where the modal age at death for males is in the 48–53 age range.

It may be instructive to note that a study of 221 British tombstones by Szilagyi[94] yielded an average age at death of 32.5, which varied from 27.8 for females to 34.6 for males. A more recent and larger study of 496 tombstones[95] gave generally similar but less detailed results, the modal age at death for both males and females occurring in the 18–40 year category, with significantly larger numbers of males in the 41+ age group. The tombstone data suggest that the rather imprecise information yielded by the skeletal samples discussed here is within a reasonable range. The pattern of early female death is fairly consistent where it can be documented. Sex distributions lack a similar consistency, for reasons that remain obscure and may vary from one location to another.

[84] Warwick 1968, 163.
[85] Márquez-Grant and Loe 2008, 34.
[86] ibid. 33.
[87] Molleson 1993, 209.
[88] Brothwell et al. 2000, 145.
[89] Pinter-Bellows 2001, 266.
[90] Barber and Bowsher 2000, 278.
[91] Pinter-Bellows 1993, 63.
[92] Wells 1982, 136.
[93] Warwick 1968, 163.
[94] Szilagyi 1959, cited in Acsadi and Nemeskeri 1970, 222.
[95] Adams and Tobler 2007, 21.

vi. DISCUSSION

The demographic patterns seen at the 1967–72 Lankhills excavations can be summarized briefly and placed in their spatial and temporal perspective. Children at Lankhills 1967–72 most frequently die under the age of a year, while adult deaths peak between 20 and 30 years (26–35 years, using the Oxford Archaeology age categories), with males having a slightly older average age at death.

It may be reasonable to infer that the adult samples drawn from Lankhills 1967–72, especially Lankhills Areas F, E, O, as well as Victoria Road West, actually represent the populations from which they were drawn, without great distortion. According to Weiss,[96] three tests of completeness in samples include 30% or more of children under 15, a late subadult mortality significantly lower than the infant mortality rate, and the healthiest segment of the population represented by children between the ages of 10 and 14. Victoria Road West and the late phase of Lankhills generally meet these criteria. At Lankhills Areas F, E, O, 33.6% of children in the aged sample are under the age of 14, while the corresponding percentage at Victoria Road West is 41.4%. The earlier phase of Lankhills 1967–72 and the overall sample come very close, primarily lacking the requisite number of children (21.6% and 28.4% respectively). However, when the clear under-representation of neonates and very small infants is factored in, one may suggest that the entire 1967–72 excavations, as well as Area W, probably meet these criteria also, as does the site as a whole, factoring in all three excavations conducted at Lankhills.

At the time of initial data analysis in the late 1970s, Victoria Road West was believed partially to overlap Lankhills chronologically, but to continue later into the fifth century. Although that view may now be open to debate,[97] we believe the osteological data provide some support for it, so the original discussion is presented here, with additional comments. When the late Roman population of Winchester was evaluated in three slightly overlapping chronological units consisting of Lankhills Area W, Lankhills Areas F, E, O, and Victoria Road West, two trends emerged. First, the proportion of subadults in the samples steadily increases, from 27% in the mid-fourth century, to 32.8% in the late fourth century, to 46% into the early fifth century. This trend is accompanied by a similar change in the proportion of very small infants, which rises from 3.6 to 21.1%. While problems of differential preservation and recovery cannot be fully excluded, at least two other possibilities also exist. On the one hand, these figures may indicate increasing levels of infant mortality as the fourth century progressed. On the other hand, this trend may reflect an increasing cultural tendency to bury infants in the same cemetery locations occupied by adults, either because of breakdowns in traditional practices, or because of changed beliefs regarding the status of infants. However, it is important to reinforce the fact that these differences in proportions of children are small, and are not statistically significant. Further, if Victoria Road West is indeed fully contemporaneous with Lankhills, then the observed chronological differences apply to Lankhills only, and another explanation must be found for the much greater numbers of children, especially infants, at Victoria Road West.

The second temporal trend evident in the demography of late Roman Winchester as reflected in these three samples is a gradually increasing average age at death for both sexes, although women generally die younger than men. The differences are greatest for both sexes, at statistically significant levels, between the two Lankhills samples. When Lankhills and Victoria Road West are compared, the

[96] Weiss 1973, 46–9, cited in Leach 2001, 266.

[97] Ottaway et al. 2012; see also above, p. 15, n. 35.

difference, though still present, is much less, and is not statistically significant. It was not possible to evaluate these chronological trends within the larger osteological sample provided by all Lankhills excavations combined, as chronology in the Oxford Archaeology excavations has been handled somewhat differently.[98] Similarly, the data are not presently available to examine these questions for the entire northern cemetery, nor for the Roman population of Winchester as a whole. There are, however, indications that portions of the western cemetery may have been reserved for infant burial.[99]

Generalizations about Lankhills in a wider Romano-British context are hard to draw with a great degree of confidence. However, like Lankhills, many of the comparative Romano-British sites examined in this study suggest high levels of infant mortality under the age of two years. This is true whether the 1967–72 and 2000–5 excavations are considered separately, or whether the site is considered as a whole. When Lankhills and Victoria Road West were compared to the four other largest sites, Poundbury, Butt Road Colchester, London East, and Cannington, certain similarities and differences emerged in spite of the fact that the age brackets chosen for infants were not strictly comparable across all four sites. The early phase of Lankhills is notable for its extremely low percentage of neonates and infants under the age of six months. The suggestion has been made at Cannington that while infants received much the same burial treatment as other members of the population, there is some evidence for spatial concentrations of juveniles on the periphery of the excavated area.[100] The London East cemetery appears to have a similar lack of infants aged less than one year, although the possibility is raised that this may be related to spatially separated excavations within the site.[101] At Poundbury, newborns appear to be buried with the rest of the population, although fetuses and stillborn may have been buried elsewhere.[102] There is a similar lack of fetuses and infants at Butt Road, where no fetal bone was found and only four still- or newborn skeletons were identified, again suggesting both differential burial customs and preservation problems.[103] Like most other sites, Lankhills was not excavated to its limits on all sides, and the possibility remains that most very small infants were interred in an unexcavated portion of the cemetery, at least in the earlier phase. So few fetuses were found at Lankhills that, like Poundbury, fetuses and stillbirths may have been excluded from the cemetery. However, infant bone preservation was so poor that this can only be conjecture. Like many other Romano-British sites, the Winchester sites suggest a modal age at death of between 20 and 40 years for adults, and a pattern of earlier ages at death for women than men. The adult mortality data agrees fairly well with limited tombstone data.

The ratio of males to females lacks consistency across the broad spectrum of these sites. In six sites[104] the proportions of males and females are nearly equal, with an insignificant predominance of one sex or the other. In five other sites[105] males clearly predominate, while at two sites[106] a higher percentage of females is present. Many different factors can affect these ratios, the two greatest being incomplete excavation and high percentages of skeletons that cannot be sexed. Therefore, unless the differences between numbers of males and females are very great indeed, these data should not be pushed too far, and one cannot exclude the possibility that the proportion of males and females in the general cemetery population was in fact balanced.

98 Clough and Boyle 2010, 453–62.
99 Ottaway et al. 2012, 226.
100 Brothwell et al. 2000, 143–5.
101 Barber and Bowsher 2000, 279.
102 Molleson 1993, 214.
103 Pinter-Bowes 1993, 61, 63.
104 1967–72 Lankhills excavations, Victoria Road West, Lankhills all excavations combined, Winchester north cemetery, Lankhills 2000–5 excavations, Shepton Mallet.
105 London East cemetery, Butt Road Colchester, Cirencester, York, 120–2 London Road.
106 Poundbury, Cannington.

3
PHYSICAL CHARACTERISTICS

i. INTRODUCTION

THIS chapter presents data describing and comparing the physical characteristics of the Lankhills people with other selected Romano-British cemetery samples. Cranial and postcranial measurement data are presented for the 1967–72 Lankhills excavations, as well as information regarding stature. Cranial, cranial height, and upper face indices are calculated. As well as evaluating the site as a whole, the earlier phase (Area W) is compared to the later phase (Areas F, E, O). The 1967–72 excavations are then compared to the more recent Oxford Archaeology excavations at Lankhills, and to the site of Victoria Road West. To the extent possible the northern cemetery as a whole is considered in relation to the other Roman cemeteries in Winchester. Finally, comparisons are made based on cranial data and stature with other selected Roman and sub-Roman period sites, especially large cemeteries such as Poundbury, Cannington, and Butt Road (Period 2), Colchester, for the purpose of beginning to place the Winchester material within a larger geographical and cultural context.

ii. METHODS

In examining the physical characteristics of the late Roman population of Winchester, data from the sites of Lankhills 1967–72 and Victoria Road West have been presented separately. Within Lankhills 1967–72 itself, comparisons between the early and late phase samples have been restricted to stature and cranial index. Comparisons between Lankhills 1967–72 and Victoria Road West were made for stature, cranial index, and cranial measurements. Males and females were tested separately, and within each site the two sexes were tested against each other.

Cranial and postcranial measurements, as listed in Tables 2.23–2.25 and 2.45, were taken using standard anthropometric techniques.[1] Measurements were made on all skulls and long bones sufficiently intact to permit examination, including those that were substantially reconstructed. If the position of a missing anthropometric landmark on a damaged bone could be estimated accurately, the relevant measurement was taken using this estimation. This technique[2] is used to minimize problems of missing data occurring on fragmentary material that will be subjected subsequently to quantitative analysis. Measurements were not taken when breakage, erosion of cortical bone, or distortion caused by warping clearly made accuracy impossible. For consistency in making comparisons, bilateral measurements of the skull, such as orbital dimensions, were normally taken on the left side since skulls are rarely completely bilaterally symmetrical.

Cranial non-metric traits will be discussed in Part 3, as one component of investigating the transition from Roman Britain to Early Anglo-Saxon England.

[1] Bass 1971; Brothwell 1972. [2] cf. Howells 1973, 34.

Stature calculations were based on the formulae of Trotter and Gleser.[3] While different bones were used to calculate individual stature, depending on the completeness of the skeleton, only stature estimates based on the most frequently found bone, the left femur, were used to test differences between samples. Since the regression equations used to calculate stature from different bones have different constants and different standard deviations, calculating means of pooled figures derived from these different equations can lead to inaccurate results. However, the Catalogue of the Burials in Chapter 7 provides stature estimations for as many skeletons as possible, using several different formulae as indicated in the text. Within the 1967–72 Lankhills and Victoria Road West samples, tests for possible statistically significant differences in stature, cranial index, or cranial measurements were limited to univariate analyses employing t-tests.

iii. LANKHILLS IN ROMANO-BRITISH PERSPECTIVE

Lankhills 1967–1972 excavations

Summary descriptive statistics for cranial, mandibular, and postcranial measurements will be found in Tables 2.23–2.25. These figures are for the 1967–72 Lankhills sample as a whole, and are given both by sex and by side as appropriate.

T-tests based on cranial and mandibular measurements (Table 2.26) indicate high levels of sexual dimorphism in the Lankhills sample, involving dimensions of the cranial vault slightly more than the face. However, when an indicator of shape, the cranial index, is examined there is no significant difference between the sexes (Table 2.27, Illus. 2.13), a finding which has also been established in other studies.[4]

As is commonly the case, females exhibit a larger mean cranial index (77.5) than do males (76.7), suggesting slightly rounder crania (Table 2.28). The cranial and mandibular measurements taken together with the cranial index indicate that there is an absolute size difference of the head reaching significant levels between the sexes (see Table 2.26), but both male and female skulls tend to be shaped the same way. While there is great variation within the sample, the average skull at Lankhills is mesocranial, neither conspicuously long nor markedly round.

The difference in mean stature between the two sexes at Lankhills (Table 2.29, Illus. 2.14) is highly statistically significant. Mean stature for males at Lankhills is 171.6 cm, while for females it is 156.9 cm (Table 2.30). This is a difference of 14.7 cm, or 8.6%, between the two sexes. Expressed in feet and inches, Lankhills males average approximately 5′ 7½″, while mean height for females is around 5′ 1″. The tallest male reached 183.9 cm (approximately 6′ ½″), while the shortest female was only a shade over 4′ 10″, or 147.7 cm.

The samples from the earlier portion of Lankhills in Area W were compared with the later samples from Areas F, E, O only with regard to cranial index and stature. In both the early and late phase samples there is no significant difference between the sexes in cranial index (Table 2.27), although stature is significantly sexually dimorphic (Table 2.29). Thus each individual sample conforms closely to the overall site pattern as well as to the other sample.

[3] Trotter and Gleser, 1952; 1958. No attempt was made by the excavators to measure stature of relatively complete skeletons in the grave. Nor was the anatomical method (Raxter et al. 2007) employed. As pointed out by Mays 2010, 130, while this technique may be the most accurate, it is rarely used in osteoarchaeology because of the incompleteness of excavated skeletal material. Such was the case at Lankhills.

[4] cf. Hennessy and Stringer 2002.

TABLE 2.23

Cranial and mandibular measurements, Lankhills 1967–72 excavations

Measurements	Males				Females			
	N	Mean	S.D.	Range	N	Mean	S.D.	Range
Cranial Length	53	190.15	7.16	171–209	31	180.90	5.36	170–194
Cranial Breadth	50	145.30	5.14	135–160	22	140.86	5.82	132–152
Cranial Height	35	133.26	6.87	120–145	22	126.09	4.11	119–132
Auricular Height	37	116.76	4.4	108–127	17	113.29	4.12	106–123
Basion-Prosthion Length	25	93.28	3.99	82–102	12	88.92	4.74	80–96
Basion-Nasion Length	35	100.63	3.25	95–110	21	95.48	3.79	85–102
Minimum Frontal Breadth	57	98.67	4.95	88–111	38	95.21	4.29	88–105
Nasion-Prosthion Height	33	70.64	4.11	64–79	21	66.81	3.87	61–75
Zygomatic Breadth	19	132.42	6.1	116–141	5	125.00	4.95	118–132
Orbital Height	35	34.00	1.53	31–38	20	33.55	2.04	30–39
Orbital Breadth	34	42.21	1.74	39–48	20	41.00	2.25	38–47
Nasal Breadth	30	23.90	1.79	20–28	21	23.14	1.98	20–26
Nasal Length	28	51.79	2.04	48–56	19	48.84	2.34	45–54
Alveolar Breadth	22	63.18	3.32	57–70	17	59.88	2.89	56–67
Alveolar Length	30	52.60	3.67	46–66	18	49.61	4.02	42–57
Palatal Breadth	22	37.23	3.29	31–43	18	35.67	2.79	31–41
Palatal Length	27	42.67	3.13	36–47	19	40.16	2.22	37–44
Biasterionic Breadth	44	115.55	6.04	100–127	27	110.15	4.42	101–117
Simotic Chord	32	9.28	1.89	5–13	22	9.14	2.08	6–13
Nasion-Bregma Chord	56	113.09	4.84	100–122	35	107.86	4.44	99–115
Bregma-Lambda Chord	59	117.54	6.45	99–131	33	115.42	5.23	103–125
Lambda-Opisthion Chord	45	96.69	5.14	87–110	30	94.23	5.20	85–109
Frontal Arc	56	131.00	6.52	113–142	35	125.37	6.96	113–140
Parietal Arc	59	130.78	7.61	103–146	33	128.78	7.10	111–143
Occipital Arc	45	121.09	6.88	109–140	30	115.97	8.36	98–142
Mandibular Body Length	41	106.83	8.83	95–151	29	99.55	5.41	89–111
Bicondylar Breadth	31	122.81	6.02	111–137	18	115.72	5.91	103–123
Minimum Ramus Breadth	56	31.95	2.12	27–37	39	30.90	2.56	25–36
Ramus Height	52	64.29	4.65	55–76	34	57.27	3.39	51–64
Bigonial Breadth	33	103.58	5.79	90–117	19	94.63	7.07	82–109
Coronoid Height	54	67.30	5.86	54–79	34	59.15	4.24	50–70
Symphysis Height	44	33.27	2.71	27–38	37	30.41	2.60	25–40
Gonial Angle	41	121.07	6.59	107–132	27	123.78	4.81	115–134

When examined by sex, the early and late phases of Lankhills also resemble each other closely. Both males and females from the later phase of Lankhills are slightly longer-headed than their earlier counterparts (Table 2.28), but the differences are not statistically significant (Table 2.31), and could be due to chance alone. Males from Area W are slightly taller on average than later males. The finding is reversed for females, who are taller on average in the later phase (Table 2.30). However, as held true for the cranial index, stature differences between the early and late phases at Lankhills are not statistically significant for either sex (Table 2.32), and the samples resemble each other closely.

The 1967–72 Lankhills excavations can be compared with the more recent Oxford Archaeology Lankhills excavations with regard to cranial index, upper facial index, cranial height index, stature, platymeria, platycnemia, and handedness.

The average male cranial index in the Oxford Archaeology excavations is 79.8,[5] indicating a male sample that is somewhat more round-headed than the sample from the 1967–72 excavations, a pattern that is reversed for the females (77.5 in the 1967–72 excavations, 75.95 in the 2000–5

[5] Clough and Boyle 2010, 356.

TABLE 2.24
Postcranial measurements, males, Lankhills 1967–72 excavations

Measurements	Right side				Left side			
	N	Mean	S.D.	Range	N	Mean	S.D.	Range
HUMERUS								
Max. morphological length	33	335.0	17.7	299–383	42	326.6	18.5	295–378
Physiological length	33	329.0	18.0	297–377	43	321.8	17.5	291–371
Maximum shaft diameter	29	24.4	1.8	21–28	36	23.6	1.6	21–27
Minimum shaft diameter	29	19.4	1.5	16–22	35	18.9	1.5	16–23
Maximum head diameter	21	44.0	1.9	41–48	16	43.6	1.6	41–47
Minimum circumference	37	70.0	4.5	61–80	38	67.8	3.8	61–77
RADIUS								
Max. morphological length	34	251.6	13.6	224–277	34	248.7	11.9	228–275
Physiological length	34	236.5	12.7	212–258	37	235.4	11.7	214–258
Minimum circumference	34	47.6	3.9	40–56	41	46.3	3.5	40–54
ULNA								
Max. morphological length	30	273.3	12.0	244–293	31	275.7	13.7	238–301
Physiological length	34	239.2	11.6	212–262	35	240.4	12.3	204–263
Minimum circumference	29	43.0	3.6	37–52	33	41.3	3.2	36–46
FEMUR								
Max. morphological length	60	455.6	22.0	415–503	60	457.1	23.0	413–510
Physiological length	59	452.3	21.7	411–501	59	453.2	23.0	411–505
A-P shaft diameter	53	27.1	2.2	23–33	54	27.8	2.6	23–36
Transverse shaft diameter	54	35.0	2.6	30–44	54	34.8	2.4	30–41
Maximum head diameter	42	50.0	2.5	46–58	46	49.5	2.4	46–57
TIBIA								
Max. morphological length	67	371.2	21.1	324–412	73	368.9	20.2	325–410
Physiological length	67	353.3	20.8	305–397	72	351.0	19.1	310–390
Transverse shaft diameter	62	25.1	1.9	21–32	64	24.9	1.9	22–32
A-P shaft diameter	62	36.2	2.4	32–42	60	36.5	2.5	30–42
FIBULA								
Max. morphological length	16	363.7	20.2	327–396	16	359.3	19.1	327–395

excavations), although the differences are not likely to be significant. In both samples these figures put the average skull in the mesocranial range. The figures for the 1967–72 excavations will be found in Table 2.33, while those for the two excavations combined are in Table 2.34 and Illus. 2.15.

The upper facial index and cranial height index were not calculated as part of the original project, as the univariate and multivariate statistics employed provided much the same information. However, those indices have been included here in order to facilitate comparisons with the Oxford Archaeology excavations[6] and to create a general sense of the site as a whole. Table 2.35 contains the upper facial index for the 1967–72 excavations, while the upper facial index for the two excavations combined is located in Table 2.36. The mean upper facial index for males in the 1967–72 excavations is 53.76 with a range of 49.64 to 63.64, while for females the mean is 56.86 with a range of 66.12 to 72.7. The sample sizes from the 1967–72 excavations are very small, especially the female sample, as facial areas on skulls were so badly damaged that both necessary measurements were rarely present. The Oxford Archaeology sample sizes are also small (11 male, 7 female),[7] but both samples show similar trends, which become more clear when Lankhills as a whole is considered. The largest number of individuals, both male and female, has average or medium-sized upper faces,

[6] ibid. 256, Table 5.19. [7] ibid.

TABLE 2.25

Postcranial measurements, females, Lankhills 1967–72 excavations

Measurements	Right side				Left side			
	N	Mean	S.D.	Range	N	Mean	S.D.	Range
HUMERUS								
Max. morphological length	23	295.8	16.9	276–352	28	292.5	16.1	270–334
Physiological length	20	292.9	17.7	274–345	27	287.9	15.0	266–330
Maximum shaft diameter	19	20.2	1.6	18–23	26	20.7	1.7	18–25
Minimum shaft diameter	19	16.1	1.7	14–20	26	16.7	1.4	14–19
Maximum head diameter	17	37.9	1.9	35–42	15	38.0	2.2	34–43
Minimum circumference	31	58.9	4.2	49–67	38	59.6	4.2	50–69
RADIUS								
Max. morphological length	19	215.9	11.9	194–240	24	213.5	12.6	190–240
Physiological length	25	202.8	11.1	179–226	24	201.9	12.1	175–225
Minimum circumference	28	40.5	2.9	35–46	28	40.3	3.1	34–45
ULNA								
Max. morphological length	15	236.3	13.7	214–264	18	236.0	15.8	208–270
Physiological length	23	208.0	14.5	183–247	21	205.8	14.8	179–238
Minimum circumference	25	39.6	3.1	31–44	18	36.5	2.9	30–42
FEMUR								
Max. morphological length	40	415.0	19.6	382–463	44	416.2	21.0	379–467
Physiological length	36	409.3	20.1	378–460	43	411.6	20.9	375–464
A-P shaft diameter	50	23.7	1.8	20–27	44	23.6	2.1	19–28
Transverse shaft diameter	50	31.1	2.0	27–35	46	30.4	2.0	27–34
Maximum head diameter	34	43.1	2.0	39–47	39	42.1	1.8	39–46
TIBIA								
Max. morphological length	48	333.4	19.1	302–381	49	337.5	17.2	302–378
Physiological length	48	319.2	20.1	286–365	51	321.2	16.8	285–362
Transverse shaft diameter	50	22.1	1.8	19–26	52	21.7	1.8	19–26
A-P shaft diameter	50	30.5	2.5	25–37	50	30.9	2.7	26–39
FIBULA								
Max. morphological length	10	330.0	19.0	299–365	8	320.3	17.3	297–357

followed closely by those with narrow faces. No one in either sample was found to have an extremely broad face, and only three individuals, two of whom were female, had very narrow faces.

The cranial height index is used to assess the height of the skull relative to its length. The index values for the 1967–72 excavations are given in Table 2.37, which indicates that the largest number of individuals, both male and female, have skulls of medium or low height, with very few in the hypsicranial (high skull) range. The average for males is 70.72 with a range of 60.30 to 79.53, while for females the average is 69.73 with a range of 66.12 to 72.47. The pattern is very similar in the Oxford Archaeology excavations, with male means of 70.3 and female means of 72.9.[8] The pattern is reaffirmed in the site as a whole, as can be seen in Table 2.38.

Statures in the 1967–72 excavations have been described above.[9] Results from the Oxford Archaeology excavations indicate the males are slightly shorter than those found in the 1967–72 excavations, with a mean stature for males of 169 cm[10] (172 cm in the 1967–72 excavations). The mean stature for females in both samples is exactly the same, 157 cm. Given the fact that the Victoria Road West mean male stature is very close to that for the Oxford Archaeology sample, and

[8] Clough and Boyle 2010, 357, Table 5.21.

[9] See pp. 49–50 and Tables 2.29, 2.30 and 2.32.

[10] Clough and Boyle 2010, 354, Table 5.16.

TABLE 2.26

T-tests, cranial and mandibular measurements, males v. females, Lankhills 1967–72 and Victoria Road West

Measurements	Lankhills			Victoria Road		
	T	DF	P	T	DF	P
Cranial Length	6.24	82.0	0.000***	4.48	37.0	0.000***
Cranial Breadth	3.13	70.0	0.003**	2.91	38.0	0.006**
Cranial Height	4.93	54.9	0.000***	4.57	32.0	0.000***
Auricular Height	2.74	52.0	0.008**	3.89	37.0	0.000***
Basion-Prosthion Length	2.93	35.0	0.006**	1.50	22.0	0.149
Basion-Nasion Length	5.40	54.0	0.000***	2.67	32.0	0.012*
Minimum Frontal Breadth	3.51	93.0	0.001***	2.85	38.0	0.007**
Nasion-Prosthion Height	3.41	52.0	0.001***	3.37	28.0	0.002**
Zygomatic Breadth	2.50	22.0	0.020*	2.53	15.0	0.023*
Orbital Height	0.93	53.0	0.358	0.21	31.0	0.837
Orbital Breadth	2.21	52.0	0.032*	3.18	30.0	0.003**
Nasal Breadth	1.42	49.0	0.161	1.11	22.0	0.280
Nasal Length	4.57	45.0	0.000***	3.30	32.0	0.002**
Alveolar Breadth	3.25	37.0	0.002**	2.85	11.0	0.016**
Alveolar Length	2.64	46.0	0.011*	1.93	26.0	0.065
Palatal Breadth	1.60	38.0	0.119	−0.37	11.5	0.716
Palatal Length	3.00	44.0	0.004**	0.84	22.0	0.407
Biasterionic Breadth	4.02	69.0	0.000***	2.91	37.0	0.006**
Simotic Chord	0.27	52.0	0.791	−0.07	9.2	0.942
Nasion-Bregma Chord	5.17	89.0	0.000***	4.83	38.0	0.000***
Bregma-Lambda Chord	1.61	90.0	0.110	2.01	38.0	0.051
Lambda-Opisthion Chord	2.02	73.0	0.047*	3.42	33.0	0.002**
Frontal Arc	3.90	89.0	0.000***	4.17	38.0	0.000***
Parietal Arc	1.25	90.0	0.214	1.50	38.0	0.141
Occipital Arc	2.90	73.0	0.005**	2.91	33.0	0.006**
Mandibular Body Length	4.26	66.8	0.000***	4.00	35.0	0.000***
Bicondylar Breadth	4.00	47.0	0.000***	4.49	24.0	0.021*
Minimum Ramus Breadth	2.18	93.0	0.032*	2.46	39.0	0.600
Ramus Height	7.59	84.0	0.000***	0.53	38.0	0.000***
Bigonial Breadth	4.95	50.0	0.000***	6.57	28.0	0.001***
Coronoid Height	7.03	86.0	0.000***	3.79	38.0	0.000***
Symphysis Height	4.83	79.0	0.000***	4.93	26.0	0.019*
Gonial Angle	−1.83	66.0	0.071	2.51	33.0	0.860
TESTS SIG./TOTAL TESTS			26/33			22/33

* = $p < 0.05$ ** = $p < 0.01$ *** = $p < 0.001$

TABLE 2.27

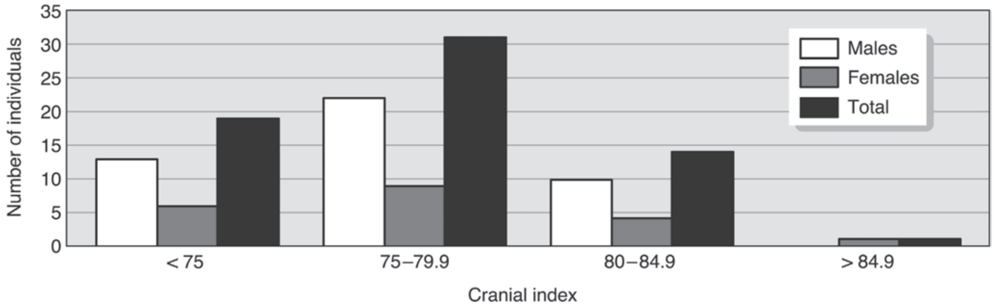
T-tests, cranial indices, males v. females, Lankhills 1967–72 and Victoria Road West

Sample	T	DF	P
Lankhills Area W	−1.48	41	0.142
Lankhills Areas F, E, O	0.03	20	0.973
Lankhills total	−0.89	63	0.617
Victoria Road West	−1.30	36	0.199

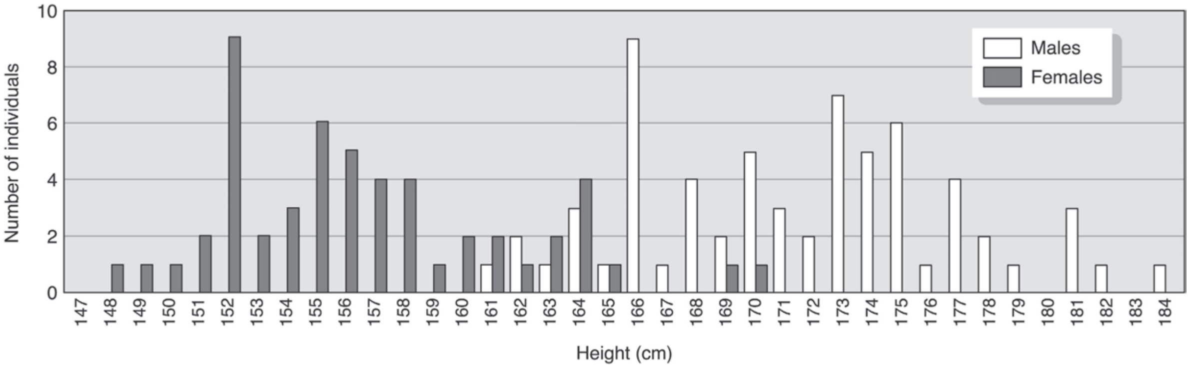
* = $p < 0.05$ ** = $p < 0.01$ *** = $p < 0.001$

there is no statistically significant difference between Victoria Road West males and Lankhills 1967–72 males, the difference seen between the Oxford Archaeology males and the 1967–72 males is also likely to be insignificant.

When the 1967–72 and Oxford Archaeology samples are combined, the mean height for males is



Illus. 2.13. Cranial indices, Lankhills 1967–72 excavations.



Illus. 2.14. Male and female statures, Lankhills 1967–72 excavations.

TABLE 2.28

Cranial indices, Lankhills 1967–72 and Victoria Road West

Sample	Males				Females			
	N	Mean	S.D.	Range	N	Mean	S.D.	Range
Lankhills Area W	32	77.1	3.53	70.1–83.8	11	78.9	3.37	74.6–85.3
Lankhills Areas F, E, O	13	75.6	3.33	70.1–81.6	9	75.7	3.51	69.8–81.6
Lankhills 1967–72	45	76.7	3.50	70.1–83.8	20	77.5	3.81	69.8–85.3
Victoria Road West	24	76.0	3.04	69.8–83.9	14	77.5	3.73	71.6–82.5

TABLE 2.29

T-tests, stature, males v. females, Lankhills 1967–72 and Victoria Road West

Sample	T	DF	P
Lankhills Area W	12.39	65	0.000***
Lankhills Areas F, E, O	6.22	34	0.000***
Lankhills total	13.85	101	0.000***
Victoria Road West	5.94	33	0.000***

* = $p < 0.05$ ** = $p < 0.01$ *** = $p < 0.001$

170.3 cm with a range of 156–184 cm, while for females the mean height is 156.7 cm with a range of 147–172 cm (Illus. 2.16). It may be notable that the ranges for both males and females are greater in the Oxford Archaeology samples than they are in the Lankhills samples (1967–72 excavation

TABLE 2.30

Statures in centimetres, Lankhills 1967–72, Lankhills 2000–5, and Victoria Road West

Sample	Males				Females			
	N	Mean	S.D.	Range	N	Mean	S.D.	Range
Lankhills Area W	35	171.9	5.28	162.0–183.9	32	156.5	4.72	147.7–165.0
Lankhills Areas F, E, O	25	171.1	5.27	161.3–180.8	11	158.3	6.09	151.2–169.4
Lankhills 1967–72 total	60	171.6	5.29	161.3–183.9	43	156.9	5.17	147.7–169.4
Lankhills 2000–5[1]	38	169		157–187	31	157		148–172
Victoria Road West	22	169.9	5.76	154.6–179.7	13	157.4	5.96	144.5–167.0

[1] Clough and Boyle 2010, 354, Table 5.16

TABLE 2.31

T-tests, cranial indices by sex, Lankhills 1967–72 and Victoria Road West

Sample	Males			Females		
	T	DF	P	T	DF	P
Lankhills Area W v. Lankhills Areas F, E, O	1.28	44	0.204	1.98	17	0.059
Lankhills 1967–72 total v. Victoria Road West	0.77	68	0.549	0.05	31	0.963

* = $p < 0.05$ ** = $p < 0.01$ *** = $p < 0.001$

TABLE 2.32

T-tests, stature by sex, Lankhills 1967–72 and Victoria Road West

Sample	Males			Females		
	T	DF	P	T	DF	P
Lankhills Area W v. Lankhills Areas F, E, O	0.58	58	0.571	1.00	41	0.323
Lankhills 1967–72 total v. Victoria Road West	1.26	80	0.207	0.26	54	0.794

* = $p < 0.05$ ** = $p < 0.01$ *** = $p < 0.001$

TABLE 2.33

Range of cranial indices, Lankhills 1967–72 excavations

Skull shape	Cranial index	Male	Female	Total
Dolichocranial	<75	13	6	19
Mesocranial	75–79.9	22	9	31
Brachycranial	80–84.9	10	4	14
Hyperbrachycranial	>84.9	0	1	1
Total		45	20	65

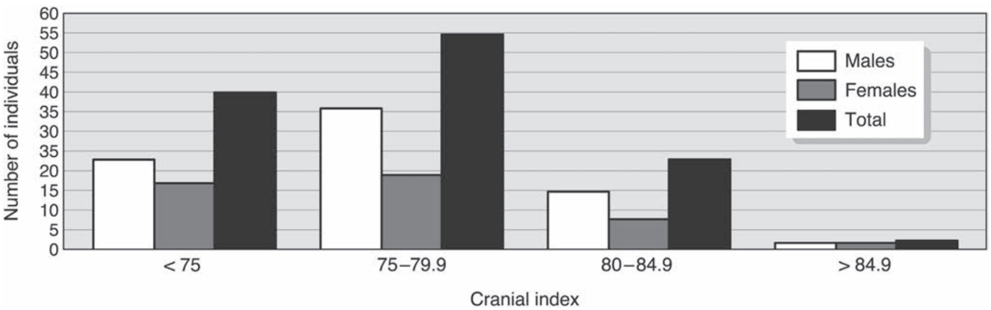
males vary by 22.6 cm, females by 21.7 cm; 2000–5 excavation males vary by 30 cm, females by 24 cm). This suggests that like the 1967–72 excavation, the males and females in the Oxford Archaeology sample, and in the site overall, are highly sexually dimorphic.

The platymeric index (or meric index, as it is also called) assesses the degree of anterior-posterior flattening found in the proximal femoral shaft. This information for the Lankhills 1967–72

TABLE 2.34

Range of cranial indices, Lankhills 1967–72 and 2000–5 excavations combined

Skull shape	Cranial index	Male	Female	Total
Dolichocranial	<75	23	17	40
Mesocranial	75–79.9	36	19	55
Brachycranial	80–84.9	15	8	23
Hyperbrachycranial	>84.9	1	1	2
Total		75	45	120



Illus. 2.15. Cranial indices, Lankhills 1967–72 and 2000–5 excavations combined.

TABLE 2.35

Upper facial index, Lankhills 1967–72 excavations

Upper facial shape	Index range	Males	Females	Total
Hypereuryeny (very wide or broad face)	<44.9	0	0	0
Euryeny (wide or broad face)	45–49.9	1	0	1
Meseny (average or medium face)	50–54.9	11	1	12
Lepteny (slender or narrow face)	55–59.9	5	2	7
Hyperlepteny (very slender or narrow face)	>60	1	1	2
Total		18	4	22

excavations will be found in Table 2.39. The index was calculated for 67 (51.9%) males and 54 (42.9%) females. These percentages are slightly higher than those obtained in the Oxford Archaeology sample (48.9% males, 37.2% females).[11] The lower the index, the greater the degree of shaft flattening. Mean values for both males (78.6) and females (77.1) fall within the platymeric range, indicating relatively flattened femoral shafts. According to some authorities[12] very high index value in the stenomeric range is usually associated with pathology. Only one left femur of a female (LH 243) in the 1967–72 excavations fell into the stenomeric range, and no pathology was observed in this case, although given the condition of the bone, pathology may have been present but undetected. The data for the platymeric index from the Oxford Archaeology excavations[13] has been combined with the 1967–72 data (see Table 2.40) to give a more comprehensive picture of the entire site. The mean values for both males (84.5) and females (80.9)[14] are somewhat higher than those found in the 1967–72 excavations,

[11] Clough and Boyle 2010, 358.
[12] Bass 1995, 225.
[13] Clough and Boyle 2010, 358, Tables 5.22 and 5.23.
[14] ibid.

TABLE 2.36
Upper facial index, Lankhills 1967–72 and 2000–5 excavations combined

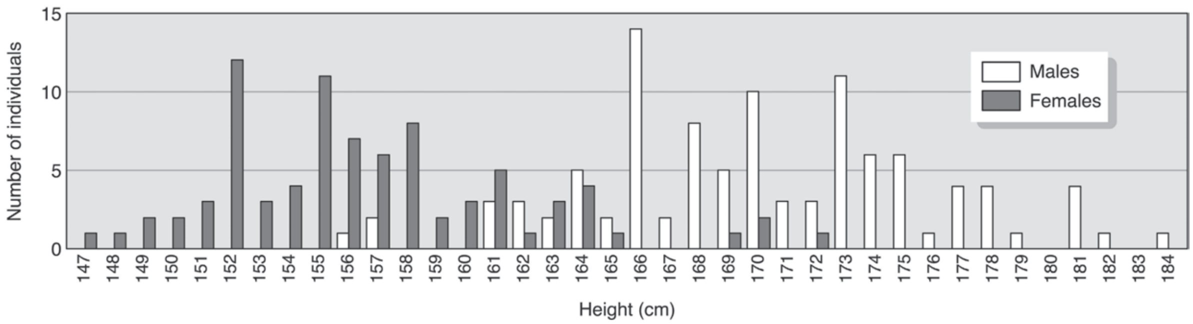
Upper facial shape	Index range	Males	Females	Total
Hypereuryeny (very wide or broad face)	<44.9	0	0	0
Euryeny (wide or broad face)	45–49.9	2	0	2
Meseny (average or medium face)	50–54.9	16	5	21
Lepteny (slender or narrow face)	55–59.9	10	4	14
Hyperlepteny (very slender or narrow face)	>60	1	2	3
Total		29	11	40

TABLE 2.37
Cranial height index, Lankhills 1967–72 excavations

Skull height	Index range	Males	Females	Total
Chamaecranial (low skull)	<70	13	11	24
Orthocranial (medium height)	70–74.9	16	10	26
Hypsicranial (high skull)	>75	4	0	4
Total		20	10	30

TABLE 2.38
Cranial height index, Lankhills 1967–72 and 2000–5 excavations combined

Skull height	Index range	Males	Females	Total
Chamaecranial (low skull)	<70	21	17	38
Orthocranial (medium height)	70–74.9	26	17	43
Hypsicranial (high skull)	>75	5	2	7
Total		52	36	88



Illus. 2.16. Statures, Lankhills 1967–72 and 2000–5 excavations combined.

but are still within the platymeric range. The differences may be partially explained by the smaller sample sizes in the Oxford Archaeology excavations. Eight cases of stenomeric male femora were found by Oxford Archaeology, whereas there are none among the males in the 1967–72 excavations. One female in each of these samples falls in this range. Of these 10 cases in total, only three clearly have

TABLE 2.39

Platymeric index, Lankhills 1967–72 excavations (column percentages)

	Male						Female					
	R. femur		L. femur		Total		R. femur		L. femur		Total	
	N	%	N	%	N	%	N	%	N	%	N	%
Platymeric, X–84.9	48	88.9	41	77.4	89	83.2	45	90.0	36	85.7	81	88.0
Eurymeric, 85.0–99.9	6	11.1	12	22.6	18	16.8	5	10.0	5	11.9	10	10.9
Stenomeric, 100–X	0	0	0	0	0	0	0	0	1	2.4	1	1.1
Total	54	100.0	53	100.0	107	100.0	50	100.0	42	100.0	92	100.0
Average index value	77.5		79.6		78.6		76.6		77.7		77.1	
Range	63.6–94.1		62.5–96.7		62.5–96.7		62.5–92.9		66.7–100.0		62.5–100.0	

TABLE 2.40

Platymeric index, Lankhills 1967–72 and 2000–5 excavations combined (column percentages)

	Male						Female					
	R. femur		L. femur		Total		R. femur		L. femur		Total	
	N	%	N	%	N	%	N	%	N	%	N	%
Platymeric, X–84.9	76	77.6	63	67.0	139	72.4	72	83.7	60	81.1	132	82.5
Eurymeric, 85.0–99.9	19	19.4	26	27.7	45	23.4	13	15.1	13	17.6	26	16.3
Stenomeric, 100–X	3	3.1	5	5.3	8	4.2	1	1.2	1	1.4	2	1.3
Total	98	100.0	94	100.0	192	100.0	86	100.0	74	100.0	160	100.0
Index range*	63.6–104.8		62.5–104.3		62.5–104.8		62.5–99.4		66.7–127.9		62.5–127.9	

* Average index value data for 2000–5 not available.

other pathology.[15] In the site as a whole, 72.4% of the male femora and 82.5% of the female femora fall into the platymeric range. While it is more pronounced on the right than on the left in both males and females in the 1967–72 sample, the differences are small. However, the same pattern is seen in the Oxford Archaeology sample, and in the site as a whole.

In the 1967–72 sample the platycnemic (or cnemic) index could be calculated for 77 males (59.7%) and 60 females (47.6%). This percentage is approximately double the percentage of individuals for whom the platycnemic index could be calculated in the Oxford Archaeology sample (26.6% males, 28.7% females),[16] a fact that may be partially explained by the extensive reconstruction work undertaken on the earlier sample. Tables 2.41 and 2.42 respectively contain the platycnemic index data for the 1967–72 excavations and the combined Lankhills samples. In the 1967–72 sample (Table 2.41) mean values for males hover at the border of the mesocnemic/eurycnemic range, while the females are more clearly eurycnemic, indicating low levels of medio-lateral shaft flattening. This pattern is reversed in the Oxford archaeology sample,[17] but for the site as a whole the highest percentages of both sexes fall in the eurycnemic range (see Table 2.42).

The Oxford Archaeology Lankhills sample appears to have been predominantly right-handed,

[15] Clough and Boyle 2010, 358. Oxford Archaeology skeleton 434 (Grave 535), skeleton 451 (Grave 590), skeleton 1281 (Grave 1350).

[16] ibid. 358.

[17] ibid. 359.

TABLE 2.41

Platycnemic index, Lankhills 1967–72 excavations (column percentages)

	Male						Female					
	R. tibia		L. tibia		Total		R. tibia		L. tibia		Total	
	N	%	N	%	N	%	N	%	N	%	N	%
Hyperplatycnemic, X–54.9	0	0	0	0	0	0	0	0	0	0	0	0
Platycnemic, 55.0–62.9	6	9.5	8	12.7	14	11.1	2	4.1	3	5.9	5	5.0
Mesocnemic, 63.0–69.9	24	38.1	23	36.5	47	37.3	10	20.4	17	33.3	27	27.0
Eurycnemic, 70.0–X	33	52.4	32	50.8	65	51.6	37	75.5	31	60.8	68	68.0
Total	63	100.0	63	100.0	126	100.0	49	100.0	51	100.0	100	100.0
Average index value	70.0		68.5		69.2		73.2		71.5		72.3	
Index range	58.5–88.5		60.0–87.5		58.5–88.5		61.3–89.3		60.6–95.7		58.5–95.7	

TABLE 2.42

Platycnemic index, Lankhills 1967–72 and 2000–5 excavations combined (column percentages)

	Male						Female					
	R. tibia		L. tibia		Total		R. tibia		L. tibia		Total	
	N	%	N	%	N	%	N	%	N	%	N	%
Hyperplatycnemic, X-54.9	0	0	0	0	0	0.	0	0	0	0	0	0
Platycnemic, 55.0–62.9	7	8.0	9	10.7	16	9.3	2	2.6	7	9.7	9	6.1
Mesocnemic, 63.0–69.9	28	31.8	27	32.1	55	32.0	14	18.4	21	29.2	35	23.6
Eurycnemic, 70.0-X	53	60.2	48	57.1	101	58.7	60	78.9	44	61.1	104	70.3
Total	88	100.0	84	100.0	172	100.0	76	100.0	72	100.0	148	100.0
Index range	58.5–88.5		60.0–89.3		58.5–89.3		61.3–100.0		57.1–95.7		57.1–100.0	

although the sample is very small, and is restricted primarily to an evaluation of 17 pairs of humeri.[18] In no case was the left side longer than the right. The sample available from the 1967–72 excavations is larger (Table 2.43), and includes 22 sets of paired humeri plus radii, permitting an evaluation of the relationship of full arm length as well as that of the humerus and radius individually. Corresponding values for the 1967–72 and Oxford Archaeology excavations are located in Table 2.44. While the right side generally predominates, the left side is longer in two pairs of male humeri[19] (7.1%, 1967–72 sample; 5.3%, combined sample) and two pairs of male radii[20] (9.5%, 1967–72 sample; 8.7% combined sample). When the humerus and radius are considered together, one male[21] (5.9%, 1967–72 sample; 5.3% combined sample) appears to be left-side dominant. There is no evidence in these samples to suggest any examples of female left-side dominance, but it must have been present, although perhaps at low levels. A few individuals were found to have arm bones of equal length on both sides, indicating no clear side dominance. These include humeri from one male, radii from five males, total arm length from two males, and humeri from one female.[22]

[18] ibid. 359, Tables 5.26, 5.27.

[19] LH 208 and LH 411.

[20] LH 309 and LH 427.

[21] LH 208.

[22] LH 54; LH 35, LH 107, LH 226, LH 305, and LH 427; LH 309 and LH 427; LH 365.

TABLE 2.43

Humerus and radius asymmetry, Lankhills 1967–72 excavations

	Max. length				Divergence in mm, right/left			
	N	mean	S.D.	range	N	mean	S.D.	range
MALES								
R. humerus	29	334.1	18.6	299–383				
L. humerus	29	327.0	18.5	299–378	29	7.1	4.7	−8–+16
R. radius	21	250.5	13.0	230–277				
L. radius	21	248.8	12.9	224–275	21	1.7	3.7	−8–+8
R. hum + rad	17	587.7	29.7	542–638				
L. hum + rad	17	580.2	29.5	535–628	17	7.6	6.8	−5–+20
FEMALES								
R. humerus	14	297.2	20.4	276–352				
L. humerus	14	287.3	16.8	270–334	14	9.9	5.0	0–18
R. radius	7	213.3	14.7	194–240				
L. radius	7	208.7	14.4	190–237	7	4.6	2.9	3–11
R. hum + rad	5	497.2	20.3	470–527				
L. hum + rad	5	484.8	13.3	466–502	5	12.4	8.2	4–25

TABLE 2.44

Humerus and radius asymmetry, Lankhills 1967–72 and 2000–5 excavations combined

	Max. length				Divergence in mm, right/left			
	N	mean	S.D.	range	N	mean	S.D.	range
MALES								
R. humerus	38	332.8	17.2	299–383				
L. humerus	38	324.9	17.3	299–378	38	7.9	4.5	−6–+16
R. radius	23	251.0	12.6	230–277				
L. radius	23	249.4	12.4	224–275	23	1.7	3.5	−8–+8
R. hum + rad	17	587.7	29.7	542–638				
L. hum + rad	17	580.2	29.5	535–638	19	8.3	6.7	−5–+20
FEMALES								
R. humerus	22	300.3	20.4	276–352				
L. humerus	22	290.7	18.5	270–334	22	9.5	4.5	0–18
R. radius	9	214.6	13.2	194–240				
L. radius	9	209.7	12.9	190–237	9	4.9	2.8	3–11
R. hum + rad	5	497.2	20.7	470–527				
L. hum + rad	5	484.8	13.3	466–502	7	13.3	7.1	4–25

An earlier study[23] of handedness in the 1967–72 sample suggested that when the whole arm was considered, approximately 6.6% of the males were left side dominant, but none of the females. Those findings are very similar to the findings of this study, although the specific methodologies were not identical. Using somewhat different techniques on different bones of the arm in the earlier study, male left side dominance ranged from 0% to a high of 42.8% when radii were considered alone.[24] However, results derived solely from the radius are less reliable than those derived from the radius and humerus combined.

[23] Vann 2000, Table 5.2.   [24] ibid.

TABLE 2.45

Cranial and mandibular measurements, Victoria Road West

Variable	Males				Females			
	N	mean	S.D.	range	N	mean	S.D.	range
Cranial Length	24	191.42	6.59	174–206	15	181.80	6.38	168–195
Cranial Breadth	25	145.44	4.73	137–156	15	140.27	6.49	129–152
Cranial Height	22	134.68	5.28	121–143	12	125.33	6.43	115–138
Auricular Height	24	118.54	4.42	109–125	15	113.13	3.87	104–120
Basion-Prosthion Length	16	93.31	6.29	82–102	8	89.52	4.90	80–96
Basion-Nasion Length	23	101.83	5.25	93–112	11	97.00	4.10	89–103
Minimum Frontal Breadth	25	99.00	3.66	93–106	15	95.73	3.22	89–100
Nasion-Prosthion Height	20	71.30	3.53	65–77	10	66.30	4.40	58–75
Zygomatic Breadth	11	132.64	3.47	125–137	6	127.17	5.49	121–135
Orbital Height	22	33.96	1.91	30–38	11	33.82	1.47	32–36
Orbital Breadth	21	41.86	1.85	39–46	11	39.91	1.14	38–42
Nasal Breadth	17	24.59	3.48	20–36	7	23.00	2.24	21–26
Nasal Length	24	53.13	2.80	48–59	10	49.90	1.97	45–52
Alveolar Breadth	8	64.25	2.66	60–68	5	60.20	2.17	58–63
Alveolar Length	18	55.28	5.66	50–76	10	51.50	3.31	46–56
Palatal Breadth	10	36.10	4.48	28–43	6	36.67	1.37	34–38
Palatal Length	16	43.50	2.58	39–47	8	42.63	1.92	40–45
Biasterionic Breadth	24	117.54	4.17	110–126	15	113.13	5.22	104–123
Simotic Chord	15	9.60	0.91	9–12	9	9.67	2.60	6–13
Nasion-Bregma Chord	25	115.20	3.83	108–122	15	108.33	5.12	99–115
Bregma-Lambda Chord	24	116.75	7.33	103–134	16	112.50	5.09	102–119
Lambda-Opisthion Chord	23	99.09	5.18	89–109	12	93.33	3.68	89–102
Frontal Arc	25	113.32	5.11	120–144	15	125.27	7.08	113–136
Parietal Arc	24	128.58	8.54	111–149	16	124.88	6.03	112–135
Occipital Arc	23	124.52	7.28	109–141	12	117.25	6.50	109–132
Mandibular Body Length	25	105.88	5.57	95–115	12	97.92	3.66	92–104
Bicondylar Breadth	16	123.69	5.04	116–136	10	118.10	6.49	110–131
Minimum Ramus Breadth	26	32.04	2.71	27–37	15	31.60	2.26	29–35
Ramus Height	25	64.84	4.79	53–74	15	55.33	3.74	48–62
Bigonial Breadth	20	101.55	4.44	93–111	10	93.40	7.35	82–103
Coronoid Height	26	66.50	5.00	58–73	14	58.93	3.83	54–66
Symphysis Height	17	34.12	3.60	28–40	11	30.73	3.32	26–37
Gonial Angle	25	121.72	5.67	110–133	10	122.10	5.88	112–131

Victoria Road West

The Victoria Road West sample was compared to the 1967–72 Lankhills sample with regard to cranial measurements, cranial index, and stature. Cranial index and stature were also compared with the Oxford Archaeology sample and the site as a whole, but statistical testing was limited to the 1967–72 sample and Victoria Road West. Descriptive statistics for cranial and mandibular measurements at Victoria Road West will be found in Table 2.45. As was true at Lankhills, t-tests of these measurements indicate that the Victoria Road West sample is highly sexually dimorphic, although slightly less so than Lankhills (Table 2.26). When 1967–72 Lankhills sample and Victoria Road West are compared by sex, t-tests yield no significant differences in cranial measurements for males, and a significant difference for females in only one test (Table 2.46). Thus, the cranial measurements in these two samples are most notable for their high degree of similarity.

The mean cranial index for males at Victoria Road West is 76.0, while the female mean for the same index is 77.5 (Table 2.28). This difference is not significant (Table 2.27). When each sex is

TABLE 2.46

T-tests, cranial and mandibular measurements by sex, Lankhills 1967–72 v. Victoria Road West

Variable	Males			Females		
	T	DF	P	T	DF	P
Cranial Length	−0.74	75.0	0.464	−0.50	44.0	0.620
Cranial Breadth	−0.11	73.0	0.913	0.29	35.0	0.772
Cranial Height	−0.83	55.0	0.410	0.42	32.0	0.677
Auricular Height	−1.54	59.0	0.128	0.11	30.0	0.911
Basion-Prosthion Length	−0.02	22.7	0.985	−0.27	18.0	0.793
Basion-Nasion Length	−0.98	33.1	0.335	−1.05	30.0	0.302
Minimum Frontal Breadth	−0.30	80.0	0.763	−0.43	51.0	0.672
Nasion-Prosthion Height	−0.60	51.0	0.551	0.33	29.0	0.745
Zygomatic Breadth	−0.11	28.0	0.916	−0.68	9.0	0.513
Orbital Height	0.10	55.0	0.922	−0.38	29.0	0.704
Orbital Breadth	0.76	20.9	0.456	1.79	28.9	0.083
Nasal Breadth	−0.90	45.0	0.374	0.16	26.0	0.874
Nasal Length	−1.99	50.0	0.084	−1.22	27.0	0.234
Alveolar Breadth	−0.82	28.0	0.421	−0.23	20.0	0.823
Alveolar Length	−1.79	25.7	0.052	−1.26	26.0	0.217
Palatal Breadth	0.80	30.0	0.430	−0.84	22.0	0.412
Palatal Length	−0.90	41.0	0.374	−2.74	25.0	0.011*
Biasterionic Breadth	−1.44	66.0	0.155	−1.97	40.0	0.056
Simotic Chord	−0.78	44.9	0.439	−0.60	29.0	0.553
Nasion-Bregma Chord	−1.92	79.0	0.058	−0.33	48.0	0.741
Bregma-Lambda Chord	−0.49	81.0	0.627	1.85	47.0	0.070
Lambda-Opisthion Chord	−1.82	66.0	0.074	0.55	40.0	0.588
Frontal Arc	−1.58	79.0	0.119	0.05	48.0	0.961
Parietal Arc	1.15	81.0	0.253	1.88	47.0	0.066
Occipital Arc	−1.91	66.0	0.061	−0.48	40.0	0.637
Mandibular Body Length	0.54	63.9	0.594	0.96	39.0	0.344
Bicondylar Breadth	−0.50	45.0	0.619	−0.99	26.0	0.333
Minimum Ramus Breadth	−0.17	80.0	0.868	−0.93	52.0	0.356
Ramus Height	−0.48	75.0	0.631	1.78	47.0	0.081
Bigonial Breadth	1.34	51.0	0.186	0.44	27.0	0.663
Coronoid Height	0.60	78.0	0.553	0.17	46.0	0.868
Symphysis Height	−0.99	59.0	0.325	−0.34	46.0	0.737
Gonial Angle	−0.41	64.0	0.685	0.89	35.0	0.381
TESTS SIG./TOTAL TESTS			0/33			1/33

* = $p < 0.05$ ** = $p < 0.01$ *** = $p < 0.001$

tested against the 1967–72 Lankhills samples, there are also no significant differences in cranial index (Table 2.31). Male skulls at Victoria Road West are slightly longer than Lankhills male skulls, while the mean cranial index for females in the two sites is identical. In the Oxford Archaeology samples, the mean cranial indices for males are slightly larger (79.48), while those for females are slightly smaller (75.95).[25] For the Lankhills combined sample, the majority of skulls fall in the mesocranial range, with a significant minority of dolichocranial skulls (Table 2.34).

In the Victoria Road West sample male stature averages 169.9 cm, or slightly over 5′ 6¾″, while the female mean is 157.4 cm, or almost 5′ 2″ (Table 2.30). This difference between the sexes is highly statistically significant (Table 2.29), but not quite as large as the difference in stature seen in the 1967–72 Lankhills samples. Neither sex differs significantly from its Lankhills counterpart (Table 2.32), although males at Victoria Road West are slightly shorter than Lankhills males, while females are slightly taller. The mean stature for females in the Oxford Archaeology sample is virtually

[25] Clough and Boyle 2010, 356.

identical to that for Victoria Road West, Lankhills Area W, and the total 1967–72 Lankhills female sample (Table 2.30). The Oxford Archaeology male sample is, on average, approximately one centimetre shorter than the Victoria Road West sample and two centimetres shorter than the 1967–72 sample, but these differences are likely to be due to sampling or to slightly different methods, and are almost certainly not meaningful.

In all respects examined—skull measurements, cranial index, and stature—the physical dimensions of the 1967–72 Lankhills and Victoria Road West samples are very similar. They are also very similar to the Oxford Archaeology sample with regard to cranial index and stature. This is a reasonable finding since they all represent samples of the Winchester population. The evidence suggests no statistically significant change in the biological composition of the population during the time period covered by these samples, and no differences that might be related to their environment.

The other Romano-British cemeteries in Winchester

Given the current data, the physical characteristics of the larger Winchester Romano-British population can be compared primarily in cranial index and stature. These data are found in Tables 2.47 and 2.48. It should be noted that there is some overlap in the figures given for Victoria Road West, which come from this study, and those for the Northern cemetery, which also incorporate figures for Victoria Road West from Browne's report.[26] However, the figures for the Northern cemetery do not include any data from Lankhills.

The cranial indices for both males and females in all these samples are very similar, and fall in the mesocranial range (Illus. 2.17). Male means vary from 76.0 at Victoria Road West to a high of 79.5 in the Oxford Archaeology sample. Both the Lankhills 1967–72 and combined Northern, Eastern and Western male samples cluster between 76.3 and 76.7. These differences are so small that the major inference must be that all these samples are showing great consistency with regard to head shape, and do indeed represent samples drawn from the same underlying population. The higher male mean in the Oxford Archaeology sample may be driven by the one hyperbrachycranial individual with a cranial index of 109.4,[27] which could be pathological. The male sample sizes from the Western and Eastern cemeteries are too small to be meaningful. The consistency seen in the male samples carries through to the females. The female cranial indices range from 76.0 in the Lankhills Oxford Archaeology sample to 77.5 in the samples from Lankhills 1967–72, Victoria Road West, and the Northern cemetery. Again the sample sizes from the Western and Eastern cemeteries are too small to be useful, but the composite of all three cemeteries yields a female cranial index of 76.3.

The stature data give a very similar picture of samples that resemble each other closely. Male mean statures fall within a very narrow band between 169 and 172 cm, with five of the eight samples having a mean of 170 cm (Table 2.48). The tallest man, at 187 cm, came from the Lankhills Oxford Archaeology sample and stood approximately 6′ 1½″, as opposed to the more common male height of just under 5′ 7″. The shortest man, at 153 cm, came from the Northern cemetery and was barely 5′ 0¼″. The average woman was significantly smaller than the average man. Female means range from 156 to 160 cm (the latter coming from a very small sample at the Western cemeteries), with all the Lankhills samples and the Victoria Road West sample giving a mean stature of 157 cm,

[26] Browne 2012. [27] Clough and Boyle 2010, 356.

TABLE 2.47
Cranial indices, all Winchester Romano-British cemetery samples

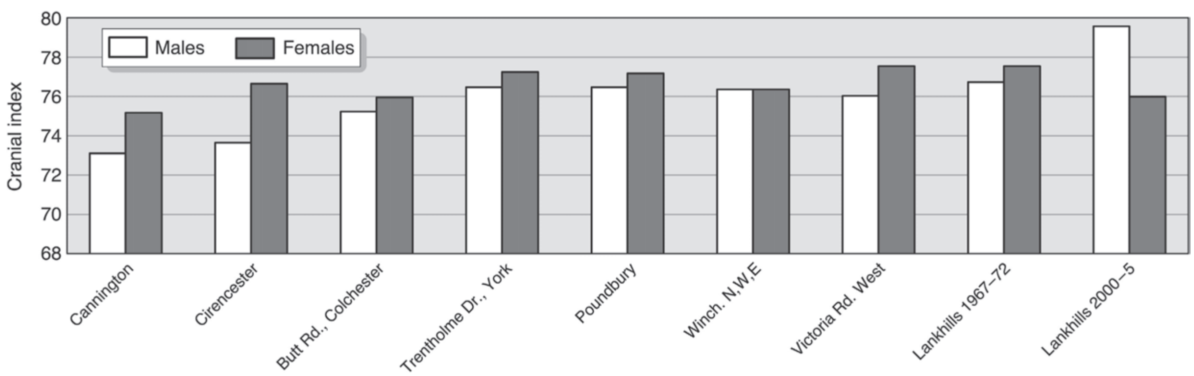
Site	Males			Females		
	N	Mean	Range	N	Mean	Range
Lankhills 1967–72	45	76.7	70.1–83.8	20	77.5	69.8–85.3
Lankhills 2000–5*	30	79.5	70.1–109.4	25	76.0	67.7–84.3
Victoria Road West	24	76.0	69.8–83.9	14	77.5	71.6–82.5
Northern cemetery**	36	76.9	69.3–82.6	10	77.5	70.4–83.1
Western cemeteries**	3	72.0	71.2–72.6	3	72.7	70.2–75.0
Eastern cemetery**	6	74.8	70.5–79.1	5	75.7	73.6–77.9
Total North, West, East**	45	76.3	69.3–82.6	18	76.3	70.2–83.1

* Clough and Boyle 2010, 356, Table 5.18.
** Browne 2012, Table 28.

TABLE 2.48
Stature, all Winchester Romano-British cemetery samples

Sample	Males			Females		
	N	Mean	Range	N	Mean	Range
Lankhills 1967–72	60	172	161–184	43	157	148–169
Lankhills 2000–5*	38	169	157–187	31	157	148–172
Total Lankhills	98	170	157–187	74	157	148–172
Victoria Road West	22	170	155–180	13	157	145–167
Northern cemetery**	54	169	153–179	35	158	146–170
Western cemeteries**	8	170	164–176	9	160	151–174
Eastern cemetery**	32	170	161–178	21	156	146–166
Total North, West, East**	94	170	153–179	65	158	146–174

* Clough and Boyle 2010, 354, Table 5.16.
** Browne 2012, 219, Table 27.



Illus. 2.17. Mean cranial indices, selected Romano-British sites.

or slightly over 5′ 1¾″. The tallest woman, who comes from the Western cemeteries, stood 174 cm, or 5′ 8½″, which would have elevated her almost seven inches above most of her female contemporaries. The shortest woman is 145 cm, barely over 4′ 9″, and comes from Victoria Road West.

Comparison with other Romano-British sites

Means of cranial measurements from the Lankhills 1967–72 excavations and Victoria Road West (Table 2.49) were compared with the samples from Poundbury,[28] Cannington,[29] and Trentholme Drive.[30] Similar data from the Oxford Archaeology Lankhills excavations and the other Winchester Romano-British cemeteries were not accessible at the time of writing. The figures in Table 2.49 suggest that the Poundbury population, geographically the closest to Lankhills, was probably very similar in physical appearance. The more northern Romano-British sample from Trentholme Drive, York, was somewhat similar to Lankhills, although there was some variation. Mean measurements for males at Trentholme Drive suggest that compared to Lankhills males their skulls were a little shorter, narrower, and higher, with slightly wider cheek bones, shorter faces, larger noses, and squarer eye sockets. Compared to Lankhills females, the females at Trentholme Drive had slightly longer skulls that were narrower and higher, narrower cheek bones and longer faces, noses that were shorter and wider, and higher and narrower orbits. The population at Cannington, located further to the west in Somerset and chronologically slightly later, looked a little different from the others, especially from the Trentholme Drive sample. Cannington males had skulls that were longer, narrower and higher, with longer, narrower faces. Similar differences were seen in females, although they were less pronounced. Until more formal statistical testing is done, it is not possible to say whether these variations reach significant levels, or are simply random effects of the sample structures. It is also possible that they represent minor regional variations in population composition that may have a true genetic basis, or may be related to different chronological, environmental and cultural factors.

Cranial indices from nine Romano-British samples are listed in Table 2.50 and Illus. 2.17. Lankhills 1967–72 appears to fit well within the range of available material. The mean male cranial index at Lankhills, 76.7, is very close to that found at both Trentholme Drive and Poundbury, 76.4. Cannington again stands out from the other sites, with a male mean cranial index of 73.1, which is identical to the Saxon 2 sample used in this study.[31] The outlier at the other end of the spectrum is the 2000–5 Lankhills sample, with a mean male cranial index of 79.5. However, it should be noted that all these mean male indices fall in the mesocranial range. The picture for females is very similar, although by a slight margin Lankhills 1967–72 and Victoria Road West females have the largest cranial index of this group, 77.5. Cannington females have the lowest mean cranial index at 75.1, which is lower, and thus more long-headed, than any of the other female samples, including the Hampshire Early Anglo-Saxons. At least based on cranial shape, the Cannington population more nearly resembles the Hampshire Early Anglo-Saxons than it does the other Romano-British sites, although without statistical testing one cannot determine the significance of this observation. It may be due to the location of Cannington in the west of England, or chronological variation, since Cannington is classified as a sub-Roman site, and its period of *floruit* was later than the Winchester material. With the exception of the Oxford Archaeology Lankhills sample, females have mean cranial indices that are equal to or larger than their male counterparts at all sites.

The comparative data for cranial height index and upper face index are more limited. Mean cranial height indices from both Lankhills excavations, Butt Road Colchester, and Poundbury are given in Table 2.51. While Lankhills excavations and Butt Road have mean values that suggest a

[28] Molleson 1993, *Mf.* 3, A6, C8.

[29] Brothwell et al. 2000, 162.

[30] Warwick 1968, 164.

[31] See below, pp. 221–4, Table 3.10.

TABLE 2.49

Mean cranial measurements, five Romano-British sites

Measurement	Males					Females				
	Lankhills	Victoria Road W	Poundbury	Cannington	Trentholme Drive, York	Lankhills	Victoria Road W	Poundbury	Cannington	Trentholme Drive, York
Cranial Length	190.15	191.42	190.0	192.49	187.57	180.90	181.80	180.75	183.40	181.00
Cranial Breadth	145.30	145.44	145.4	140.97	141.65	140.86	140.27	139.42	137.68	137.07
Cranial Height	133.26	134.68	133.2	136.53	132.37	126.09	125.33	126.30	128.04	128.91
Basion-Nasion Length	100.63	101.83	102.6	106.06	102.41	95.48	97.00	96.13	98.48	98.38
Minimum Frontal Breadth	98.67	99.00		98.22	98.09	95.21	95.73		95.88	95.16
Nasion-Prosthion Height*	70.64	71.30	70.5	71.53	73.02	66.81	66.30	65.93	66.29	69.76
Zygomatic Breadth	132.42	132.64	134.8	128.18	133.52	125.00	127.17	125.53	123.67	123.91
Orbital Height	34.00	33.96	34.8	33.66	34.28	33.55	33.82	34.20	34.29	34.24
Orbital Breadth	42.21	41.86		41.49	40.00	41.00	39.91		37.78	40.00
Nasal Breadth	23.90	24.59	24.7	25.12	25.08	23.14	23.00	23.77	24.02	24.05
Nasal Length	51.79	53.13	53.5	52.61	53.15	48.84	49.90	49.99	50.00	49.95
Palatal Breadth	37.23	36.10		41.20		35.67	36.67		39.18	
Palatal Length	42.67	43.50	45.3	45.69		40.16	42.63	43.09	43.64	
Biasterionic Breadth	115.55	117.54	114.5	113.30		110.15	113.13	109.73	109.54	
Simotic Chord	9.28	9.60		9.34		9.14	9.67		9.42	
Nasion-Bregma Chord	113.09	115.20		113.75		107.86	108.33	108.81	108.70	
Bregma-Lambda Chord	117.54	116.75	117.7	118.20		115.42	112.50	112.51	114.21	
Lambda-Opisthion Chord	96.69	99.09	97.8	100.00		94.23	93.33	94.63	97.29	
Frontal Arc	131.00	133.32		131.13		125.37	125.27		125.03	
Parietal Arc	130.78	128.58		131.39		128.78	124.88		127.43	
Occipital Arc	121.09	124.52		123.09		115.97	117.25		116.09	
Mandibular Body Length	106.83	105.88	104.7	103.17		99.55	97.92	101.81	98.93	
Minimum Ramus Breadth	31.95	32.04	32.0	32.01		30.90	31.60	30.30	30.70	
Ramus Height	64.29	64.84	61.2	65.32		57.27	55.33	54.84	58.82	
Bigonial Breadth	103.58	101.55	102.4			94.63	93.40	93.26		
Coronoid Height	67.30	66.50	66.9	67.95		59.15	58.93	58.78	60.89	
Symphysis Height	33.27	34.12	31.2	33.13		30.41	30.73	28.00	29.55	
Gonial Angle	121.07	121.72	120.1	120.91		123.78	122.10	122.97	123.34	

* At Cannington and Poundbury, this measurement was taken from Nasion-Alveolare. The two landmarks are very close together, and can easily be confused. The differences will be minimal.

TABLE 2.50

Cranial indices, selected Romano-British sites

	Males	Females
Cannington	73.1	75.1
Cirencester	73.6	76.6
Butt Rd (P. 2) Colchester	75.2	75.9
Victoria Road West	76.0	77.5
Winchester N, W, E	76.3	76.3
Trentholme Drive, York	76.4	77.2
Poundbury	76.4	77.1
Lankhills 1967–72	76.7	77.5
Lankhills 2000–5	79.5	76.0

Cannington: Brothwell and Powers 2000, 163
Cirencester: cited in Pinter-Bellows 1993, 67
Butt Rd (P. 2) Colchester: Pinter-Bellows 1993, 67
Winchester North, West, East cemeteries combined: Browne 2012, 219, Table 28
Trentholme Drive: Warwick 1968, 164
Poundbury: Molleson 1993, 167
Lankhills 2000–5: Clough and Boyle 2010, 356

TABLE 2.51

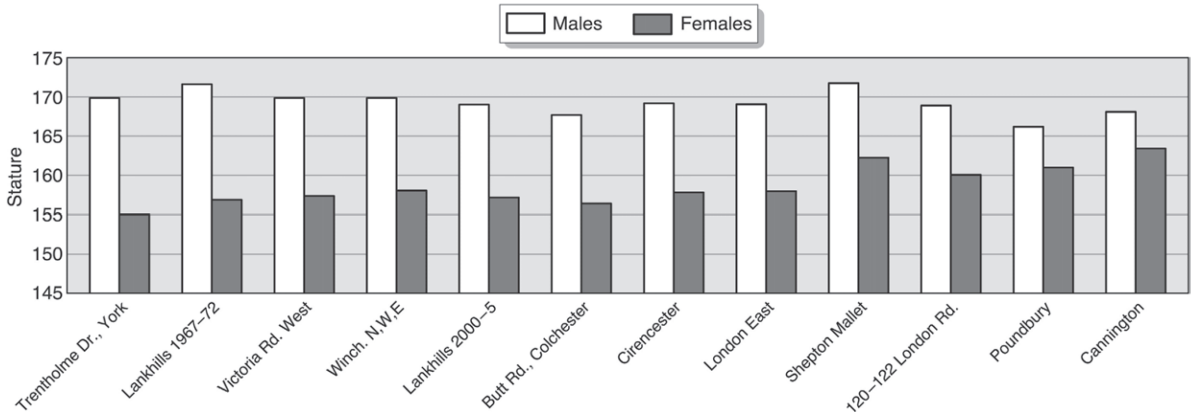
Mean cranial height indices, selected Romano-British sites

	Males		Females	
	N	Mean	N	Mean
Butt Rd (P. 2) Colchester	36	70.7	46	71.1
Poundbury	207	91.6	204	90.6
Lankhills 1967–72	33	70.7	18	69.7
Lankhills 2000–5	19	70.3	15	72.9

Butt Rd (P. 2) Colchester: Pinter-Bellows 1993, 67
Poundbury: Molleson 1993, 167
Lankhills 2000–5: Clough and Boyle 2010, 357

medium height skull, the values from Poundbury suggest very high skulls for that sample. This could represent a true difference in the populations. However, Poundbury is similar to the Lankhills material in so many other ways that the possibility of different analytical techniques must be considered as well for this particular index. The upper face index means can be compared only within the Lankhills samples (see Table 2.35 and 2.36) and with Trentholme Drive,[32] although ranges are also available for Butt Road.[33] While a spread of values is found at all sites, the general tendency is for males to have medium wide faces, and for females to have somewhat narrower faces, based on this index. For the males, medium wide faces predominate at Lankhills 1967–72 and Trentholme drive. In the male Oxford Archaeology Lankhills sample, there are an equal number of males with medium and with narrow faces, but the sample sizes are very small.[34] Only at Butt Road do narrow faces predominate among the males. The female samples are very similar, with medium facial indices predominating in both Lankhills samples and narrow facial indices predominating at Trentholme Drive and Butt Road.

[32] Warwick 1968, 164.
[33] Pinter-Bellows 1993, 66.
[34] Clough and Boyle 2010, 356.



Illus. 2.18. Mean stature in centimetres, selected Romano-British sites.

TABLE 2.52

Mean stature in centimetres, selected Romano-British sites

	Males	Females	Difference
Trentholme Drive, York*	170.0	155.0	15.0
Lankhills 1967–72	171.6	156.9	14.7
Victoria Road West	169.9	157.4	12.5
Winchester N, W, E cemeteries	170.0	158.0	12
Lankhills 2000–5	169.0	157.1	11.9
Butt Rd (P. 2) Colchester	167.6	156.3	11.3
Cirencester	169.1	157.9	11.2
London East cemetery	169.0	158.0	11.0
Shepton Mallet	171.7	162.1	9.6
120–122 London Rd., Gloucester	169.0	160.0	9.0
Poundbury	166.2	160.9	5.3
Cannington	168.0	163.5	4.5

Trentholme Drive, York: Warwick 1968, 149
Winchester N, W, E cemeteries: Browne 2012, 219
Lankhills 2000–5: Clough and Boyle 2010, 354
Butt Rd (P.2) Colchester: Pinter-Bellows 1993, 64
Cirencester: Wells 1982, 140
London East cemetery: Barber and Bowsher 2000, 280
Shepton Mallet: Pinter-Bellows 2001, 267
120–122 London Rd., Gloucester: Márquez-Grant and Loe 2008, 33
Poundbury: Molleson 1993, 168
Cannington: Brothwell and Powers 2000, 166
*converted from feet and inches

Comparative mean stature data are given in Table 2.52 and Illus. 2.18. For males, there is a range of 5.5 cm between the tallest, at Shepton Mallet (171.7 cm), and the shortest, at Poundbury (166.2 cm). This difference of approximately 3.2% is not likely to be highly meaningful, especially in view of the lack of standardization of technique across all the sites in calculating statures. The Lankhills 1967–72 male mean statures are among the tallest in the group at 171.6 cm. All four Winchester samples cluster between 169 and 171.6 cm. Conversely, the Lankhills 1969–72 females are among the shortest in this group at 156.9 cm. The mean statures for females from all four Winchester samples cluster in a very tight range, varying by only slightly more than one centimetre. Only the females from Trentholme Drive, York, are shorter at 155 cm. The tallest females, who average 163.5

cm, are found at Cannington. The difference of 5.2% between the tallest and shortest means is greater for the females than for the males, and may indicate that they are reflecting somewhat different factors, which might be genetic, environmental, or socioeconomic. Very small sample sizes at some sites may also be skewing results for both sexes at those sites. Sexual dimorphism in stature ranges between lows of 2.7% at Cannington and 3.2% at Poundbury to highs of 8.8% at Trentholme Drive, York, and 8.6% at Lankhills 1967–72. While the differences in height between males and females at Lankhills 1967–72 and Victoria Road West are highly statistically significant (Table 2.29), the Cannington and Poundbury samples are more notable for the relative similarity of male and female heights, which may not reach significant levels. Although the male/female stature differences have not been tested statistically for the Lankhills 2000–5 or the Winchester combined samples, those differences in sexual dimorphism are likely to be significant as well, given their similarity to Lankhills 1967–72 and Victoria Road West.

iv. DISCUSSION

The morphological data presented in this chapter clearly indicate that Lankhills 1967–72 and Victoria Road West are very similar, as may be expected. T-tests reveal no significant differences between the two sites in individual cranial measurements, cranial index or stature in either sex. Cranial shape as reflected in the cranial indices shows little sexual dimorphism. The similarities between Lankhills 1967–72 and Victoria Road West extend to the 2000–5 Lankhills excavations, and to the samples from the Winchester Romano-British cemeteries generally, where they can be documented.

With regard to hand dominance, it has been asserted that left-handedness can vary from 2 to 23%, and is more prevalent in males.[35] Although the sample sizes from both Lankhills 1967–72 and Oxford Archaeology Lankhills are small, they tend to support this assertion. The findings also accord with the earlier Vann study on the Lankhills 1967–72 material.[36]

Dimorphism in stature can be expressed as an index (DI), or percentage of male stature relative to female stature. In modern populations male stature generally ranges between 104 and 111 per cent of female stature.[37] The dimorphism index for 14 samples from Roman and sub-Roman period sites is given in Table 2.53. Statures are highly sexually dimorphic at Lankhills 1967–72 and Victoria Road West, especially in the earlier phase of Lankhills (Area W), where the mean difference between males and females reaches 15.4 cm (DI 109.8). Sexual dimorphism in stature at Victoria Road West is somewhat lower, with a mean difference between the sexes of 12.5 cm (DI 107.9). Although this is still highly statistically significant, it may suggest a possible chronological trend towards reduction in male–female height differences from the mid-fourth to the early fifth century. The Victoria Road West males have a slightly lower mean height than the Lankhills males, while the mean height for females increases. Given the overall similarity of the two samples, this tentative interpretation of a chronological trend towards less sexual dimorphism in height should be treated with caution, as other explanations are possible.

Lankhills and Victoria Road West fit reasonably well within the broader context of the Romano-British cemeteries included here. Most of these sites are widely separated geographically, ranging

[35] Steele 2000. [36] Vann 2000. [37] Stini 1985, 214.

TABLE 2.53

Sexual dimorphism index (DI), selected Romano-British sites

Site	DI
Lankhills Area W	109.8
Trentholme Drive	109.7
Lankhills 1967–72 total	109.4
Lankhills Areas F, E, O	108.1
Victoria Road West	107.9
Lankhills 2000–5	107.6
Winchester N, W, E cemeteries	107.6
Butt Rd (P. 2), Colchester	107.2
Cirencester	107.1
London East cemetery	107.0
Shepton Mallet	105.9
120–122 London Road, Gloucester	105.6
Poundbury	103.3
Cannington	102.8

DI calculated from data in Tables 2.31 and 2.52

from York to London to Somerset, and there is chronological variation as well. Standards of excavation and analysis differ, as does the completeness of the samples. Under these conditions, considerable variation is to be expected, even if one could hypothesize a homogeneous population, which was certainly not the case. Cannington stands out regarding cranial shape, especially for males, with longer, narrower skulls than the other Romano-British samples. The males at Lankhills are among the tallest, exceeded only by those at Shepton Mallet, while the females at Lankhills are among the shortest, exceeded only by those at Trentholme Drive. As a consequence, the level of sexual dimorphism in stature is higher at Lankhills than at all other sites except Trentholme Drive. The very great diversity in sexual dimorphism exhibited by these sites, with dimorphism indices ranging from 102.8 to 109.8, may reflect multiple processes at work. Although the factors affecting sexual dimorphism are only partially understood, stature certainly has a genetic component. It may also be affected by nutritional status, environment, gender roles, marriage customs, or patterns of subsistence.[38] Some studies[39] suggest that reduced levels of sexual dimorphism may result from suppressed growth brought on by protein deficiency malnutrition. In this scenario, skeletal maturation is delayed in early childhood, and males are frequently more affected than are females. With improved nutrition, catch-up growth may take place in adolescence, usually at an earlier age and with more impact in girls than in boys. If nutritional levels do not improve, both sexes continue to be affected. In addition, because of the nutritional requirements of childbearing and lactation, there may be a selective advantage for small females in a nutritionally inadequate environment, since their requirements will not be as great as those of larger individuals.[40] This may suggest that the processes at work at Lankhills and Trentholme Drive were quite different from those at Poundbury and Cannington, and if nutritional factors were involved, the Poundbury and Cannington people may have been experiencing some level of protein reduction not shared in similar degree by other sites. Molleson's findings with regard to diet and nutrition at Poundbury would tend to support this view.[41] It might also suggest that the population of Lankhills and

[38] Kirchengast 2000–1; Holden and Mace 1999; Gray and Wolfe 1980.

[39] Stini 1969.

[40] Frisancho et al. 1973.

[41] Molleson 1993, 183–4.

Victoria Road West were among the better nourished or healthier groups in the sites considered here. However, if Victoria Road West does in fact go out of use slightly later than Lankhills, the reduction in sexual dimorphism seen at Victoria Road West may reflect a degree of deteriorating protein access in the later 4th and early 5th centuries, at least for this segment of the population. This is a reasonable inference given the known deterioration of the town of Winchester during that period.

4

DENTITION

i. INTRODUCTION

DENTAL data can yield significant information regarding the health status of a population. Teeth and the structures of tissue and bone which support them are affected by a number of interacting hereditary, developmental, environmental, and pathological agents. The stresses to which dental structures are subjected during life alter those structures, leaving behind a trail of defects, wear, and disease.

This chapter describes and compares dental data for Lankhills 1967–72 within their spatial and temporal context, concentrating on dental pathology and variants rather than metric analysis. The original study detailed the frequency of caries, abscesses, ante mortem tooth loss and third molar agenesis, all of which were compared across a number of Roman and Early Anglo-Saxon period sites. In addition, congenital anomalies in the Lankhills 1967–72 sample have been described, and a brief review of juvenile dentition has been made, although the original study focused on adults. Because the presence of linear enamel hypoplasia (LEH) may have significant implications for understanding the nutritional and health status of a group, a separate study of this phenomenon was undertaken for the Lankhills 1967–72 sample some years after original research for this project was completed. Data on LEH had not been collected at Victoria Road West as part of the original project, so the site does not figure in comparisons made here with other Romano-British sites regarding this condition, except as reflected in data from Winchester's Northern cemetery sample, of which it was a part. Dental pathology and variants at Lankhills 1967–72 are first described within the context of late Roman Winchester, and then as related to broader Romano-British samples. Similar data from the comparison group of Hampshire Early Anglo-Saxon sites are presented and the findings are discussed in Part 3.

ii. LANKHILLS IN ROMANO-BRITISH PERSPECTIVE

Lankhills 1967–1972 and 2000–2005

In the Lankhills 1967–72 sample 2,477 teeth could be examined *in situ* in adult skulls. Of these, 1,362 teeth came from males, while 1,115 teeth originated in female skulls. By tooth type, there were 214 central incisors (I1), 286 lateral incisors (I2), 362 canines (C), 370 first premolars (PM1), 338 second premolars (PM2), 340 first molars (M1), 331 second molars (M2), and 236 third molars (M3).

Caries (Table 2.54)

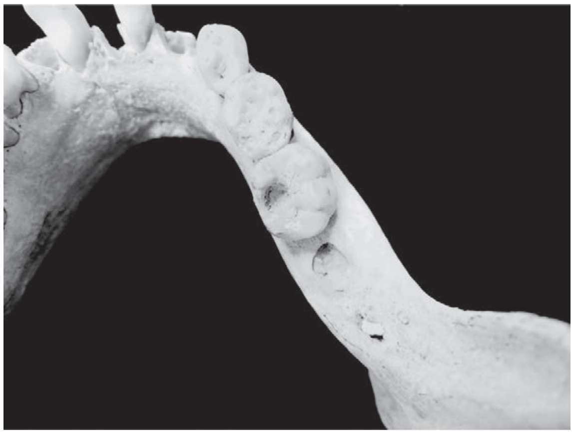
Dental caries is an infectious disease process in which bacterial agents attack the tooth surface and destroy it, creating a cavity. While bacteria are necessary, certain preconditions of poor enamel formation or structural features of the teeth themselves, especially in molars, may further encourage the onset and development of caries, as may constituents of the diet. If left untreated, caries extending into the pulp cavity

TABLE 2.54

Frequency (TPR) of caries, adults, Lankhills 1967–72

MALES	I1	I2	C	PM1	PM2	M1	M2	M3	TOTAL
MAXILLA, RIGHT									
No. observations	31	39	50	46	43	46	41	27	323
No. caries	2	3	4	5	2	13	14	4	47
% caries	7	8	8	11	5	28	34	15	15
MAXILLA, LEFT									
No. observations	30	38	54	54	51	45	44	32	348
No. caries	0	1	3	8	7	8	10	6	43
% caries	0	3	6	15	14	18	23	19	12
No. observations	61	77	104	100	94	91	85	59	671
Total no. caries	2	4	7	13	9	21	24	10	90
Total % caries	3	5	7	13	10	23	28	17	13
MANDIBLE, RIGHT									
No. observations	26	37	44	48	42	43	50	42	332
No. caries	0	1	0	3	3	8	9	12	36
% caries	0	3	0	6	7	19	18	29	11
MANDIBLE, LEFT									
No. observations	30	43	52	52	50	45	45	42	359
No. caries	1	1	1	1	7	14	10	6	41
% caries	3	2	2	2	14	31	22	14	11
Total no. observ.	56	80	96	100	92	88	95	84	691
Total no. caries	1	2	1	4	10	22	19	18	77
Total % caries	**2**	**3**	**1**	**4**	**11**	**25**	**20**	**21**	**11**
TOTAL OBSERV.	117	157	200	200	186	179	180	143	1362
TOTAL NO. CARIES	3	6	8	17	19	43	43	28	167
TOTAL % CARIES	**3**	**4**	**4**	**9**	**10**	**24**	**24**	**20**	**12**

FEMALES	I1	I2	C	PM1	PM2	M1	M2	M3	TOTAL
MAXILLA, RIGHT									
No. observations	18	26	38	40	31	40	34	22	249
No. caries	0	0	1	2	3	7	7	3	23
% caries	0	0	3	5	10	18	21	14	9
MAXILLA, LEFT									
No. observations	19	26	40	39	39	41	35	18	257
No. caries	0	0	2	2	8	7	10	3	32
% caries	0	0	5	5	21	17	29	17	13
No. observations	37	52	78	79	70	81	69	40	506
Total no. caries	0	0	3	4	11	14	17	6	55
Total % caries	0	0	4	5	16	17	25	15	11
MANDIBLE, RIGHT									
No. observations	25	41	37	44	36	41	43	31	298
No. caries	0	0	0	1	4	10	7	5	27
% caries	0	0	0	2	11	24	16	16	9
MANDIBLE, LEFT									
No. observations	35	36	47	47	46	39	39	22	311
No. caries	2	2	1	1	3	15	6	7	37
% caries	6	6	2	2	7	39	15	32	12
Total no. observ.	60	77	84	91	82	80	82	53	609
Total no. caries	2	2	1	2	7	25	13	12	64
Total % caries	**3**	**3**	**1**	**2**	**9**	**31**	**16**	**23**	**11**
TOTAL OBSERV.	97	129	162	170	152	161	151	93	1115
TOTAL NO. CARIES	2	2	4	6	18	39	30	18	119
TOTAL % CARIES	**2**	**2**	**3**	**4**	**12**	**24**	**20**	**19**	**11**
TOTAL NUMBER OF OBSERVATIONS, SEXES COMBINED	214	286	362	370	338	340	331	236	2477
TOTAL NUMBER OF CARIES, SEXES COMBINED	5	8	12	23	37	82	73	46	286
TOTAL PERCENT CARIES, SEXES COMBINED	**2**	**3**	**3**	**6**	**11**	**24**	**22**	**20**	**12**



Illus. 2.19. Caries in the right M_1. LH 46, child age *c.*9 years.

of a tooth may result in abscess and more generalized infection.[1]

In the Lankhills 1967–72 sample a total of 12% (True Prevalence Rate, or TPR) of all teeth exhibited at least one carious lesion. Teeth were scored for approximal, pit, and fissure caries. The distribution between the sexes was very even, as 12% of male teeth were carious, while 11% of female teeth were affected. The distribution of caries between upper and lower dentition was also quite even in both sexes, although the condition was found slightly more often in male maxillae (13%). Females consistently showed a higher frequency of caries on the left side of the mouth, both upper and lower dentition. No similarly consistent side pattern was present for males.

Overall, the single most frequently carious tooth was the first molar, which exhibited cavities in 24% of the first molars examined. In males, the second molar was affected with equal frequency. In both sexes the anterior dentition had much lower caries frequencies than did the posterior dentition. While frequency rates varied from 11–24% for the teeth ranging from PM2 to M3, rates were only 2–6% for I1 to PM3.

Oxford Archaeology investigators found a much lower rate of caries in the Lankhills 2000–5 sample, ranging from 4.7% in males to 7.5% in females, with an overall rate of 5.9%.[2] This apparent large discrepancy between the samples from the two excavations is discussed further below.

Abscesses (Table 2.55)

Abscesses may result from infection of the tooth pulp cavity due to caries, or they may result from periodontal disease, in which case the focus of the abscess is outside the pulp cavity.[3] With larger abscesses the origin of the abscess can be hard to determine if the tooth has been lost. Both types of abscess were considered together in the Lankhills 1967–72 sample. Jaws frequently could be examined for evidence of abscess when teeth had been lost post mortem, resulting in higher sample sizes than were available when evaluating caries. The actual number of sites examined will be found in Table 2.55.

Of the tooth sites which could be examined at Lankhills, 4% (TPR) were found to have evidence of at least one abscess. There was very little difference between the sexes (4% males, 3% females). Generally abscesses were more common in the maxilla than in the mandible in both sexes (5% maxilla/3% mandible in males; 4% maxilla/2% mandible in females), although there was no consistent pattern of presence by side.

This dental pathology was analysed somewhat differently in the Lankhills 2000–5 material, where the small sample of 27 adults was evaluated for periapical cavities only, including granulomata, periapical cysts, and abscesses.[4] These lesions were found in 1.5% of the sample, with no breakdown by sex given. The frequency appears to be based on the number of

[1] Ortner and Putschar 1981, 438–9.
[2] Clough and Boyle 2010, 395.
[3] Ortner and Putschar 1981, 442.
[4] Clough and Boyle 2010, 397.

TABLE 2.55

Frequency (TPR) of abscesses, adults, Lankhills 1967–72

MALES	I1	I2	C	PM1	PM2	M1	M2	M3	TOTAL	FEMALES	I1	I2	C	PM1	PM2	M1	M2	M3	TOTAL
MAXILLA, RIGHT										MAXILLA, RIGHT									
No. observations	66	67	66	66	64	63	60	54	506	No. observations	45	50	53	53	51	52	50	49	403
No. abscesses	1	3	2	4	3	6	5	1	25	No. abscesses	1	3	0	0	1	5	2	1	13
% abscesses	2	5	3	6	5	10	8	2	5	% abscesses	2	6	0	0	2	10	4	2	3
MAXILLA, LEFT										MAXILLA, LEFT									
No. observations	66	65	71	73	69	67	64	60	535	No. observations	49	50	53	54	53	52	45	40	396
No. abscesses	0	3	4	5	6	8	1	2	29	No. abscesses	1	1	3	5	4	2	2	2	20
% abscesses	0	5	6	7	9	12	2	3	5	% abscesses	2	2	6	9	8	4	4	5	5
No. observations	132	132	137	139	133	130	124	114	1041	No. observations	94	100	106	107	104	104	95	89	799
No. abscesses	1	6	6	9	9	14	6	3	53	No. abscesses	2	4	3	5	5	7	4	3	33
% abscesses	1	5	4	7	7	11	5	3	5	% abscesses	2	4	3	5	5	7	4	3	4
MANDIBLE, RIGHT										MANDIBLE, RIGHT									
No. observations	61	62	64	65	66	68	68	69	523	No. observations	59	58	56	56	54	60	58	58	459
No. abscesses	1	0	2	1	3	3	5	1	16	No. abscesses	0	0	3	1	0	4	1	1	10
% abscesses	2	0	3	2	5	4	7	1	3	% abscesses	0	0	5	2	0	7	2	2	2
MANDIBLE, LEFT										MANDIBLE, LEFT									
No. observations	61	64	64	68	69	67	66	66	525	No. observations	59	59	57	58	58	56	54	52	453
No. abscesses	0	1	1	0	0	4	3	2	11	No. abscesses	0	0	1	0	0	3	3	2	9
% abscesses	0	2	2	0	0	6	5	3	2	% abscesses	0	0	2	0	0	5	6	4	2
No. observations	122	126	128	133	135	135	134	135	1048	No. observations	118	117	113	114	112	116	112	110	912
No. abscesses	1	1	3	1	3	7	8	3	27	No. abscesses	0	0	4	1	0	7	4	3	19
% abscesses	1	1	2	1	2	5	6	2	3	% abscesses	0	0	4	1	0	6	4	3	2
Total no. observ.	254	258	265	272	268	265	258	249	2089	Total no. observ.	212	217	219	221	216	220	207	199	1711
Total no. abscess	2	7	9	10	12	21	14	6	81	Total no. abscess	2	4	7	6	5	14	8	6	52
Total % abscess	**1**	**3**	**3**	**4**	**5**	**8**	**5**	**2**	**4**	**Total % abscess**	**1**	**2**	**3**	**3**	**2**	**6**	**4**	**3**	**3**
TOTAL OBSERVATIONS, SEXES COMBINED											466	475	484	493	484	485	465	448	3800
TOTAL NO. ABSCESSES, SEXES COMBINED											4	11	16	16	17	35	22	12	133
TOTAL % ABSCESSES, SEXES COMBINED											**1**	**2**	**3**	**3**	**4**	**7**	**5**	**3**	**4**

TABLE 2.56

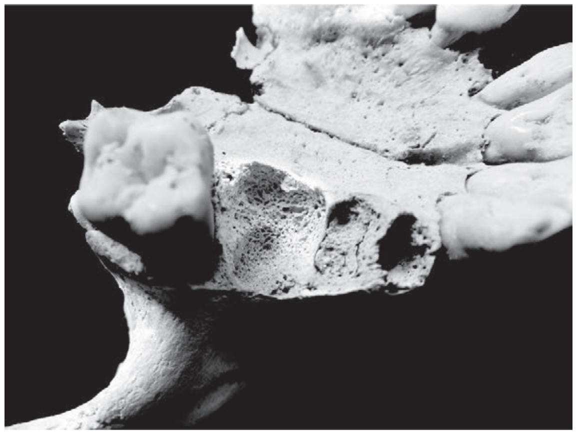
Frequency (TPR) of ante mortem tooth loss, adults, Lankhills 1967–72

MALES	I1	I2	C	PM1	PM2	M1	M2	M3	TOTAL
MAXILLA, RIGHT									
No. observations	67	70	72	70	66	68	64	61	538
No. AM loss	2	3	2	6	9	16	14	7	59
% AM loss	3	4	3	9	14	24	22	12	11
MAXILLA, LEFT									
No. observations	67	68	73	75	72	70	67	65	557
No. AM loss	3	1	3	5	8	22	19	15	76
% AM loss	5	2	4	7	11	31	28	23	14
No. observations	134	138	145	145	138	138	131	126	1095
No. AM loss	5	4	5	11	17	38	33	22	135
% AM loss	4	3	3	8	12	28	25	18	12
MANDIBLE, RIGHT									
No. observations	63	66	67	67	67	69	69	70	538
No. AM loss	3	2	0	4	7	24	10	8	58
% AM loss	5	3	0	6	11	35	15	11	11
MANDIBLE, LEFT									
No. observations	64	67	69	69	69	68	68	68	542
No. AM loss	2	0	0	3	5	19	16	10	55
% AM loss	3	0	0	4	7	28	24	15	10
No. observations	127	133	136	136	136	137	137	138	1080
No. AM loss	5	2	0	7	12	43	26	18	113
% AM loss	4	2	0	5	9	31	19	13	11
Total no. observ.	261	271	281	281	274	275	268	264	2175
Total no. AM loss	10	6	5	18	29	81	59	40	248
Total % AM loss	**4**	**2**	**2**	**6**	**11**	**30**	**22**	**15**	**11**

FEMALES	I1	I2	C	PM1	PM2	M1	M2	M3	TOTAL
MAXILLA, RIGHT									
No. observations	51	52	55	55	53	53	52	47	418
No. AM loss	3	2	1	6	9	10	9	8	48
% AM loss	6	4	2	11	17	9	17	17	12
MAXILLA, LEFT									
No. observations	55	56	56	57	57	57	53	46	437
No. AM loss	3	2	2	7	9	13	13	9	58
% AM loss	6	4	4	12	16	23	25	20	13
No. observations	106	108	111	112	110	110	105	93	855
No. AM loss	6	4	3	13	18	23	22	17	106
% AM loss	6	4	3	12	16	21	21	18	12
MANDIBLE, RIGHT									
No. observations	63	63	63	60	59	62	61	58	489
No. AM loss	1	1	1	1	4	17	14	10	49
% AM loss	2	2	2	2	7	27	23	17	10
MANDIBLE, LEFT									
No. observations	64	65	65	63	62	58	58	54	489
No. AM loss	1	1	0	1	7	18	16	8	52
% AM loss	2	2	0	2	11	31	28	15	11
No. observations	127	128	128	123	121	120	119	112	978
No. AM loss	2	2	1	2	11	35	30	18	101
% AM loss	2	2	1	2	9	29	25	16	10
Total no. observ.	233	236	239	235	231	230	224	205	1833
Total no. AM loss	8	6	4	15	29	58	52	35	207
Total % AM loss	**3**	**3**	**2**	**6**	**13**	**25**	**23**	**17**	**11**

SEXES COMBINED	I1	I2	C	PM1	PM2	M1	M2	M3	TOTAL
TOTAL OBSERVATIONS, SEXES COMBINED	494	507	520	516	505	505	492	469	4008
TOTAL NO. AM LOSS, SEXES COMBINED	18	12	9	33	58	139	111	75	455
TOTAL % AM LOSS, SEXES COMBINED	**4**	**2**	**2**	**6**	**12**	**28**	**23**	**16**	**11**

ILLUS. 2.20. Abscess of the left M_1, resulting from a carious lesion on the tooth crown that penetrated the root. Moderately heavy deposits of calculus are seen on all premolars and molars. LH 352, male age 22–23.



ILLUS. 2.21. Ante mortem loss of dm^2 resulting from an abscess. LH 46, child age *c.*9 years.

individuals examined, rather than the number of tooth sockets. The differences in methodology suggest that these numbers are not directly comparable to those found in the Lankhills 1967–72 sample.

Ante mortem tooth loss (Table 2.56)

While ante mortem tooth loss can result from a number of factors including deliberate extraction of healthy teeth, in archaeologically derived samples it is most commonly the result of other pathological processes affecting the mouth such as dental caries, abscess, or periodontal disease. Thus the frequency of ante mortem tooth loss can be an important indicator of the general state of dental health in an archaeological population.

Of the 4,008 tooth sites in the Lankhills 1967–72 sample that could be examined for ante mortem tooth loss, a total of 11% (TPR) gave evidence of tooth loss prior to death. The frequency was identical for both sexes, and there also appeared to be little difference between maxillary and mandibular occurrence, although there was a very slight predominance of ante mortem tooth loss in maxillae. There was no clear differentiation of pattern by side in either sex.

Like the findings regarding caries and abscesses, the site of the first molar was most frequently affected by ante mortem tooth loss (28%). While this was true for both sexes, the frequency was higher for males (30%) than for females (25%). There was also a significant difference between the frequency of ante mortem tooth loss on the anterior dentition (2–6%) and in the posterior dentition (12–28%).

A total ante mortem tooth loss rate of 15.4% was reported for the Lankhills 2000–5 excavations.[5] This was based on examination of 3,644 teeth, but no separate figures were given for males and females.

Congenital absence, M3 (Table 2.57)

The third molar is the most genetically unstable molar in the tooth row, and it is congenitally absent in a significant number of individuals in modern groups. Proportions as high as 20–49% have been reported for European populations.[6] At Lankhills 1967–72, 15% of all third molars appeared to be congenitally absent. In some

5 Clough and Boyle 2010, 397.

6 Bass 1995, 291.

TABLE 2.57

Congenital absence, M3, adults, Lankhills 1967–72

	MAXILLA			MANDIBLE			SITE TOTAL
	R. M3	L. M3	TOTAL	R. M3	L. M3	TOTAL	
MALES							
No. observations	61	65	126	70	68	138	264
No. absent	11	6	17	10	10	20	37
% absent	**18**	**9**	**14**	**14**	**15**	**15**	**14**
FEMALES							
No. observations	47	46	93	58	54	112	205
No. absent	7	7	14	10	11	21	35
% absent	**15**	**15**	**15**	**17**	**20**	**19**	**17**
TOTAL NO. OBSERVATIONS	108	111	219	128	122	250	469
TOTAL NO. ABSENT	18	13	31	20	21	41	72
TOTAL % ABSENT	**17**	**12**	**14**	**16**	**17**	**16**	**15**

TABLE 2.58

Presence of linear enamel hypoplasia (CPR), Lankhills 1967–72

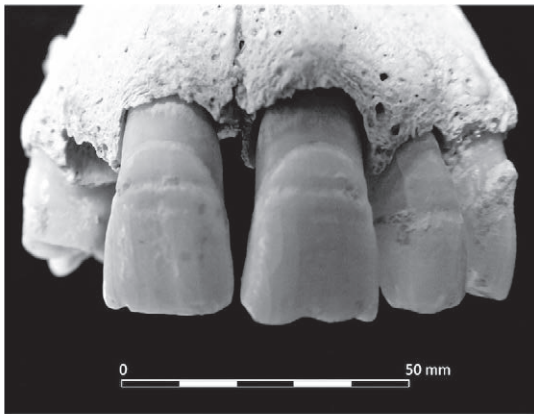
	Males		Females		Total	
	N	%	N	%	N	%
Lankhills, Early Phase (Area W)						
No LEH	20	61	19	70	39	65
Group 1	1	3	2	7	3	5
Group 2	6	18	2	7	8	13
Group 3	6	18	4	15	10	17
Total	33		27		60	
Multiple bands (n/N)	7/13	54	5/8	63	4/7	57
Lankhills, Late Phase (Areas F, E, O)						
No LEH	23	62	28	82	51	72
Group 1	2	5	1	3	3	4
Group 2	7	19	5	15	12	17
Group 3	5	14	0	0	5	7
Total	37		34		71	
Multiple bands (n/N)	1/2	50	2/6	33	9/20	45
Lankhills, Full Sample						
No LEH	43	61	47	77	90	68
Group 1	3	4	3	5	6	5
Group 2	13	19	7	12	20	15
Group 3	11	16	4	7	15	12
Total	70		61		131	
Multiple bands (n/N)	14/27	52	7/14	50	21/41	51

* Groups are defined on p. 79.

cases this was confirmed or disproven radiographically, but the majority of skulls were not x-rayed, so the findings must remain somewhat tentative. Male (14%) and female (17%) frequencies showed little real variation. In both sexes a slightly higher percentage of third molars was missing in mandibles than in maxillae, but the differences were not meaningful. There was no consistent patterning by side.

Twenty-six individuals in the Lankhills 2000–5 excavated sample appeared to have agenesis of at least one M3,[7] but in the absence

[7] Clough and Boyle 2010, 398.



Illus. 2.22. One moderately pronounced band of LEH, as well as at least one other less pronounced band, is seen on the upper incisors and canine. Note also the calculus deposit on the left canine and grooving of the incisors, which may suggest an activity such as repeatedly drawing thread through the teeth. Fragmentary maxilla. LH 112, male age 22–5.

of any percentages it is not possible to make comparisons with the 1967–72 excavations.

Linear enamel hypoplasia (Table 2.58)

The occurrence of enamel hypoplasias in teeth is caused by interruptions to the normal process of enamel crown formation that are due to systemic interference, and result in defects of mineralization which may take several different forms detectable either microscopically or in the gross structure of the tooth crown.[8] Since these enamel defects are created during the process of enamel formation, they preserve a record of the chronology and timing of systemic insult sufficiently intense to interfere with normal tooth mineralization. Although there is wide agreement that enamel hypoplasias are related to dietary and disease stresses,[9] the specific aetiology is unknown and may be very variable.

Among the most common gross forms of expression of enamel hypoplasia are pits, lines, and wide bands or grooves.[10] The narrow bands of linear enamel hypoplasia (or LEH) represent single acute metabolic assaults, and are almost the only type of enamel hypoplasia seen in these samples. Although the evidence is inconclusive, the possibility exists that the lighter bands of LEH are disease-related while more pronounced bands represent growth arrest indicative of extreme dietary deficiency or starvation.[11]

In the early phase Lankhills 1967–72 sample (Area W), a very high proportion of adults of both sexes had no evidence of LEH at all (61% males, 70% females). While males (39%) showed a slightly greater frequency of LEH than females (30%), they also appeared to have fewer detectable multiple episodes (54% male, 63% female).

Because the presence of LEH links metabolic insult (whether nutrition- or disease-related) to the chronology of tooth crown formation, examination of the distribution of LEH can yield useful information regarding physiological stresses encountered in childhood. Since a number of teeth in these samples exhibited multiple manifestations of LEH, the frequency of occurrence was grouped into four categories: (1) those individuals showing no evidence of LEH at all; (2) Group 1 comprised those teeth whose crowns form early in life, generally terminating between the ages of 3 and 5 years, i.e. central and lateral incisors and first molars; (3) Group 2 comprised those teeth whose crowns form later in childhood, generally terminating between 6 and 14 years old, i.e. canines, first and second premolars, second and third molars, and (4) Group 3 comprised those individuals who exhibit LEH on teeth in both the previous two categories. The results will be found in Table 2.58.

When the timing of LEH in Area W was examined, the frequency in males appeared to be greatest in later childhood (Group 1 + Group 3 = 21%; Group 2 + Group 3 = 36%). Females, on the other hand, showed an even distribution

[8] El-Najjar et al. 1978, Pindborg 1970.
[9] Cook and Buikstra 1979, Corruccini et al. 1982.
[10] Sarnat and Shour 1941–2.
[11] Corruccini et al. 1982.

Illus. 2.23. Dental crowding has resulted in rotation of the left lateral incisor of the mandible. LH 365, female age *c*.30.

Illus. 2.24. The lower right canine is impacted. The socket for the retained deciduous canine is present. LH 97, male age 20–25.

throughout childhood (22% in both Group 1 + Group 3, and Group 2 + Group 3). While there was no good evidence for severe nutritional deficits based on these data, it would nonetheless appear that in later childhood males were susceptible to unknown causal conditions in a way that females were not.

In addition to the adults, 22 children from the early phase of Lankhills 1967–72 could be examined. No LEH was seen in deciduous dentition. The only two cases observed were both in adult teeth.

In the later sample at Lankhills 1967–72 (Areas F, E, O), again a very high proportion of the adults had no evidence whatsoever of LEH. While male percentages were approximately the same in the two periods, female percentages jumped from 70% to 82% exhibiting no LEH. In addition to having a higher frequency of LEH, males also showed more evidence of repeated episodes (50%) than did females (33%). Both sexes appeared to have had more assaults in late childhood than in early childhood. The substantial improvement over the earlier sample from Area W seen in females, and their generally lower frequency of LEH as compared to males, may have several possible explanations. Sampling problems caused by relatively small sample sizes cannot be completely excluded. Alternatively, these data may be pointing towards improved nutrition for females. It is also possible that changes in patterns or levels of disease exposure and response were involved, or it may have been a combination of factors.

In this later phase from Lankhills 1967–72, 15 children could be examined. No evidence of LEH was seen on the deciduous dentition except for two cases where hypoplastic lesions may have been associated with other pathological conditions. Only one child showed any LEH on the permanent dentition.

In examining the 1967–72 Lankhills sample as a whole, it was apparent that females (23%) showed a considerably lower frequency of LEH than did males (39%). Frequency of assault was greatest in later childhood, suggesting disease as a causative agent, with little or no evidence for severe nutritional stress. The inference of greater male susceptibility was based not only on higher frequency of the presence of LEH, but also on data indicating that males experienced more multiple assaults.

The results from the Lankhills 2000–5 excavations are not directly comparable, as they are reported separately for adults (22.7%) and subadults (34.8%).[12] The subadult defects were found in permanent teeth with the exception of one individual, suggesting that the overall occurrence of enamel hypoplasias in the two Lankhills excavations may have been quite similar.

Dental anomalies

In the Lankhills 1967–72 sample, rotation, crowding, and overlapping were observed in 11 adults: six females and five males.[13] Canines were most frequently affected, but these conditions were also found in central and lateral incisors and first and second premolars. Specific details for each individual are given in Chapter 7.

Retained deciduous dentition was found in seven individuals, three males and four females.[14] Five of these, three males and two females, also had impacted anterior dentition.[15]

Anterior teeth, either lateral incisors, canines, or second premolars were congenitally absent in four individuals.[16]

Two females also had peg teeth, which were found in the locations of the right M^3 of LH 133, and the left maxillary canine of LH 266.

There appeared to be two clusters of these anomalies in the cemetery, both related to features. LH 97 cut the enclosure of Feature 2, and LH 53 and LH 98 were close by. LH 48 was in the same general area, but a little further removed. The other cluster contained three graves, LH 335, LH 340, and LH 343, cut into the southern portion of the ditch of Feature 9. These spatial relationships are discussed more fully in Chapter 5.

All these traits except retained deciduous dentition were reported for the 2000–5 Lankhills excavations as well.[17] In addition, enamel pearl formation and transposition of teeth were reported, neither of which was seen in the 1967–72 sample.

Illus. 2.25. The upper central and lateral incisors are absent, probably congenitally. The canines have migrated slightly towards the midline, and have erupted at an angle with their tips pointing towards each other. LH 410, male age 30–35.

Juvenile dentition

A total of 18 children and adolescents in the Lankhills 1967–72 sample manifested some type of dental pathology or anomaly. Given the damage and incompleteness of many juvenile mandibles and maxillae, this represents only the minimum number of juveniles with a dental abnormality. The true number may have been much higher.

Caries were seen in the deciduous molars of four children ranging in age between five and ten years old, as well as in the permanent M^1s of one adolescent.[18] One child, a nine-year-old in LH 46, had cavities on both the upper and lower M1s, as well as dm_2, which was also abscessed.[19] This was the only abscess found in subadults. This same

[12] Clough and Boyle 2010, 397.

[13] Females: LH 48, LH 98, LH 270, LH 340, LH 343, LH 365. Males: LH 20, LH 109, LH 130, LH 335, LH 397.

[14] Females: LH 48, LH 53, LH 179, LH 343. Males: LH 97, LH 104, LH 287.

[15] Females: LH 48, LH 343. Males: LH 97, LH 104, LH 287.

[16] Lateral incisors: LH 53, LH 287, LH 410. Central incisors: LH 410. Second premolars: LH 179.

[17] Clough and Boyle 2010, 399 Table 5.53.

[18] Graves 46, 136, 169, 188 and 308(2).

[19] See Illus. 2.19 and 2.21 above.

child was found to have calculus deposits on the left dm_1, dm_2, and M_1 as well as the right M^1.

Calculus was found on the teeth of five other juveniles as well, some as young as seven years old.[20] It is quite possible that more children were affected, but not identified, since calculus deposits on teeth in archaeological sites can often break off or erode away.

Carabelli's cusp is an extra cusp that occurs on the lingual surface of the mesiolingual cusp of the upper molars.[21] Although it has different degrees of expression, it appears to be under genetic control, and occurs with different frequencies in different modern populations.[22] In samples with advanced dental attrition on many individuals it can be difficult to score this trait accurately and the percentages reported may be misleading, or not directly comparable with other samples. For that reason, in the Lankhills 1967–72 sample only juveniles under the age of 20, who as a group had relatively little dental wear, were examined for this trait. It was found on the dm^2s of eight juveniles[23] as well as on the M^1s of eight individuals.[24] Two of these burials, LH 250 and LH 257, cut Feature 6 on the north side and were part of the group of burials oriented on that feature. LH 250, aged 17–19, could not be sexed skeletally, but the grave goods suggested a possible female.[25] LH 257 was an infant aged approximately nine months. The possibility of a family relationship, perhaps parent/child, cannot be completely excluded. One example of Carabelli's cusp was reported in the 2000–5 excavations.[26]

Victoria Road West and the other Winchester Romano-British cemeteries

Victoria Road West yielded a smaller sample of 871 adult teeth *in situ*, of which 533 were from males, and substantially fewer, 338, were from females. Overall there were 90 central incisors, 110 lateral incisors, 127 canines, 122 first premolars, 124 second premolars, 103 first molars, 115 second molars, and 80 third molars.

Caries, abscesses and ante mortem tooth loss (Tables 2.59–2.61)

The frequency of caries at Victoria Road West was very similar to that found in the Lankhills 1967–72 skeletons, in spite of the difference in sample size. Caries affected 12% of all teeth, again nearly equally distributed between males and females (11% males, 12% females). In both sexes, caries were somewhat more frequent in the maxillary dentition than in mandibular teeth, but the differences were not great. There was no consistent pattern by side in either sex, perhaps partially reflecting the relatively small sample sizes.

Like Lankhills 1967–72, at Victoria Road West the most commonly carious tooth was the first molar (29%), although the rate was equally high in the second molar for females. The same pattern of substantially lower caries frequency in the anterior dentition was also seen.

The occurrence of abscesses at Victoria Road West was similar to Lankhills 1967–72 in almost all respects. Overall abscess frequency was 4%, equally balanced between the sexes. Again there was a slight predominance of abscesses in maxillary sites, but no clear pattern of presence by side. The site of the first molar was most frequently abscessed (8%), and there was no clear progression of frequency from anterior to posterior dentition.

Whereas Victoria Road West paralleled the Lankhills 1967–72 pattern very closely with regard to caries and abscess frequency, the site

20 LH 90, 179, 308(2), 377, and 384.
21 Buikstra and Ubelaker 1994, 65.
22 Bass 1995, 296.
23 LH 90, 132, 154, 177, 179, 188, 257, and 290.
24 LH 90, 132, 136, 155, 164, 179, 250, and 377.
25 WS 3.ii, 57.
26 Clough and Boyle 2010, 399, Table 5.53.

TABLE 2.59

Frequency (TPR) of caries, adults, Victoria Road West

MALES	I1	I2	C	PM1	PM2	M1	M2	M3	TOTAL
MAXILLA, RIGHT									
No. observations	13	19	19	20	19	13	17	11	131
No. caries	0	0	1	2	1	4	5	1	14
% caries	0	0	5	10	5	31	29	9	11
MAXILLA, LEFT									
No. observations	18	16	21	18	18	13	14	10	128
No. caries	2	0	2	1	3	7	4	2	21
% caries	11	0	10	6	17	54	29	20	16
Total no. observ.	31	35	40	38	37	26	31	21	259
Total no. caries	2	0	3	3	4	11	9	3	35
Total % caries	7	0	8	8	11	42	29	14	14
MANDIBLE, RIGHT									
No. observations	12	17	19	20	20	16	15	15	134
No. caries	0	1	0	0	2	5	4	7	19
% caries	0	6	0	0	10	31	27	47	14
MANDIBLE, LEFT									
No. observations	15	16	19	19	22	19	18	12	140
No. caries	0	0	0	1	1	2	1	1	6
% caries	0	0	0	5	5	11	6	8	4
Total no. observ.	27	33	38	39	42	35	33	27	274
Total no. caries	0	1	0	1	3	7	5	8	25
Total % caries	**0**	**3**	**0**	**3**	**7**	**20**	**15**	**30**	**9**
TOTAL OBSERV.	58	68	78	77	79	61	64	48	533
TOTAL NO. CARIES	2	1	3	4	7	18	14	11	60
TOTAL % CARIES	**4**	**2**	**4**	**5**	**9**	**30**	**22**	**23**	**11**

FEMALES	I1	I2	C	PM1	PM2	M1	M2	M3	TOTAL
MAXILLA, RIGHT									
No. observations	8	12	12	11	14	12	12	7	88
No. caries	0	2	0	2	1	2	5	3	15
% caries	0	17	0	18	7	17	42	43	17
MAXILLA, LEFT									
No. observations	11	12	14	11	10	10	13	9	90
No. caries	0	0	1	0	1	1	4	4	11
% caries	0	0	7	0	10	10	31	44	12
Total no. observ.	19	24	26	22	24	22	25	16	178
Total no. caries	0	2	1	2	2	3	9	7	26
Total % caries	0	8	4	9	8	14	36	44	15
MANDIBLE, RIGHT									
No. observations	7	9	11	12	10	10	15	7	81
No. caries	1	0	0	0	0	4	4	0	9
% caries	14	0	0	0	0	40	27	0	11
MANDIBLE, LEFT									
No. observations	6	9	12	11	11	10	11	9	79
No. caries	0	0	1	1	1	5	2	0	10
% caries	0	0	8	9	9	50	18	0	13
Total no. observ.	13	18	23	23	21	20	26	16	160
Total no. caries	1	0	1	1	1	9	6	0	19
Total % caries	**8**	**0**	**4**	**4**	**5**	**45**	**23**	**0**	**12**
TOTAL OBSERV.	32	42	49	45	45	42	51	32	338
TOTAL NO. CARIES	1	2	2	3	3	12	15	7	45
TOTAL % CARIES	**3**	**5**	**4**	**7**	**7**	**29**	**29**	**22**	**12**
TOTAL NUMBER OF OBSERVATIONS, SEXES COMBINED	90	110	127	122	124	103	115	80	871
TOTAL NUMBER OF CARIES, SEXES COMBINED	3	3	5	7	10	30	29	18	105
TOTAL PERCENT CARIES, SEXES COMBINED	**3**	**3**	**4**	**6**	**8**	**29**	**25**	**23**	**12**

TABLE 2.60

Frequency (TPR) of abscesses, adults, Victoria Road West

MALES	I1	LI	C	PM1	PM2	M1	M2	M3	TOTAL	FEMALES	I1	I2	C	PM1	PM2	M1	M2	M3	TOTAL
MAXILLA, RIGHT										MAXILLA, RIGHT									
No. observations	25	24	24	25	25	25	24	23	195	No. observations	15	15	16	17	18	18	17	16	132
No. abscesses	0	1	2	3	1	3	5	0	15	No. abscesses	0	0	0	2	1	4	2	0	9
% abscesses	0	4	8	12	4	12	21	0	8	% abscesses	0	0	0	12	6	22	12	0	7
MAXILLA, LEFT										MAXILLA, LEFT									
No. observations	26	25	26	27	25	24	22	21	196	No. observations	15	16	16	16	16	15	15	15	124
No. abscesses	0	0	2	2	1	2	1	0	8	No. abscesses	0	1	0	0	0	1	0	1	3
% abscesses	0	0	8	7	4	8	5	0	4	% abscesses	0	6	0	0	0	7	0	7	2
No. observations	51	49	50	52	50	49	46	44	391	No. observations	30	31	32	33	34	33	32	31	256
No. abscesses	0	1	4	5	2	5	6	0	23	No. abscesses	0	1	0	2	1	5	2	1	12
% abscesses	0	2	8	10	4	10	13	0	6	% abscesses	0	3	0	6	3	15	6	3	5
MANDIBLE, RIGHT										MANDIBLE, RIGHT									
No. observations	23	23	24	24	24	24	24	24	190	No. observations	18	18	17	17	17	18	18	18	141
No. abscesses	0	1	1	0	0	1	1	0	4	No. abscesses	0	2	0	0	0	0	1	0	3
% abscesses	0	4	4	0	0	4	4	0	2	% abscesses	0	11	0	0	0	0	6	0	2
MANDIBLE, LEFT										MANDIBLE, LEFT									
No. observations	23	23	25	25	25	25	25	25	196	No. observations	19	19	19	17	17	18	18	17	144
No. abscesses	0	1	0	0	1	1	0	0	3	No. abscesses	1	3	0	1	0	1	0	0	6
% abscesses	0	4	0	0	4	4	0	0	2	% abscesses	5	16	0	6	0	6	0	0	4
No. observations	46	46	49	49	49	49	49	49	386	No. observations	37	37	36	34	34	36	36	35	285
No. abscesses	0	2	1	0	1	2	1	0	7	No. abscesses	1	5	0	1	0	1	1	0	9
% abscesses	0	4	2	0	2	4	2	0	2	% abscesses	3	14	0	3	0	3	3	0	3
Total no. observ.	97	95	99	101	99	98	95	93	777	Total no. observ.	67	68	68	67	68	69	68	66	541
Total no. abscess	0	3	5	5	3	7	7	0	30	Total no. abscess	1	6	0	3	1	6	3	1	21
Total % abscess	**0**	**3**	**5**	**5**	**3**	**7**	**7**	**0**	**4**	**Total % abscess**	**1**	**9**	**0**	**5**	**2**	**9**	**4**	**2**	**4**
TOTAL OBSERVATIONS, SEXES COMBINED											164	163	167	168	167	167	163	159	1318
TOTAL NO. ABSCESSES, SEXES COMBINED											1	9	5	8	4	13	10	1	51
TOTAL % ABSCESSES, SEXES COMBINED											**1**	**6**	**3**	**5**	**2**	**8**	**6**	**1**	**4**

TABLE 2.61

Frequency (TPR) of ante mortem tooth loss, adults, Victoria Road West

MALES	I1	I2	C	PM1	PM2	M1	M2	M3	TOTAL	FEMALES	I1	I2	C	PM1	PM2	M1	M2	M3	TOTAL
MAXILLA, RIGHT										MAXILLA, RIGHT									
No. observations	28	27	27	26	26	26	26	24	210	No. observations	19	20	20	21	20	20	19	19	158
No. AM loss	3	2	1	5	3	12	8	7	41	No. AM loss	1	1	2	4	5	7	7	4	31
% AM loss	11	7	4	19	12	46	31	29	20	% AM loss	5	5	10	19	25	35	37	21	20
MAXILLA, LEFT										MAXILLA, LEFT									
No. observations	28	27	27	28	27	26	24	23	210	No. observations	16	17	17	18	18	17	17	17	137
No. AM loss	4	4	3	4	5	12	9	9	50	No. AM loss	1	1	3	5	6	6	4	4	30
% AM loss	14	15	11	14	19	46	38	39	24	% AM loss	6	6	18	28	33	35	24	24	22
No. observations	56	54	54	54	53	52	50	47	420	No. observations	35	37	37	39	38	37	36	36	295
No. AM loss	7	6	4	9	8	24	17	16	91	No. AM loss	2	2	5	9	11	13	11	8	61
% AM loss	13	11	7	17	15	46	34	34	22	% AM loss	6	5	14	23	29	35	31	22	21
MANDIBLE, RIGHT										MANDIBLE, RIGHT									
No. observations	27	27	27	27	27	27	27	27	216	No. observations	17	18	18	18	17	18	18	18	142
No. AM loss	6	4	2	2	5	9	10	11	49	No. AM loss	4	2	1	2	5	7	3	3	27
% AM loss	22	15	7	7	19	33	37	41	23	% AM loss	24	11	6	11	29	39	17	17	19
MANDIBLE, LEFT										MANDIBLE, LEFT									
No. observations	27	27	27	27	27	27	27	27	216	No. observations	18	19	19	18	18	18	18	17	145
No. AM loss	5	4	2	2	4	7	9	10	43	No. AM loss	4	0	1	3	3	7	5	2	25
% AM loss	19	15	7	7	15	26	33	37	20	% AM loss	22	0	5	17	17	39	28	12	17
No. observations	54	54	54	54	54	54	54	54	432	No. observations	35	37	37	36	35	36	36	35	287
No. AM loss	11	8	4	4	9	16	19	21	92	No. AM loss	8	2	2	5	8	14	8	5	52
% AM loss	20	15	7	7	17	30	35	39	21	% AM loss	23	5	5	14	23	39	22	14	18
Total no. observ.	110	108	108	108	107	106	104	101	852	Total no. observ.	70	74	74	75	73	73	72	71	582
Total no. AM loss	18	14	8	13	17	40	36	37	183	Total no. AM loss	10	4	7	14	19	27	19	13	113
Total % AM loss	**16**	**13**	**7**	**12**	**16**	**38**	**35**	**37**	**22**	**Total % AM loss**	**14**	**5**	**10**	**19**	**26**	**37**	**26**	**18**	**19**
TOTAL OBSERVATIONS, SEXES COMBINED											180	182	182	183	180	179	176	172	1434
TOTAL NO. AM LOSS, SEXES COMBINED											28	18	15	27	36	67	55	50	296
TOTAL % AM LOSS, SEXES COMBINED											**16**	**10**	**8**	**15**	**20**	**37**	**31**	**29**	**21**

presented a very different picture of ante mortem tooth loss. This picture was almost entirely, but not completely, attributable to the much higher rates of ante mortem tooth loss seen in the Victoria Road West samples. A total of 21% of all tooth sites that could be examined at Victoria Road West showed evidence of ante mortem tooth loss. This was almost double the rate seen at Lankhills 1967–72. The frequency was slightly higher in males (22%) than in females (19%), but the differences are probably not statistically significant. In both sexes the maxilla was very slightly more often affected than the mandible, with no clear predominance by side. Overall, the site of the first molar was most affected (37%), with very similar percentages for both males and females. Canines were least subject to ante mortem loss (8%). While loss percentages were higher for all teeth than those seen in the Lankhills 1967–72 samples, there was still a marked difference between anterior (8–16%) and posterior dentition (20–37%). A considerably higher proportion of front teeth was lost ante mortem at Victoria Road West than at Lankhills 1967–72, raising a question as to possible causes for this finding.

As can be seen in Table 2.63, the frequency of caries varies at the other Winchester Romano-British cemeteries from 5.6% to 9.3%, well below the 12% seen at Lankhills 1967–72 and Victoria Road West. The Northern cemetery figures include a more recent study of the Victoria Road West skeletons.[27] As the largest site in the Northern cemetery sample, the numbers from Victoria Road West are driving the whole sample and must therefore be lower than the percentages found in the current study. There are several possible explanations for the large variation seen between the Lankhills and Victoria Road West caries percentages in the current study and those reported for the Lankhills 2000–5 and Northern cemetery samples. Differences in sample structure certainly play a part, as this study has incorporated only those individuals aged 20 or over, whereas the other studies have either used all permanent teeth or have defined adults as anyone aged 18 or more. This will have the effect of adding younger, healthier dentitions to the samples, consequently reducing the likelihood of caries and lowering the overall frequency. Further, it has been demonstrated that there is wide interobserver variability in scoring caries, with a strong bias towards missing lesions that actually exist.[28] In consequence, the apparent discrepancies in caries frequency between the various Winchester reports may primarily reflect differences in sample structure, methodology, and technique amongst different observers.

The data for abscess frequency in the Winchester samples are also quite variable, ranging from 0.9% in the Eastern cemetery to 4.8% in the Western cemeteries. However, all sites have in common the fact that the frequency of abscess is much lower than that for caries, generally only reaching levels that are one-third to one-half the frequency of caries.

With the exception of the Western cemeteries and Winchester 1967–72, ante mortem tooth loss is uniformly more frequent than caries. The greatest discrepancies are seen at the Northern cemetery (caries = 6.7%, ante mortem loss = 17%) and at Lankhills 2000–5 (caries = 5.9%, ante mortem loss = 15.4%). At least in the case of Lankhills 2000–5 these numbers may reflect the increasing deterioration in dental health one might expect to see in a sample with an older age profile.

Congenital absence, M3 (Table 2.62)

The total frequency of absent third molars in the Victoria Road West sample was identical to that of Lankhills: 15%. However, the distribution was markedly different, and may have been

[27] Browne 2012.

[28] Liebe-Harkort and Ástvaldsdóttir 2011.

TABLE 2.62
Congenital absence, M3, adults, Victoria Road West

	MAXILLA			MANDIBLE			SITE TOTAL
	R. M3	L. M3	TOTAL	R. M3	L. M3	TOTAL	
MALES							
No. observations	24	23	47	27	27	54	101
No. M3 absent	4	3	7	1	1	2	9
% absent	**17**	**13**	**15**	**4**	**4**	**4**	**9**
FEMALES							
No. observations	19	17	36	18	17	35	71
No. M3 absent	3	4	7	7	3	10	17
% absent	**16**	**24**	**19**	**39**	**18**	**29**	**24**
TOTAL NO. OBSERVATIONS	43	40	83	45	44	89	172
TOTAL NO. M3 ABSENT	7	7	14	8	4	12	26
TOTAL % ABSENT	**16**	**18**	**17**	**18**	**9**	**14**	**15**

affected by small sample size. Males appeared to lack third molars in 9% of all cases, while 24% of females were affected. In males, third molars were more frequently missing in the maxilla (15%), while in females the mandible was more frequently affected (29%). Again there was no consistent patterning by side.

Enamel hypoplasias

Enamel hypoplasias were not scored at Victoria Road West in this study. The frequency was, however, included in the figures for Winchester's Northern cemetery. Rates varied from 22.7% for the adults at Lankhills 2000–5 (34.8% for the subadults) to a high of 36% in Winchester's Eastern cemetery (see Table 2.64).

Comparison with other Romano-British sites

Table 2.63 contains the data on caries, abscess, ante mortem tooth loss, and M3 agenesis from seven Romano-British sites in addition to the Winchester cemeteries. The most notable aspect of the figures for caries was the great range of variation, from an overall low of 3.9% at Colchester,[29] to a high of 15.8% at Poundbury.[30] Trentholme Drive,[31] Cirencester,[32] Lankhills 2000–5 and Winchester's Eastern cemetery also had low caries rates, below 6%, while both Lankhills 1967–72 and Victoria Road West, at 12% overall, fell between Poundbury and Shepton Mallet.[33] The frequency of caries between males and females was equal at Poundbury, and very nearly so at most other sites except Shepton Mallet, where the rate for males was almost double that of females, and Lankhills 2000–5, where the rate for females was notably higher than that for males. At Lankhills 1967–72, Cannington,[34] and London East cemetery[35] males had slightly higher percentages than females, while at Victoria Road West, Colchester, Trentholme Drive, and Cirencester caries in females predominated slightly. However, given the many factors that can affect these numbers, for example different data collection methodologies, different demographic profiles or varying rates of attrition, the small gender differences seen in these sites probably have little significance. Data for caries frequency by gender were not available for Winchester's Northern, Eastern and Western cemeteries.

[29] Pinter-Bellows 1993, 79–85.
[30] Molleson 1993, 183.
[31] Warwick 1968, 190–208.
[32] Wells 1982, 146–50.
[33] Pinter-Bellows 2001, 273–9.
[34] Brothwell et al. 2000, 244–53.
[35] Barber and Bowsher 2000, 283–4.

TABLE 2.63
Frequency of dental pathology and M3 agenesis at selected Roman and Sub-Roman sites (%)

	Caries			Abscess			Ante Mortem Loss			M3 Agenesis		
	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total
Lankhills 1967–72	12.0	11.0	12.0	4.0	3.0	4.0	11.0	11.0	11.0	14.0	17.0	15.0
Lankhills 2000–5	4.7	7.5	5.9	na	na	1.5	na	na	15.4	na	na	11.8
Victoria Road West	11.0	12.0	12.0	4.0	4.0	4.0	22.0	19.0	21.0	9.0	24.0	15.0
Winchester N. cemetery	na	na	6.7	na	na	3.0	na	na	17.0	na	na	na
Winchester W. cemeteries	na	na	9.3	na	na	4.8	na	na	8.9	na	na	61*
Winchester E. cemetery	na	na	5.6	na	na	0.9	na	na	10.3	na	na	na
Poundbury	15.8	15.8	15.8	na	na	na	na	na	na	35.0	43.0	39.0
Cannington	8.4	5.4	6.7	4.3	4.2	4.3	15.3	17.6	16.6	na	na	10.1**
Shepton Mallett	15.2	7.9	10.7	1.8	1.6	1.7	9.2	12.5	10.4	na	na	na
Butt Rd. (P. 2) Colchester	3.8	3.9	3.9	0.8	0.5	0.7	13.0	8.0	10.7	na	na	na
London East cemetery	8.5	8.2	7.3	na	na	na	na	na	na	na	na	na
Trentholme Drive	4.3	5.2	4.5	na	na	<1.0	na	na	na	na	na	12.2
Cirencester	5.0	5.4	5.1	na	na	1.2	7.3	11.4	8.5	22.9	27.8	24.3

na = data not available
* = % individuals, not total M3's
** = % maximum number of individuals, not total M3's
Winchester Northern cemetery: Browne 2012, 222, Table 31
Winchester Western cemeteries: Browne 2012, 222, Table 31; 238, Table 53
Winchester Eastern cemetery: Browne 2012, 222, Table 31
Lankhills 2000–5: Clough and Boyle 2010, 395–398
Poundbury: Molleson 1993, 183
Cannington: Brothwell and Powers 2000, 244–253
Shepton Mallett: Pinter-Bellows 2001, 273–279
Colchester: Pinter-Bellows 1993, 79–85
London East cemetery: Barber and Bowsher 2000, 283–284
Trentholme Drive York: Warwick 1968, 190, 205–208
Cirencester: Wells 1982, 146–150

Rates of abscess were generally low, and varied relative to the degree of caries present. The figures ranged from less than 1% at Trentholme Drive and Colchester to 4.8% at Winchester's Western cemeteries. Rates for males and females were very similar where they could be documented.

Ante mortem tooth loss was more frequent at Victoria Road West (21%) than at any other site. All other sites ranged between a low of 8.5% at Cirencester and 17%, seen at Winchester's Northern cemetery. There was no consistency by gender.

Comparative data by tooth site on M3 agenesis were available from Poundbury, Trentholme Drive, and Cirencester in addition to Lankhills 1976–72, Lankhills 2000–5, and Victoria Road West. The rates at Poundbury were very high, especially for females (43%). The overall rate of 39% at Poundbury was over double that found at Lankhills and Victoria Road West (15%). At all the sites for which data were available by gender, the frequency of M3 agenesis was higher in females than in males, sometimes by a very large amount.

Enamel hypoplasias (LEH) were recorded at four other sites besides Lankhills and the other Winchester cemeteries (see Table 2.64). They manifested at rates varying between 23% of individuals at Shepton Mallet,[36] and 53.9% of individuals at Cannington.[37] Lankhills 1967–72, at 31.3%, fell midway between Poundbury at 38.5%[38] and Winchester's Northern cemetery at 25%.[39] The earlier phase of Lankhills 1967–72

[36] Pinter-Bellows 2001, 179.
[37] Brothwell et al. 2000, 253.
[38] Stuart-Macadam 1985, 394.
[39] Browne 2012, 222, Table 31.

TABLE 2.64
Enamel hypoplasias in selected Roman and Sub-Roman sites (%)

Site	Male	Female	Total
Lankhills 1967–72 Area W	39.4	29.6	35.0
Lankhills 1967–72 Areas F, E, O	37.8	17.7	28.2
Lankhills 1967–72	38.6	23.0	31.3
Lankhills 2000–5	na	na	22.7*
Winchester N. cemetery	na	na	25.0
Winchester E. cemetery	na	na	36.0
Poundbury	39.1	36.5	38.5
Cannington	38.3	57.5	53.9
Butt Rd. (P. 2) Colchester	na	na	27.2
Shepton Mallett	na	na	23.0

na = data not available
* Adults only. Subadults = 34.8
Lankhills 2000–5: Clough and Boyle 2010, 397
Winchester Northern cemetery: Browne 2012, 222, Table 31
Winchester Eastern cemetery: Browne 2012, 222, Table 31
Poundbury: Stuart-Macadam 1985, 394
Cannington: Brothwell and Powers 2000, 253
Colchester: Pinter-Bellows 1993, 88
Shepton Mallett: Pinter-Bellows 2001, 279

(Area W) at 35% in particular closely resembled Poundbury. At both Lankhills 1967–72 and Poundbury, the frequency of LEH was greater in males than in females. At Cannington, quite the reverse was true, by a margin of almost 20%. Data by gender were not available for the other sites.

iii. DISCUSSION

As will be seen from the data above, deriving consistent conclusions is an exercise fraught with difficulty for several reasons. Samples have different degrees of completeness and different age profiles, which must be taken into account. There is also variation in data collection methods, standards, and reporting. Therefore, only the most general conclusions will be attempted.

Of the 10 sites for which caries frequency by sex was available, males predominated in four, females predominated in four, and the sexes were evenly balanced, or very nearly so, in two (see Table 2.63). Thus there is no apparent factor affecting one sex more greatly on any consistent basis in these samples. The same general pattern is present in the more limited data on ante mortem tooth loss. Since ante mortem loss is often a consequence of caries, this finding might be expected. Of the five sites for which abscess data by sex are given, abscesses were more prevalent in males at four, while the sexes were evenly balanced only at Victoria Road West. Four sites provided data on M3 agenesis by sex. In each one M3 agenesis was more common in females than in males.

When the sites are considered as a group, the most notable aspect of caries frequency is its great variability, from a low of 3.9% at Colchester to 15.8% at Poundbury, a rate almost five times higher. Factors affecting this great range of variation are likely to include the sites' demographic profiles, their locations in either urban or rural environments, dietary patterns, and methods of data collection. Interestingly, the lowest levels of caries frequency represented in these sites (Colchester, Trentholme Drive, Cirencester) are approximately the same as the levels present in the Hampshire Early Anglo-

Saxons.[40] This may suggest some commonalities in eating patterns, and a lack of emphasis on foods with high sugar content at those sites, although these were known to be part of the Roman diet.[41]

In relation to all the sites considered here, the dental health of the Lankhills 1967–72 sample as reflected in rates of caries, abscess, and ante mortem tooth loss, falls within the range seen at Romano-British sites generally, although it is at the higher end of that range. Many individuals would have suffered greatly from their teeth. Particularly notable are the relatively high numbers of subadults exhibiting dental pathology. Figs and numerous grain species have been found at Winchester,[42] indicating that sugars and starches were readily available in this urban environment, which may partially explain the frequencies seen here.

The frequency of dental pathology provides evidence of localised (and potentially systemic) infection caused by bacterial action on the teeth and gums. The presence of LEH, on the other hand, can allow other inferences to be made regarding dietary deficiencies and illness, specifically those episodes occurring in childhood. At both Lankhills 1967–72 and Poundbury slightly more than one in three individuals exhibited enamel hypoplasias, and at Lankhills 1967–72 over 50% of affected individuals showed evidence of more than one episode. Winchester's Eastern cemetery closely paralleled Lankhills, but at the Northern cemetery the frequency of enamel hypoplasia was one in four, as was the case at Lankhills 2000–5.[43] At both Poundbury and Lankhills 1967–72 males were affected more frequently than females. Notably, at Cannington, which was both in a different geographic area and somewhat later chronologically, the pattern was reversed and enamel hypoplasias were more frequent in females, by a margin of over 19%, suggesting different underlying factors than those operating in the southern sites. Poundbury exhibited higher percentages than either Lankhills or the Winchester cemeteries of both caries and enamel hypoplasias, suggesting a population that was marginally less healthy. Molleson[44] attributed the poor oral health of the people at Poundbury to the diet of adults and the poor nutritional status of children while their teeth were developing. At Lankhills, while there may have been some differential access to resources, analysis of carbon and nitrogen isotopes from the 2000–5 excavations indicate that overall the population had access to multiple sources of animal protein and that they were generally adequately nourished.[45] Therefore, since systemic dietary deficiency did not appear to be a major factor at Lankhills, levels of LEH may reflect more generalized episodes of acute illnesses not normally detectable in bone, which the individuals nonetheless survived.

40 See below, pp. 238–42, Tables 3.34–3.36.

41 Moore and Corbett 1973, 141, cited in Clough and Boyle 2010, 395.

42 Green 2010, 338.

43 Clough and Boyle 2010, 398.

44 Molleson 1993, 184.

45 Clough and Boyle 2010, 400.

5
PATHOLOGY

i. INTRODUCTION

This chapter summarizes and discusses pathological conditions found in the Lankhills 1967–72 skeletons and listed individually in Chapter 7. Emphasis is placed on the types of pathology most relevant to interpreting activity levels and cultural practices, nutritional status, and disease loads. It is organized into six broad categories: trauma, arthritis, metabolic and deficiency diseases, inflammatory and infectious diseases, neoplasms and related lesions, and congenital and developmental anomalies. Where possible, comparisons of pathology particularly relevant for understanding workloads, nutrition, and health status have been made with the Lankhills 2000–5 excavations, the other Winchester Romano-British cemeteries considered as a group, and other Romano-British sites, primarily Poundbury, Cannington, Colchester, Cirencester, and Trentholme Drive, York.

The data presented in this chapter, and the inferences drawn from it, will surely be subject to future refinement and expansion. Certain types of pathology, for example mastoiditis, could benefit from more systematic, large-scale studies using radiology or CT scans. Analysis of the lead content in bone, which was beyond the scope of this study, would prove useful in developing a more complete picture of diet and nutritional status. Similarly, other biochemical studies such as stable carbon and nitrogen isotopic analysis could provide additional dietary information not otherwise obtainable regarding the consumption of meat, fish, and grains, as well as geographic place of origin. Some of this work has already begun, with positive results.[1] DNA studies might be helpful in further verifying or disproving some of the familial relationships suggested here.

The condition of many skeletons undoubtedly will have skewed the results of numerous observations, and for this reason attempts at quantification have been kept to a minimum. Fingers, toes, ribs, and vertebrae were either entirely absent or extremely fragmentary in a large proportion of burials. As a result, any pathology affecting those body parts was unquestionably under-represented. Extensive breakage, incomplete preservation, and erosion of bone surfaces created further observational challenges. Thus the findings described here should be considered provisional and subject to future reinterpretation in some areas. Nonetheless, they do provide some useful insights into the physical challenges experienced by the people of Lankhills 1967–72.

[1] Evans et al. 2006; Cummings and Hedges 2010; Chenery et al. 2010.

ii. TRAUMA

A trauma is any injury to bone or any other tissue resulting from an accidental or cultural act.[2] Accident-related trauma to bone includes fractures caused by tension, compression, torsion, flexion, or shearing of bone; crushing injuries; and wounds caused by pointed or edged weapons.[3] Pathological fractures may also occur, and are related to bone weakened by underlying disease processes. Culturally related trauma can involve alteration of bone shape or other forms of mutilation.

The traumatic pathology seen at Lankhills 1967–72 could be grouped into several categories: fractures, dislocation, myositis ossificans traumatica, and other trauma-related pathology such as amputation, decapitation, various bony prominences, and arthritic changes probably related to trauma. These categories are discussed in relation to age, sex, chronological placement within the cemetery, and grave furnishings as appropriate.

TABLE 2.65
Occurrence of fracture by bone, Lankhills 1967–72

Location	Males	Females	Total
SKULL			
Frontal bone	1	0	1
Orbit	1	0	1
Nasal bone	0	1	1
AXIAL SKELETON			
Clavicle, left	2	1	3
Clavicle, right	1	1	2
Ribs	4	0	4
Cervical vertebrae	1	0	1
Thoracic vertebrae	3	2	5
Lumbar vertebrae	2	1	3
APPENDICULAR SKELETON			
Radius, left	0	1	1
Femur	1	0	1
Tibia, left	2	0	2
Tibia, right	5	1	6
Fibula, left	2	0	2
Fibula, right	5	0	5
TOTAL	30	8	38

TABLE 2.66
Frequency of fracture by bone, Lankhills 1967–72

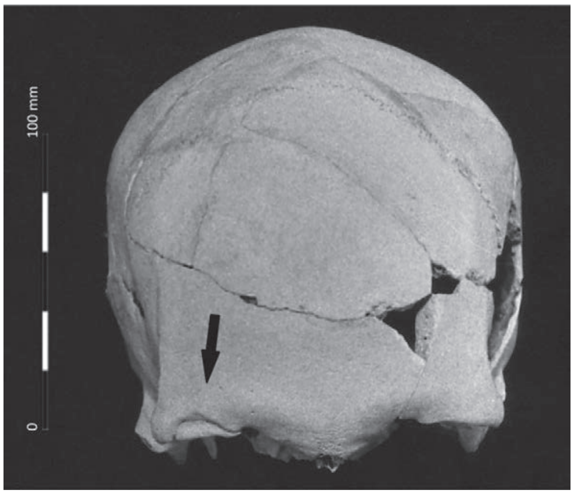
MALES	n/N	%	FEMALES	n/N	%
Skull, frontal	1/39	2.6	Skull, nasal	1/12	8.3
Skull, orbit	1/39	2.6			
Clavicle, left	2/55	3.6	Clavicle, left	1/36	2.8
Clavicle, right	1/55	1.8	Clavicle, right	1/36	2.8
Clavicle, total	3/110	2.7	Clavicle, total	2/72	2.8
Radius, left	1/25	4.0			
Femur, right	1/161	0.6			
Tibia, left	2/74	2.7			
Tibia, right	5/70	7.1	Tibia, right	1/49	2.0
Tibia, total	7/144	4.7			
Fibula, left	2/19	10.5			
Fibula, right	5/19	26.3			
Fibula, total	7/38	18.4			

Fracture

Out of 250 adult burials and one intrusive skull that could be sexed, 28 individuals were found to have fractures. This number represents 11.2% of the sample, which may well be low due to the fragmentary and incomplete nature of the material. In addition to the adults, only one fracture was found in a child (LH 294–2). No fractures were found in unsexed skeletons. Two other graves (LH 25 and LH 352) contained bones with possible old healed fractures, but the diagnosis was so uncertain that they have not been included here. Twenty of 128 adult males, representing 15.6% of the male sample, had at least one broken bone.[4] Six males had multiple broken bones.[5] Females exhibited a much lower frequency of fracture. Only eight individuals out of a sample of 122 adult females, or 6.6%, had at least one broken bone.[6]

[2] Zimmerman and Kelley 1982, 42.
[3] Ortner and Putschar 1981, 55.
[4] LH 8, LH 37, LH 47, LH 76, LH 161, LH 226, LH 227, LH 231, LH 261, LH 283, LH 291, LH 331, LH 349, LH 388, LH 399, LH 408, LH 410, LH 414, LH 442, and LH 447.
[5] LH 47, LH 261, LH 291, LH 349, LH 399, and LH 410.
[6] LH 45, LH 101, LH 119, LH 168, LH 171, LH 204, LH 212, and LH 272.

Illus. 2.26. Healed fracture of the left nasal bone. LH 119, female age 34–40.

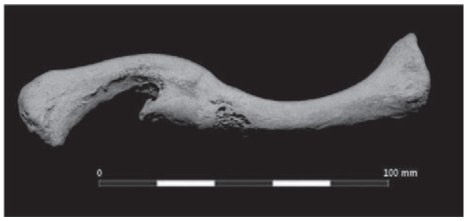


Illus. 2.27. Healed fracture of the superior border of the right orbit. LH 231, intrusive skull of a male, age 35–40.

Illus. 2.28. Severe incompletely healed intertrochanteric fracture of the neck of the right femur, with 90° shaft rotation posteriorly. LH 226, male age 30–35.

A total of 38 broken bones were examined (Table 2.65). Where the information could be determined, the percentages of fracture for individual bones tended to be quite low. However, the sample sizes in many cases were so small that these numbers should be treated with caution. For males, the overall frequency of lower leg bone fracture was approximately 7.8% of the adult male individuals.

The most commonly broken bones were tibiae, fibulae, clavicles, thoracic vertebrae, and ribs (Table 2.66). Arm bones were notable for their lack of fracture. Only one female, age 35–40 (LH 212), had a healed Colles' fracture of the wrist involving the left radius, probably caused by a fall. Similarly, there were very few skull injuries. One female (LH 119) had a healed nasal fracture. Two males had skull injuries. The



Illus. 2.29. Healed misaligned fracture of the right clavicle. LH 161, male age 25–30.

Illus. 2.30. Well-aligned healed fracture of the right tibia. LH 47, male age 35–40.

intrusive male skull in LH 231 exhibited a healed fracture of the superior border of the right orbit, while the male in LH 399 had a healed, depressed fracture at the centre of the frontal bone. This latter individual also had a well-aligned healed spiral fracture of the distal third of the left tibial shaft.

The right femur of the male in LH 226 was found to have a severe incompletely healed intertrochanteric fracture of the neck, with resulting shaft rotation (see Illus. 2.28). The number of fractures is presented in Table 2.65, while the percentage for each individual bone is presented in Table 2.66.

Chronologically, all the females with fractures were found in Area W, the earlier part of the cemetery. Males with fracture were more evenly divided, ten having been found in Area W,[7] and ten having been found in Areas F, E, O.[8] Since there were fewer burials overall in Areas F, E, O, this suggests that fracture among males may have been more common in these later phases of the site.

Six males had multiple fractures.[9] Two (LH 47, LH 261) were found in Area W, the other four belonging to the later phases of the cemetery. In Area W, the male in LH 47, an individual aged approximately 35–40, had suffered a well-aligned healed fracture of the right tibia and a compression fracture of the fifth lumbar vertebra. The male of the same age in LH 261 had healed fractures of the distal third of both the right tibia and fibula. In the later phase of the cemetery, LH 291 also had fractures of the distal right tibia and fibula.

The male in LH 349, aged over 35, was found to have healed fractures on four rib fragments (see Illus. 2.31), and a well-aligned healed fracture of the proximal right fibula. Extensive roughening and bony proliferative activity on

[7] LH 8, LH 37, LH 47, LH 76, LH 161, LH 226, LH 227, LH 231, LH 261, and LH 447.

[8] LH 283, LH 291, LH 331, LH 349, LH 388, LH 399, LH 408, LH 410, LH 414, and LH 442.

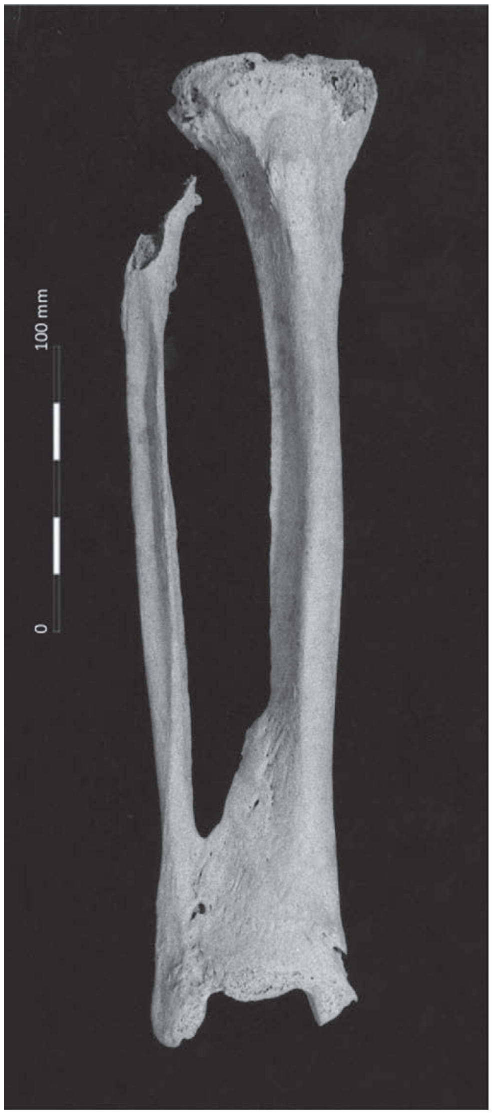
[9] LH 47, LH 261, LH 291, LH 349, LH 399, and LH 410.

Illus. 2.31. Fragments of four ribs with healed fractures. LH 349, male age 35+.

muscle and ligament attachments, especially in the legs, suggested a lifestyle placing great physical strain on the body generally, and on the lower extremities in particular. The individual in LH 399, discussed above, suffered a healed, depressed fracture of the frontal bone and a well-aligned healed spiral fracture of the distal third of the left tibia. Numerous other arthritic changes in his hips, the left side of his spine, and T7–10 which had caused ankylosis and kyphosis, may have been disease-related, possibly DISH (Diffuse Idiopathic Skeletal Hyperostosis), but certainly would have caused physical limitations and discomfort.

The individual in LH 410 suffered fractures of both ankles, described more fully in Chapter 7, The Catalogue of the Burials. This injury may have been caused by a fall or jump from a considerable height, which the man survived. Mild osteoarthritis was present in the hips and in the phalanges of the feet. In other pathology, his entire vertebral column except for a few cervical vertebrae was fused at the anterior right margins of the vertebral bodies, which may have represented DISH.

All the females with fractures were located in Area W, and none of them exhibited multiple fractures. Three females (LH 101, LH 168, and LH 272) had compression fractures of the vertebrae. All of these individuals were over 35 years old, and the individual in LH 101 was clearly over 45. The young female in LH 119



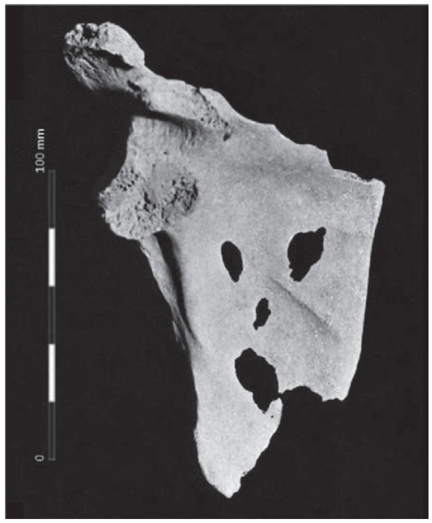
Illus. 2.32. Healed spiral fracture of the distal right tibia, with ankylosis to the fibula. The distal shaft has been displaced laterally, and has been overridden medially by the shaft above it. The right fibula was fractured proximally, suggesting that the foot was turned outward, so the line of the fracturing force commenced at the ankle medially, travelled up the leg, and exited at the proximal fibula fracture site laterally. LH 410, male age 30–35.

had broken her nose at some point prior to her death. Although still detectable, the break had healed.[10] While it is tempting to speculate that she had been hit by someone, a bad fall or bump might have been equally likely causes. Two women had broken their collar bones. The 25–35 year old female in LH 45 had fractured her left clavicle, which had healed, but was misaligned. In LH 171, a female aged 25–28 had a partially healed fracture of the right clavicle, indicating that the injury had occurred only a matter of weeks prior to her death. LH 272 was a double burial containing a middle-aged female and a ?male. The female, in addition to having considerable osteoarthritis, especially in the spine, had an extra, sixth, lumbar vertebra which exhibited a compression fracture. The two remaining fractures found among females were in long bones. The middle-aged female in LH 212 had broken her left radius, which had healed. The last female, a young woman aged 22–25 in LH 204, had a poorly aligned, healed fracture of her lower right tibia.[11]

Only one child showed signs of fracture, a two-year old infant buried with an older child in LH 294. These skeletons were very fragmentary and the tibiae on both children exhibited abnormal degrees of curvature. The diagnosis proposed initially was rickets, but further radiographic studies suggested that the two-year old in fact had a healed traumatic bowing fracture,[12] although rickets may remain a better explanation for the deformities seen in the older child.

Dislocation

Several joints are fairly subject to dislocation. In the case of joints that become chronically dislocated, or where reduction is delayed by several weeks or more, changes to the bones of the joint may be detectable.[13]



Illus. 2.33. Dislocation of the right shoulder creating a new articular facet immediately anterior and inferior to the glenoid fossa of the scapula. LH 389, adult age 30–35.

Only one probable dislocation was observed in the Lankhills 1967–72 material. LH 389 (see Illus. 2.33) contained an adult of indeterminate sex, aged 30–35, buried in Areas F, E, O without grave goods. The right shoulder had been dislocated for some time towards the front and slightly below its normal position, creating a new articular facet for the humerus on the scapula immediately anterior and inferior to the glenoid fossa.

Myositis Ossificans Traumatica

Diverse bony prominences and sharp bone spurs suggesting a possible origin in traumatic injury were seen in many Lankhills 1967–72 skeletons, and are individually described in Chapter 7. This section reviews only pathology that can be almost certainly or reasonably attributed to myositis ossificans traumatica.

Myositis ossificans traumatica is a condition in which proliferative ossification of soft tissue adjacent to bone takes place during healing

[10] See Illus. 2.26.
[11] See Illus. 2.57a, b.
[12] cf. Stuart-Macadam et al. 1998.
[13] Zimmerman and Kelley 1982, 49.

Illus. 2.34. Myositis ossificans traumatica: (a) humerus at mid-shaft over the deltoid tuberosity. LH 94, male age 40–50; (b) on the posterior distal third of the right femoral shaft. LH 374, female age 28–30.

following a traumatic injury. It is often characterized by flat, bony projections with fairly sharp edges.[14] Myositis ossificans traumatica is found most frequently in the distal humerus, medial and lateral aspects of the proximal and distal femur, and along the linea aspera, although it can occur in other locations as well.[15]

Six individuals in Lankhills 1967–72 clearly

[14] Ortner and Putschar 1981, 322.

[15] Zimmerman and Kelley 1982, 49.

appeared to exhibit myositis ossificans traumatica.[16] Of these individuals, three were male, two were female, and one could not be sexed. The three males and one female were located in Area W. The remaining female and the unsexed skeleton were found in Areas F, E, O. All the males exhibiting pathology most confidently identified as myositis ossificans traumatica (LH 94, LH 150, and LH 447) were over 40 years old and generally had other pathology as well. The two females (LH 272 and LH 374) may have been in their 30s and, like the males, exhibited other pathology.

Other trauma-related pathology

One possible case of osteochondritis dissecans was found at Lankhills 1967–72. This condition is an ischemic necrosis probably caused by trauma, although there may be a genetic factor as well. It most frequently affects males between the ages of 15 and 25, and is usually found in the knee, hip, elbow, or ankle joints.[17] A deformity of the distal right humerus may indicate that this condition was present in the elbow joint of a young male (LH 20) aged 21–25 who had been buried in Area W. However, there remains the possibility that this defect may instead have been due to the dislocation of the joint.

Possible ossified haematomata were found on two individuals in area W. Both were males over the age of 35. In the case of the individual in LH 47, the ossified haematoma was located on the left femur. The 35–40 year old male in LH 76 showed a probable ossified haematoma on the mastoid process, which may have been caused by a blow to the head.

Amputation

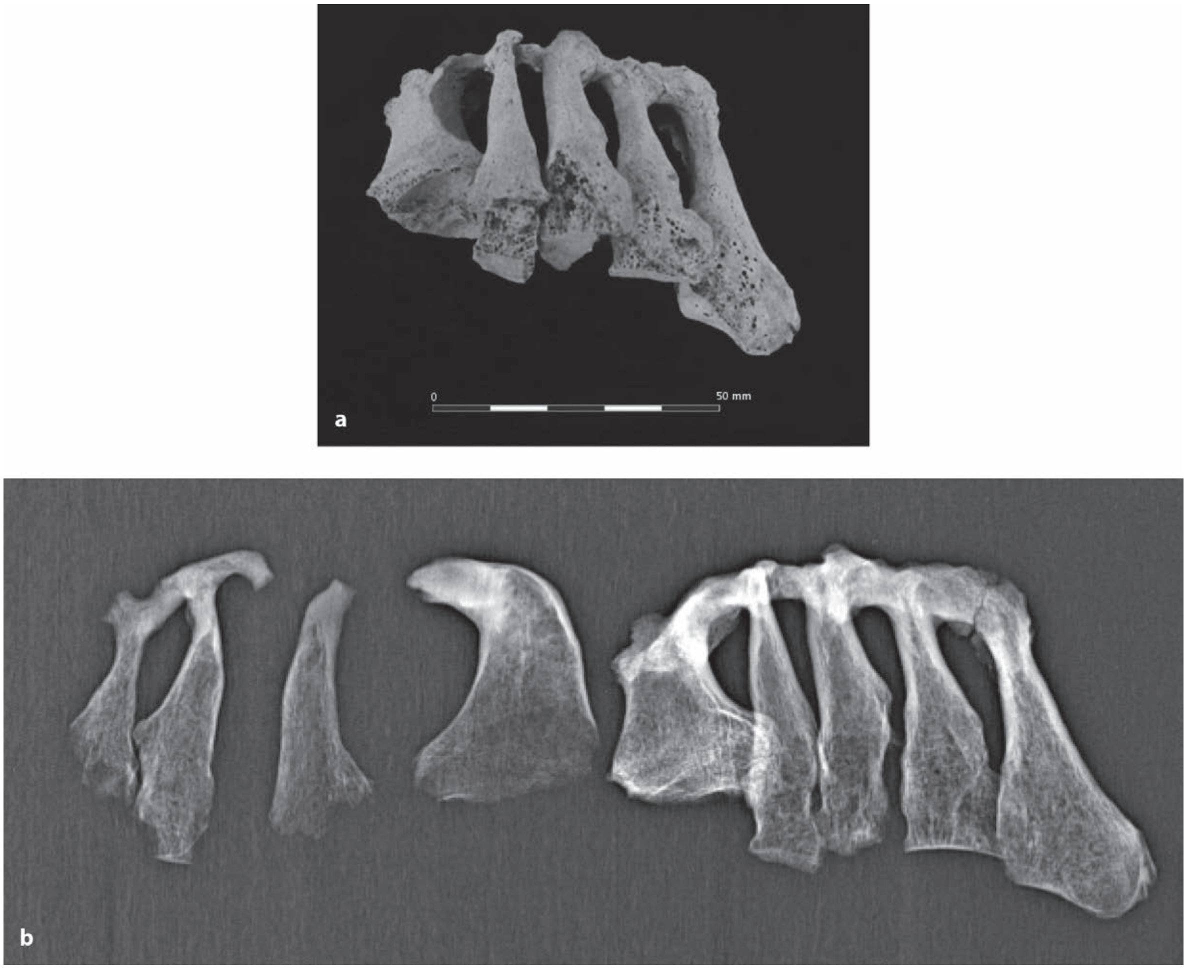
Two amputations were found in the Lankhills 1967–72 skeletons, one involving the feet of LH 299, and the other involving fingers on the left hand of LH 427. They are described in more detail below.

Illus. 2.35. A possible case of osteochondritis dessicans in the distal right humerus, shown on the left. LH 20, male age 21–25. A normal humerus is seen on the right for comparison.

LH 299: a bilateral transmetatarsal amputation[18] (Illus. 2.36).

LH 299 contained a male aged at least 35–40, buried supine in the latest part of the cemetery and dated to approximately 390–410. An uncoffined burial, the grave goods consisted of a single flagon.[19] The metatarsals of both feet appeared severed by a transmetatarsal amputation of the distal portion of the shafts, immediately proximal to the metatarsophalangeal joints. Upon x-ray, no cortical irregularity or periosteal reaction was seen along the metatarsal shafts. New cortical bone obliterating the underlying marrow space was present at the distal tips of the metatarsals, suggesting healing. Heterotopic ossification and possibly periosteal bone was seen between the metatarsals, fusing the distal aspect of all the metatarsals and forming an arcade configuration. Osteopoenia appeared to be present in all the surviving foot bones, more

[16] LH 94, LH 150, LH 272, LH 374, LH 388, and LH 447.
[17] Zimmerman and Kelley 1982, 70–1.
[18] See also Stuckert and Kricun 2011.
[19] WS 3.ii, 63.



Illus. 2.36. Transmetatarsal amputation of the right forefoot: (a) with bony fusion of the distal metatarsals; (b) radiograph of the metatarsals on both feet. The fifth metatarsal of the left foot has been omitted. LH 299, male at least 35–40.

so on the left than the right. This may suggest that the left foot was amputated earlier than the right, or that some underlying pathology may have caused decreased mobility on the left, resulting in a greater degree of disuse osteopoenia. The bony fusion of the right metatarsals has survived intact, but post mortem breakage has caused separation of the distal synostoses on the left. Other skeletal abnormalities were observed, and are described more fully in Chapter 7, the Catalogue of the Burials. These included the osteopoenia referred to above, as well as osteoarthritis in the joints, probable DISH (diffuse idiopathic skeletal hyperostosis) in the spine,[20] and ankylosis of the sacrum to the pelvis on the right side.

The reason for these double forefoot amputations remains obscure. Numerous causes were considered and rejected, including accident, interpersonal conflict, or underlying medical conditions such as leprosy, diabetes mellitus, or frostbite.[21] The most likely causes were either surgery necessitated by trench foot or the punitive amputation of healthy feet, although

[20] See Illus. 2.43.

[21] Stuckert and Kricun 2011, 115.

it is impossible to reach a firm conclusion. The male in LH 299 died of an unknown cause unrelated to these amputations.

Illus. 2.37. Palmar surface of the left hand, showing well-healed amputation of the proximal phalanx of the second metacarpal and the medial phalanx of the fifth metacarpal. LH 427, male age 25–28.

LH 427: Amputation of digits of the left hand, *by Katie Tucker*

During the re-analysis of one of the decapitated individuals from the 1967–72 excavations, the adult male in LH 427, well healed amputations of the proximal phalanx for the second left metacarpal and of the medial phalanx for the fifth left metacarpal were identified (Illus. 2.37). The amputation of the proximal phalanx had occurred at the distal end of the shaft and the element was slightly atrophied, with the distal end terminating in a roughened sclerotic mass of bone. The amputation of the medial phalanx had occurred at the proximal end of the shaft with the stump being slightly tapered and sclerotic in appearance. There was associated atrophy of the proximal phalanx.

Ante mortem amputations are rare in the archaeological record, although two adult males from the Lankhills 2000–5 excavations also demonstrated manual digit amputations[22] and there was an individual from the 1967–72 excavations with bilateral amputation of the distal parts of the feet.[23] Digit amputations were also recorded in two adult male Romano-British skeletons from Horcott Quarry, Gloucestershire,[24] and a single adult male from Kempston, Bedfordshire,[25] whilst osteological analysis undertaken by the author as part of doctoral research identified an amputation of part of the fifth digit of another adult male, and part of a distal hand phalanx of an adult female from Dunstable, Bedfordshire. It is interesting that all but one of these digit amputations were recorded in adult males. There are references to individuals seeking to avoid military service by amputating their fingers,[26] or, in one case, a father amputating the fingers of his sons to prevent them from becoming liable for conscription,[27] although there is also the possibility that the amputations could have occurred as a result of accidents or interpersonal violence.

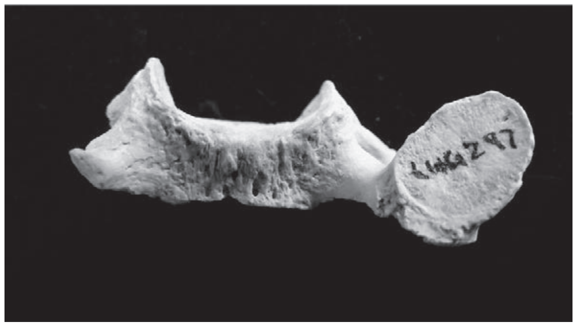
[22] Clough and Boyle 2010, 368.
[23] See above, pp. 98–100, 190–1.
[24] Clough, n.d.
[25] Boyleston and Roberts 2004, 342.
[26] Pharr 1952, *Cod. Theod.* VII. 13. 4,10.
[27] Hurley 2011.

The physical evidence for decapitation from Lankhills, by Katie Tucker

1967–1972 Excavations

LH 120.[28] The skeleton was supine and extended, with the lower limbs bent to the left at the hip and the upper limbs straight by the sides. The cranium, mandible, and C1–C3 were found beyond the feet with the cranium on its crown, possibly facing to the right. The skeleton was contained in a wooden coffin and there were hobnails at the feet. C1, C2 and all of the arches from C3–C7 were present. The current analysis identified the individual as a Young Child of 1–3 years. Watt did not see any evidence for decapitation on the surviving elements.[29] However, in this analysis a perimortem chop through the left pedicle of C3 was recorded that removed the inferior portion of the pedicle. A chop is a cut essentially perpendicular to the cut surface. It is distinguished by having a length much greater than its width and often presents with striations running parallel to the short axis of the cut surface, presumed to be produced by blades with defects in their cutting edge.[30] Chops are produced by a chopping action, as occurs with, for example, machetes and axes. The chop was horizontal and did not affect the rest of the arch or C4. It was not possible to tell the direction of the cut. It would appear that the head was removed with this single chop.

LH 297 (Illus. 2.38). The skeleton was prone with the lower limbs slightly flexed at the knee, the right upper limb under the body and the left tightly flexed at the elbow with the hand under the right shoulder. The cranium and mandible were found on the right shoulder facing to the left of the grave and the vertebral column was not connected to the cranium. It was not possible from the records to tell which vertebrae were found with the cranium and mandible. The skeleton had hobnails between the femora and distal lower limbs, and a bone comb on the left shoulder. C1, part of C3, and C4–C7 were present. This burial was not regarded as a decapitation during excavation but was identified from osteological evidence during the author's current research. The present analysis identified the individual as a Young Middle Adult (26–35 years) female. C4 exhibited a single perimortem chop through the arch and body from a posterior-anterior direction. It did not totally bisect the element, leaving the left side of the arch unaffected by the cut, but demonstrating perimortem fracturing of the pedicle. The right clavicle also exhibited two small perimortem chops into the superior surface of the acromial end. It appears that the head was not entirely removed by the chop through C4, and the cuts to the clavicle may represent attempts to cut through any remaining soft tissue in order to completely remove the head, which was presumably also accomplished by breaking the neck through C4.



Illus. 2.38. Chop through body and arch of vertebra C4. LH 297, decapitated female, age 20–25 (aged 26–35 by Tucker, see this page).

LH 302. Only one end of the grave was excavated, and only the cranium, mandible, and two cervical vertebrae were recovered, making it impossible to determine what relationship they

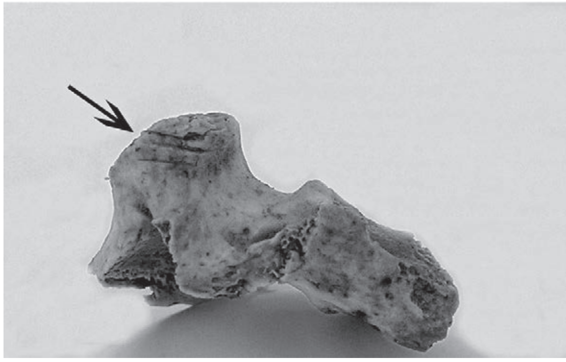
[28] See Association D below, pp. 159–60, 181, and Illus. 2.62.

[29] Watt 1979, 343.

[30] Wakely 1997, 32; Loe 2009, 273.

had to the rest of the body in the grave. The cranium was facing to the left and C1 and C5 were the only vertebrae present. This burial was not recovered during the main cemetery excavations but came from an associated rescue excavation in 1970 which was not included in the original publication. The present analysis identified the individual as an adult male. There was a perimortem chop through C1 and the right ascending ramus of the mandible and a perimortem fracture of the left ascending ramus that align if the neck had been flexed. The chop was possibly made from a posterior-anterior direction. This may suggest that decapitation had been the manner of death, which may be supported by the presence of a perimortem chop through the right maxilla and left mandibular body from an anterior-posterior direction that was sharply angled right-superior to left-inferior. This could have been an incapacitating blow or a failed decapitation attempt in a moving victim.

LH 348.[31] The skeleton was supine, with the lower limbs flexed at the knee and the upper limbs slightly flexed at the elbow. The hands were on the pelvis. The cranium, mandible and C1–C2 were found by the right knee, with the cranium on its crown facing the head end of the grave. C1, C2, and parts of C3–C7 were present. Watt did not find any evidence for decapitation on this individual as the remains examined, including a C2, did not actually belong to the main individual, which was missing at the time of his analysis.[32] During the author's current research the skeleton was relocated in the archive, commingled with a separate individual, which was confirmed by matching the original site photograph and identification of osteological evidence for decapitation. The present analysis identified the individual as an Older Child/Adolescent of 12–15 years. There were a

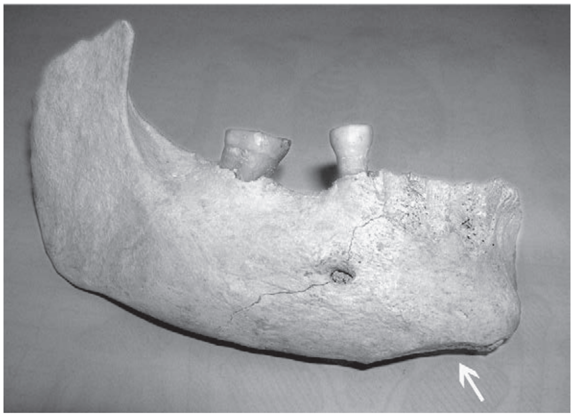


Illus. 2.39. Incised cuts to the right superior facet of vertebra C4. LH 348, decapitated adolescent, age 12–15.

total of seven separate incised perimortem cuts to the anterior aspect of the left and right superior articular processes of C4 and the left inferior articular process of C3. The cuts were angled left-superior to right-inferior on the left arch and right-superior to left-inferior on the right arch, and came from an anterior-posterior direction. Incised cuts are distinguished by their narrow and fine appearance, with striations often present running parallel to the long axis of the cut. They are produced by drawing a sharp blade across a surface—in this case of a bone—rather than through it, and are commonly produced by knives.[33] The cuts on LH 348 seem to be related to removal of the connective tissue at the intervertebral articular joints and suggest a careful disarticulation of the head from the majority of the cervical column once the musculature and connective tissue had been cut through.[34]

LH 379.[35] The skeleton was supine, with the lower limbs flexed at the knee and the left distal lower limb crossed over the right. The right upper limb was straight. The left was flexed at the elbow with the hand on the right elbow. The cranium and mandible were upright and facing to the left. C1–C3 and part of C4 were

[31] See Association G below, pp. 163–4, 193, and Illus. 2.65.
[32] Watt 1979, 343.
[33] Smith and Brickley 2004, 20, 22; Homes Hogue 2006.
[34] See Appendix D, Glossary, p. 445.
[35] See Association H below, pp. 164–5, 195, and Illus. 2.66.



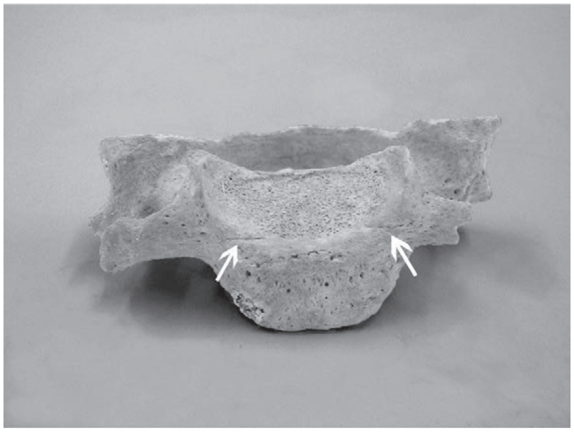
Illus. 2.40. Chop through the inferior border of the mandible. LH 379, decapitated female age 40–45 (aged 26–35 by Tucker, see below and p. 164).

found to the left of the left knee. There were hobnails around the feet. C1–C4 and C6–C7 were present. The individual was identified as a Young Middle Adult (26–35 years) female. Watt recorded decapitation trauma affecting the mandible and C3.[36] At the present analysis, a perimortem chop was recorded through the inferior arch of C3 and the superior body of C4 that could not be assigned a direction due to post mortem degradation. There was a second perimortem chop through the inferior body, left pedicle and into the anterior of the left inferior facet of C4 that also cut through the inferior margin of the mandible from an antero-posterior direction. It is possible that neither of these cuts completely severed the neck, as the spinous processes of C5 and C6 seem to demonstrate perimortem fractures, suggesting the head may have finally been snapped off posteriorly.

LH 427.[37] The skeleton was supine and extended, with the left upper limb straight and the right upper limb flexed at the elbow, with the hand on the left side of the pelvis. The cranium, mandible, and C1–C3 were found by the right knee. The cranium was on its crown facing the head end of the grave. A coin was found in the mouth of the severed head. C1–C3 were present but C4–T2 were missing, although they were recorded as present on the original grave plan. The present analysis identified the individual as a Young Middle Adult (26–35 years) male. Watt recorded four areas of decapitation trauma to C3.[38] This analysis largely confirms those findings, with five separate incised perimortem cuts being identified on the anterior and inferior aspects of the neural arch and left inferior facet of C3, all of which were angled right-superior to left-inferior, and came from an antero-posterior direction. These seem to relate to careful severing of the connective tissue and musculature of the neck to allow the head to be removed, although the absence of C4–T2 precludes the possibility of identifying further cuts.

LH 441.[39] The skeleton was prone and extended, with upper limbs straight and with the left hand in front of the left femur. The right hand was behind the right femur. The lower limbs were slightly apart with the cranium, mandible, and C1–C3 placed between the distal lower limbs. The cranium was face down with the face pointing towards the foot end of the grave. C1–C7 were present. The current analysis identified the individual as an Old Middle Adult (36–45 years) female. Watt found decapitation trauma on the arch of C4.[40] When reexamined in the current study, a perimortem chop was identified through the arch of C4 from a postero-anterior direction. It aligns with a chop into the arch of C5 from a postero-anterior direction if the head was held in extension. This appears to have been the main decapitating blow, although perimortem chops through the spinous processes of C3 and C4 from a supero-inferior direction suggest additional blows were necessary to completely sever the head.

[36] Watt 1979, 343.
[37] See Association A below, pp. 154–6, 198, and Illus. 2.59.
[38] Watt 1979, 343.
[39] See Association C below, pp. 157–9, 198–9, and Illus. 2.61.
[40] Watt 1979, 344.



Illus. 2.41. Incised cuts into the anterior body of vertebra C5. LH 445, decapitated female age 30–35.

LH 445.[41] The skeleton was slightly on its right side and tightly compressed, with the right upper limb straight and the left flexed at the elbow. Both hands were together on the right side of the abdomen. The cranium, mandible, C1–C2 and possibly C3 were found on the right femur, with the cranium on its crown facing towards the foot end of the grave. C1–C3, part of C4, and C5–C7 were present. This analysis identified the individual as a Middle Adult (26–45 years) female. Watt recorded decapitation trauma to the body of C4.[42] The current study found a perimortem incised cut on the anterior aspect of the body of C5, which was angled slightly right-inferior to left-superior and came from an antero-posterior direction (Illus. 2.41). Two perimortem chops were also identified, one from an antero-posterior direction that passed through the inferior body and right inferior articular facet of C3, and one that cut into the anterior aspect of the right superior articular process of C4 from the antero-posterior direction. The incised cut seems to relate to a cutting of the throat at the level of C5, with the decapitating chopping blows being directed at C3 and C4.

LH 451.[43] The skeleton was prone and extended, with the lower limbs apart and the upper limbs behind the back. Both upper limbs were flexed at the elbow with the distal upper limbs parallel across the right side of the lower back and the right shoulder raised. The cranium, mandible, and C1–C4 were between the femora, with the cranium upright and facing the right knee. The skeleton was probably within a coffin. C1–C4 were present. The present analysis identified the individual as an unsexed adult. Watt found no evidence for decapitation on any of the surviving elements,[44] and this was confirmed in the current study. As C1–C4 were present with the cranium and mandible, it is probably to be assumed that decapitation occurred at the level of C5.

2000–2005 Excavations

OA 110 (SK 118).[45] The skeleton was supine and extended, with the left upper limb and lower limbs straight, the right upper limb being disturbed. The cranium and mandible with some cervical vertebrae were found on the distal lower limbs and feet, facing the head end of the grave.[46] The skeleton was within a coffin. Two bone bracelets, a copper alloy bracelet, and a string of twenty-six beads (twenty-five of glass and one of amber) were found on the torso.[47] Parts of C1 and C3–C7 were present. The present analysis classified the individual as a Young Child (1–2 years). Oxford Archaeology did not identify any evidence for decapitation on the surviving elements, but this study found five perimortem incised cuts, three of which were very shallow parallel cuts to the posterior surface of the left arch of C1, made from the posterior left. There was also a cut that removed the superior surface of the right superior facet of C4. The cut was angled left-inferior to right-superior but it was

[41] See Association C below, pp. 157–9, 199, and Illus. 2.61.
[42] Watt 1979, 344.
[43] See Association B below, pp. 156–7, 199, and Illus. 2.60.
[44] Watt 1979, 344.
[45] See Association K below, p. 167.
[46] Booth et al. 2010, 45.
[47] ibid. 70–1.

not possible to assign a direction. A cut into the left side of the left superior facet of C5 was angled right-superior to left-inferior and was directed from the posterior left. The cuts would seem to relate to careful severing of the connective tissue and musculature of the neck in order to remove the head.

OA 1150 (SK 1084).[48] The skeleton was supine and extended, with the upper and lower limbs straight. The cranium, mandible, and C1–C3 were found between the femora and were face down.[49] The skeleton was within a coffin with flint packing stones around the edges of the grave. A coin was found in the chest area.[50] C1–C3, C6, and parts of C4–C5 and C7 were present. The current analysis classified the individual as a Young Middle Adult (26–35) female. Oxford Archaeology identified a diagonal cut on the body of C5.[51] The present analysis found a single chop that affected the left arch of C4 inferior to the superior facets. It chopped through the body of C5 and into the superior surface of the body of C6, and was angled sharply left-superior to right-inferior. It came from the posterior left. The head must have been tilted right when the blow was delivered.

OA 1329 (SK 1289).[52] The skeleton was supine and extended, with the upper limbs flexed at the elbow and the hands placed on the pelvis with the left wrist crossed over the right. The cranium, mandible, and C1–C2 were found between the ankles facing the foot end of the grave.[53] The skeleton was in a coffin and there were hobnails at the feet.[54] C1 and C2 were present. The present analysis classified the individual as an Old Middle Adult (36–45) male. Oxford Archaeology did not identify any evidence for decapitation on any of the surviving elements. The present analysis found three chops to the inferior border of the right mandibular body with some peeling of the bone and 'skimming' of the blade. The blows were directed from the posterior and inferior right, and the blade nicked into the bone on the anterior margin of the chop marks.

OA 1515 (SK 1517).[55] The skeleton was supine with the upper right limb straight. The upper left limb was flexed at the elbow with the hand under the right distal upper limb. The lower limbs were tightly flexed at the hip and knee and turned to the right. The cranium and mandible were found between the feet. The grave had been truncated slightly at the foot and head ends by other graves.[56] C1–C5 were originally present. The current analysis classified the individual as an Old Middle Adult (36–45) male. Oxford Archaeology identified cuts to the arch of C3 and the body of C5.[57] C3, present and originally misidentified as C4, had no evidence of perimortem trauma. The proper C4 and C5, missing but well illustrated photographically, apparently sustained a single posterior chop through the left interior facet of C4 and the arch and body of C5.[58]

SK 2064. This skeleton was identified during post-excavation analysis of the disarticulated material associated with OA 1735 and OA 1738, and was classified as a child of 4–6 years.[59] A cut to the anterior and inferior surface of the mandible was found.[60] The present analysis identified this cut as being post mortem, as the broken edges and surfaces of the bone were rough and paler than the surrounding bone, and there was also chalky soil smeared across the surfaces of the 'cut'. This suggests that the damage was actually caused when the remains were excavated.

In summary, thirteen decapitation burials

[48] See Association J below, pp. 165–6, and Illus. 2.67.
[49] Booth et al. 2010, 157.
[50] ibid. 158.
[51] ibid. 369.
[52] See Association E below, p. 160, and Illus. 2.63.
[53] Booth et al. 2010, 44.
[54] ibid. 175.
[55] See Association F below, pp. 161–3, and Illus. 2.64.
[56] Booth et al. 2010, 199–200.
[57] ibid. 369.
[58] ibid.
[59] ibid.
[60] ibid.

were identified during the present research, nine of which were from the 1967–72 excavations and four of which were from those undertaken between 2000 and 2005. Seven of the decapitations from the 1967–72 excavations had been previously recorded in Winchester Studies 3.ii, with osteological evidence for decapitation being recorded by Watt on four of those individuals.[61] Of the five decapitations recorded by Oxford Archaeology,[62] one was identified during the present analysis as demonstrating post mortem damage rather than perimortem decapitation. Of the remaining four individuals, Oxford Archaeology identified osteological evidence for decapitation on two individuals.[63] The present analysis identified osteological evidence for decapitation on all of the thirteen burials with the exception of LH 451, for which it was only possible to say that the decapitation probably occurred at the level of C5, and OA 1515, whose cut-marked vertebrae were not available for analysis.

Of the twelve individuals where cut marks were recorded, three individuals (OA 110, LH 348, and LH 427) demonstrated incised cuts, eight demonstrated chopping cuts,[64] whilst only one (LH 445) displayed both types of cut. The number of cuts varied from one in the cases of LH 120, OA 1150, and OA 1515, to five in the cases of OA 110 and LH 427, and seven in the case of LH 348, with two or three blows being most common and seen in six individuals.[65] The blows were directed to the posterior of the neck in seven individuals,[66] and to the anterior of the neck in four individuals,[67] whilst the direction of the blow could not be determined for one individual (LH 120). From the osteological evidence, it could be suggested that decapitation may have been the mechanism of death in the case of six individuals based on the postero-anterior direction of the blows,[68] their chopping nature, and the head position when the blows occurred. The cut throat is assumed to have been the mechanism of death in the case of LH 445. The incised cuts to the vertebrae of OA 110, LH 348, and LH 427, and the probable careful disarticulation of the head, would suggest that the process occurred once the individuals were already dead. For the remaining four individuals, including LH 451 where no osteological evidence was recorded, the nature of the evidence does not permit any conclusions to be drawn about the nature of their decapitation.

iii. ARTHRITIS

Arthritis is a general term for a complex of diseases located in and around the joints, and is probably the single most frequently found pathological condition in skeletal samples. Degenerative arthritis, called osteoarthritis, is not an inflammatory reaction, but rather involves cartilaginous deterioration with formation of new bone at the surface of diarthrodial joints, most commonly those bearing weight.[69] The most common form of arthritis, it appears to be related to biological ageing and physiological stress levels. In advanced cases considerable bone deformity may be evident, although ankylosis of the joints is very rare.[70]

In the Lankhills 1967–72 skeletal material there were six cases of osteoarthritis related to

[61] Watt 1979.

[62] Booth et al. 2010.

[63] ibid.

[64] LH 120, LH 297, LH 302, LH 379, LH 441, OA 1150, OA 1329, and OA 1515.

[65] LH 297, LH 302, LH 379, LH 441, LH 445, and OA 1329.

[66] OA 110, LH 297, LH 302, LH 441, OA 1150, OA 1329, and OA 1515.

[67] LH 348, LH 379, LH 427, and LH 445.

[68] LH 297, LH 302, LH 441, LH 445, OA 1150 and OA 1515.

[69] See Appendix D, Glossary, pp. 443–4, for a more extended discussion.

[70] Steinbock 1976, 284.

trauma, and two cases of osteoarthritis secondary to other pathology. All other examples involved either degenerative changes to the spine or osteoarthritis of the joints. No cases of rheumatoid arthritis were noted, nor were any examples of gout or pseudogout seen. All findings, however, must remain tentative since many skeletons were in poor condition and the resulting samples were small. This was especially true regarding analysis of the spine, which yielded a sample of only 47 individuals. For reasons that are not clear, in many graves the axial skeleton had almost totally decayed or was very fragmentary, while the bones of the appendicular skeleton remained intact and in better condition.

Traumatic osteoarthritis

Of the six individuals with osteoarthritis related to trauma, three (LH 218, LH 226, and LH 249) were located in Area W, while the remaining three (LH 283, LH 293, and LH 414) were all located in Area O and dated to the latest phase of the cemetery, 390–410. LH 283, a male over the age of 35, was also identified by Clarke as one of a group of intrusive burials, probably Anglo-Saxon in origin.[71]

In Area W, there were two females and one male with osteoarthritis related to trauma. The male (LH 226), aged 30–35, sustained a severe, incompletely healed intertrochanteric fracture of the neck of the right femur, with lateral and posterior 90° rotation of the shaft and consequent secondary osteoarthritis.[72] This fracture would have left his right leg essentially useless, and may well have contributed to his death. He also had some moderate osteoarthritis and vertebral osteophytosis in his spine, affecting T8–12.

The traumatic osteoarthritis found on the two women in Area W did not appear to be directly related to fracture, but rather to other forms of trauma. Both women were probably among the older individuals in the cemetery, although neither could be aged with precision. The female in LH 218 was certainly over 35, and her skeleton reflected a hard life. Severe osteoarthritis was present in the right knee, which was badly deformed, with burnishing and grooving of the condylar surfaces of the tibia and femur, and patellar involvement (Illus. 2.42). Because the left knee was com-

Illus. 2.42. Severe traumatic osteoarthritis in the right knee, as seen on the proximal tibia. LH 218, female age 35+.

[71] WS 3.ii, 390.

[72] See Illus. 2.28 above.

pletely normal, the inference was made that the condition of the right knee related to some earlier traumatic event or series of events. She also had mild to moderate osteoarthritis in her right shoulder and left foot. A band of linear enamel hypoplasia on her lower second molars suggested at least some episodes of nutritional or disease stress during childhood. The other female (LH 249) was at least 45 years old. Although many of the bones were very fragmentary, she clearly suffered from advanced osteophytosis and osteoarthritis in her spine and feet, with most other joints being affected to a lesser degree. However, her left ankle joint was severely deformed by osteoarthritis, especially the talus. The articular surfaces of the tibia and talus were eburnated and grooved, with extensive degenerative and proliferative bony changes. The right ankle, although exhibiting some mild osteoarthritis, was essentially normal, suggesting trauma as a possible originating or complicating factor in the left ankle.

All three individuals in the Area O section of Areas F, E, O were male, and in at least two cases the traumatic osteoarthritis noted was secondary to fracture. LH 283, a male aged over 35, had a healed spiral fracture of the distal third of the right fibula, with associated moderate to severe osteoarthritic changes in the distal joint. A small bony prominence of probable traumatic origin was also present on the anterior distal shaft of the right tibia. Osteoarthritic changes were present in many other joints as well, especially in the spine.[73] This individual was one of a group of six burials identified by Clarke as foreign, probably Anglo-Saxon.[74] Although not in a coffin, there was some evidence to suggest planks had been laid over the body. This man was buried with a knife, a whetstone, a bronze buckle, a knife handle, two coins, and a buckle loop. A third coin was found in the fill above his chest.[75]

LH 414 contained a male approximately 30 years old, who had a well-aligned healed spiral fracture of the proximal left fibula. The osteoarthritis seen in the left tibia laterally may be secondary to that fracture. This burial was disturbed and incomplete.

The final grave in this series, LH 293, contained a male aged 25–28. The first cuneiform of the right foot was badly deformed and osteoarthritic, suggesting a traumatic origin, while some osteoarthritis was also present in the right first metatarsal proximally. This individual may have been relatively unhealthy during a fairly short life. A perforated outer table of the cranial vault suggested possible healed porotic hyperostosis, and multiple bands of linear enamel hypoplasia were evident on the incisors, canines, premolars and M1s. These factors hinted at possible earlier disease stresses, nutritional deficiencies, and anaemias.

Osteoarthritis secondary to other pathology

LH 309 contained a male aged over 45 years in a burial dated to 390–410. There were extensive osteoarthritic changes to the skeleton, as described more fully in Chapter 7,[76] as well as osteoporotic bone and abnormally large sacral foramina. The causes for this pathology are unclear, but include possible neurofibromatosis or congenital anomaly.

Vertebral osteophytosis

Vertebral osteophytosis, also called spondylosis deformans and hypertrophic spondylitis, is a degenerative condition of the spinal intervertebral joints, which is included within the category of osteoarthritis by some researchers.[77]

[73] See below, p. 189. [74] WS 3.ii, 390. [75] ibid. 61.
[76] See below, pp. 191–2. [77] cf. Zimmerman and Kelley 1982.

Others treat it separately, since these joints are secondary cartilaginous joints lacking a synovial membrane,[78] although degenerative lesions on the other vertebral facets, which are synovial joints, are included under osteoarthritis. The incidence, age of onset, and distributional pattern of vertebral osteophytosis varies in different populations. In extreme cases ankylosis of the vertebral facets and bodies can occur, in the latter case producing a characteristic 'parrot-beak' profile at the anterior aspect of the intervertebral surfaces.

Because of the fragmentary condition of many skeletons, only 47 individuals were found who could be diagnosed with some degree of vertebral osteophytosis. Indeed, for most of those 47 individuals the spinal column was either incomplete or badly damaged, making only the most tentative conclusions possible. Table 2.67 presents the occurrence of vertebral osteophytosis by age, sex, and location in the cemetery. A few observations emerged that may be valid in spite of the small sample size. Vertebral osteophytosis was more than twice as common in males as in females for the site as a whole. While this may have been partially due to factors of differential preservation, the gap was so great that it may represent a genuine reflection of reality. The most frequent age at onset was in the fourth decade of life, in the 30–39 age group, although a fairly large proportion of this sample (approximately 19%) also showed some evidence of the condition in the 20–29 age group. The lower back, especially in the lumbar region, was most frequently affected, with relatively infrequent involvement of the cervical spine. There did not appear to be any meaningful differences between the earlier (Area W) and later (Areas F, E, O) phases of the site, although the proportion of males with vertebral osteophytosis was higher in the earlier sample.

Five individuals with extensive degenerative changes to the spine[79] have not been included in the figures above because the exact nature and aetiology of their pathology is unclear, but all exhibited possible diffuse idiopathic skeletal hyperostosis, or DISH. While the specific cause of DISH is unknown, it may be associated with obesity or diabetes mellitus, and is generally more common in older males.[80] Two of these individuals were located in Area W, the earlier phase of the cemetery. LH 15, a male aged approximately 35–40, was affected in the lower thoracic and lumbar vertebrae which had sustained extensive post mortem damage, with clear ankylosis of T11–12. There was also possible fusion of the costovertebral articulations of four thoracic vertebrae, and degenerative changes in many other joints. A female (LH 168) aged at least 35 exhibited severe osteophytosis with fusion and partial collapse of T5–9, resulting in lateral left scoliosis as well as mild kyphosis. In addition, the manubrium and first ribs were fused. The other three individuals were located in the later phases of the site. LH 277, a male aged 40–50, buried in Area O, had involvement of the thoracic and lumbar vertebrae, with ankylosis of T8–11.

In LH 299,[81] the thoracic spine from T6 to T12 showed thick flowing ossification of the anterior longitudinal ligament on the right side, although the intervertebral disk spaces were preserved and the articular facets were not involved (Illus 2.45). The lumbar vertebrae exhibited moderate to severe osteophytosis. The manubrium, body, and xiphoid process of the sternum were fused. In LH 399, a male aged over 45 located in Area E, there was ankylosis and kyphosis of T7–10, as well as pathology in the lumbar vertebrae. This individual also had osteoarthritis in his hips.

[78] Steinbock 1976, 287.
[79] LH 15, LH 168, LH 277, LH 299 and LH 399.
[80] Roberts and Manchester 2005, 159.
[81] See below, pp. 190–1.

TABLE 2.67

Occurrence of vertebral osteophytosis, Lankhills 1967–72

Age	Cervical		Thoracic		Lumbar		C & T		T & L		C & T & L		Total	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
AREA W														
20–29	0	1	2	0	2	0	0	0	1	0	1	0	6	1
30–39	0	0	4	0	4	2	1	0	1	1	0	1	10	4
40–49	2	0	0	0	0	0	0	0	0	0	1	2	3	2
50–59	0	0	0	0	0	0	0	0	0	0	0	0	0	0
60+	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ind.	0	0	0	0	1	0	0	0	0	0	0	0	1	0
Total	2	1	6	0	7	2	1	0	2	1	2	3	20	7
AREA F, E, O														
20–29	0	0	1	1	0	0	0	0	0	0	0	0	1	1
30–39	1	0	0	1	2	1	0	1	3	2	2	1	8	6
40–49	0	1	0	0	1	0	0	0	1	0	0	0	2	1
50–59	0	0	0	0	0	0	0	0	1	0	0	0	1	0
60+	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ind.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	1	1	1	2	3	1	0	1	5	2	2	1	12	8
WHOLE SITE														
20–29	0	1	3	1	2	0	0	0	1	0	1	0	7	2
30–39	1	0	4	1	6	3	1	1	4	3	2	2	18	10
40–49	2	1	0	0	1	0	0	0	1	0	1	2	5	3
50–59	0	0	0	0	0	0	0	0	1	0	0	0	1	0
60+	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Indet.	0	0	0	0	1	0	0	0	0	0	0	0	1	0
Total	3	2	7	2	10	3	1	1	7	3	4	4	32	15

Illus. 2.43. Diffuse idiopathic skeletal hyperostosis (DISH) of vertebrae T6–12. LH 299, male at least 35–40.

Vertebral osteoarthritis, facets

The pattern of osteoarthritis seen in the articular facets of the vertebrae was, as might be expected, very similar to the pattern of osteophytosis, although just as many females as males were affected. However, the total sample size was only 14 individuals. In females the frequency was highest in the lumbar vertebrae (5), while males were evenly split between the cervical and lumbar vertebrae (3 each).

Extraspinal osteoarthritis

The occurrence of extraspinal osteoarthritis is given in Table 2.68. As with the spinal data, these findings were heavily affected by the poor condition of many skeletons. Forty males were observed with some degree of osteoarthritis in at least one joint (Crude Prevalence Rate, or CPR, 31.3%; 40/128), as were fourteen females (CPR 11.5%; 15/122). Two observations are notable, however. First is the high frequency of hip involvement, followed by shoulders and feet. Osteoarthritis in elbows, wrists, hands, knees and ankles was found much less frequently. Second, the number of males affected is almost three times as great as females, although there appear to be very few differences between earlier and later areas of the cemetery.

iv. METABOLIC AND DEFICIENCY DISEASES

Porotic hyperostosis and cribra orbitalia

Porotic hyperostosis and cribra orbitalia are both cranial lesions characterized by a sieve-like appearance, which in severe cases takes on a spongy texture. Often the conditions have been considered separately, as it was unclear whether or not these manifestations share a common aetiology.[82] However, the two conditions are often considered under a single term, 'porotic hyperostosis', since widening of the diploic spaces and irregular trabeculation is common to both.[83] Other work has strengthened the case for considering both manifestations to have a single aetiology.[84] Alternatively, some recent studies have indicated different aetiologies for porotic hyperostosis and cribra orbitalia and suggested that the correlation between them is

[82] Steinbock 1976; Ortner and Putschar 1981.

[83] Mensforth et al. 1978, 4; Stuart-Macadam 1982, 1985, 1987a, 1987b.

[84] Stuart-Macadam 1989.

TABLE 2.68
Occurrence of extraspinal osteoarthritis, Lankhills 1967–72

Joint	MALES			FEMALES			Site Total
	Area W	Area F, E, O	Total	Area W	Area F, E, O	Total	
Shoulder, right	5	3	8	3	1	4	12
Shoulder, left	3	5	8	2	2	4	12
Elbow, right	1	3	4	0	1	1	5
Elbow, left	1	1	2	1	1	2	4
Wrist, right	2	1	3	0	0	0	3
Wrist, left	1	1	2	0	0	0	2
Hand, right	0	0	0	1	0	1	1
Hand, left	0	0	0	1	0	1	1
Clavicle, right	2	2	4	4	0	4	8
Clavicle, left	3	2	5	3	0	3	8
Sacroiliac	4	2	6	0	1	1	7
Hip, right	11	11	22	7	2	9	31
Hip, left	10	10	20	5	1	6	26
Knee, right	2	4	6	1	0	1	7
Knee, left	2	2	4	2	0	2	6
Ankle, right	3	2	5	1	0	1	6
Ankle, left	4	0	4	0	0	0	4
Foot, right	4	6	10	2	0	2	12
Foot, left	6	4	10	2	0	2	12
Foot, indet.	1	0	1	1	1	2	3

not very strong.[85] Because of the distributional differences in these two lesions seen in the Lankhills 1967–72 samples, the separate terminology is retained. Thus, porotic hyperostosis here refers to those lesions found on the cranial vault, and cribra orbitalia refers to lesions on the anterior supraorbital plate.

While the aetiology of these lesions is not fully understood, early work by Angel,[86] Moseley,[87] Hengen,[88] and a host of others has heavily implicated different anaemias. These may have a hereditary base, [89] or the cause may be chronic iron-deficiency anaemia. This type of anaemia has a number of possible causative agents including parasites, lack of iron in the diet, the presence of substances that interfere with intestinal iron absorption, malabsorptive diseases, prolonged nursing on milk with low iron content, or weaning trauma such as weanling diarrhoea.[90] Another major contributor to the onset of iron-deficiency anaemia may be infectious disease.[91] In addition to iron-deficiency anaemias, chronic dietary deficiencies and malabsorption of vitamin B_{12} or folic acid are the most common causes of megaloblastic anaemias.[92] The causes of these and other anaemias are not mutually exclusive, and multiple causes may be present in the same individual.[93] The presence of porotic hyperostosis or cribra orbitalia is now commonly viewed as one of a number of stress markers for evaluating the health and nutrition of earlier populations.[94]

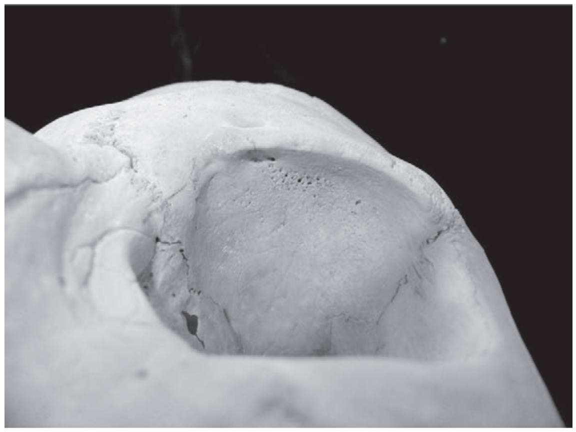
85 Walker et al. 2009.
86 Angel 1966, 1967.
87 Moseley 1963, 1966.
88 Hengen 1971.
89 Angel 1964.
90 Steinbock 1976, 246–7.
91 Stuart-Macadam 1992.
92 Walker et al. 2009, 112. See also Appendix D, Glossary, pp. 442-3 for a fuller description of the different types of anaemia.
93 Ibid. 111.
94 Hummert and Van Gerven 1985; Huss-Ashmore et al. 1982.

In British skeletal material porotic hyperostosis of the cranial vault is relatively uncommon, while the lesions of cribra orbitalia are seen frequently, either alone or in combination with porotic hyperostosis.[95] In this respect, Lankhills 1967–72 fits in well with other samples. Only two individuals showed any evidence of porotic hyperostosis. One of these (LH 25) was a 30–35 year old male in Area W with evidence of slight pitting on both parietals and the occipital. The cranial vault of the other (LH 293), a 25–28 year old male in Areas F, E, O was pitted, especially on the parietals posteriorly, and the palate was also very porotic.

The occurrence and per cent frequency of cribra orbitalia at Lankhills 1967–72 are given in Tables 2.69 and 2.70. In the full sample, 204 individuals could be examined for these lesions, 167 adults and 37 children. Of these, 11 children under the age of 20, or 30% of the sample, had cribra orbitalia. In the adults, 12% of the sample (11 males and 9 females) exhibited some degree of this condition. When tested using chi-squares, the difference between males and females was not statistically significant, nor was the difference in distribution between the earlier and later phases of the cemetery. However, the difference between adults and children was significant at the $p < 0.01$ level.

The presence of cribra orbitalia was scored as either mild, moderate, or severe, using the degree of severity outlined by Nathan and Haas[96] and subsequently modified by Stuart-Macadam.[97] All individuals except nine exhibited minimal presence of these lesions (Illus. 2.44). Of the nine who scored moderate or moderate/severe, indicating active lesions,[98] six were subadults ranging in age from infants to 19 years old, and only three were adults.

The fact that cribra orbitalia was present more frequently in children, at statistically significant levels, and the fact that two-thirds of the more severe lesions were found in younger individuals, tends to support the findings of other studies indicating that this is a marker of megaloblastic anaemia or childhood iron-deficiency anaemia with potentially lethal consequences, and that the mild lesions seen in adults represent healed or healing childhood metabolic insults that were overcome.[99] It has been shown that individuals with active lesions of porotic hyperostosis or cribra orbitalia do indeed have a higher mortality.[100]



Illus. 2.44. Mild cribra orbitalia of the left orbit. The right orbit was also affected to a lesser degree. LH 107, male age 22–25.

Osteoporosis

The term ‘osteoporosis’ refers to abnormally light, porous bone characterized by a reduced amount of mineralized osteoid per unit of bone volume.[101] It is regarded as a by-product of ageing, especially in post-menopausal females where hormonal imbalances may interfere with normal osteoblastic activity. Other factors that may be involved in the development of osteoporosis include diet, gender, level of exercise,

[95] Roberts and Manchester 2005, 230.
[96] Nathan and Haas 1966.
[97] Stuart-Macadam 1982.
[98] As indicated by their unhealed margins. Mays 2010, 231.
[99] Stuart-Macadam 1985; Roberts and Manchester 2005.
[100] Huss-Ashmore et al. 1982.
[101] Steinbock 1976, 12.

TABLE 2.69

Occurrence of cribra orbitalia by age and sex, Lankhills 1967–72

Age	Subadult			Male			Female			Adult, sex indeterminate			Total		
	Present	Absent	Total	Present	Absent	Total	Present	Absent	Total	Present	Absent	Total	Present	Absent	Total
0–6 months	0	4	4										0	4	4
7 months–6 years	4	12	16										4	12	16
7–13 years	5	7	12										5	7	12
14–19 years	0	1	1				2	1	3				2	2	4
Subadult	0	1	1				0	0	0				0	1	1
Total	9	25	34				2	1	3				11	26	37
20–29 years				4	27	31	7	39	46	0	1	1	11	67	78
30–39 years				6	24	30	1	28	29	0	1	1	7	53	60
40–49 years				0	13	13	1	3	4	0	0	0	1	16	17
50–59 years				0	2	2	0	0	0	0	0	0	0	2	2
60+ years				0	1	1	0	0	0	0	0	0	0	1	1
Adult				1	2	3	0	5	5	0	1	1	1	8	9
Total				11	69	80	9	75	84	0	3	3	20	147	167
Total	9	25	34	11	69	80	11	76	87	0	3	3	31	173	204

TABLE 2.70
Frequency (CPR) of cribra orbitalia by age and sex, Lankhills 1967–72

Age	Subadult %	Male %	Female %	Indet. %	Total %
0–6 months	0				0
7 months–6 years	33				33
7–13 years	42				42
14–19 years	0		67		50
Subadult	0				0
Total	27		67		30
20–29 years		13	15	0	14
30–39 years		20	4	0	12
40–49 years		0	25	0	6
50–59 years		0	0	0	0
60+ years		0	0	0	0
Adult		33	0	0	11
Total		14	13	0	12
Total	27	14	12	0	15

prolonged lactation, a high number of pregnancies, smoking, caffeine, and alcohol.[102] Some studies suggest that the risk for developing osteoporosis, the timing of onset and the rate of decrease in bone mass after onset, are under at least partial genetic control.[103] Premature osteoporosis found in children or young adults may be related to dietary insufficiency or other pathology such as malabsorption.[104]

At Lankhills 1967–72, only six skeletons showed clear evidence of osteoporosis. Interestingly, they were all male or possibly male, which is probably more indicative of problems with bone preservation than any real trend in the data. Three individuals were located in Area W (LH 11, LH 112, and LH 229). Of these three, only one (LH 229), a ?male over 65, clearly had senile osteoporosis, which had affected the entire skeleton. In the other two individuals, both young males in their twenties, osteoporosis was confined primarily to the lower thoracic and lumbar vertebrae, and may have been secondary to other nutritional deficiencies or pathology. Both individuals also exhibited linear enamel hypoplasia on their teeth, suggesting nutritional or disease stress in childhood.

The remaining individuals were found in Areas F, E, O, and were somewhat older. The male in LH 309 was certainly over 45. He was afflicted with considerable arthritis, and many bones of the skeleton were extremely osteoporotic. However, the additional presence of abnormally large foramina on the sacrum complicates the picture and requires consideration of a number of other pathological processes. The 35–40-year-old male in LH 299[105] exhibited osteoporosis associated with moderate osteoarthritis in both clavicles and humeral heads, and was more pronounced on the left side. This may have been related to whatever metabolic condition was causing severe arthritic changes with ankylosis and both kyphosis and scoliosis in the spine. The final individual in this group, a male approximately 40 years old in LH 357, exhibited porosities in his left ilium suggestive of osteoporosis, possibly related to some disease process, but no firm conclusions could be made.

102 Roberts and Manchester 2005, 243.
103 Karasik et al. 2000; Rubin et al. 2000.
104 Huss-Ashmore et al. 1972.

105 The same individual with a bilateral double forefoot amputation described above, pp. 98–100.

Vitamin deficiency

One additional class of diseases needs to be examined; those caused by vitamin deficiencies such as rickets (vitamin D) and scurvy (vitamin C). Rickets occurs most commonly in infants and pre-pubertal children, and is characterized by inadequate mineralization of the osteoid matrix, leading to light bones exhibiting expanded metaphyses, cranial vault changes, and frequent bowing of the long bones. The adult form, osteomalacia, does not exhibit metaphyseal involvement, but can result in spinal and pelvic distortion, and bowing of the long bones.[106] While not common prior to the Industrial Revolution, European cases have been reported from York, England,[107] Ireland,[108] medieval Denmark,[109] and Sweden.[110] Ortner and Mays identified ten characteristically abnormal bone features in a childhood sample from medieval Wharram Percy.[111]

Scurvy also typically attacks small children, although it can be found in adults. The most important clinical manifestation in skeletal material is ossified subperiosteal haemorrhage on the long bones, and frequently fractures through the metaphysis caused by weakening of cancellous bone, which upon healing may produce small spurs on the lateral borders of the metaphysis. Ortner[112] and Roberts[113] among others suggest that the jaws, orbits, and the lines of the temporalis muscle may be the most common sites for new bone formation in response to bleeding caused by chewing. Ortner et al. have also implicated porous and occasionally hypertrophic lesions of the greater wing of the sphenoid.[114] One of the effects of scurvy is a weakening of periodontal collagen, allowing abnormally easy access by bacteria to the tissues around the tooth and consequent increased tooth loss and 'wobbly teeth'. According to Steinbock, 'Historically, scurvy has been the scourge of sailors on long voyages, soldiers in the field, and people under siege', although any diet severely restricted in vitamin C will bring about the same result.[115]

Both of these conditions can be difficult to diagnose accurately in skeletal material unless they are present in extreme form, and the skeletons are essentially complete. No lesions that could be attributed to scurvy were seen in the Lankhills 1967–72 material.

The situation with rickets is a little more complicated, although it would not seem to have been a major health problem for this population. Only two children showed any lesions that may possibly have been caused by rickets. The right femoral shaft of the two-year-old in LH 154 showed a markedly abnormal angulation of the distal third of the shaft, with periostitis near the metaphysis. In LH 294 there was a double burial of two children, one aged six to seven, the other approximately two years old. While both had abnormal curvatures in their long bones, the causes for these pathologies appear to have been different in each case. The younger child had an extremely bowed tibia with periostitis proximally, and periostitis on the left femur as well (Illus. 2.45). Radiography indicated that rather than rickets, this was in fact traumatic bowing due to a healed fracture.[116] The older child presented a different set of symptoms. Both tibiae were severely bowed anteriorly, with a flattened cross-section, and there were significant enamel defects in the lower first molars of the jaw. The skeleton was too fragmentary to evaluate for 'rickety rosary'.

106 Steinbock 1976, 262–74.
107 Dawes and Magilton 1980.
108 Power and O'Sullivan 1992.
109 Møller-Christensen 1958.
110 Gejvall 1960.
111 Ortner and Mays 1998.
112 Ortner 1984.
113 Roberts 1987
114 Ortner et al. 1999.
115 Steinbock 1976, 254.
116 See above, p. 96.

Illus. 2.45. Abnormal angulation of the distal third of the right femoral shaft, suggesting possible rickets. LH 154, child *c.*2.

Nutritional deficiency, probably rickets, may be the best explanation for these findings.

One adult bone, an intrusive right radius mixed in with the burial in LH 358, was abnormally bowed with an abnormally round shaft circumference. Although not frequently found in non-weight-bearing bones, this might also represent a case of rickets or osteomalacia.

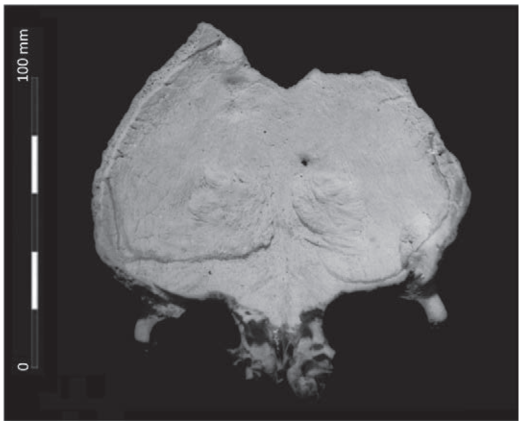
Four other adults, three males (LH 94, LH 181, and LH 260) and one female (LH 340) exhibited various bowing deformities of their leg bones, but none of these can be attributed to rickets or osteomalacia. In the case of the male in LH 181 and the female in LH 340, rickets was excluded based on x-ray interpretation and a more likely explanation may be bone remodelling due to biomechanical stress. In the case of LH 340 the bowing might also have a genetic component. The remaining two males (LH 94 and LH 260) both had bowed femora associated with periostitis or other pathology that may be indicative of nutritional deficits at some point in their lives, although biomechanical stress must also be considered.

The absence of scurvy in this sample, and minimal, tentative findings related to rickets, especially in infants and children, suggest deficiencies of vitamins C and D were not major health stressors in this group.

Hyperostosis frontalis interna

Hyperostosis frontalis interna is an enigmatic condition generally of no direct consequence, characterized by thickening and billowing of the lower internal surface of the frontal bone, the aetiology of which is poorly understood and is the subject of some debate.[117] However, it may be related to pituitary gland disorders or other hormonal functions. It is most commonly, but not exclusively, found in postmenopausal females, and can show apparently progressive degrees of expression. While reported infrequently in the archaeological literature, recent research comparing radiographic studies of modern samples with those derived archaeologically suggests that different observational techniques, rather than different demographic profiles, may explain much of the variance between past and more frequent present rates of occurrence.[118]

[117] Zimmerman and Kelley 1982, 61; Roberts and Manchester 1995, 182; Hershkovits et al. 1999; Barber et al. 1997.
[118] Barber et al. 1997.



Illus. 2.46. Hyperostosis frontalis interna. LH 249, female age 45+.

At Lankhills 1967–72 only one unambiguous case of hyperostosis frontalis interna was detected. This individual, a female over 45 (LH 249), exhibited considerable irregular deposition of bone on the interior endocranial surface of the frontal bone (Illus. 2.46). LH 249 also had extensive osteoarthritic changes in the spine and lower leg joints. She was buried in a portion of the cemetery in Area W dating to 350–370/90. This finding was based on direct observation of the bone, and it is highly probable that more comprehensive radiographic studies might reveal a higher frequency in the cemetery.

Other

A child aged approximately 2½ in LH 34 had severe enamel defects on all deciduous second molars, resulting in extensive pitting, mottling, and abnormally pointed cusps, which may have been related to metabolic or nutritional causes. Another individual, a female aged 25–30 in LH 315, suffered from periostitis on all long bones, the clavicle (especially laterally), and the acetabular area of the innominate. The tibiae also appeared to be bowed medially. The hands, feet, and spine were unaffected. Radiography revealed no underlying bone destruction, and the cause of this pathology remains unclear.

v. INFECTIOUS AND INFLAMMATORY DISEASES OTHER THAN ARTHRITIS

Mastoiditis

Otitis media and mastoiditis are extremely common infections in many recent populations.[119] While more prevalent in children today, there is some evidence to suggest that adults may have been afflicted more frequently in ancient times, at least in certain areas.[120] In skeletal samples the most obvious manifestation of this disease is mastoid perforation, indicating abscess. This is the advanced stage of a disease process that begins with otitis media, a far more frequent infection that may leave little effect on skeletal material. Certain diagnosis of mastoiditis, especially in children, can be made difficult by the effects of post mortem soil erosion.[121] While mastoid abscess represents an advanced, active phase of ear infection, evidence of prior disease may be obtained by radiologic examination of the mastoids to detect abnormalities of pneumatization.[122]

At the time this study was undertaken, it was not possible to x-ray all the skulls systematically for evidence of prior mastoid infection, although such an effort would undoubtedly yield new and useful information. Based on direct observation alone, only two individuals showed some evidence for mastoiditis. These were a male aged 25–30 in LH 61, and another male aged approximately 30 in LH 291. The

[119] cf. Gregg and Steele 1982.
[120] Schultz 1979.
[121] McKenzie and Brothwell 1967.
[122] Titsche et al. 1981.

latter individual had a greatly enlarged mastoid foramen, but a radiograph of the area indicated normal aeration. The findings for both these individuals were thus somewhat tentative, in part due to post mortem damage and erosion. The absence of any evidence for this condition in children may be due to the frequently damaged and fragmentary nature of the material. It is probably safe to assume that ear infections were a relatively common affliction, but generally resolved without trace on the bones, as in modern populations.

Non-specific periostitis

No cases of advanced osteomyelitis were detected in the Lankhills 1967–72 sample. Periostitis (inflammation of the periosteum) is another form of osteitis in which there is deposition of woven bone originating from osteoblastic activity of the inner surface of the periosteum. It is a secondary bone change in many pathological conditions, but may exist as a separate disease entity of uncertain aetiology.[123] Non-specific periostitis is common on the long bones of archaeological samples, and its cause is frequently attributed to infection,[124] or trauma, especially when its occurrence is localized.[125] With the exception of the cases described below, only one individual exhibited nonspecific periostitis of a long bone, a 25–30-year-old male in LH 140 whose left femur was involved.

In Britain, especially in Anglo-Saxon samples, localized tibial periostitis, which appears to have causes other than those related to more generalized osteomyelitis, is relatively common.[126] The cause is uncertain, and proposed explanations range from localized repetitive shin trauma to leg ulcerations, or other possible determinants of biological stress in a population.[127]

At Lankhills 1967–72 only five examples of this condition were seen; two males (LH 192, LH 252; Illus. 2.47), two females (LH 1, LH 332), and one adult, age indeterminate (LH 180). In all cases either the tibia or tibia and fibula were affected. The femora of LH 332 were also affected. This condition was present on the fibula alone in one other individual, a male aged over 35 in LH 349.[128]

Other possible infectious or inflammatory conditions

Four other individuals may have had conditions caused by infections or other inflammatory processes. The 35–40-year-old male in LH 76 had an infection in the right maxillary sinus that was clearly related to a dental abscess and consequent ante mortem loss of the upper first molar. The pitting seen on the palate was probably also related to this condition. A second individual, a young male aged 22–23 in LH 352, had an enormous maxillary abscess on the left side, extending from the second premolar back through the location of the third molar. The abscess cavity penetrated the maxillary sinus and quite possibly the floor of the nasal passage as well. Finally, the 20–25-year-old male in LH 260 exhibited diffuse periostitis on all leg bones, and some bowing of the femora accompanied by a widening of the shaft on the left femur that might have been the result of trauma. Radiographic examination of the right tibia revealed chronic periosteal reaction with new bone deposition, possibly related to infection.

[123] Ortner and Putschar 1981, 129–31.
[124] Mensforth et al. 1978.
[125] Ortner and Putschar 1981, 132.
[126] Roberts and Manchester 2005, 172–3.
[127] Goodman et al. 1988.
[128] See Table 2.75.

Illus. 2.47. Periostitis: (a) detail of tibial periostitis illustrating the deposition of woven bone. Portions have broken off post mortem. LH 192, male age *c.*25; (b) severe periostitis on the left tibia antero-laterally in the distal third of the shaft. Myositis ossificans traumatica is seen on the proximal third of the shaft laterally. LH 252, ?male, adult.

vi. NEOPLASMS (TUMOURS) AND RELATED PATHOLOGY

Strictly speaking, 'tumour' means swelling, and growths commonly called tumours should be referred to as neoplasms, reflecting the fact that they are *new* growths of abnormal tissue which may be locally restricted if benign, or may disperse widely throughout the body if malignant.[129] Neoplasms confined to soft tissue are usually undetectable in archaeological samples unless they have secondary consequences for bone. However, many types of both benign and malignant neoplasms do affect bone, and have been found with varying degrees of frequency in

[129] Roberts and Manchester 2005, 252.

the archaeological record.[130] Malignant neoplasms tend to be less common, in part because ancient populations died fairly young and cancer tends to be a disease of ageing.[131]

All the tumours and tumour-related lesions seen at Lankhills 1967–72 were benign. Generally, these lesions would have had little, if any, negative impact on quality of life for the individuals involved. Indeed, in many cases the individual may have been totally unaware of the condition. The lack of any evidence for malignancies may be due, at least in part, to the often fragmentary and eroded condition of the skeletons as well as the fairly young age profile of the sample. The benign lesions fell into three categories; osteochondromata, osteomata, and cysts, as described below.

Osteochondromata

Osteochondromata are neoplasm-like proliferations of cartilaginous tissue at or near an epiphyseal line, involving the femur or tibia in over 50% of cases. They develop during growth in childhood, and usually cease development by the time growth is completed so that they do not proliferate indefinitely, unlike true neoplasms.[132] Although sometimes classified like neoplasms, they are more accurately described as a developmental irregularity or hamartoma arising from faulty ossification of the growth plate.[133] While normally benign, they may occasionally become malignant.[134]

Two possible osteochondromata were found. While the diagnosis is not certain, the abnormalities seen in the right distal tibia and fibula of the female aged 30–35 in LH 59 may have been due to a broad-based osteochondroma. In the case of a female aged 20–25 in LH 335, an osteochondroma was present laterally just below the knee on the left tibia. This was a double burial which also contained a male aged 30–35. The grave was located in Area W and dated to 310–350. Both individuals appeared to have been buried at the same time, the female on the bottom in a normal extended face-up position, the male immediately above her and face-down. Both appeared to have been interred in the same coffin.

Osteomata

Osteomata were by far the most commonly found benign tumour in the Lankhills 1967–72 sample, occurring in a total of 18 individuals. They arise from periosteal tissue, and generally are confined to the inner and outer surfaces of the skull and jaw, although they may be found occasionally on other bones.[135] Of the 18 individuals with osteomata at Lankhills 1967–72, 16 exhibited common 'button' osteomata, characterized by a smooth round or oblong shape, generally less than one to two centimetres in diameter. Multiple osteomata in a single individual were quite common, being found in eight people. In all cases but one (LH 349), these multiple osteomata were located on the frontal bone. Two individuals, a male in LH 252 and a female in LH 272, each had three osteomata, but in all other cases of multiple osteomata there were only two. Distributionally, button osteomata were located on the frontal bone in ten individuals, on the parietal in three individuals, and on the temporal bone or mandible in one individual each. By sex, these osteomata were found in ten males,[136] seven females,[137] and one ?adult of indeterminate age (LH 62).

In addition to the button osteomata described above, two nasal tumours were found. One was

130 Steinbock 1976; Zimmerman and Kelley 1982, 109–28.
131 Ortner and Putschar 1981, 365.
132 Steinbock 1976, 321.
133 Roberts and Manchester 2005, 254.
134 Anderson 1976, cited in Zimmerman and Kelley 1982, 112.
135 Steinbock 1976, 327.
136 LH 9, LH 47, LH 158, LH 214, LH 225, LH 252, LH 299, LH 319, LH 331, and LH 349.
137 LH 17, LH 59, LH 201, LH 272, LH 320, LH 386, and LH 436.

Illus. 2.48. A spongy osteoma arising from the middle ethmoid group of air cells on the left side of the nasal aperture. LH 436, ?female age 30–35.

an ovoid smooth osteoma on the floor of the left nasal aperture in a male aged 30–35 in LH 319. The second was an osteoma in the nasal aperture of a ?female aged 30–35 in LH 436 (Illus 2.48). Arising from the middle ethmoid group of air cells on the left side, this spongy mass resulted in widening and distortion of the nasal passage.[138]

Cysts

One individual had lesions suggestive of a benign bone cyst. These cysts originate in the epiphyseal regions of long bones during growth, most frequently the humerus, femur, and tibia,[139] although they may be found in the radius, ulna, and metatarsals as well.[140] As individuals age and growth in long bones is completed, these cysts, retained into adult life, appear to migrate away from the epiphyses as the bone grows. The female in LH 358 was over 30, and the distal right radius was affected.

Another individual, the male aged over 35 in LH 283, exhibited a degenerative subarticular cyst in the glenoid fossa of the right scapula adjacent to the anterior margin, which had been exposed due to post mortem damage (Illus. 2.49). A similar lesion seen on the posterior margin was the result of post mortem damage as well, as were the perforations seen on the surface of the glenoid fossa itself. This pathology had previously been misdiagnosed as osteomyelitis.[141] However, re-examination and radiographic analysis in the summer of 2011 demonstrated conclusively that no osteomyelitis was present.

One other individual merits mention. An older female in LH 330 exhibited an enlarged and depressed area in the basal skull that may represent erosive pressure from a soft tissue tumour, aneurysm, or cyst, although the possibility of post mortem damage cannot be firmly excluded.

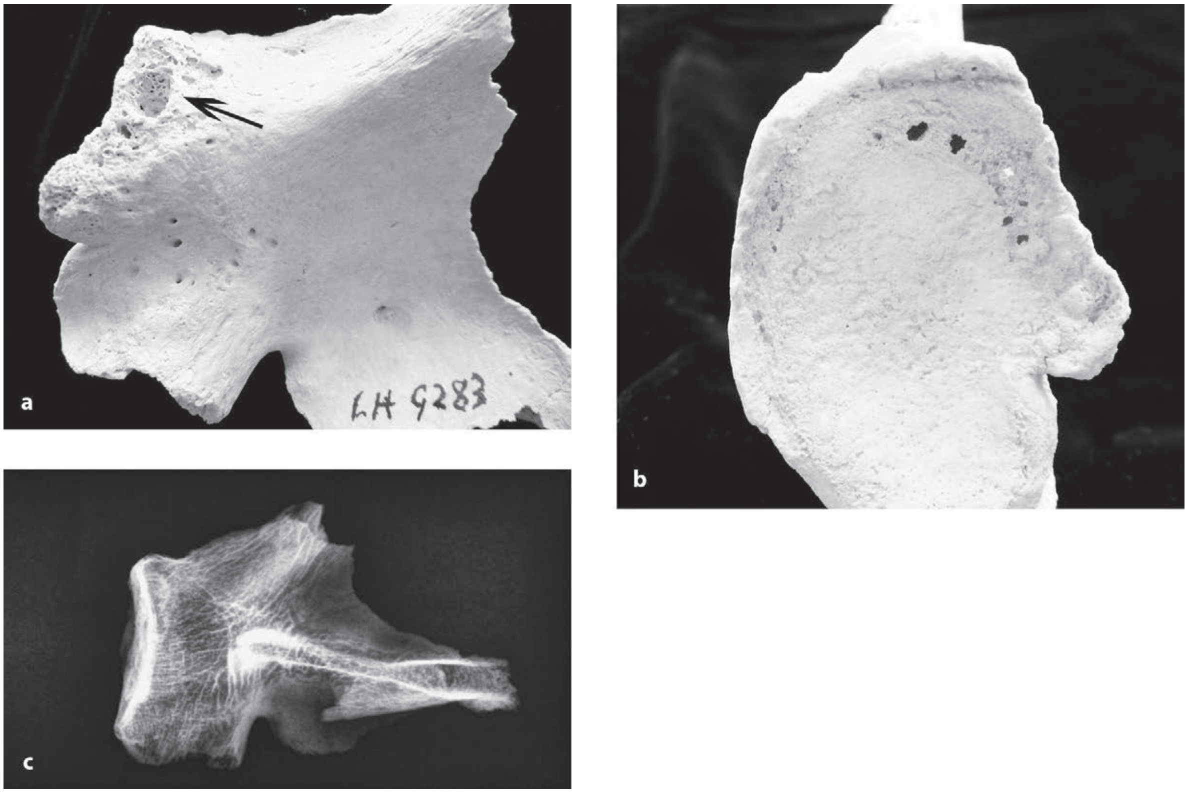
vii. CONGENITAL AND DEVELOPMENTAL ANOMALIES

This section summarizes the congenital and developmental anomalies found in the skeletal material at Lankhills 1967–72. The aetiology of these anomalies is often poorly understood, but in many cases it involves the interaction of genetic inheritance with environmental and developmental influences *in utero* or after birth. Even when there is debate regarding the causative agent, as for example with auditory tori and other epigenetic traits,[142] study of the traits themselves may provide useful comparative information at the population level.[143]

At a gross level there are six basic types of congenital and developmental anomalies:

(1) fusion abnormalities (i.e. abnormal fusion between bones or failure of expected fusion); (2) additional ossification centres (e.g. bipartite patella); (3) accessory structures (e.g. extra fingers, toes, ribs); (4)

138 See Illus. 2.48.
139 Zimmerman and Kelley 1982, 115.
140 Steinbock 1976, 344.
141 Gowland 2004, 141.
142 Berry and Berry 1967; Kennedy 1986; Carson 2006.
143 See below, pp. 227–37.



Illus. 2.49. Subarticular cyst: (a) degenerative subarticular cyst in the glenoid fossa of the right scapula adjacent to the anterior margin, which has been exposed due to post mortem damage; (b) the large holes on the superior aspect of the glenoid fossa of the right scapula are the result of post mortem erosion of the margin of the cystic cavity. The other holes seen are due to degenerative changes in the joint; (c) radiograph of the fragmentary right scapula and glenoid fossa, showing the subarticular cyst. LH 283, male age 35+.

underdeveloped structures; (5) absence or agenesis of a structure; and (6) generalized skeletal abnormalities (osteogenesis imperfecta, osteopetrosis, achondroplasia).[144]

Dental development, including agenesis of the third molar, has been dealt with elsewhere.[145] While other types of abnormalities were found, the vast majority of congenital and developmental anomalies seen at Lankhills 1967–72 related to premature, abnormal, or failed fusion.

Cranium

Sixteen individuals, eight male[146] and eight female,[147] were found with a full metopic suture, although numerous others had partial metopism.[148] Four other individuals, all male, possessed other cranial suture anomalies. These included two individuals (LH 181 and LH 427) where ossicles and other irregularities along the lambdoid suture had produced a bathrocephalic, protruding appearance at the back of the skull.

[144] Zimmerman and Kelley 1982, 19.

[145] See above, pp. 86–7.

[146] LH 51, LH 86, LH 140, LH 163, LH 299, LH 306, LH 380, and LH 427.

[147] LH 111, LH 175, LH 219, LH 256, LH 273, LH 330, LH 379, and LH 398.

[148] As defined in this study, 'full metopic suture' means a metopic suture open on the outer table of the skull from nasion to bregma. A partial metopic suture is an open suture on the outer table of the skull originating at nasion, but extending only part of the way to bregma.

Two other individuals manifested cranial suture hyperossification. In the case of LH 349 this was found along the sagittal suture, contributing to the appearance of a 'keeled' skull, while LH 306 exhibited hyperossification along portions of both the coronal and sagittal sutures. The associated shallow depression running across the cranium in this individual might have resulted from these anomalies, or it might have been related to long-term pressure from some type of headgear, such as a head strap used for carrying weights on the back.

The last congenital or developmental anomaly associated with the cranium in this sample was found in LH 331, a ?female aged approximately 25, whose atlas vertebra was fused to the bone around the foramen magnum of the skull.

Illus. 2.50. Partial left-side ankylosis of a L6 vertebra to the sacrum. LH 104, male age 21–5.

Sternum

Three individuals, all male between the ages of 30 and 40 (LH 299, LH 380, and LH 414), exhibited synostosis of the sternal body and xiphoid process. In a fourth individual, the male aged 22 to 25 in LH 107, fusion had failed between the second and third sternal segments, which are normally fused, while the sternum and manubrium were unfused.

Vertebrae

Numerous vertebral anomalies were seen in the Lankhills 1967–72 skeletons, affecting 25 individuals. The majority of these anomalies occurred in the region of the fifth lumbar vertebra and the sacrum. Two individuals, both female (LH 272 and LH 273), clearly had a supernumerary sixth lumbar vertebra, while another female (LH 53) exhibited lumbarization of the first sacral segment. The female in LH 101 had six sacral segments. Three other skeletons had less clearly defined anomalies in this region, primarily due to the condition of the remains.

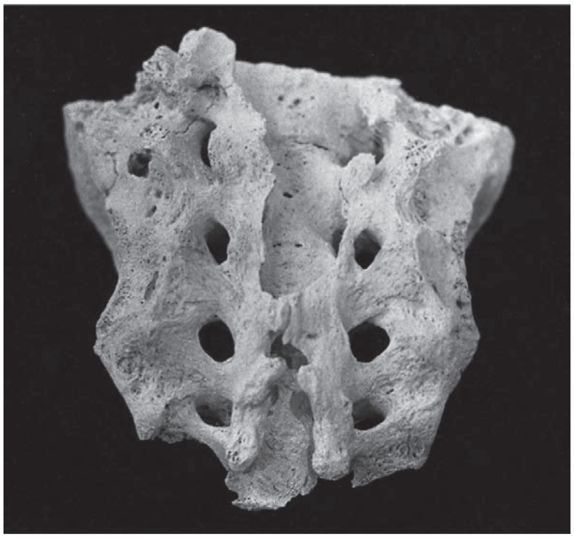
A male in LH 104 and a female in LH 118 both appeared to have a sixth lumbar vertebra that was partly ankylosed to the sacrum, on the left in the LH 104 skeleton and on the right in the LH 118 skeleton (Illus. 2.50). A similar situation existed with the male in LH 160, although in this case the exact relationship of the vertebral segments was less clear due to damage. Six individuals, five males[149] and one female (LH 281), exhibited clear sacralization of the fifth lumbar vertebra.

Two individuals, a young male in LH 16 and a much older male in LH 94, had bilateral neural arch separation, or spondylolysis, of the fifth lumbar vertebra. While this condition can have a congenital origin, it can also be due to stress fractures or degenerative conditions.[150] In all likelihood it would have been asymptomatic.

Five individuals exhibited various other fusion defects in the spine. The neural arch of the atlas vertebra was unfused in an older male

[149] LH 51, LH 76, LH 291, LH 306, and LH 407.

[150] Zimmerman and Kelley 1981, 129; Mays 2007.



ILLUS. 2.51. Spina bifida occulta of the sacrum. The neural canal is completely open except for a bridge of bone at the level of the third foramen. LH 304, male age *c.*27.

in LH 94. The left inferior articular facet of L5 was unfused in the male in LH 414. Three other individuals, two males (LH 35, LH 123) and a female (LH 168), exhibited an unfused spinous process in the first sacral vertebral segment.

Spina bifida, a condition in which developmental failure of the neural arches leaves the spinal cord exposed along the full length of the sacrum and possibly lower lumbar spine as well, is an extremely serious and disabling condition that is relatively uncommon in skeletal material. More common is spina bifida occulta, a partial failure of closure, which is usually asymptomatic and can occur in approximately 10% of modern populations[151] although lower frequencies of approximately 2.7% have been reported for some early British samples.[152]

At Lankhills 1967–72 this condition was seen in five individuals. In one skeleton, the male aged *c.*27 in LH 304, the condition was quite severe, as the neural canal of the sacrum was completely open except for a bridge of bone at the level of the third foramen (Illus.2.51). In three other cases (LH 66, LH 141, LH 281) spina bifida occulta was present superiorly to the level of the second sacral vertebral segment. Finally, in LH 97 the condition was found on the inferior portion of the sacrum, up to the level of S2.

Congenital hip dysplasia

Congenital hip dislocation, or dysplasia, is a relatively common condition with an incidence of approximately 10 to 20 per 1,000 live births in modern populations.[153] At Lankhills 1967–72 this condition was seen in two skeletons, a young adult male in LH 107, and a female who was part of a mixed assemblage of bones in LH 66 and cannot be associated for certain with that grave (Illus. 2.52). Both of these individuals exhibited the characteristic straight femoral neck angle and shallow acetabulum bilaterally, with a degree of femoral head flattening. In the case of LH 107 a possible cyst in the femoral head was revealed upon x-ray. Both skeletons also contained sacral anomalies.

Other

Four other examples of congenital or developmental anomalies deserve brief mention. These are a right-side synostosis of the sacroiliac in the male in LH 299, ankylosis of the talus and calcaneus in the male in LH 128, a bipartite patella in the male in LH 349, and a possible congenital anomaly producing generalized osteoporosis in a male in LH 309, although in this latter case alternative diagnoses must be considered as well, including the possibility of neurofibromatosis.

151 ibid. 29.
152 Brothwell and Powers 1968.
153 Sartoris 1995, cited in Roberts and Manchester 2005, 57.

Illus. 2.52. LH 66, female adult: possible congenital bilateral hip dysplasia reflected in (a) shallow acetabulum of the pelvis as well as (b) in the straight femoral neck angles and mild femoral head flattening.

viii. DISCUSSION

Summary

In summarizing the pathology of this sample, it is important to note what was *not* found. Among traumatic pathology there was no evidence for sword cuts or injuries from other weapons, although deliberate blows to the head may have been represented. Almost all fractures, with the exception of the three found on the skull, could be explained by falls or jumps. Contrary to other reports,[154] no osteomyelitis was found. While there was some evidence for rickets, no scurvy was detected, nor was there any tuberculosis, leprosy, or treponemal disease.[155] Although there were a plethora of benign neoplasms, no malignancies could be identified. One must be careful with these data, however. All of these conditions may have been present in this population at low levels, but either not in the skeletons comprising this sample, or not identifiable in existing skeletons. Most individuals in the Lankhills 1967–72 sample died of unknown causes. Many of those individuals probably died of acute infections that killed them rather quickly. Only chronic, long-lasting infection will leave its mark on bone.

The detectable pathology at Lankhills 1967–72 does give some useful indications of the lifestyles and levels of biological stress encountered by the inhabitants of *Venta Belgarum*. It was particularly notable that fracture was four times as common in men's bones as in women's, and over twice as many individual men had broken at least one bone. While no instances of multiple fractures were found in women, almost half the men with broken bones had more than one fracture. These findings suggest much higher and more risk-laden activity levels for males than for females. However, given that no evidence for weapon injuries was found, and that the distributional pattern of fracture by bone was essentially the same for both sexes, the higher frequency seen in males was unlikely to be due to organized conflict in any form, and instead may have been related to occupational conditions or the hazards of more demanding daily activities. It should be noted further that the most common fracture sites were the clavicle, tibia, and fibula, with an almost total absence of broken arms.

The findings regarding osteoarthritis lend some support to these conclusions. However, research in recent years has shown that the aetiology of osteoarthritis may be multifactorial, related not only to age at onset and activity levels, especially when young, but also genetic influences, weight, and sex differences resulting from hormones, body size, and anatomy.[156] Thus caution in interpreting the findings in skeletal samples is warranted. Osteoarthritis in the major joints at Lankhills 1967–72 tended to concentrate in the shoulders, hips, and feet with no meaningful differences in distribution detectable by sex. Osteophytosis in the spine, however, was twice as common in males, most frequently in the lumbar vertebrae, and with the most frequent age at onset in the fourth decade of life. This suggests that there may have been a similar underlying biological pattern for both men and women, but with a high premium on activities such as extensive walking or carrying

[154] Clough and Boyle 2010, 401; Gowland 2004, 141. In addition to LH 283, discussed above, Gowland also asserted that LH 373 had osteomyelitis in his tibia and fibula. Upon re-examination of the bones, we found no evidence of osteomyelitis. The report indicated that a third individual was also found with this pathology, but since no grave number was given, it could not be re-evaluated. Thus our original findings stand.

[155] But see below, p. 139.

[156] Weiss and Jurmain 2007.

TABLE 2.71

Occurrence of dental and skeletal anomalies listed by burial, Lankhills 1967–72

(+ indicates present)

Grave	DENTAL ANOMALIES					SKELETAL ANOMALIES		
	M3 agenesis	Other agenesis	Crowding, impaction	Carabelli's cusp	Retained deciduous	Metopic suture	Transitional vertebrae	Sacrospinal fusion defects
16	–	–	–	–	–	–	–	+
18	+	–	–	–	–	–	–	–
20	–	–	+	–	–	–	–	–
24	+	–	–	–	–	–	–	–
25	+	–	–	–	–	–	–	–
31	+	–	–	–	–	–	–	–
35	–	–	–	–	–	–	–	+
36	+	–	–	–	–	–	–	–
38	+	–	–	–	–	–	–	–
48	–	–	+	–	+	–	–	–
50	+	–	–	–	–	–	–	–
51	–	–	–	–	–	+	+	–
52	+	–	–	–	–	–	–	–
53	+	+	–	–	+	–	+	–
66	–	–	–	–	–	–	–	+
74	+	–	–	–	–	–	–	–
76	–	–	–	–	–	–	+	–
78	+	–	–	–	–	–	–	–
86	–	–	–	–	–	+	–	–
90	–	–	–	+	–	–	–	–
94	+	–	–	–	–	–	–	+
97	–	–	+	–	+	–	–	+
98	–	–	+	–	–	–	–	–
101	–	–	–	–	–	–	+	–
104	–	–	+	–	+	–	+	–
109	–	–	+	–	–	–	–	–
111	–	–	–	–	–	+	–	–
118	–	–	–	–	–	–	+	–
123	–	–	–	–	–	–	–	+
128	+	–	–	–	–	–	–	–
130	–	–	+	–	–	–	–	–
132	–	–	–	+	–	–	–	–
133	+	–	–	–	–	–	–	–
136	–	–	–	+	–	–	–	–
140	–	–	–	–	–	+	–	–
141	–	–	–	–	–	–	–	+
150	+	–	–	–	–	–	–	–
154	–	–	–	+	–	–	–	–
155	–	–	–	+	–	–	–	–
160	–	–	–	–	–	–	+	–
161	+	–	–	–	–	–	–	–
163	–	–	–	–	–	+	–	–
164	–	–	–	+	–	–	–	–
168	–	–	–	–	–	–	–	+
175	–	–	–	–	–	+	–	–
177	–	–	–	+	–	–	–	–
179	–	+	–	+	+	–	–	–
188	–	–	–	+	–	–	–	–
192	+	–	–	–	–	–	–	–
214	+	–	–	–	–	–	–	–
218	+	–	–	–	–	–	–	–
219	–	–	–	–	–	+	–	–
220	+	–	–	–	–	–	–	–
225	+	–	–	–	–	–	–	–
227	+	–	–	–	–	–	–	–

TABLE 2.71 (*cont.*)

Grave	DENTAL ANOMALIES					SKELETAL ANOMALIES		
	M3 agenesis	Other agenesis	Crowding, impaction	Carabelli's cusp	Retained deciduous	Metopic suture	Transitional vertebrae	Sacrospinal fusion defects
233	+	–	–	–	–	–	–	–
248	+	–	–	–	–	–	–	–
249	+	–	–	–	–	–	–	–
250	–	–	–	+	–	–	–	–
256	–	–	–	–	–	+	–	–
257	–	–	–	+	–	–	–	–
266	–	–	–	–	–	+	–	–
270	–	–	+	–	–	–	–	–
272	–	–	–	–	–	–	+	–
273	–	–	–	–	–	+	+	–
281	–	–	–	–	–	–	+	+
287	–	+	+	–	+	–	–	–
290	–	–	–	+	–	–	–	–
291	–	–	–	–	–	–	+	–
304	+	–	–	–	–	–	–	+
306	–	–	–	–	–	+	+	–
307	+	–	–	–	–	–	–	–
319	+	–	–	–	–	–	–	–
330	–	–	–	–	–	+	–	–
335	–	–	+	–	–	–	–	–
340	–	–	+	–	–	–	–	–
343	+	–	+	–	+	–	–	–
349	+	–	–	–	–	–	–	–
362	+	–	–	–	–	–	–	–
365	–	–	+	–	–	–	–	–
377	–	–	–	+	–	–	–	–
379	–	–	–	–	–	+	–	–
380	–	–	–	–	–	+	–	–
386	+	–	–	–	–	–	–	–
397	–	–	+	–	–	–	–	–
398	–	–	–	–	–	+	–	–
402	+	–	–	–	–	–	–	–
407	–	–	–	–	–	–	+	–
410	–	+	–	–	–	–	–	–
414	–	–	–	–	–	–	–	+
415	+	–	–	–	–	–	–	–
427	–	–	–	–	–	+	–	–
443	+	–	–	–	–	–	–	–
445	+	–	–	–	–	–	–	–

large loads that over time would have placed heavy stresses on the shoulders, lumbar region, hips, and legs. Superimposed on this pattern shared by men and women was a clear image of male differences that may have been at least partly related to more demanding and stressful activity levels. The fracture data discussed above show essentially the same pattern.

The metabolic and deficiency data indicate a relatively healthy population, at least for the period. Children were probably under some level of iron or folate-deficiency stress, as reflected in the cribra orbitalia data, but it tended to be relatively mild. There could have been many causes, but intestinal parasites must be among the prime suspects. Clear cases of osteoporosis were infrequent and with two exceptions were confined to older individuals. Other diseases indicative of nutritional deficiencies were rare. The absence of scurvy has been mentioned. Only two children and one adult bone were diagnosed with possible cases of rickets, and even those findings must remain somewhat tentative. Non-specific periostitis was also relatively uncommon. While the aetiology of this condition is unclear, its presence at high frequencies in a population does tend to suggest a compromising factor for the health status of that population. This condition was a minor stressor at Lankhills 1967–72.

Congenital and developmental anomalies may have a number of causes, but there is reason to think that there is a strong genetic component.[157] Even allowing for significant input from environmental or developmental factors, these traits may be useful in helping to identify possibly related individuals, and so contribute to our understanding of mortuary patterns and the cultural choices individuals made when burying their dead. DNA sampling, although potentially a more powerful tool, was not available when data for this study were originally collected.

Spatial organization of possibly related individuals in the 1967–72 excavations

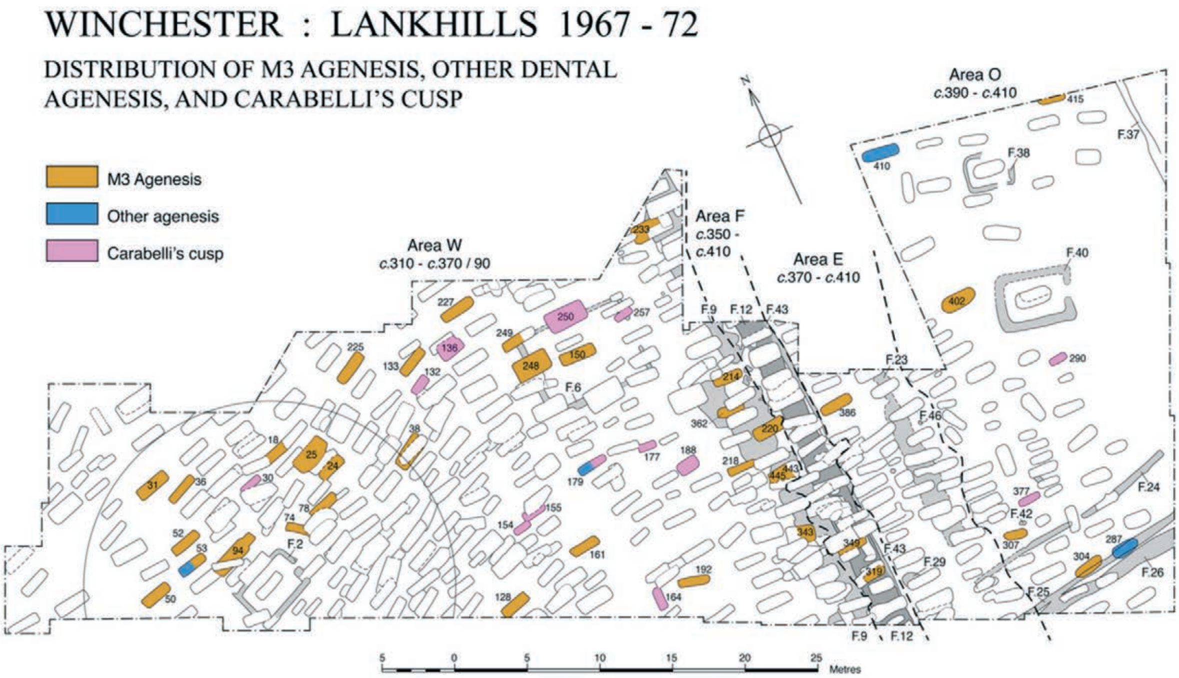
In a preliminary attempt to determine if burial clusters could be identified within the larger cemetery, congenital anomalies of the spine, especially spina bifida occulta and lumbosacral anomalies, as well as metopism and certain dental anomalies including crowding, rotation, congenital absence, and the presence of Carabelli's cusp (in subadults only—adult dentition was usually too worn to score this trait reliably) were plotted on a series of site plans (Illus. 2.53–2.55) and are listed by individual burial in Table 2.71.

The results indicated that the spatial distribution of these traits was uneven throughout the cemetery, and was generally far more common west of Feature 9. Indeed, 35% of all sacral and vertebral anomalies, including 43% of those occurring in females, were found within an arc radiating 12.5 metres from the centre of LH 100 in Feature 2. This radius is rather arbitrary, and was chosen to contain what appeared to be a spatially related cluster of traits. The density of distribution of these anomalies thins noticeably as one moves to the east of this arc, with the single exception of a concentration of dental variants found in the thick cluster of graves along Features 9 and 12.

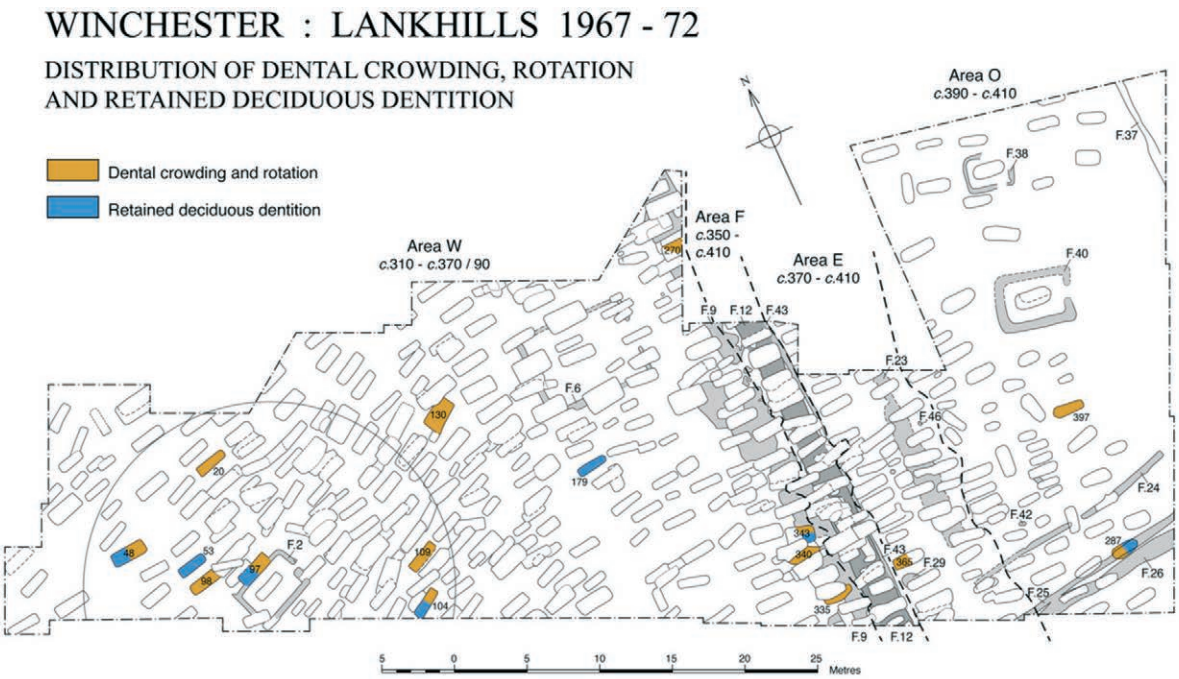
Six potential groupings emerged, ranging from two to six individuals, and possibly more. Four of these groupings were associated with features (F.2, F.6, F.9 and F.42), while another group tended to support Clarke's hypothesis that at least some graves were organized in lines head to foot rather than rows side by side.[158] The remaining group was not associated with any feature, but may have been part of a short line of graves.

Features 2 and 6 each had a central burial that was probably enclosed with a hedge. Numerous other graves intersected the borders of these features at some time after the hedge trenches were established. Three individuals associated with Feature 2 (LH 66, LH 97, and LH 101) showed sacral anomalies that may indicate a genetic relationship. LH 66 may have predated the cutting of the bedding trenches for Feature 2, as the boundaries of the feature appeared to respect the western edge of this grave.[159] Dated to approximately 310–350, it contained a female who had both congenital hip dysplasia and spina bifida occulta. Spina bifida occulta was also found in a second individual associated with this feature, a male buried in LH 97. This grave, dated to 330–370/90, was later than LH 66 and had been dug into the northern hedge bedding trench of the enclosure. The third individual was a female buried in LH 101, dated to 370–390, and cutting the western bedding trench of

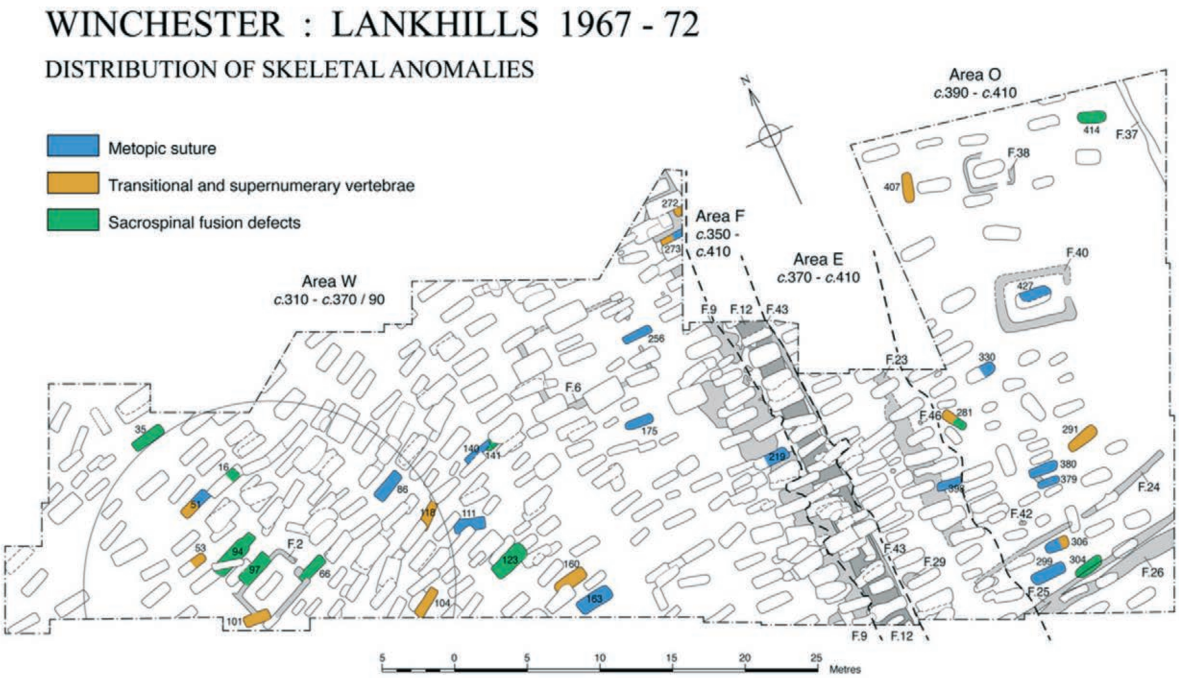
[157] Zimmerman and Kelley 1982, 6.
[158] WS 3.ii, 185.
[159] ibid. 96.



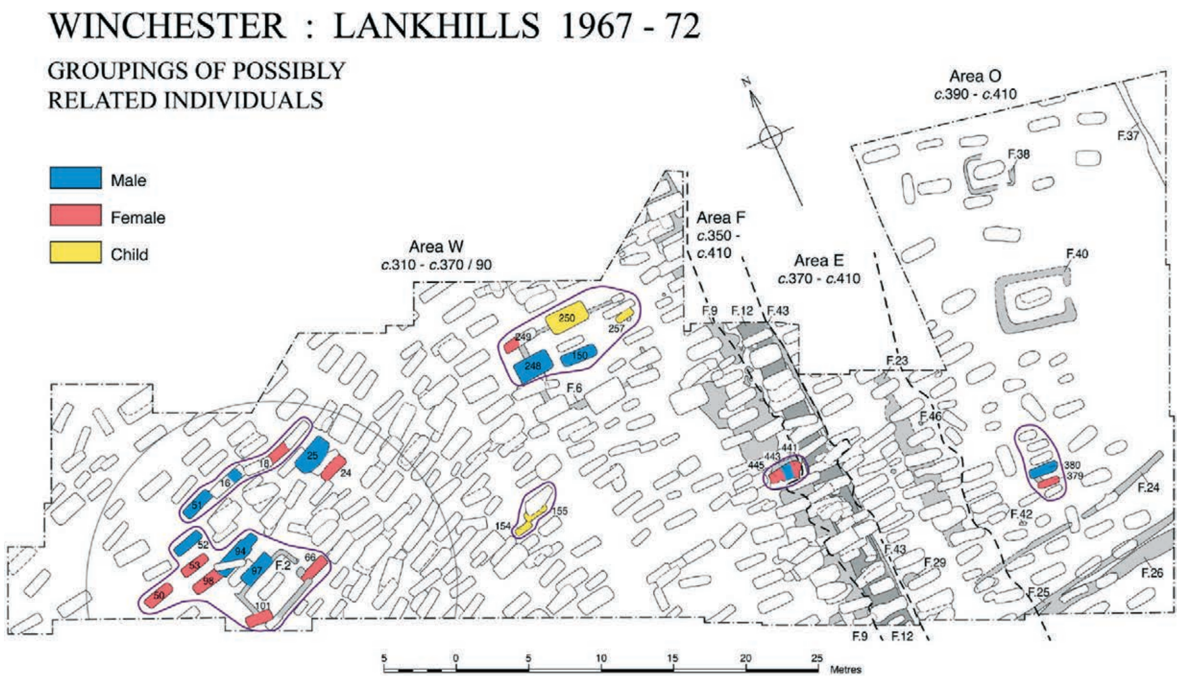
Illus. 2.53. Distribution of M3 agenesis, other dental agenesis, and Carabelli's cusp, Lankhills 1967–72.



Illus. 2.54. Distribution of dental crowding, rotation, and retained deciduous dentition, Lankhills 1967–72.



Illus. 2.55. Distribution of skeletal anomalies, Lankhills 1967–72.



Illus. 2.56. Groupings of possibly related individuals, Lankhills 1967–72.

the enclosure. This woman also had a sacral anomaly, but in her case it was a sixth sacral vertebra, making the relationship somewhat tentative. It was not possible to make further observations on her sacrum.

Within the 12.5 metre arc described above, five other individuals were found with vertebral and sacral anomalies. Two of these, an older male in LH 94 and a female aged approximately 30 in LH 53, were both located slightly to the north of Feature 2 and probably predated it. In addition to their spinal anomalies, both of these individuals appeared to have congenital absence of at least one third molar. This same trait (M3 agenesis) was also found in LH 52, immediately adjacent to the north side of LH 53, and also in LH 50, slightly to the west. LH 97 shared dental crowding and rotation with LH 98, which was intersected by LH 94. Thus these eight graves[160] may have contained individuals who had some relationship with each other, although this is certainly not proven. The case may be particularly strong for positing a genetic relationship between LH 53, LH 94, and LH 97, as all three of these skeletons exhibit both dental and skeletal anomalies. Since the young female (LH 100) buried in the centre of Feature 2 apparently shared none of these characteristics, the importance of this clustering close to the feature must remain obscure.

A number of other individuals within the area described by the 12.5 metre arc, but further removed from Feature 2, shared similar variants with the group close to Feature 2. Seven other individuals exhibited M3 agenesis, there were four other cases of sacro-vertebral anomalies, and three cases of dental rotation, crowding, or retained deciduous dentition. Although not found in the burials more closely associated with Feature 2, there were also two examples of metopic sutures and two juveniles with Carabelli's cusp.

Feature 6 also enclosed a burial. The central grave, LH 150, was that of a male aged approximately 40 who had M3 agenesis. This trait was also found in two later graves (LH 248, LH 249) associated with the feature. LH 248, containing a male aged 25–30, was cut into the bedding trench on the western side of the feature, and was part of a cluster of graves dug into the feature at this location. LH 249, cut into the north-western corner of the feature, contained an elderly female. Two other graves cut into Feature 6 may have contained subadults related to each other, but no relationship with the adults exhibiting M3 agenesis can be established. Both subadults exhibited Carabelli's cusp on the molars, a trait that is probably under strong genetic control.[161] The first, in LH 250, was an adolescent aged approximately 17 to 19. The skeleton was too fragmentary to sex, but grave goods suggested the possibility that the individual may have been female.[162] The grave was dated to 330–350. The second burial (LH 257) was an infant of approximately 9 months. This grave was dated to 330–370/90. It is tempting to speculate that these burials represent a young mother and her child, but the relationship cannot be proven. The individuals could have been siblings, or even totally unrelated.

The third group was dug into Feature 9 and involved three burials, two of which were decapitations. The initial burial in this group, LH 443, dated to approximately 350–370 and buried with grave goods suggesting a military role,[163] was a young male who had M3 agenesis. A decapitated female in LH 445, aged 30–35, with no signs of this trait, was buried in the fill at the same time the male was buried. Subsequently LH 441, dated to approximately 370–390, was dug into the fill of these earlier graves. LH 441 contained a female aged approximately 35–40, buried with her head between her lower

[160] LH 50, LH 52, LH 53, LH 94, LH 97, LH 98, LH 101, and LH 66.

[161] Dahlberg, ed. 1971, 258.

[162] WS 3.ii, 57.

[163] ibid. 265 ff.

legs, face down. Like the male in LH 443, she also had M3 agenesis.

The fourth group was a row of six burials,[164] two of which (LH 379 and LH 380) were immediately next to each other and were both superimposed on Feature 42. Both of these graves were dated to the latest phase of the site, 390–410, and were buried—probably not in coffins—without grave goods except for hobnails. Both individuals, the female in LH 379 and the male in LH 380, were 35 or older, and both had full metopic sutures. The female had been decapitated, and her head was placed to the left of her knees.[165] The remaining burials in what was apparently a row of burials were all children, and all dated to the same time period as the two adult burials. There was no skeletal evidence to link them with each other, or with the two adult burials, but the spatial and chronological proximity of the individuals in this row suggests they had some culturally sanctioned relationship with each other.

Within the 12.5 metre arc described earlier were several distributions of graves that suggested lines of graves, rather than rows. One of the most conspicuous was a chain of graves running from LH 19 in the north-east to LH 51 in the south-west, and including LH 18, LH 17, LH 61, LH 16, LH 29, and LH 51. Two of these, the young male in LH 16 and the young male in LH 51, both exhibited sacro-vertebral anomalies. The female aged *c.*25 in LH 18 had M3 agenesis, as did two burials immediately to the south and next to each other, the female in LH 24 and the male in LH 25. LH 31 and LH 36, both females in their 20s in adjacent graves, also exhibited this trait.

The final group was in what appeared to be a line of at least three, and possibly four, burials. The second and third graves in the line (LH 154 and LH 155) contained children respectively aged approximately two and ten. These graves were chronologically quite close together, being dated to 310–370/90 (LH 154) and 310–350/70 (LH 155). Both of these children exhibited Carabelli's cusp and might have been related to each other. One, or possibly two, burials at the two ends of the line (LH 156 and LH 125) were both female. Although the Carabelli's trait could not be identified in either (partially for lack of evidence), the possibility of a family relationship with the children should be considered, based in part on the spatial relationship of the graves.

These findings are provisional and incomplete. By themselves they cannot establish genetic relationships of individuals, but the non-random nature of the clusterings suggests that further research in this area might prove fruitful. It appears that there were numerous choices regarding placement of the dead.

Comparison with the Lankhills 2000–5 excavations

The pathology found in the Lankhills 2000–5 excavations has been fully described in the publication of that site, and it is not our purpose to restate their findings here.[166] Rather, this section compiles selected results from both excavations at Lankhills in order to develop a fuller picture of the site as a whole. Inevitably, this effort is hampered somewhat by variations in analytical techniques and recording standards, and the differing states of preservation in the two skeletal collections. However, common ground can be found in some areas. The comparisons made here concentrate on trauma, osteoarthritis, other pathology, and congenital or developmental anomalies.

[164] LH 378, LH 379, LH 380, LH 382, LH 383, and LH 384.
[165] WS 3.ii, 81.
[166] Clough and Boyle 2010, 362–404.

TABLE 2.72

Frequency of fractures in the skull and long bones, Lankhills 1967–72 and 2000–5 combined

MALES	n/N	%	FEMALES	n/N	%
Skull, parietal	1/166	0.6	Skull, parietal	2/166	1.2
Skull, frontal	*1/39*	*2.6*	Skull, nasal	2/74	2.7
Skull, orbit	*1/39*	*2.6*			
Skull, nasal	8/95	8.4	Mandible	1/133	0.8
Clavicle, left	3/108	2.8	*Clavicle, left*	1/36	2.8
Clavicle, right	*1/55*	*1.8*	*Clavicle, right*	1/36	2.8
Clavicle, total	4/163	2.5	*Clavicle, total*	2/72	2.8
Humerus, right	3/153	1.9	Humerus, right	1/155	0.6
Radius	2/147	1.4	*Radius, left*	1/25	4.0
			Radius, right	1/124	0.8
			Total radius	2/149	1.3
Ulna, right	2/147	1.4			
Femur, right	1/161	1.6	Femur, right	1/161	0.6
Tibia, left	2/74	2.7	Tibia, left	1/155	0.6
Tibia, right	5/70	7.1	*Tibia, right*	1/49	2.0
Tibia, total*	11/312	3.5	Tibia, total	2/204	0.9
Fibula, left	2/19	10.5			
Fibula, right	5/19	26.3			
Fibula, total*	11/169	6.5			

italics = data from Lankhills 1967–72 only
bold = data from Lankhills 2000–5 only
* = total, both excavations. Percentages by side not available from Lankhills 2000–5.
Lankhills 2000–5 data from Clough and Boyle 2010, 365, Table 5.30.

Trauma

The combined total of fractures in both Lankhills excavations will be found in Table 2.72. For the site as a whole, 65 individuals (14.8%; 65/438) were diagnosed with fracture, of which 44 were males (19.8%; 44/222) and 21 were females (9.7%; 21/216). Fractures were more common in the 2000–5 sample (25.5% males, 13.8% females)[167] than in the 1967–72 excavations (15.5% males, 6.6% females), which probably has little significance in view of differences in preservation and age structure in the two samples. In the site as a whole, and both excavations separately, fracture in males was at least twice as common as fracture in females. With regard to the skull, nasal fractures were seen in both samples, although primarily in males in the 2000–5 excavations while only one nasal fracture, in a female, was seen in the 1967–72 sample. Expressed as a percentage, this was the most common fracture seen at Lankhills, although in absolute numbers, fractures of the fibula were more frequently found, and ribs were the most frequently fractured element in the 2000–5 excavations. While nine individuals from the 2000–5 excavations had fractured ribs,[168] only one individual with this pathology was found in the 1967–72 excavations, which may be partially attributable to less well preserved axial skeletons. The lack of arm fractures seen in the 1967–72 excavations was counterbalanced to some extent by the nine arm-bone fractures identified in the 2000–5 excavations. Again, factors of skeletal preservation may play a role in this apparent discrepancy.

[167] ibid. 363.

[168] ibid.

Illus. 2.57. LH 204, female age 22–25: (a) poorly aligned, healed fracture of the distal third of the right tibia shaft and (b) radiograph of the right tibia showing the misalignment of the fracture ends, and the callus formed during healing.

Contrary to the preliminary findings in an earlier report, which suggested that fractures at Lankhills tended to be well aligned,[169] numerous misaligned fractures were seen in the Lankhills 1967–72 skeletons. The proportions were roughly the same as those found in the 2000–5 excavations, which indicated that over half of fractures were not well aligned.[170] In the 1967–72 excavations 15 males and five females exhibited fractures other than compressed vertebrae. In seven males and all the females, these fractures were misaligned (Illus. 2.57). The misalignments occurred primarily in fracture sites that are difficult to stabilize, such as orbits, nasal bones, or clavicles; or in long bones that would be difficult to align and immobilize without the use of traction or surgery, such as femora (where spasm of the large muscles in the thigh can

[169] Gowland 2004, 143.

[170] Clough and Boyle 2010, 363.

cause fractured elements to override each other), or spiral fractures affecting both the tibia and the fibula. Simple fractures of a single bone tended to heal in anatomically normal position, presumably with the assistance of the medical technology available at the time.

Other trauma seen in these samples included myositis ossificans traumatica, osteochondritis dissecans, and ossified haematoma (see Table 2.73). Myositis ossificans traumatica was found in a total of nine individuals; six in Lankhills 1967–72 and three in Lankhills 2000–5. Clear cases of osteochondritis dissecans were found in two individuals site-wide, with possibly an additional six in Lankhills 2000–5, although those diagnoses were more tentative. Three ossified haematomata, apparently unrelated to other pathology, were found: two in Lankhills 1967–72 and one in Lankhills 2000–5.

It is also worth noting the significant numbers of amputations and decapitations found at Lankhills. The site as a whole has produced evidence of amputations in four individuals, including fingers and a bilateral forefoot transmetatarsal amputation at Lankhills 1967–72,[171] and two individuals with fingers amputated at Lankhills 2000–5.[172] A total of 13 decapitated individuals was found in the two assemblages, including men, women, and children. Discussed more fully elsewhere,[173] these represent 1.9% (13/691) of the total sample, or almost two out of every 100 individuals.

Osteoarthritis and related conditions

A total of 95 adults representing 20.2% of the combined Lankhills 1967–72 and 2000–5 adult samples exhibited some degree of vertebral osteophytosis. Of these, 47 were found in Lankhills 1967–72 material, and 48 in the Lankhills 2000–5 sample.[174] Given the fact that many individuals could not be scored for this pathology, especially in the Lankhills 1967–72 skeletons, this figure is likely to under-represent the true occurrence of the condition. In both samples it was more common in males than females and while the lumbar vertebrae were most heavily affected in the Lankhills 1967–72 sample, the thoracic vertebrae most frequently exhibited osteophytosis in the 2000–5 sample. However, these differences are not likely to be meaningful given the relatively small proportion of adults overall who could be evaluated for this pathology.

Although DISH might be caused by a metabolic disturbance, its effect on the spine can be pronounced. Eight probable cases of DISH were identified in the two samples (see Table 2.73), and represent a minimum of 1.7% of the adult sample.

Fifty-four adults (CPR 18.4%; 54/293) in Lankhills 1967–72 were affected by extraspinal osteoarthritis, as were 24 adults (CPR 10.9%; 24/220) from Lankhills 2000–5.[175] For the site as a whole, 78 adults were diagnosed with osteoarthritis in various non-vertebral joints, giving a CPR of 15.2% (78/513). In both samples males exhibited approximately two to three times the frequency of extraspinal osteoarthritis as females. The percentages for both sexes were higher in the Lankhills 1967–72 excavations than in the Lankhills 2000–5 sample, which may reflect slightly different analytical techniques used by different researchers. The CPR found for males was 31.3% (40/128) at Lankhills 1967–72 and 15.9% (15/94) at Lankhills 2000–5, while the corresponding numbers for females were 11.5% (14/122) and 8.5% (8/94). The Lankhills 2000–5 report distinguished between extraspinal osteoarthritis and degenerative joint disease[176] while this report evaluated them as a

[171] See above, pp. 98–100.
[172] Clough and Boyle 2010, 368.
[173] See above, pp. 101–6, and Ch. 6, pp. 147–72.
[174] Clough and Boyle 2010, 375–6.
[175] ibid. 379.
[176] ibid. 375, 379.

TABLE 2.73

Pathology other than fracture and osteoarthritis, Lankhills 1967–72 and 2000–5

Pathology	1967–72	2000–5*	Total
TRAUMA			
Joint dislocation	1	0	1
Myositis ossificans traumatica	6	3	9
Avulsion injury	0	1	1
Osteochondritis dessicans	1	1 (6?)	2 (6?)
Ossified haematoma	2	1	3
Amputation	2	2	4
Decapitation	9	4	13
METABOLIC AND DEFICIENCY DISEASES			
Diffuse idiopathic skeletal hyperostosis	5	3	8
Porotic hyperostosis	2	6	8
Cribra orbitalia	29	40	69
Osteoporosis	6	0	6
Rickets	3	5	8
Scurvy	0	5	5
Bowing deformities, long bones	4	0	4
Hyperostosis frontalis interna	1	5	6
INFECTIOUS AND INFLAMMATORY DISEASES			
Mastoiditis	2	0	2
Non-specific periostitis, tibia	5	16	21
Sinusitis	1	26	27
Non-specific pulmonary disease	0	2	2
TUMOURS AND RELATED PATHOLOGY			
Osteochondroma	2	0	2
Osteoma	18	5	23
Cyst	3	0	3

*Clough and Boyle 2010, 362–394.

single entity. If the Lankhills 2000–5 numbers for degenerative joint disease and extraspinal osteoarthritis are added together, the resulting sample consists of 30 adult males and 14 adult females, indicating that these figures are actually most comparable to Lankhills 1967–72. If so, this would suggest a combined CPR for adult males of 31.5% (70/222) and for females of 13.0% (28/216). Taking this into account, the distributional pattern of extraspinal osteoarthritis in both samples is very similar: the greatest occurrence is seen in hips, followed by shoulders, other joints of the upper body, and feet.

Other pathology

Table 2.73 summarizes other pathology in both Lankhills excavations. In this discussion we will concentrate on cribra orbitalia, possibly indicative of anaemia; rickets and scurvy, which suggest nutritional deficits; and non-specific periostitis, which represents an inflammatory reaction of unknown aetiology.

Cribra orbitalia were diagnosed in 71 individuals, 31 of whom came from the Lankhills 1967–72 excavations while the remaining 40 individuals were found in the Lankhills 2000–5 sample (see Table 2.74). This represents 15% and 14.3% of those samples respectively, and 14.7% of the site overall. In both samples children were more frequently affected than adults. For Lankhills as a whole 12% (36/382) of the adults and 24.8% (25/101) of the subadults were found to have this condition. For total Lankhills, females were slightly more likely to have cribra orbitalia than males (16.2% females; 13.9% males), a figure that is being driven by the

TABLE 2.74

Frequency of cribra orbitalia, Lankhills 1967–72 and 2000–5

	1967–72	2000–5	Lankhills combined
Site total	31/204 (15%)	40/279 (14.3%)	71/483 (14.7%)
Adult	20/167 (12%)	26/215 (12.1%)	46/382 (12.0%)
Subadult	11/37 (30%)	14/64 (21.9%)	25/101 (24.8%)
Male	11/80 (14%)	9/64 (14%)	20/144 (13.9%)
Female	9/84 (12%)	18/53 (33 %)	27/137 (16.2%)

Lankhills 2000–5 data from Clough and Boyle 2010, 393.

TABLE 2.75

Frequency of non-specific periostitis, Lankhills 1967–72 and 2000–5

	1967–72	2000–5	Lankhills combined
Site total	7/411 (1.7%)	24/284 (8.5%)	31/695 (4.5%)
Adult	7/293 (2.3%)	20/220 (9.1%)	27/513 (5.3%)
Subadult	0/118 (0.0%)	4/64 (6.3%)	4/182 (2.2%)
Male	4/128 (3.1%)	10/94 (10.6%)	14/222 (6.3%)
Female	2/122 (1.6%)	8/94 (8.5%)	10/216 (4.6%)
Adult, sex indeterminate	1/43 (2.3%)	2/32 (6.3%)	3/75 (4.0%)

Lankhills 2000–5 data from Clough and Boyle 2010, 383.

greater frequency in females in the Lankhills 2000–5 sample. The difference between males and females is not statistically significant in Lankhills 1967–72 (14% males; 12% females), suggesting that the difference seen in the site as a whole is also not likely to be significant, although that has not been tested. In both samples, the majority of individuals appears to have had relatively mild manifestations of cribra orbitalia, with only approximately 25.5% (14/55) evincing more advanced forms. This figures must be considered somewhat tentative, however, as slightly different methods of scoring were used in the two collections.[177]

Rickets, scurvy and tuberculosis were all probably present at Lankhills, but at relatively low levels (see Table 2.73). Scurvy and tuberculosis were not diagnosed in the Lankhills 1967–72 sample, and rickets was seen more often in Lankhills 2000–5 than in Lankhills 1967–72. This may reflect, at least in part, the better state of bone preservation in the more recent excavations, making identification of these diseases more possible. In both samples, symptoms of rickets were seen more frequently in children (2/3 in Lankhills 1967–72; 3/5 in Lankhills 2000–5[178]). All the individuals found with possible cases of scurvy in Lankhills 2000–5 were children, three of whom were a year old or less.[179] Two cases diagnosed as non-specific lung disease were identified at Lankhills 2000–5. While they might have represented cases of tuberculosis, the evidence was inconclusive.[180]

Non-specific periostitis was found in seven individuals at Lankhills 1967–72 and 24 individuals at Lankhills 2000–5.[181] Both the absolute number and the Crude Prevalence Rate were much higher in the later excavations. This may be explained by the fact that bone surfaces on surviving elements were often badly eroded in

[177] Clough and Bozie 2010, 393. [178] ibid. 390. [179] ibid. 392.
[180] ibid. 387. [181] See Table 2.75.

the Lankhills 1967–72 skeletons, thus obliterating evidence of the condition. The overall CPR for the site was 4.5% (31/695). Males were affected twice as often as females in Lankhills 1967–72, but the proportions were more nearly equal in Lankhills 2000–5. Four cases of non-specific periostitis in subadults were identified in Lankhills 2000–5,[182] but none were seen in children in the earlier excavations. In both samples, non-specific periostitis was seen most frequently in the tibiae, affecting eight bones in four individuals at Lankhills 1967–72 and 16 of 323 bones at Lankhills 2000–5.[183]

Congenital and developmental anomalies

Most of the congenital and developmental anomalies seen in the Lankhills 1967–72 sample were also reported in the Lankhills 2000–5 skeletal series. Of particular note is the occurrence of a full metopic suture, which was reported in 9.1% (16/175) of the sample in Lankhills 1967–72 and 9.2% of the sample (23/251) in Lankhills 2000–5.[184] In the earlier excavations 8.6% (8/93) of the males were affected, while a full metopic suture was seen in 9.8% (8/82) of the females. Figures by sex were not given for the Lankhills 2000–5 sample. When the two samples were combined, the frequency of metopism at Lankhills was 9.2%.

In other anomalies, spondylolysis of L5 (or L6 in the case of two individuals from Lankhills 2000–5)[185] was seen in seven skeletons, two from Lankhills 1967–72 and five from Lankhills 2000–5. Sacralization of L5 was found in six skeletons at Lankhills 1967–72, and occurred in three at Lankhills 2000–5, yielding a total of nine for the site as a whole. Lumbarization of the first sacral vertebra was reported six times for the whole site, once from the 1967–72 excavations and in five cases from the 2000–5 excavations. Spina bifida occulta was seen only once in Lankhills 2000–5, but was found in five sacra at Lankhills 1967–72, totalling six for the whole site.

Comparison with other Romano-British sites in Winchester and elsewhere

The comparison of pathology in different skeletal series is heavily dependent upon many factors. Different states of bone preservation strongly affect the outcome of these investigations. The interests or training of different researchers, and the questions considered archaeologically significant, shift over time. These shifting interests and research strategies can result in unavoidably comparing data that are not fully equivalent when trying to assess the similarities or differences in the pathology reported at different sites. Inter-observer variance can also be a factor. Diagnosing pathology in the living can be a challenge. In skeletal material it becomes even more problematic, the more so as the signs and symptoms of past pathologies may have differed somewhat from those of the same conditions today, creating an additional compounding factor.

For these reasons, comparisons of the Lankhills material with other sites concentrate on a limited number of sites, and limited types of pathology. Where possible, the site of Lankhills is treated as a whole, using the combined results from the 1967–72 and 2000–5 excavations. The other Winchester Romano-British cemeteries are also treated as a unit. The attempt is made to draw very broad general comparisons in order to begin to address basic issues. Were the Lankhills people healthier than their peers? Were their nutritional levels better or worse? How physically stressful or violent were their lives compared to their contemporaries? These questions cannot be answered conclusively. However, we can begin to get quick glimpses of possible answers, and inevitably, to generate even more questions.

182 Clough and Boyle 2010, 383.
183 ibid. 383.
184 ibid. 360.
185 ibid. 370.

In addition to the other Winchester Romano-British cemeteries, the five cemeteries used for comparison here are Poundbury; Cannington, Phase 2; Butt Road, Colchester; Cirencester; and Trentholme Drive, York. These sites overlap chronologically, but are separated geographically and served very different kinds of communities. Poundbury, in Dorset, is the most directly comparable to Lankhills, but there were important distinctions between the two communities, both in religious orientation and economic base. Poundbury appears to have been primarily Christian in burial ritual and serving a rural community, while Lankhills represented primarily, if not exclusively, pagan interments in an urban environment.

There was no convincing evidence for blade-induced trauma at Lankhills, and little, if any, at Poundbury.[186] However, at Lankhills the seven (CPR 1.6%) cranial and facial fractures found may have been the result of direct aggression, either with a blunt instrument or by a blow to the face. A slightly higher rate of cranial fracture was found in the other Winchester cemeteries (n=5; CPR 2.5%).[187] There were also healed cut marks on two individuals (one from the Northern cemetery and one from the Eastern cemetery) and unhealed cut marks on a third individual from the Eastern cemetery, suggesting possible blade injuries.[188] Four skull fractures were found at Colchester,[189] while eight were seen at Cannington.[190] At Cirencester, a military garrison, there were many head injuries due to sword cuts or lance thrusts, as well as evidence for aggression in the angle at which numerous ribs had been fractured.[191] At Trentholme Drive one fracture might have been associated with an open wound, but there were no clear weapon injuries, although the author was tempted to attribute a military source to many of the fractures based on the fact they all occurred in men over the age of 35.[192]

A common attribute shared by all these sites was the far higher frequency of fracture in males as opposed to females. The ratio was over 2:1 at Lankhills by bone and by individual, approximately 1.5:1 at the other Winchester cemeteries,[193] over 3:1 at Cirencester, 2:1 at Poundbury, and all fractures were found only in males at Trentholme Drive. Fractures were also more common in males at Colchester and Cannington, with the notable exception that females more often had 'non-accidental' fractures of the skull and ulna at Colchester.[194] However, there were some interesting differences in the distribution of fractures. The most common sites for postcranial broken bones at Lankhills were fibulae, tibiae, and clavicles. The most common sites in the other Winchester cemeteries were fibulae, ribs, and tibiae.[195] This pattern was also noted at Poundbury (rib fractures were not quantified),[196] although the fracture percentages in males for fibulae and tibiae at Lankhills was greater by approximately 1%, suggesting that men at Lankhills may have been exposed to greater sources of physical risk than men at Poundbury. Although ribs were the most frequently fractured bone at Cirencester, the frequency of tibia and fibula fracture for males was very similar to that at Poundbury.[197] Directly comparable figures were not available for Trentholme Drive. At Colchester the number of fractures in bones of the arms and legs was approximately equal,[198] while at Cannington legs and feet were the most common sites of fracture, in addition to skulls.[199]

186 Molleson 1993, 203.
187 Bonsall 2011, 5.
188 Browne 2012, Table 31.
189 Pinter-Bellows 1993, 76.
190 Brothwell et al. 2000, 208.
191 Wells 1982, 161–3.
192 Warwick 1968, 151.
193 Bonsall 2011, 4.
194 Pinter-Bellows 1993, 76.
195 Bonsall 2011, 4.
196 Molleson 1993, 204.
197 Wells 1982, 168.
198 Pinter-Bellows 1993, 76.
199 Brothwell et al. 2000, 207–8.

Decapitations were found at Poundbury, Lankhills, and Cirencester, and are discussed more fully above[200] and in Chapter 6. Two possible decapitations were found in the other Winchester cemeteries.[201] The technique of decapitation varied, both within Lankhills[202] and at other sites. Front to back decapitation seen in four skeletons at Lankhills appeared similar to Poundbury, but the treatment of the deceased with regard to location in the cemetery varied between the two sites, suggesting different ritual considerations may have been involved. The six decapitations at Cirencester (five male, one female) were quite different, except from one of the Lankhills decapitations. The heads had been placed in anatomical position at the top of the spine, and the decapitation was accomplished with a sharp blow from back to front in all except one case.[203] Decapitations were notably absent at the other three sites, although decapitations were found at other locations in Colchester.[204]

Osteochondritis dissecans, found in only two skeletons (but possibly six others) at Lankhills and not mentioned at all at the other Winchester cemeteries or Poundbury, was seen in 39 individuals at Cirencester, primarily in the foot and knee, and with a 2:1 ratio of males over females. Only one very questionable case was noted at Cannington, but 26 cases were reported at Colchester, with a male to female ratio of approximately 1.5:1, and found most commonly in the ankle. Since this condition, although poorly understood, may have both a genetic and traumatic component, the different frequencies at these sites may reflect both different activity patterns and different population structures.

When comparing arthritis in these samples, it should be noted immediately that while rheumatoid arthritis was found at Trentholme Drive, it was not diagnosed at Lankhills, the other Winchester cemeteries, Poundbury, or Cirencester. Nor was it reported at Cannington or Colchester. This fact may relate more to conditions of preservation and difficulties in making the diagnosis than to the actual frequency in these populations, which must remain unknown.

Osteoarthritis in skeletons had a very high frequency of occurrence in these samples, although Lankhills had one of the lowest rates seen, affecting 20% of the adult sample. However, these numbers are unquestionably affected by the very small sample sizes, especially at Lankhills 1967–72, due to preservation factors. At Cirencester the probable rate in adults approached 80%,[205] while at Trentholme Drive almost all adult skeletons were somewhat affected.[206] At Colchester osteoarthritis was reported in 56% of adults, with a frequency of 61% in males and 46% in females.[207] Cannington reported an overall frequency of joint disease in approximately 30% of adults, but it should be noted that the figures from Cannington include vertebral osteophytosis as well as osteoarthritis of the vertebral articular surfaces and other joints. Osteoarthritis was slightly more common in males than females, with vertebrae, elbows, and knees most affected.[208] The Poundbury and Lankhills 1967–72 data were both handled somewhat differently, and overall rates are not directly comparable. However, some differences in pattern can be detected.

Approximately 15.2% of adults at Lankhills exhibited some degree of extraspinal osteoarthritis, although analytical differences preclude detailed pooling of the data from the two samples. Osteoarthritis in the major joints (shoulder, elbow, wrist, hip, knee, ankle) was

200 See above, pp. 101–6, and below, p. 170.
201 Browne 2012.
202 See above, p. 106.
203 Wells 1982, 108–9, 194.
204 Crummy et al. 1993, 194–6.
205 ibid. 151.
206 Warwick 1968, 160.
207 Pinter-Bellows 1993, 85.
208 Brothwell et al. 2000, 218–25.

distributed in a pattern that was essentially similar for both males and females at Lankhills 1967–72, with the hip and shoulder most frequently affected. There were more examples of osteoarthritis in the elbows, wrists, knees, and feet of males, and a higher total number of cases, but it is not clear that these findings reflected a real gender difference. They may have been affected by differential bone preservation, or differences in the age structure of the two sexes. The pattern in the Lankhills 2000–5 sample was slightly different, with osteoarthritis predominating in elbows, wrists, and hips. No analysis by sex was made. In the other Winchester cemeteries, arthropathy in the postcranial joints was seen in 26 individuals, most frequently in the wrist and hand (nine individuals), followed by the knee and the ankle and foot, with five each.[209] At Poundbury, males were more frequently affected overall, usually in the shoulders, wrists, hips, or ankles. The pattern for females varied, as they were far more frequently affected in the knee, suggesting a different activity pattern.[210] At Cirencester the overall distribution of osteoarthritis was fairly similar for males and females, with the notable exception that females were slightly more prone to problems in the knee. The author concluded that '. . . the Cirencester women probably performed a disproportionately high amount of the total heavy work load of the group'.[211]

Degenerative changes in the spine leading to vertebral osteophytosis were also found in these groups, but the true frequency cannot be quantified reliably at most of the sites. At all sites, this condition was found more frequently in males than females, with one exception. In the oldest age group at Colchester, vertebral osteophytosis was seen more frequently in females.[212] The other sites did not break down the frequency by age. There was little involvement of cervical vertebrae at either Poundbury or Lankhills 1967–72, and far more involvement of the lower back, although in males at both sites these lesions did appear more frequently along the whole spine than in females. At least at Lankhills 1967–72, the poor preservation of most spines made it impossible to judge whether this suggested difference by sex was meaningful. The Lankhills 2000–5 data for spinal osteophytosis suggest a slightly different pattern, with the highest frequency of occurrence found in the thoracic spine, followed by the cervical spine.[213] The peak age of occurrence was approximately the same at both Poundbury and Lankhills 1967–72, taking place in the 35–45 age group at Poundbury, and the 30–40 age group at Lankhills 1967–72. This was also peak frequency of occurrence at Cannington.[214] The data were not broken down by age at Lankhills 2000–5.

The most useful information for assessing the relative degree of nutritional stress in these groups is gained from examining the presence of porotic hyperostosis and cribra orbitalia, possibly indicative of iron-deficiency anaemia or megaloblastic anaemia, and the presence or absence of other nutritionally-related diseases such as rickets and scurvy.

Eight suspected cases of porotic hyperostosis were found at Lankhills, and one was seen in the other Winchester cemeteries.[215] The frequency of cribra orbitalia at Lankhills fell within the very wide range of variation found at a number of other sites, but tended to be somewhat lower than many. Of those skulls that could be evaluated, 14.7% of the total sample (24.8% of the children and 12% of the adults) were affected. Most lesions (74.5%) were mild or

209 Browne 2012.
210 Molleson 1993, 203.
211 Wells 1982, 159.
212 Pinter-Bellows 1993, 85–6.
213 Clough and Boyle 2010, 376, Table 5.35.
214 Brothwell et al. 2000, 223.
215 Browne 2012, Table 31.

moderate. Cribra orbitalia were reported for 26% of the individuals in the other Winchester cemeteries, but no breakdown by age was given.[216] The most important Romano-British site for comparative purposes is Poundbury Camp, where the frequency of cribra orbitalia reached 36.4% for juveniles and 26% for adults. Males and females were equally affected at Poundbury whereas there was a slight, but probably insignificant, predominance of females at Lankhills. However, there was greater severity of expression in the Poundbury material, and cribra orbitalia were accompanied by the vault lesions of porotic hyperostosis in a number of cases, whereas this latter condition was infrequent at Lankhills.[217] These findings suggest that the Lankhills population may have been under less metabolic stress related to iron-deficiency anaemia than the Romano-British occupants of Poundbury. Porotic hyperostosis and cribra orbitalia were not reported at Trentholme Drive, although they might have been present. A somewhat different pattern was reported at Cirencester.[218] Like Lankhills and Poundbury, juvenile frequency (35.1%) was high. However, the condition was 50% more common in men (19.9%) than in women (13.3%). As with Lankhills, most of the lesions (88.7%) were very mild. At Cannington, cribra orbitalia were reported for 34.6% of the 185 individuals who could be examined, with greater frequency found in juveniles and adolescents than in adults.[219] On the other hand, at Colchester very low frequencies of cribra orbitalia were reported—a total of 9.9%, almost equally divided between adults/juveniles and males/females in the adult sample. There was no evidence of porotic hyperostosis.[220] It was noted that when cases of cribra orbitalia and linear enamel hypoplasia were plotted on the site plan, they clumped into the family groupings that had been hypothesized on other grounds.[221]

Other nutritional diseases are extremely difficult to identify in fragmentary material and appear to have occurred infrequently in earlier populations. No mention of either rickets or scurvy was made in the Colchester, Cannington, Cirencester, and Trentholme Drive reports. Eight possible cases of rickets were identified from the combined excavations at Lankhills, and there were five possible cases of scurvy, all from the 2000–5 sample. One possible case of rickets was reported from the Northern cemetery in Winchester, but no scurvy.[222] A very similar situation existed at Poundbury, where only two infants and one adult may have had rickets, and there was one very tentative potential finding of scurvy in a child.[223]

Osteoporosis and hyperostosis frontalis interna were diagnosed more frequently at Poundbury than at Lankhills 1967–72. At Poundbury, although the findings were somewhat tentative, osteoporosis was diagnosed in 23 women and eight men, while hyperostosis frontalis interna was found in 19 women, six men, and one not sexed.[224] Osteoporosis was reported in only six skeletons at Lankhills, all in the 1967–72 excavations, all male. There was only one clear case of senile osteoporosis, in a male probably over 65. All the other cases may have been secondary to other pathology. Similarly, there were only six cases of hyperostosis frontalis interna found at Lankhills. These differences are more likely to reflect the effect of a much larger sample in the older age groups at Poundbury, and more fragmentary material at Lankhills 1967–72, than any real differences between the two populations. Four cases of

216 Browne 2012, Table 31.
217 Stuart-Macadam 1985; Roberts and Manchester 1995.
218 Wells 1982, 186.
219 Brothwell et al. 2000, 204.
220 Pinter-Bellows 1993, 87.
221 ibid. 88–91.
222 Browne 2012.
223 Molleson 1993, 184–5.
224 ibid. 194.

hyperostosis frontalis interna were reported at Cannington, but no osteoporosis.[225]

Infectious diseases were challenging to identify at Lankhills. Mastoiditis was found, as was sinus infection, and non-specific periostitis. This latter condition existed in 27 individuals, 21 of whom exhibited the localized tibial periostitis fairly common in British skeletal samples. This type of periostitis occurred in 28 individuals (12 males, 16 females) at Poundbury.[226] It was reported on 9% of the tibiae and fibulae at Colchester, almost all male.[227] There were also 26 cases at Cirencester (18 male, seven female, one unsexed), which were estimated to constitute 10–12% of the adult sample.[228] The aetiology of these lesions, which do not appear to have modern counterparts, is poorly understood and could have a number of causes. At Poundbury it has been attributed to leg ulcers resulting from prolonged and extreme nutritional deficiencies.[229]

Other infectious diseases identified in these samples include two cases of non-specific lung disease that might be tuberculosis at Lankhills, three possible cases of tuberculosis or brucellosis at Poundbury,[230] one possible case of tuberculosis at Trentholme Drive,[231] and an additional possible case of tuberculosis at Cirencester, as well as four possible cases of poliomyelitis, at least seven cases of maxillary sinusitis, and one possible example of osteomyelitis.[232] Two possible cases of tuberculosis, as well as three cases of leprosy, were reported from Cannington.[233] One possible, but very questionable, case of tuberculosis was reported at Colchester, along with 10 cases of maxillary sinusitis, but no evidence for leprosy or treponemal infections.[234] The possible presence of tuberculosis at all five comparative sites, and the confirmed presence at two other Romano-British sites in Dorset and Northamptonshire,[235] indicates that the disease may have been geographically widespread during the Romano-British period, but probably at lower frequencies than found in medieval and later periods. If so, it is reasonable to infer that tuberculosis was also present at some level in the Lankhills population in spite of the fact it was not detected in the 1967–72 sample and the findings in the 2000–5 sample are very tentative.

The overall impression conveyed by these skeletal samples suggests that on the whole men were physically far more active than women, although life contained challenges for both sexes. The stresses of daily life were reflected in the relatively early onset and frequency of osteoarthritis, although a possible genetic contribution to the occurrence of this condition cannot be overlooked. The roles of men and women clearly differed, suggesting higher activity levels for males, and also higher levels of risk, as demonstrated in the fracture data. Some of the differences in trauma and arthritis between these sites may have been due to different professions and economic patterns at each location. For example, the weapons injuries seen at Cirencester are not duplicated at the other sites, and the greater frequency of leg fracture suggests that Lankhills males may have been exposed to a set of environmental factors different from those experienced by men at Poundbury.

The frequency of cribra orbitalia suggests that iron deficiency and/or megaloblastic anaemia, no matter what caused it, was a health problem for approximately one out of every four subadults at Lankhills, and approximately one out of every three at Cirencester and Poundbury. However, its severity was greater at Poundbury,

[225] Brothwell et al. 2000, 207.
[226] Molleson 1993, 185.
[227] Pinter-Bellows 1993, 77.
[228] Wells 1982, 182.
[229] Molleson 1993, 185.
[230] ibid.
[231] Warwick 1968, 161.
[232] Wells, 1982, 181–2.
[233] Brothwell et al. 2000, 226.
[234] Pinter-Bowes 1993, 79.
[235] Stirland and Waldron 1990.

and affected twice the percentage of adults seen at Lankhills, indicating that it was a significantly greater cause of biological stress at Poundbury than at the other two sites. Colchester was notably healthier than any other site in this respect. Only at Cirencester were there any significant differences by gender, suggesting males were more likely to encounter the causative agent than females at this site, or to be more biologically vulnerable for some reason. Vitamin deficiency diseases appeared to have been rare in these populations. The effect of chronic infections was difficult to assess, but the lethal presence of acute infections at high levels can be inferred from the early age at death experienced by most people during this time.

6

LANKHILLS DECAPITATIONS REVISITED[1]

by J. L. MACDONALD

i. INTRODUCTION

There were seven instances of decapitated human beings in the earlier excavations at Lankhills.[2] When their interpretation was being considered, it was almost inevitable that the association which each of them had to other graves led to the view that they were 'in some sense sacrificial'. Some important commentators have failed to look at the associations and have doubted the interpretation.[3] The excavations of 2000–5 added four more decapitations for a total of eleven, to which two more (LH 297 and LH 302)[4] should now be added for a total of thirteen. The new evidence from Lankhills for decapitation as the cause of death makes it important to restate the case for a form of human sacrifice. It could well be that the cemetery at Lankhills is unique in this respect, as it is in others. This writer, however, no longer holds the view that the act of decapitation provided a 'vicarious substitute' for a person who would not otherwise cross over to an afterlife. Rather, it is argued that a body with a severed head was a totem, or extra life force, that enabled another person, or persons, to reach the same goal. It could also in other circumstances have a wider significance as an apotropaic force for the community that used the cemetery.

The basic archaeological evidence is laid out first. Illus. 2.58 shows the whole area of the Lankhills cemetery excavated in 1967–72 and 2000–5, and demonstrates the spatial associations of the decapitations to graves which are not just interesting but often unique. These include graves excavated by Oxford Archaeology in 2000–5, the significance of which has not yet been made apparent, in either print or plan. On Illus. 2.58 the associations for the whole site are lettered A to K (with 'I' left out). Z refers to two additional decapitations noticed by Katie Tucker.[5] Z_1 in LH 297 was overlooked in Clarke 1979 because the head was in its anatomically correct position. As will be argued below,[6] such a position makes it unlikely that the decapitation was part of a ritual. Z_2 refers to LH 302, a grave found in 1970 in a rescue operation while a pipe trench was being dug. A cranium, a mandible, and two vertebrae showing signs of decapitation were found, but no associated body.[7] Table 2.76 provides details of the relevant graves and associations.

In the following discussion, arguments against the chance of human sacrifice taking place in the

[1] The author is indebted to Connie Stuckert for her great patience and understanding, to Martin Biddle for his wise and cheerful encouragement, and to Katie Tucker, whose research has been invaluable (see above, pp. 101–6). Obviously all the possible errors are his own. He would also like to pay tribute to Paul Booth and others for their monograph *The Late Roman Cemetery at Lankhills, Winchester: Excavations 2000–2005* (Oxford, 2010). While he may not agree with them on this particular subject, the monograph is fascinating in its coverage.

[2] WS 3.ii, 414–24.

[3] e.g. Booth et al. 2010, 480–1, 520–1; Philpott 1991, 85–7.

[4] See below, pp. 167–8, Associations Z_1 and Z_2.

[5] See above, pp. 101–2; below, pp. 167–8.

[6] See below, pp. 152–3.

[7] Not mentioned in WS 3.ii, although apparently given the grave number LH 302. Its location cannot now be established and is therefore not shown on Illus. 2.58.

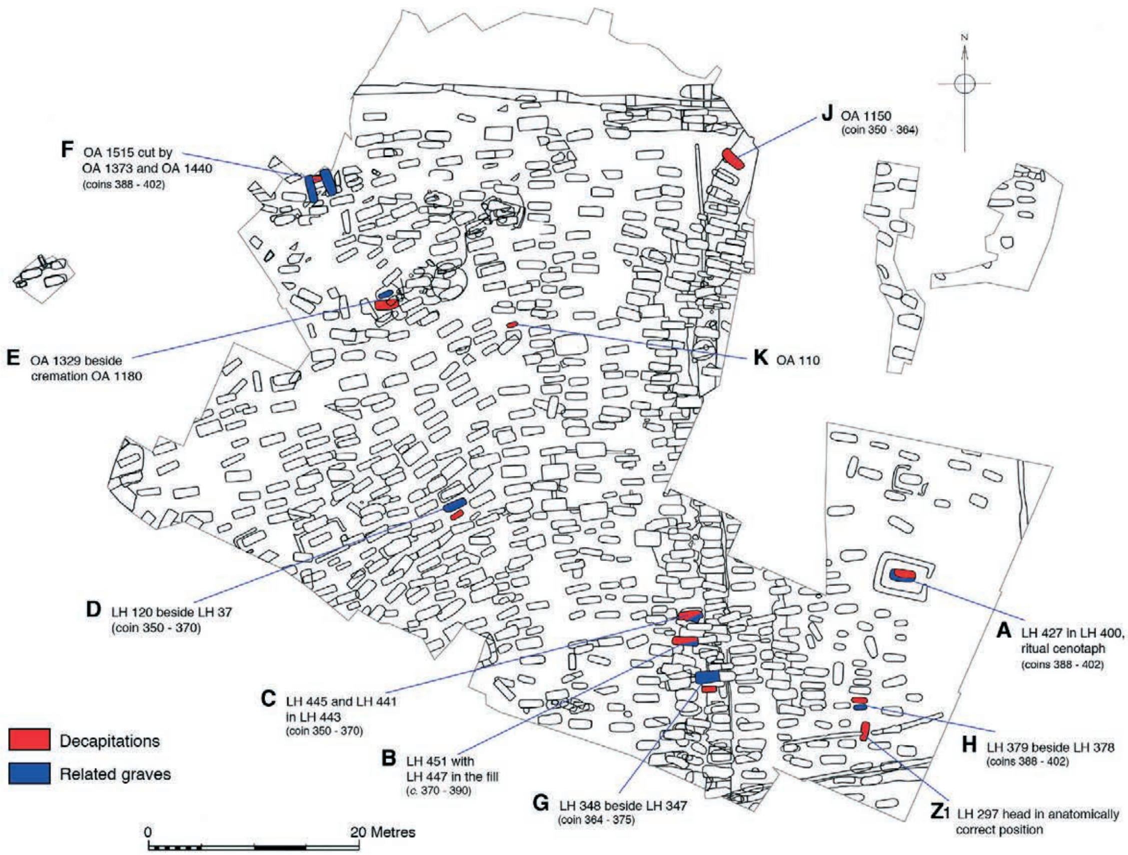
TABLE 2.76

Lankhills decapitations and associated burials

Decapitations											Associated burials						
Association	Decapitation	Date	Sex	Age	Top of body	Body attitude	Head position	Likely time of death	Coffin and depth of decapitation	Grave goods	Association with another grave	Grave goods INSIDE coffin	Grave goods OUTSIDE coffin	Depth of associated grave	Sex	Age	Date
A	LH 427	post 400	M	20–25[1]	W	Supine	Right of knees	Before decapitation	None, 0.99 m.	Coin in mouth	In fill of LH 400, cenotaph, but later	Five coins by right hand (388–402)	Dismembered dog, whole dog, turf	1.79 m.	?	?	*c.* 400
B	LH 451	370–390	M	40–45	W	Prone	Between thighs	?	Coffin, 1.10 m.	None	In fill of LH 447 Contemporary	'Sack of bones'	Jar with everted rim (270–400)	0.70 m.	M	40–45	370–390
C	LH 445	350–370	F	30–35	W	Supine	Between thighs	Killed by decapitation	None, 0.63 m.	None	In fill of LH 443 Contemporary	Knife, belt fittings beside left foot	None	1.18 m.	M	*c.* 20	350–370
C	LH 441	370–390	F	35–40	E	Prone	?Between lower legs	Killed by decapitation	None, 0.38 m.	None	In fill of LH 443 Later	ditto	ditto	ditto	ditto	ditto	ditto
D	LH 120	350–370/90	Infant	*c.* 18 months	W	Supine	Above coffin and feet	?	None, 0.90 m.	Hobnails	Beside LH 37	Knife, belt fittings to right of ankles, coin (350–364)	None	0.75 m.	M	25–30	350–370
E	OA 1329	?	M	36–45	W	Supine	Between/beside lower legs, facing E	?	Coffin, 1.00 m.	Hobnails	Beside OA 1180 (*bustum*)	Belt fittings and buckle at E end of pit ('foot end'). Hobnails	Burnt large animal bones and unburnt sheep/goat head	0.13 m.	?M	young adult	Late 4th cent.
F	OA 1515	*c.*400?	M	45+	E	Crouch or flexed	Between/beside lower legs	Killed by decapitation	None, 0.20 m.	None	Cut by OA 1373 feet to south	No coffin	7 coins (388–402), glass beaker, pottery vessel by head	1.10	?	adult	*c.* 400

F	OA 1515	ditto	ditto	ditto	ditto	ditto	ditto	ditto	None, 0.20 m.	ditto	Cut by OA 1440 feet to south	5 coins (388–402), glass beaker, brooch, pottery vessel by head	None	1.20	?M	25–30	*c.* 400
G	LH 348	380–410	?	12–15	E	Supine, flexed	Right (north) of knees	Before decapitation	None, 0.20 m.	None	Beside LH 347 Earlier or later?	Pewter vessel, iron object; pottery vessel and glass vessel by feet, coin (364–375)	Bracelets, human bones from disturbed LH 350	1.75 m.	?	20–25	390–410
H	LH 379	390–410	F	40–45[2]	W	Supine, flexed	Behind/ left of knees	?	None, 0.13 m.	Hobnails	Beside LH 378 Earlier or later?	No coffin, prone body	Three coins (388–402), arrowhead	0.33 m.	?boy	7–8	390–410
J	OA 1150	post 350	F	26–35	W	Supine	Between knees	Killed by decapitation	Coffin, 1.50 m.	Flint packing Coin (350–64) on chest	At cemetery entrance?						
K	OA 110	late 4th cent.	Child	2 months –2 years	W	Supine	Between lower legs	Before decapitation	Coffin, 0.22 m.	Brace- lets, beads	No obvious association						
Z_1	LH 297	400–410	F	20–25	S	Prone	In correct position, facing south	Killed by decapitation	None, 0.39 m.	Bone comb	No obvious association						
Z_2	LH 302	?	M	Adult	W	Supine	No torso found	Killed by decapitation	?	None found	No obvious association						

[1] Aged 26–35 by Katie Tucker, p. 103.
[2] Aged 26–35 by Katie Tucker, p. 103.



Illus. 2.58. The Roman cemetery at Lankhills 1967–72 and 2000–5. Decapitated burials and associated graves are marked with their 'Association' letters.

Roman cemetery at Lankhills after *c.*350 are contested. Second, the view that decapitation was possibly performed to do good to the victim will be countered: it will be argued to the contrary that in the context of Roman Britain the rite was intended to help people other than the victim. Third, the meaning of the rite in the various specific contexts of Lankhills will be examined, along with the matter of prone burials and burials where the body did not lie in its usual position with head to the west. Finally, there will be a brief reference to the occurrence of this rite in cemeteries other than Lankhills, before looking at Lankhills itself within the wider historical and religious contexts of Winchester and the later Roman empire.

As Tucker has suggested,[8] decapitation may have been the cause of death for six individuals (LH 297, LH 302, LH 441, LH 445, OA 1150, and OA 1515) based on the posterior direction of the blows, the fact that these were chops rather than slices, and the position of the head at the time. Death caused by a cut throat (LH 445) was an exception to this pattern. In three other individuals (OA 110, LH 348, and LH 427) evidence for careful disarticulation of the head suggested that decapitation occurred post mortem. Conclusions could not be drawn in the four remaining cases (LH 120, LH 379, LH 451, and OA 1329).

[8] See above, p. 106.

ii. OBJECTIONS TO THE POSSIBILITY OF 'HUMAN SACRIFICE'

In discussing the rite of decapitation, the authors of the report on the Lankhills excavations of 2000–5 argue against the possibility of human sacrifice.[9] In doing so they pay no attention to the very specific associations of decapitated people with people buried in unusual graves (Table 2.76). And they did not, of course, have Katie Tucker's evidence that in at least *four* cases decapitation was used lethally in ritual situations, as well as an additional two decapitations that may have been punitive.[10]

Their main argument is that under Roman law ritual decapitation was illegal. According to them the authorities would have noticed the supposed twelve instances (now found to be thirteen[11]) and would have prevented the rite taking place. Human sacrifice was indeed prohibited by Roman law. But in the changing circumstances of the late fourth century, Roman law on such matters was not necessarily effective. By 410 the emperor Honorius had told *Britannia* to look after its own affairs.[12] Already on four occasions rival emperors had in effect made *Britannia* secede.[13] As for *Venta Belgarum*, its physical structure and character had become markedly more military since some date after about 350.[14] In addition there had been a resurgence of non-Roman cults in the fourth century, for example in the temples of Lydney (Glos.) and Woodeaton (Oxon).[15] The earlier practice of using babies for foundation sacrifices in a temple at Springhead (Kent) is a sign that Roman law was not always effective, even in peacetime.[16]

Philpott misquotes the report on the Lankhills exacavations of 1967–72 by saying '[it was concluded that] the victims of decapitation [at Lankhills] were criminals, old women, children, or slaves'.[17] In fact the 1967–72 report (using Caesar as an authority) said that they 'could have been' such people.[18] The report on the 2000–5 excavations, following Philpott, argues that since the pathology, age profile, spatial distribution, and burial rites of the decapitated people at Lankhills (apart from the act of decapitation itself) were similar to what was found elsewhere on the site, these people were not criminals or otherwise marginalized and had therefore by implication not been sacrificed.[19] It is obvious that anybody at a disadvantage, especially psychologically (which would not show up in the excavated material), could be vulnerable to such abuse. What is more, as will be argued, the archaeological evidence is not quite as clear as that report suggests.

More important, perhaps, is the view taken by the authors of the report on the 2000–5 excavations 'that the provision of grave goods with four of these [decapitated] burials suggests that they were expected to have the same destiny after death as the rest of the individuals buried in the cemetery'.[20] The coins in LH 427 and OA 1150, the hobnails in LH 120, and presumably the bracelets and beads in OA 110 may support this view. But there is an argument that in the eyes of Britons burial grounds resembled pits, ditches, springs, wells, and rivers in being sacred to chthonic deities.[21] Pits discovered in 2000–5 seem to be evidence of this.[22] Much grave furniture could,

[9] Booth et al. 2010, 480–1; Philpott 1991, 85–7.

[10] See above, pp. 101–6.

[11] Originally thought to be twelve (above, p. 106), then reduced to eleven, to which Z_1 and Z_2 are now to be added (above, pp. 147, 167–8).

[12] But see now Mattingly 2006, 530, for the view that Honorius' rescript referred not to *Britannia* but 'to towns in *Bruttium* (southern Italy)'.

[13] Pearson 2002, 45–6, 128.

[14] Biddle and Kjølbye-Biddle 2007, 189.

[15] WS 3.ii, 408, 411; Wheeler and Wheeler 1932, 41; Lewis 1966, 47.

[16] WS 3.ii, 416.

[17] Philpott 1991, 87.

[18] WS 3.ii, 417.

[19] Booth et al. 2010, 430.

[20] ibid., but see below, p. 169, and Table 2.77.

[21] Esmonde Cleary 2000, 138.

[22] Booth et al. 2010, 405.

therefore, have been provided by the living to honour the divine as much as to help the dead. This is the case even in modern cemeteries.

The argument needs to be stated more clearly. Far too much emphasis is placed on Aristophanes' comic fantasy in *The Frogs* (written eight centuries earlier in a city very different from *Venta Belgarum*) of dead people paying Charon with coins to take them across the River Styx.[23] The fact is that coins were one of the offerings particularly relevant to the gods of the underworld. Coins, being originally mined from the earth, were the proper offering to gods who lived beneath the earth. It is no surprise that the Greek god of that realm was called Pluto, that is Wealth, or the Latin god Dis, that is Wealthy One. Celtic gods of the Underworld were also depicted with coins.[24] A coin in the mouth of a severed head was likely to be an offering to chthonic powers from the living, not from the dead person whose head had been severed. Similarly the offering of a horse's skull was the relevant offering to the goddess of ponies, Epona. Since she was also a Gallic and British goddess of the Underworld, it is probably right to believe that the horse skulls in OA 530, OA 655, and OA 1547 were offerings to her.[25] Finally, as discussed by the present author in the 1967–72 report, feminine jewellery, a very tangible form of wealth, was deposited in huge quantities at Lydney (Glos.), Woodeaton (Oxon), and elsewhere.[26] It could, therefore, be seen as a relevant offering from living survivors to the gods of the Underworld and thus accompany a decapitated child.

iii. THE RITE OF DECAPITATION AND THE CULT OF THE HEAD

Philpott was at pains to counter the view also expressed by the present author in the 1967–72 report that the rite of decapitation possibly provided a vicarious substitute for someone whose soul might have difficulty in reaching an 'afterlife'.[27] He was right, but the circumstances found at Lankhills make it difficult to deny some sort of sacrifice.

At the root of the whole discussion lies the Celtic and Romano-British view of the head.[28] To quote Philpott, 'All the evidence suggests that the act of severing the head brought about a renewal of life and an enhancing of the life force of the head rather than the destruction of the soul' (that is, of the decapitated person's soul—which was what was being argued). However, the 'life' of a head was not a human life. Anne Ross has written: 'For the Celts the head was seemingly the centre of life-force, capable of continued independent life after the *death* of the body' (present author's italics).[29] She also quotes evidence that a head did not like being separated from the body, but that when it was put together with its related body, its life force ceased.[30]

What did this life force do? All the evidence points to it helping people other than itself. Its relationship with wells, lakes, rivers, and temples was as an offering to help humans benefit from the spiritual power of such places. Heads placed on battlements and roofs were apotropaic, that is they guarded such places from the enemy or other malign forces. These heads had not necessarily belonged to friendly people. The Celtic tribe of the Boii defleshed and gilded the head of the Roman general Lucius Postumius, whom they had captured in 216 BC, and priests then used his

[23] Aristophanes, *Frogs*, lines 270–1 (Dover (ed.) 1993).
[24] Ferguson 1970, Pl. 33; Ross 1967, 138.
[25] Booth et al. 2010, 487, 519.
[26] WS 3.ii, 408–14.
[27] Philpott 1991, 85–7, commenting on WS 3.ii, 417–21.
[28] Ross 1967, Ch. 2.
[29] ibid. 92.
[30] ibid. 109.

head as a sacred vessel in a temple.[31] The life force was a life force, but in no sense a human being.

The story of Bran in the Mabinogion is used by many commentators in discussing severed heads in cemeteries.[32] Three points can be made about Bran. First, his head was severed when he was alive, even if he had been mortally wounded in battle. Second, the decapitation did not restore him, as a person, to life. Third, it gave his seven followers an amazing time for eighty-seven years, a time which, with its birdsong, feasting, and lack of sorrow, seems to have mirrored the joys of a pagan 'Other World' and the 'Isles of the Blest'. It is worth quoting this in full as the section on an 'Other World' is very relevant to the discussion of Association A at Lankhills (LH 400 and LH427).[33] The conclusion of the story in London is also relevant to the interpretation of OA 1150 (Association J):[34]

> The seven then continued on to Harddlech, where they sat down and began to enjoy food and drink; as they did so birds appeared and began to sing, and all the singing they had ever heard was nothing compared to this. They looked far out over the ocean to see the birds, yet they saw as clearly as if the creatures were close at hand. Seven years passed thus, and at the end of that time they set out for Gwales in Penvro, where they found a great handsome royal hall overlooking the sea; they entered and found two doors open and the third closed, the one on the Cornwall side.
>
> 'There is the door we must not open', said Manawydan. They spent all that night in joyous feasting and remembered nothing of all the grief they had seen and suffered, and nothing of any other sorrow in the world. Eighty years they spent at Gwales and they could not remember having spent a happier and more joyful time; never was it more tedious than when they first arrived, nor could any tell by looking at his companions that it had been so long, nor was having the head there more disagreeable than when Bran had been alive and with them.

Eventually they open the forbidden door, and life returns to normal. As instructed by Bran, they go to London and bury the head in White Hill, where it acted, *until it was dug up*, as an apotropaic force against plague. The story may have been Christianized, but it is totally consistent with the powers attributed to severed heads.

iv. DISCUSSION IN GREATER DETAIL OF THE RELEVANT GRAVES AT LANKHILLS

In cemeteries there is usually some principle common to all the graves, whether it is ethnic, religious, or merely a matter of custom. Lankhills was probably, at least in its earlier stages, managed, and in its later stages if not managed, nevertheless influenced by the custom of management. Within this common principle there was room for individual preference in the rite and commemoration of burial; but it is almost surprising at Lankhills that at a time of great change and religious ferment such preferences were not very obvious.[35] However, the rite of decapitation was indeed obvious and did display differences, even if there seems to have been a common theme within these differences.

[31] Livy, xxiii, 24 (Conway et al. (ed.) 1967).
[32] Gantz (trans.) 1976, 80–1.
[33] See below, pp. 154–5.
[34] See below, pp. 165–6.
[35] The reappearance of cremation, prone burials, burials with the head to the east, and the offering of horse skulls, are, it seems, new preferences.

Associations A and B, where a person who had died had not been properly buried

Association A: LH 427, a decapitated male aged 25–28[36] buried in the fill of a ritual cenotaph, LH 400 (Illus. 2.59)

In the ancient world, a cenotaph was extremely important. It was not just an 'empty grave'.[37] It was an empty grave with a purpose. In modern times, 'cenotaph' means a monument to a person or persons whose remains are elsewhere. In the ancient world it implied a ritual burial to give rest to a missing or badly buried person, and to prevent untoward wanderings of a spirit. It was a rite that in a superstitious era was taken extremely seriously.[38]

LH 400, a cenotaph, seems to be unique in Roman Britain.[39] It lay in the overspill area to the east of the cemetery. Those who were responsible for it made sure that it was visually obvious, surrounding it with a square, presumably hedged, enclosure that marked it off from other graves nearby. At a depth of almost 1.79 m in the chalk, LH 400 was the deepest grave on the site, rivalled only by OA 82, OA 1210, and LH 347.[40] At the bottom of the grave the mourners had placed an empty coffin, depositing five coins (**540–4**)[41] where the right hand would have been. These coins (*terminus post quem*, 388–402) date the grave to 400 or later. Above the coffin at the head end they put a large dog (**538**), its bones perfectly preserved. In addition there were in the fill

some fragments of human bone, many bones of a second dog [**527**], . . . and traces of turves. The human remains consisted of leg bones of uncertain source. . . . The dog bones included vertebrae, part of the pelvic girdle, and a leg. The positions of the vertebrae and leg showed that they were still articulated when buried, the vertebrae having been tied in a crown.[42]

At a later date, when the grave must still have been obvious, a decapitated male aged 25–28 (LH 427) was deposited in the fill of LH 400 at a depth of 0.99 m, with the northern and eastern edges of the earlier pit being observed. The man was supine, the upper torso to the west, the head placed beside the right knee. In the mouth of the skull there was an illegible fourth-century coin (689).

The presence of the turf and the dogs, especially the dismembered dog, are important for the interpretation of the decapitation. Hilda Ellis-Davidson in her review of human sacrifice in the late pagan period of north-western Europe drew attention to the view of Karl Struve that 'the possible indications of [human] sacrifice would be the presence of animal bones' and that 'a sacrifice is likely to be accompanied by some rite, including the slaying of animal victims'.[43]

Some knowledge of the symbolism involved in making offerings to deities is needed to interpret the ritual in the cenotaph, LH 400.[44] This in turn helps to interpret the meaning of the decapitation in LH 427. The missing man for whom some form of burial was so important was 'represented' by the coffin and the coins. The coins were also the proper offering to the chthonic gods, as explained above. The dogs too were a proper

[36] Sex and age data throughout this chapter are those provided by Stuckert for the 1967–72 excavations (see below, pp. 173–203) and Booth et al. 2010 for the 2000–5 excavations. Tucker, in her study, independently re-aged and re-sexed the skeletons (see above, pp. 101–6). There were no differences among the observers in designation of sex, and only three cases where estimation of age varied by more than ten years.

[37] cf. Philpott 1991, 82–3, who does not seem to recognize this.

[38] e.g. Cicero, *De Legibus* ii, 57 (Rudd and Powell 2008); Tacitus, *Annals* i, 62 (Furneaux (ed.) 1897); Vergil, *Aeneid* vi, 324 ff. and 362 ff. (Mynors (ed.) 1972); Horace, *Odes* i, 28 (Quinn (ed.) 1980, n. 175).

[39] WS 3.ii, 421–3.

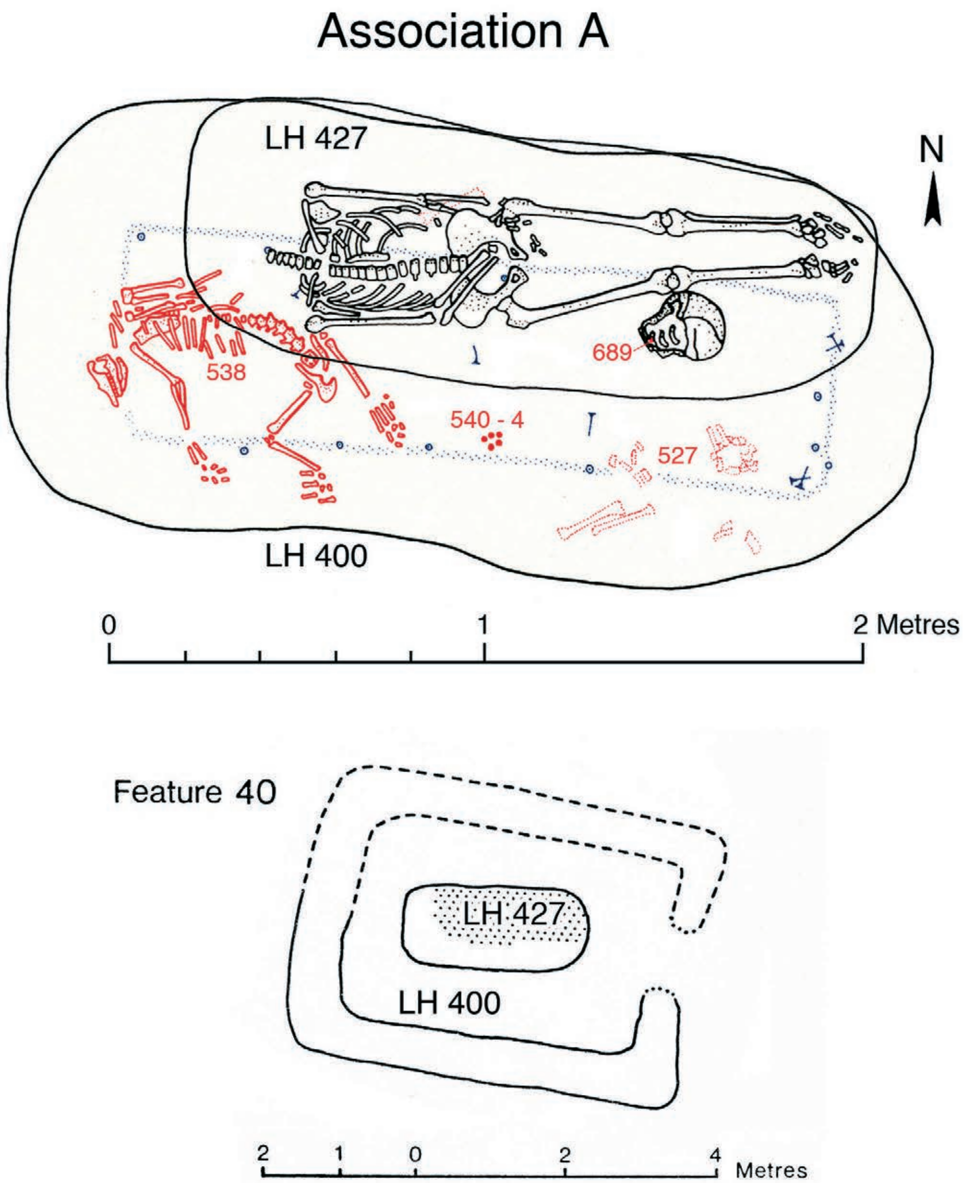
[40] For LH 347, see Association G, below, pp. 163–4.

[41] Find numbers given in bold type in the text and in red on illustrations refer to the find numbers assigned in the original publications; WS 3.ii and Booth et al. 2010.

[42] WS 3.ii, 83.

[43] Quoted in Ellis Davidson 1992, 333.

[44] See above, pp. 151–2.



Illus. 2.59. Decapitations: Association A. A ritual cenotaph surrounded by Feature 40, with a decapitated young adult male (LH 427) in the fill of the grave (LH 400).

offering, for in many cultures dogs, whether Anubis, Cerberus, or Fenrir, guarded the entrance to the Underworld. Epona, the Celtic goddess of horses, also guarded the Underworld and was often accompanied by a dog.[45] So the offering of a dog would help the missing man to pass the canine guardians. The dismembered dog would have provided a blood sacrifice; and to keep its magic in the grave, the tying of the ends of its vertebrae rendered it symbolically immobile. Finally, the turf symbolized vitality, the vitality that the missing man needed.[46] The whole ritual

[45] Ross 1967, 339.

[46] See above, p. 154, Cicero and Tacitus as quoted in n. 38.

was designed to bring the missing man to his rest in a proper grave, and then to pass on to the Other World. His spirit would also be prevented from wandering, which would allay the fears of his living survivors.

It is within this ritual context that at a later date a man (LH 427) was carefully decapitated from the front between the third and fourth vertebrae and placed (with a now illegible coin **689** in his mouth) in the fill of the LH 400, the cenotaph. It would have been so important for the missing man to reach his proper destination that his anxious survivors undertook a second ritual to give him extra vitality. There is no evidence that the man in LH 427 suffered a violent death; he could have been decapitated after a natural death, or might previously have been drugged or drowned. The latter explanation is certainly possible; the decapitated women in Association C (LH 441 and LH 445) were killed at the time of their decapitation; they, like the man in LH 427, were put in the fill of a primary grave, LH 443.

The written and folklore evidence for severed heads shows that their life force helped someone other than themselves, and so the life force of the severed head in LH 427 would have helped the missing person to reach the Other World. Bran's head enabled his followers to have had something of the same experience. One might also conjecture that in the unsettled years around 400 the missing man, like Bran, had been killed in a military venture.

Association B: LH 451, a decapitated prone male aged 40–45 in a coffin, with above and beside him a 'sack' of bones, LH 447, representing most of the skeleton of a second male also aged 40–45 (Illus. 2.60):

> [The bones] from Grave 447, although completely disarticulated, had been placed together with a pot **[609]** in a single pile so compact as to suggest they had been in a sack. . . . The possibility that the bones were in a sack may suggest that Grave 447 was not disturbed by Grave 451 at all, [but rather] that its bones were introduced from elsewhere, and thus that they represent a transfer.[47]

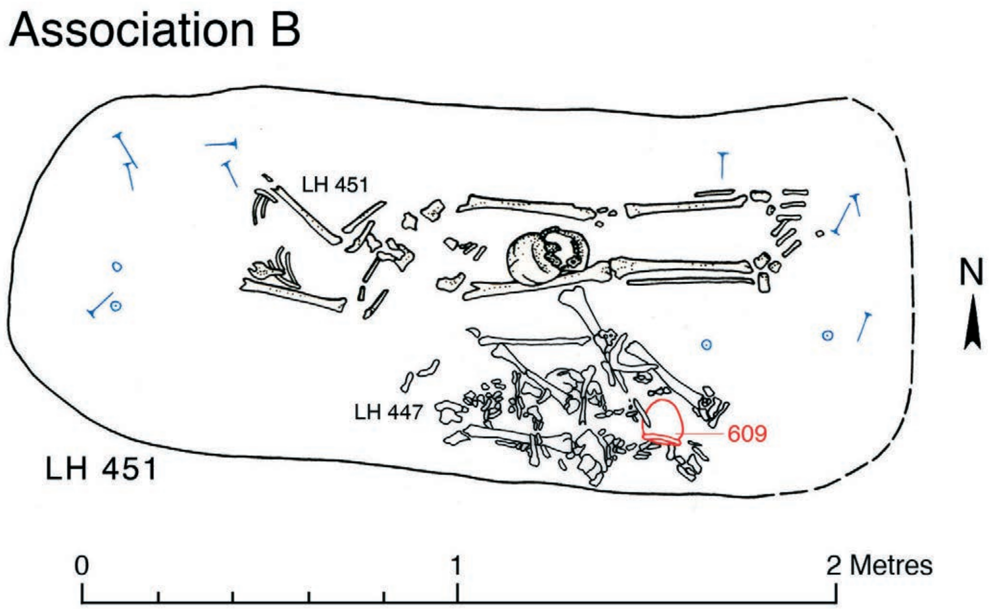
If this supposition is correct for what seems like a careful assemblage, complete with a pottery vessel, the situation is similar to that of the cenotaph LH 400: a person (in this case the man in the 'sack', LH 447) who had not received proper burial, or whose grave had been badly disturbed, is provided with help from the burial of another individual deliberately placed in the same grave. People are afraid of wandering spirits which have not found rest in an afterlife; as a result, propitiatory rites have to take place.

Here again, the life force of a decapitated person, a mature male of 40–45 (LH 451), appears to have been used to help. He was buried prone in a coffin, with his upper torso to the west, and his head between his thighs, at the same time as, but below, the 'bag of bones', LH 447.[48] There was no available evidence for the actual act of decapitation, but 'as the vertebrae C1-C4 were present with the cranium and mandible, it is probably to be assumed that decapitation occurred at the level of C5'.[49] The fact that the decapitated person was in a coffin below the 'sack' of bones can be explained as a mark of respect to the gods; or more likely, the man in LH 447 was in such peril that the life force of the body in LH 451 needed very careful attention. This was the sort of attention that the missing man of the cenotaph, LH 400, was given through the elaborate ritual of the dogs and turf. The position of LH 451 in the cemetery (Illus. 2.58) suggests a date of *c*.370–90.

47 WS 3.ii, 188.

48 ibid. 90.

49 See above, p. 104.



Illus. 2.60. Decapitations: Association B. A decapitated adult male (LH 451), with a compact pile of bones of an adult male (LH 447) in the fill of the grave.

Associations, C, D, and E, with a possible 'military' significance

LH 443, LH 37, and OA 1180 are three of only four graves (among the 800 excavated in the Lankhills cemetery) which had belt fittings at the east end of the grave and were associated with decapitations. The fourth, LH 55, was not associated with a decapitation.

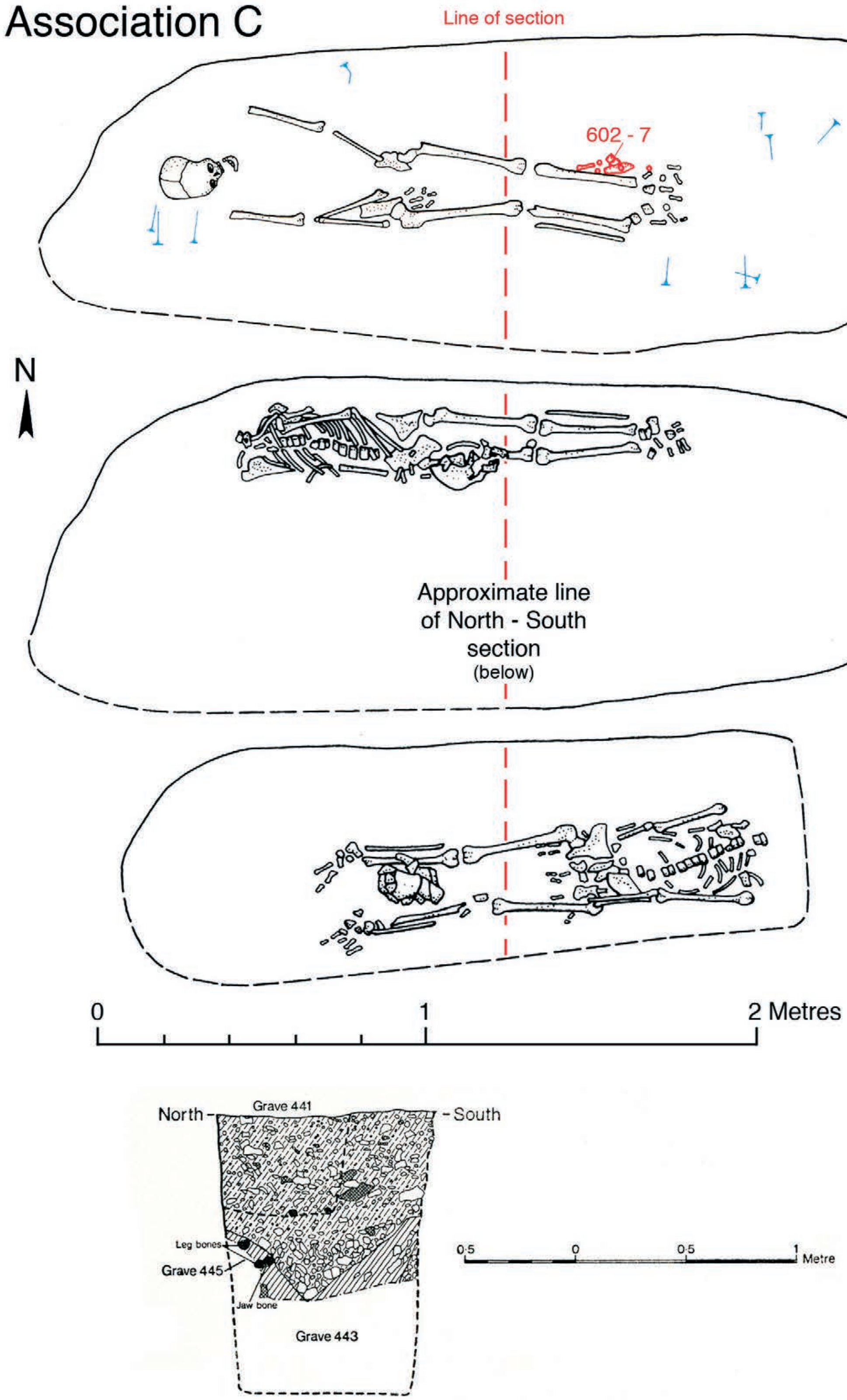
Association C: LH 445 and LH 441, two decapitated women aged 30–35 and 35–40, respectively, buried in the fill of LH 443 (Illus. 2.61)

LH 443 was the grave of a young man aged *c.*20, buried in a coffin, probably between 350 and 370. A knife and belt fittings (**602–7**), including a 'dolphin' buckle of Hawkes and Dunning, Type IIA), lay beside his lower left leg. Above him in the original fill of the grave, and therefore deposited simultaneously, was an uncoffined woman (LH 445), aged between 30 and 35, buried with her upper torso to the west and her head on the right thigh. New evidence shows that she was probably killed by having her head pulled back and after two chopping blows sliced off from the front.[50] Subsequently another woman (LH 441), aged between 35 and 40, was placed above her, again uncoffined, but this time prone, and with her upper torso to the east. She too was killed by two chopping blows, this time from the back, before her throat was cut from the front. This woman, like the young man in the primary grave (LH 443), displayed M_3 agenesis, which raises the possibility that they might have been genetically related.[51] The 'dolphin' buckle suggests that LH 443, the primary grave, dates to *c.*350–60 or later.

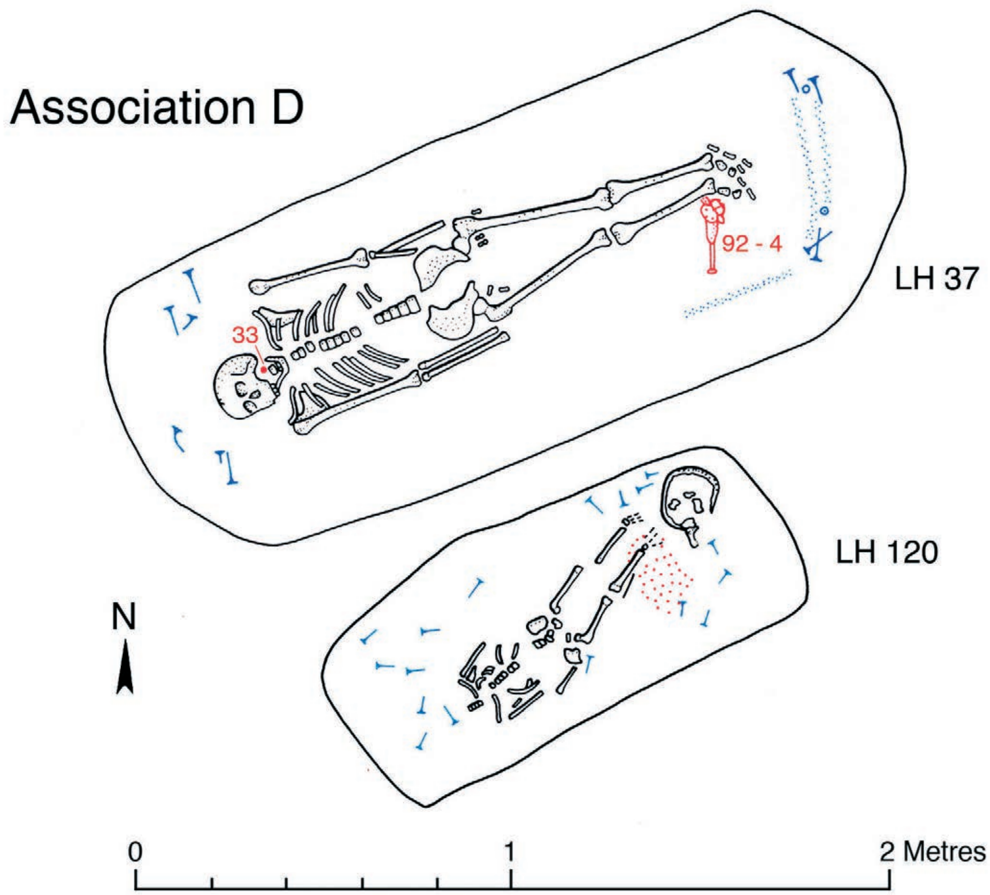
Here is a case of the victims being put in a primary grave of 'military type'. Because the women were killed by decapitation before being buried in the fill of LH 443 (i.e. after the burial of the man), it is clear that the act of decapitation was not for their benefit. Because their bodies were carefully placed in the grave, it

[50] See above, p. 104, Illus. 2.41.

[51] See above, pp. 133–4.



Illus. 2.61. Decapitations: Association C. Two decapitated adult females (LH 441 and LH 445) in the fill of the grave of a young adult male (LH 443) buried with belt and knife. The section shows the relationship between the three graves.



Illus. 2.62. Decapitations: Association D. A decapitated infant (LH 120) in a grave beside the grave of an adult male (LH 37) buried with belt and knife.

must be assumed that the rite was carried out for his benefit, the life force of their heads acting on his behalf. Unlike the case of the missing man in the cenotaph, LH 400, it is not clear why the young man needed this ritual. But as he was young and 'military', he may have died suddenly before his time. There is abundant evidence from the ancient world that this fate could prevent a person from entering the afterlife and, even worse for his survivors, who might continue to wander amongst the living as a malevolent ghost.[52]

Association D: LH 120, a decapitated infant *c.*18 months buried in a grave beside and parallel to LH 37 (Illus. 2.62)

LH 37 was the grave of an adult male age 25–30, buried in a coffin probably between 350 and 360 to judge by the 'dolphin' buckle of Hawkes and Dunning, Type IIA which lay beside his lower right leg, together with other belt fittings and a knife (**92–4**). There were hobnails beside his feet and a coin (**33**: 350–64) in his mouth. Beside and parallel to LH 37 was the grave of a decapitated infant LH 120, supine in a coffin

[52] WS 3.ii, 410–11, quoting Cumont 1922, 128 ff., 134; Vergil, *Aeneid* vi, 476 ff. (Mynors (ed.) 1972); Tertullian, *De Anima*, 56 (Waszink (ed.) 2010).

with the upper torso to the west and its decapitated head above the feet, apparently on top of the coffin, and with hobnails by the feet.[53] There was a single chop through the arch of C3, a decapitating blow,[54] but it was not possible to determine whether this was the cause of death, or death had already occurred.

LH 37, a 'military' grave, was similar in layout to LH 443. The chronological relationship of LH 37 to the decapitated infant in LH 120 is not certain, but the similarity to LH 443 would suggest that the burial of the man was earlier than, or simultaneous with, the burial of the decapitated infant in LH 120. Again, a military man may have been deemed to have died before his time and therefore in need of an extra life force.

Association E: OA 1329, a decapitated adult male aged 36–45 lay beside and at a slight angle to OA 1180, a *bustum* burial.[55] The grave of a neonate (OA 1317) cut into OA 1329 (Illus. 2.63)

OA 1180 was a cremation (*bustum*) pit containing the charred remains of a young ?male adult, with charred cattle and medium-sized mammal bones, hobnails, and a pottery vessel.[56] At the east end of the pit (where the feet would have been if OA 1180 had been an inhumation burial) were a buckle and plate (1–2), and another possible belt plate, but no knife. The cremation probably took place in the last quarter of the fourth century. Apart from the mammal bones and the act of cremation, the position of the belt fittings in OA 1180 is similar to that in LH 443 and LH 37 in Associations C and D.

OA 1329, beside and parallel to OA 1180, contained the decapitated body of a male aged 36–45 in a well-built coffin held together by 29 nails, in a comparatively deep pit (1.00 m).[57] The upper torso was at the west end, and his head lay between his ankles, facing east. Hobnails (**1–2**) were on shoes that were worn. There were three chops to the inferior border of the right mandibular body from below and behind, but these would not have been lethal. The burial was respectful, possibly towards the chthonic deities. Or more likely, as in Association D, the life force of the decapitated man in OA 1329 was much needed by the cremated man in OA 1180. The animal bones may also be significant as they seem to imply the kind of rite mentioned by Karl Struve.[58] But most of the cremations in this part of the site contained the bones of animals.[59]

Association E provides less evidence for a relationship between a decapitated person and the person who might be supposed to benefit from the life force of a head, but the parallel positions of the burials and their mutual proximity, together with the position of the belt fittings in OA 1180, are comparable to Association D (LH 37) and by extension to Association C (LH 443).

There is an extra possibility concerning OA 1317, the grave of a neonate, cut into OA 1329. Since infants dying 'before their time' were thought to find it difficult to pass over to another life, this infant's grave might have been dug into OA 1329 to share the vitality of the severed head.

Associations F, G, and H involving four late, rich, and unusual graves

These four graves were all associated with decapitations. OA 1373 and 1440 in Association F had points of comparison with LH 347 in Association G, although the latter had little in common with LH 378 in Association H.

[53] WS 3.ii, 40–1, 142, 192–3.

[54] See above, p. 101.

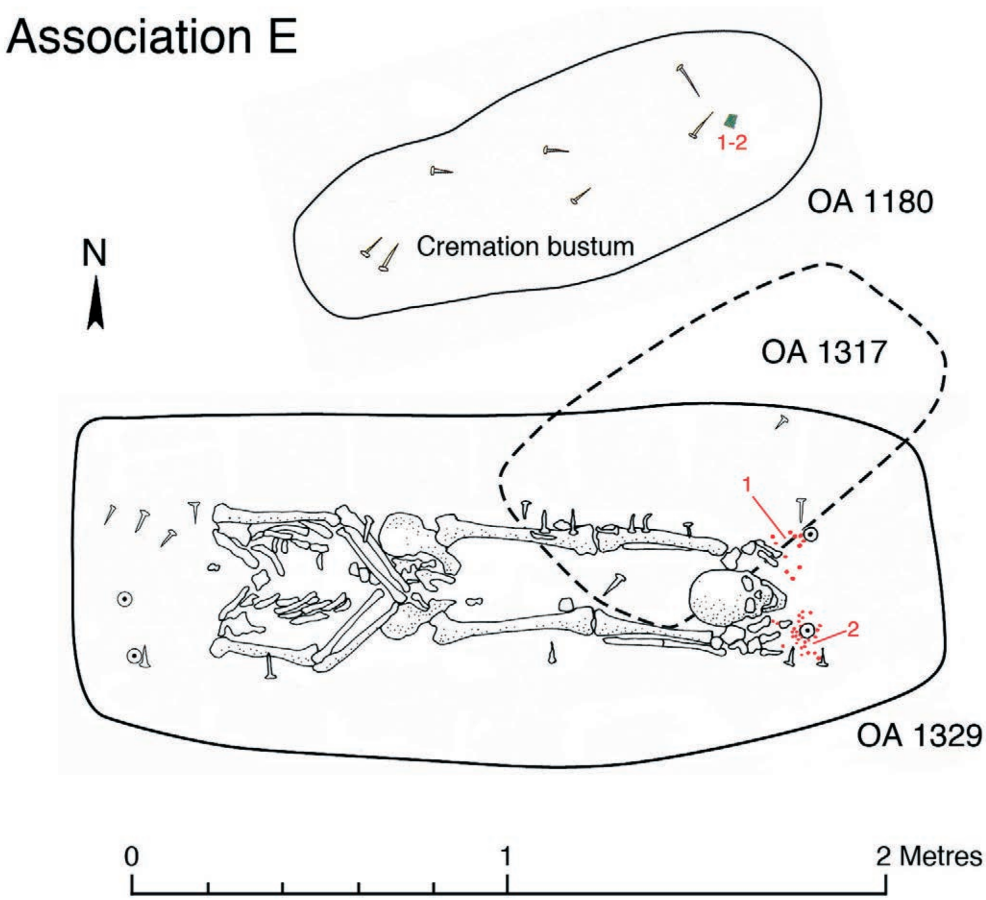
[55] For the meaning of *bustum* as used here, see Booth et al. 2010, 404–11, 441–2, 502–4.

[56] ibid. 241.

[57] ibid. 174–5.

[58] See above, p. 154.

[59] See Booth et al. 2010, 236–45.



Illus. 2.63. Decapitations: Association E. The grave of a decapitated adult male (OA 1329) cut by a neonate (OA 1317) and beside the grave of a cremated young ?male adult (OA 1180) buried with a belt, burnt and unburnt mammal bones, and the unburnt head of a sheep or goat.

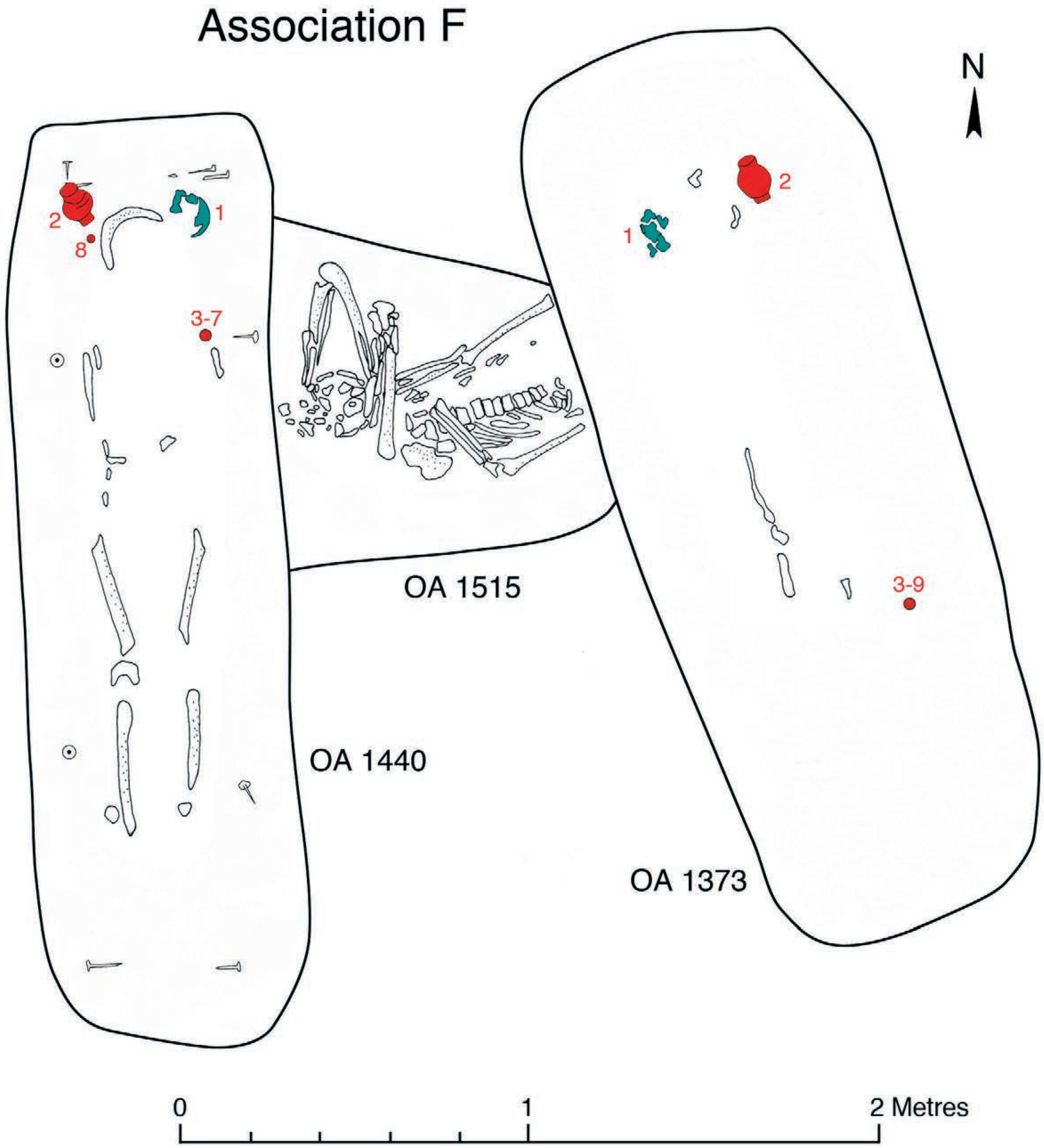
Association F: OA 1515, a decapitated male aged 45+ lay in a grave cut at the ends by OA 1373 and OA 1440 (Illus. 2.64)[60]

OA 1515, a male killed by decapitation from behind, was deposited in a shallow grave without a coffin, lying supine in a crouched/flexed position with the upper torso to the east (not west) and his head between the feet.[61] His shallow grave was cut at the ends by two parallel graves, OA 1373 (to the east) and OA 1440 (to the west), the three graves forming an H.

The two parallel graves, both with their heads to the north, were unique at Lankhills for their combination of alignment and offerings of multiple coins, glass, and pottery. OA 1373, 1.10 m deep, contained an uncoffined adult of uncertain gender with few surviving bones, but with seven coins (**3–9**: *terminus post quem* 388–402). To the right of the head was a conical glass beaker (**1**), to the left a pottery flask (**2**). OA 1440, 1.20 m deep, contained a ?male adult in a coffin together with a penannular brooch (**8**) and

[60] Their relationship is not shown in the individual grave plans in the 2000–5 report, only on the site plan, ibid. pp. 186–7 (OA 1373), 192–4 (OA 1440), and 199–200 (OA 1515); for the site plan, see Fig. 3.1 on p. 54.

[61] ibid. Fig. 3.216, *contra* the description on p. 199.

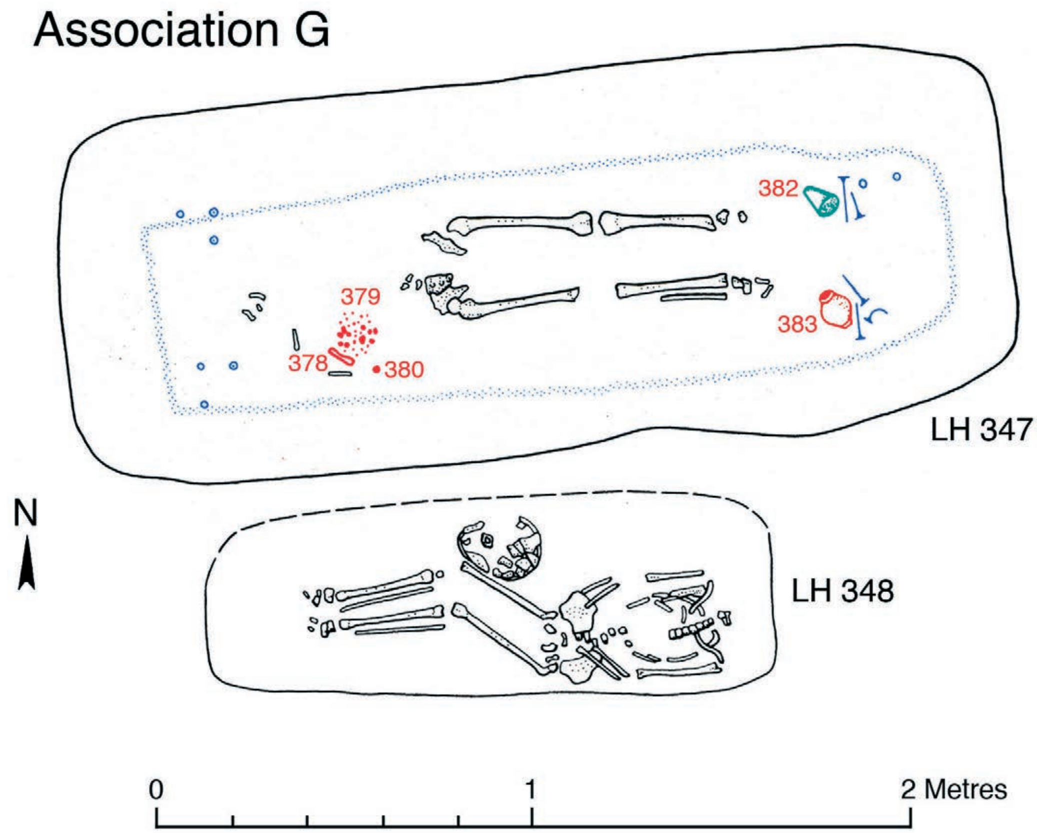


Illus. 2.64. Decapitations: Association F. Three very late graves: the grave of a decapitated adult male (OA 1515) cut by the 'rich' graves of an adult of indeterminate sex (OA 1373) and a ?male adult (OA 1440).

five coins (**3–7**: *terminus post quem* 388–402). To the right of the head was a pottery drinking vessel (**2**), and to the left a glass bowl (**1**). Possibly linked with these two graves was OA 1760, the grave of a child with an unusual glass biberon, a knife, and a coin also datable to 388–92.[62]

The crouched position of the decapitated male in OA 1515 suggests that the body was

[62] Booth at al. 2010, 269, cf. 511; Table 4.2.



Illus. 2.65. Decapitations: Association G. Two very late graves: a decapitated subadult (LH 348) beside the 'rich' grave of a young adult (LH 347).

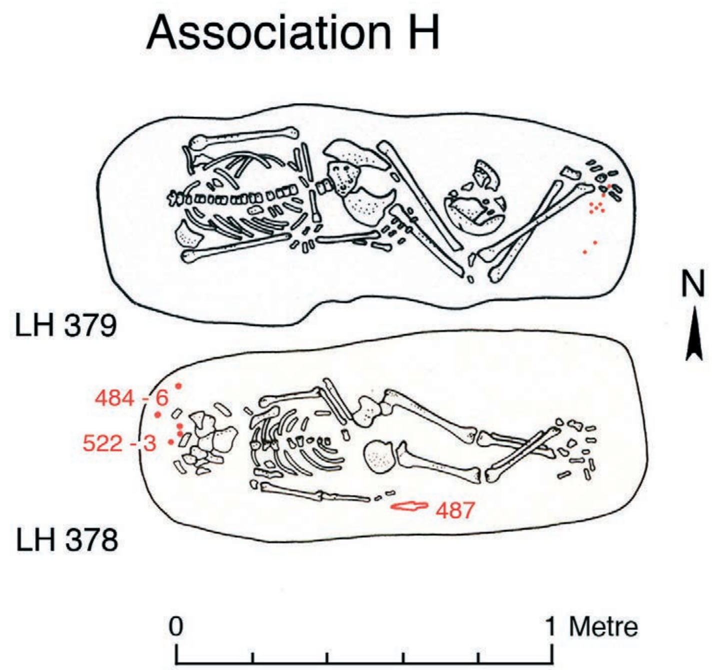
deliberately placed in a flexed position, either at the time of death or after *rigor mortis* had worn off. The intention of this association might have been to enable those buried in OA 1373 and OA 1449 to touch OA 1515 and to receive its life force, without cutting into the corpse.[63]

There is evidence of a sense of purpose, but little direct evidence of the cause of that purpose. All that can be said about OA 1373 and OA 1440 is that both contained adults with similar sets of grave goods. The comparatively rich quality of the offerings might imply some concern about the future, following an unexpected death from disease or violence.

Association G: LH 348, a decapitated subadult aged 12–15, lying beside and parallel to LH 347 (Illus. 2.65)

LH 348 lay supine in a shallow grave (0.33 m) without a coffin, the upper torso to the east, not west, and the head to the right (north) of the flexed knees, facing the upper (head) end of the grave.[64] LH 347, the second deepest grave (1.75 m) found in the 1967–72 excavations and very rich, contained the coffined body of a young adult aged 20–25 of undetermined sex. Inside the coffin, on or near the upper right arm, lay a pewter vessel (**379**), an iron object (**378**), and a coin (**380**) datable to 375–85. To the left of

[63] See above, pp. 152–3.
[64] WS 3.ii, 72, 192–3; see above, p. 102, Illus. 2.39.



Illus. 2.66. Decapitations: Association H. Two very late graves: a decapitated adult female (LH 379) beside a male child buried with an arrow head (LH 378).

the feet was a conical glass beaker (**382**), and to the right a pottery jug (**383**). There was a certain similarity of position and form between the glass and pottery grave goods in LH 347 and those found in OA 1373 and OA 1440, with the exception that in LH 347 the grave goods were by the feet and not by the head.

The decapitation in LH 348 resembled that in OA 1515 (Association F) in that both graves had the upper torso to the east not west, both were shallow, and the body in LH 348 was somewhat flexed (cf. the fully flexed position of the body in OA 1515). But LH 348 lay beside and parallel to LH 347 and was not cut by it. Nor was the individual in LH 348 killed by the process of decapitation. Like the man in LH 427 (Association A), the head had been carefully severed after death from the front between the third and fourth cervical vertebrae. While the cause of death cannot be determined, and might have been natural, the person might first have been drugged or drowned.

As with OA 1373 and OA 1440 in Association F, the comparatively rich offerings in LH 347 in Association G might imply some concern about the future. The adult in LH 347 was only 20 to 25 years of age and might have suffered an untimely death, one that required the help of the life force of the decapitation in LH 348.

Association H: LH 379, a decapitated woman aged 40–45, lay in a very shallow grave (0.13 m) without a coffin, beside and parallel to LH 378, the grave of a prone child of about seven or eight (Illus. 2.66)

At 0.33 m, LH 378 was not deep but was perhaps suitable for an eight-year old. There was no coffin; three of the five coins (**484–6**, **522–3**) were datable to 388–402. The burial was, however, unusual because the child was prone and accompanied by an iron-headed arrow (**487**), perhaps indicating that he was a boy. The burial of male accoutrements with a child was very unusual in the Western Roman Empire.

The late coins, the weapon, and the absence of a coffin resemble the uncoffined child's grave, OA 1760, in which, however, the very decayed skeleton may have been supine.[65] The grave contained more grave goods than was usual in a prone burial.

The body of the decapitated female in LH 379 was flexed,[66] and therefore had a certain resemblance to the decapitations in LH 348 and possibly OA 1515. The early and perhaps unexpected death of the child in LH 378 could explain the need for the life force of the decapitated woman.

The female LH 379 and child LH 378 in Association H were part of a group of six or more burials. These comprised two adults lying next to each other and at least four children, the entire group laid out in a neat row. The male (LH 380) and the female (LH 379) both exhibited full metopic sutures,[67] a trait under strong genetic control, suggesting that they might have been related. It was postulated earlier that the members of this little group may have had some socially sanctioned relationship with each other, whether it was family ties or some other reason.[68] Clarke thought that the arrangement of graves LH 372–6, LH 378–80, and LH 381–4 could represent a family grouping, despite the absence when he wrote of designated females.[69] His opinion is reinforced by the redesignation of the skeletons in LH 374 and LH 379 as female.[70] There is thus a possibility that the decapitated woman in LH 379 was a family member and related to the dead child in LH 378. There could be a similarity here to Association C where the decapitated woman in LH 441 might (or might not) have been related to the associated male in LH 443, since both displayed M3 agenesis.[71]

Two decapitations which had none of the associations found in Associations A to H

Association J: a decapitated woman in OA 1150 (Illus. 2.67)

A decapitated female adult was buried supine with the upper torso to the west (not east) in a well-constructed coffin with 24 nails, her head lying face down between her thighs.[72] At 1.50 m, the depth of her inhumation was surpassed by only 18 inhumations in the 1967–72 and 2000–5 excavations. Large flints had been carefully packed on both sides around the western half of the coffin. There was a single coin (**1**) beside her right arm or on her chest (see below). A blow which had fractured her skull had healed; it was perhaps the result of violence.[73] She was beheaded from behind and was perhaps killed by this blow rather than by being decapitated after death.

Those who maintain that decapitation cured its victims (to enjoy a life after death) could cite the cranial fracture and its possible consequences as a reason for the decapitation. The evidence given above suggests, however, that decapitation benefitted someone other than the victim, at least in the context of Lankhills. There are no obvious associated graves and it seems unlikely that an act which was the cause of her death had benefitted the woman herself. There are, therefore, two possible, interlinked, reasons why the woman was decapitated. Her inhumation was the closest to be discovered to one side of a possible entrance to the cemetery, at the north-eastern corner of the 2000–5 excavation,[74] in an area which could not be further excavated because of a line of trees.

Doorways, entrances, and exits were objects of

[65] Booth et al. 2010, 213–15; Cool 2010, 307–8, quoting Martin-Kilcher 2000, 73–5.

[66] WS 3.ii, 142, 193; see here p. 103, Illus. 2.40.

[67] See p. 123, n. 148 above for the definition of this term as used in this volume.

[68] See above, p. 134.

[69] WS 3.ii, 185, 190–1.

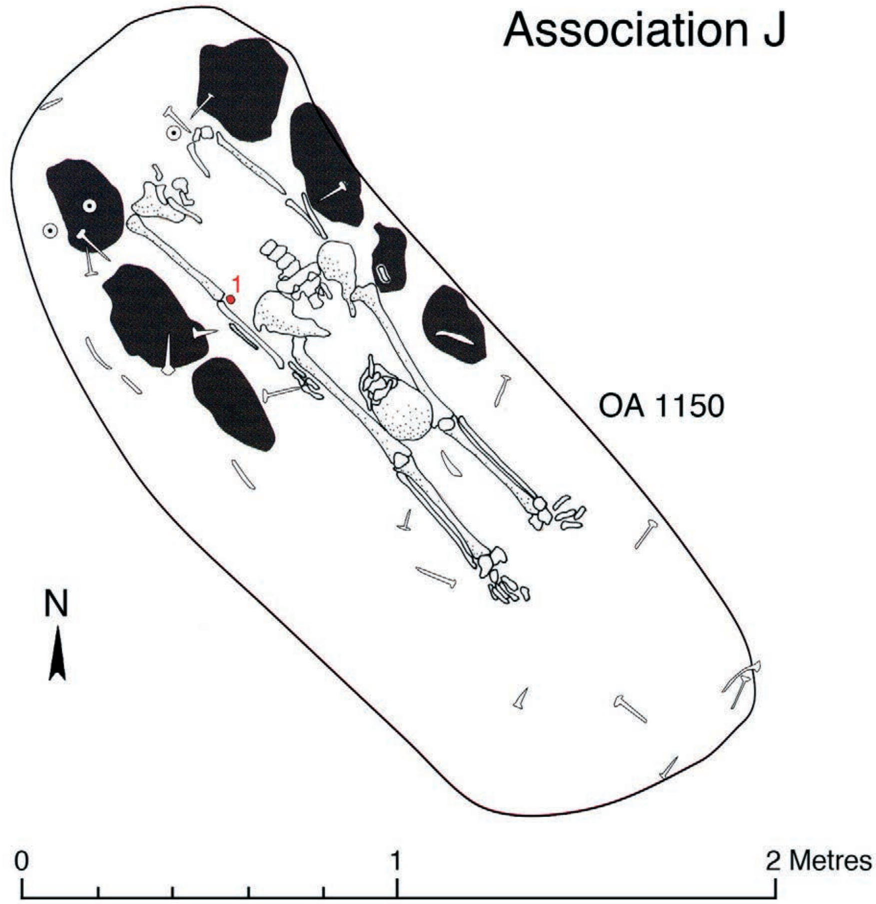
[70] See below, p. 195.

[71] See above, p. 157.

[72] Booth et al. 2010, 157–8, Fig. 3.154.

[73] ibid. 364.

[74] ibid. 54–5, Fig. 3.1; author's observation.

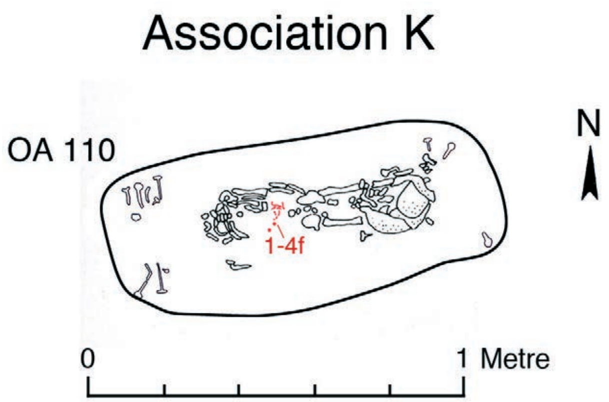


Illus. 2.67. Decapitations: possible Association J. A decapitated youngish adult female (OA 1150), the upper half of the body surrounded by large flints in an exceptionally deep grave.

awe and superstition to ancient people. The god Janus is an example of their importance. By 'guarding' an entrance, the female in OA 1150 could have been benefitting everyone who was likely to be buried in this part of the cemetery from the community that used the cemetery. This public function would explain the depth of the grave, the sturdy quality of the coffin, and the tight fit of the flint packing, all of which might have been carried out to ensure that the body would not, at some future time, be exhumed and thus, like Bran, lose its apotropaic force.

The single coin found by her arm or on her chest may be significant. It was an irregular *nummus*, datable to 350–64, with the legend *Fel(icis) Temp(oris) Reparatio* ('The Return of Happy Time'). Coins with this legend were found elsewhere on the site, but usually in a group with other coins. This coin on its own could perhaps be seen as auspicious, not unlike the gilded copper-alloy crossbow brooch with an auspicious inscription, UTRE FELIX ('Good luck to the user') found in OA 1846.[75] The coin found on OA 1150 would perhaps therefore be suitable for an apotropaic ritual at an entrance to the cemetery.

[75] Cool 2010, 279–82.



ILLUS. 2.68. Decapitations: possible Association K. A decapitated infant (OA 110) buried with three bracelets and a string of beads.

Association K: a decapitated infant in OA 110 (Illus. 2.68)

A decapitated infant aged 10 months to 2 years buried in a well-constructed coffin at a depth of 0.22 m. The upper torso lay to the west, not east, the body supine and straight, the head lying on the lower legs and feet. The respect paid to the burial was not unlike that given to the female in OA 1150 (Association J). There was no coin, but as befitted a very young child who was probably female she was accompanied by three bracelets and a string of twenty-six beads on her torso (**1–4f**).[76] These lay close to where the left hand would have been, but it is unclear whether they were or were not worn. The bracelets give a probable date in the late fourth century. As was the case with the decapitations in LH 427 (Association A) and LH 348 (Association G), the incised cuts to the infant's vertebrae were from the front. The seemingly careful disarticulation of the head probably means that decapitation was not the cause of death, although the infant might have been drugged or drowned first. The deaths of those individuals who were decapitated after death could also of course have been natural.

At least within the context of Lankhills, the same kind of argument can be applied to this decapitation as was used for the female in OA 1150 (Association J). The little girl gave her life force to others in the cemetery. She was not, however, near an entrance, and so who might have benefitted? The most likely possible recipients were the children buried sometime in the late fourth century in a rough half-circle near her: OA 291, OA 540, OA 136, and OA 1360. All had died young, but they were not buried in such an orderly fashion as the children who might have benefitted from the decapitation in LH 379 (Association H).[77] Nor were they necessarily all buried at the same time as each other. However, like those children, they may have had some socially sanctioned relationship with OA 110.

Other decapitations

Z₁: a decapitated female in LH 297 (illustrated, WS 3.ii, Fig. 64)

A decapitated female aged 20–25 buried prone with the upper torso to the south, her head placed in its anatomically proximate position, a bone comb under the left shoulder, and hobnails in

[76] Booth et al. 2010, 70–1.

[77] See above, pp. 164–5.

two groups between the legs.[78] She had been decapitated from the back. All the other acts of decapitation found on the site resulted in the head being put by the thighs, knees, or feet. Such evidence as there is of a head being put back in its right place might imply that it had lost its life force.[79] There is no obvious evidence of an associated burial. This grave was not originally thought to contain a decapitation.[80]

Z2: a possible decapitation of an adult male in LH 302

This grave was found in 1970 while a pipe trench was being dug; it was not included in the original publication although allocated a number. Only one end of the grave was excavated and the postcranial skeleton was not recovered. It was therefore impossible to determine the relationship to the rest of the body of the cranium, mandible, and two cervical vertebrae which were recovered. Chop marks suggest that the decapitation had been from the back and that this may have been the cause of death.[81]

Not a decapitation

SK 2064: a child found in Ditch 450 (the F.12 of the 1967–72 excavation) was thought possibly to have been decapitated,[82] but later examination concluded that the cut to the anterior and inferior surface of the mandible was post mortem and that the damage 'was actually caused when the remains were excavated'.[83]

V. WHO WERE THE DECAPITATED?

Since it now appears that four of the victims were ritually killed by the act of decapitation, it is difficult to avoid the conclusion that they were in some respect inherently vulnerable.[84] The decapitated woman in OA 1150 (Association J) was probably killed by the decapitation and yet had a particularly good burial. The other three victims were secondary burials: (LH 445 and LH 441 in LH 443 (Association C), and OA 1515 (Association F). They include a prone burial (LH 441) and two where the upper torso lay to the east not west (LH 441 and OA 1515). Of the other seven decapitations, three appear to be post mortem, while for the remainder evidence for the manner of their death is inconclusive. But OA 1150 (Association J) shows that a careful burial within a coffin is no guarantee that the person was not deliberately killed.

The carbon isotope values for the three adult decapitations (OA 1150, Association J; OA 1329, Association E; and OA 1515, Association F) imply that these individuals, one woman and two men, were unusual 'in that they did not have access to foods . . . that were particularly enriched in carbon (i.e. marine fish)'.[85] Similarly, there is evidence that individuals buried prone or without a coffin were comparatively depleted in both carbon and nitrogen.[86] If such an examination were done on the individuals from the 1967–72 excavation and if it were to produce the same result, this might mean that all the decapitated victims (who were all either prone or lacking a coffin) were somewhat different in their diet from the rest of the Lankhills population. Possibly they were captives, prisoners, slaves, or the children of such people. Or perhaps, located as they were near the edges of the cemetery, they were late burials, reflecting the comparative poverty of the era. In other respects, their skeletal profile reflects the age, gender, and pathology of the rest of the cemetery.

78 WS 3.ii, 62–3, Fig. 64; see above, p. 101, Illus. 2.38.
79 See above, pp. 152–3.
80 See above, p. 147.
81 For the decapitation, see above, pp. 101–2.
82 Booth et al. 2010, 369.
83 See above, pp. 105–6; cf. Booth et al. 2010, 44.
84 See above, p. 151.
85 Booth et al. 2010, 418.
86 ibid. 417, 419.

The treatment of the dead at burial as reflected in the coffins, hobnailed shoes, and grave goods with which they were or were not interred suggests some possibly significant distinctions between the decapitated and the persons with whom they seem to have been associated in death (Table 2.77). Fewer of the decapitated were buried in coffins, more in, or with, hobnailed shoes, but the clearest distinction appears in the provision of grave goods. With the exception of a single coin in the mouth of the beheaded man in Association A, no decapitated person associated with someone else was buried with grave goods. By contrast, grave goods were provided for all nine of the associated burials. Is this perhaps a sign that the decapitated people, whose life force had resided in their heads, were believed to have no expectation of an afterlife and thus no need for personal goods except perhaps in the form of the clothes in which they went to their death (of which only the hobnails would perhaps have left any trace)? If, in some cases, the decapitated were related in some way to the individual with whom they were buried, as may be the case in Associations H and C, a coffin might have been provided as a mark of affinity and respect, for instance in Associations B and E.

On that final point, a comment is apposite. Two of the decapitated women in the 1967–72 excavations, LH 379 (Association H) and LH 445 (Association C), could have been related to the males in their respective associations: LH 378 and LH 443. In these two cases, the women were not buried in coffins, but Hilda Ellis Davidson gives instances of wives and family slave-women being immolated for their dead men in north-west Europe.[87] It is remotely possible that a similar fate was suffered by women connected with family members who had died prematurely. At Lankhills there are tantalizing and will o' the wisp hints of connections with Free Germany.[88] It is not, however, the task of this author to follow that trail any further.

TABLE 2.77

The Romano-British cemetery at Lankhills: the occurrence of coffins, hobnails, and grave goods in the nine decapitations with associated burials [1]

Characteristics	Decapitations (max. nine)	Associated burials (max. nine)
in coffins	3[2]	6[3]
with hobnails	3[4]	1[5]
with grave goods	None[6]	All

[1] Not including the two decapitations without associated burials: Associations J (OA 1150) and K (OA 110).

[2] Three decapitated burials in coffins: Associations B (LH 451), D (LH 120), and E (OA 1329).

[3] Three associated burials without coffins: Associations B (LH 447, disarticulated bones in a ?sack), F (OA 1373), and H (LH 378).

[4] Three decapitated burials with hobnails: Associations E (OA 1329) and H (LH 379), the shoes in both apparently worn; Association D (LH 120) the shoes placed outside the coffin.

[5] Hobnails in *bustum* burial (OA 1180). The other eight burials are without hobnails.

[6] Other than a single coin in the mouth of the decapitated skeleton in Association A (LH 427). A second single coin lay by the right elbow in Association J (OA 1150) which is not included in this table (see above, n. 1).

vi. THE WIDER CONTEXT

Decapitations in other cemeteries

In this chapter, in order to focus on the associations noted at Lankhills, none of the other known instances of decapitation in Roman Britain have been discussed. Philpott's work, with its wide view, is useful and illuminating, and so too are the reports on Kempston (Beds.).[89] In the latter there is evidence of ritual decapitation which could have been the cause of the victim's death. There are also associations that could support the evidence from Lankhills,

[87] Ellis Davidson 1992, 334ff.

[88] e.g. Cool 2010, 308–9.

[89] Boyleston et al. 2000; personal notes from M. Dawson.

namely that individuals were decapitated to give life force to others.

Apart, however, from five decapitations found elsewhere in Winchester,[90] in cemeteries very different from Lankhills (and ones in which conditions made it difficult to identify associations), many other decapitations have been found, particularly in rural areas and possibly of an earlier date, where significant associations do not seem to exist.[91] How might it be possible to interpret decapitation in these situations? The vital point is that the act of decapitation put the life force of a person into the head, the rest of the body being deprived of it. Just as the act of decapitation helped to prevent the unquiet dead, in those graves with which the decapitated burial was contextually associated, from wandering amongst the living, so it prevented the decapitated person *qua* person from wandering. The life force was confined to the grave. As a result, decapitation in these cases would have been a rite performed *after death* which could allow superstitious people to rest easy without fears of a ghostly visitation, especially if the dead person had in some way been 'difficult' in life. There could also have been a curious inversion of this, related to the very ancient and understandable idea that the dead actually lived in their graves. As a result, a dead person whose head had been 'given life force' might have been imagined actually 'to live' in his or her grave. Relatives, therefore, who wanted to visit the grave would feel more in touch with the deceased without any fear of being haunted. The only candidate for this possibility at Lankhills would be the infant in OA 110 (Association K).

Winchester, military activity, migration, and religion

The closing sentence of Oxford Archaeology's monograph, *The Late Roman Cemetery at Lankhills, Winchester: Excavations 2000–2005*, ends

> for the present, at least, the conclusion that the Lankhills cemetery is highly unusual and important in a British and arguably wider north-western Roman provincial context is sustained.[92]

What is also particularly interesting is the way that Martin Biddle and Birthe Kjølbye-Biddle described the changes which occurred in Winchester in the middle of the fourth century, the time when ritual decapitation first appeared at Lankhills:

> The Roman city of *Venta Belgarum* underwent a profound change shortly after the middle of the 4th century. Some, or parts of some, of its public buildings already had been or were now demolished, town houses of the greater sort were levelled, large areas inside the walls were apparently laid out to compounds, the water supply re-organised, and the defences strengthened by the addition of bastions to the outer face of the city wall. At the same time the space actually in use seems to have increased to occupy much of the walled area, while the cemeteries grew greatly in extent: of some 1700 burials of the Roman period excavated by 2004, more than 1400 were of late Roman date. Whatever the physical changes to the fabric of the city, they were not apparently accompanied by a decrease in population.[93]

If anything, given all the fourth-century graves in Winchester, the population was increasing. The Biddles go on to suggest that

> a possible explanation is that the walled place had become a defended administrative base and supply centre, dealing with the tax in kind known as the *annona militaris* and engaged in the industrialised production of textiles in a *gynaecium*.[94]

90 Tucker 2012b, 240–2.
91 Philpott 1991, Chapter 16, *passim.*
92 Booth et al. 2010, 538.
93 Biddle and Kjølbye-Biddle 2007, 189; quoted also in Booth et al. 2010, 523.
94 ibid.

It is not the task of this chapter to discuss the possibility of Winchester as a supply-base for the collection of the *annona militaris* or as the site of a *gynaecium*. Winchester was, however, in a strategic position at the centre of the Roman road network, ready to receive supplies in kind. It was also in an opportune position to deal with inland disturbances. For sudden sea-borne attacks that could have taken place around the time of the *barbarica conspiratio* in 367 and thereafter, it was rivalled in the south only by Canterbury (*Durovernum*) and London. It was in easy reach of perhaps threatened maritime places like Portchester (*Portus Adurni)*, Southampton (*Clausentum*?), and Chichester (*Noviomagus*), but also for bringing in reinforcements from the directions of Silchester (*Calleva Atrebatum*), Cirencester (*Corinium*), and Gloucester (*Glevum*). A military headquarters based somewhat inland would also not be so easily taken by surprise. It was in the Roman military tradition not to have bases on the front line: York and Chester are good examples. It may also have been the case that Winchester provided a safe haven for people who lived in the countryside. As a result of both military activity and rural evacuation, the population seems to have increased at the time when ritual decapitation began to be practised at Lankhills. For a brief period before the withdrawal of imperial forces from Britain, Winchester may have been a meeting place of different people, both military and civil, with many varied beliefs. The results of the strontium and carbon isotope analyses at Lankhills and the rich archaeological finds argue for a population which included officials in military clothing. At such a time and with such people, Winchester was also likely to be full of activity, and subject to epidemics, rumours, and anxiety.

What then would be the effect on beliefs and rites connected with burial? First, and most important, at least some people would be aware of beliefs which encouraged individuals to hope for a life after death. By the end of the fourth century the emperor Theodosius I had decreed in Constantinople that his subjects had to be Christian. At the fringe of the Western Empire such a decree is perhaps unlikely to have had much force. Yet one of the main attractions of Christianity was its promise of an afterlife, particularly for people without the money to be initiated into other cults.[95] There is evidence, too, of Christianity in army camps elsewhere in Britain.[96] Even in a seemingly pagan cemetery like Lankhills there was perhaps an echo of Christianity at an earlier date in the graves connected with LH Feature 6. In a box at the end of the coffin in LH 250 (within Feature 6) there was a pottery platter with designs that resembled a Chi Iota (*Christos Iesos*) and a Christian fish (Illus. 2.69).[97] The graves in and around Feature 6 were deep and well cut, perhaps reflecting a desire to keep the group separate.[98] But it would be a mistake to consider such Christianity as anything but ephemeral. The offerings of bracelets and combs in the later graves of the group suggest a reversion to non-Christian beliefs.

Christianity was not the only possible influence. Men in Winchester with military connections would be aware of the promises of Mithras.[99] People with experience of Gaul would be aware of the promises of Isis and Cybele, whether they understood them or not. Epona too, the horse goddess of the Under-

[95] Nock 1933, e.g. 57.

[96] Pearson 2002, 169 (Richborough).

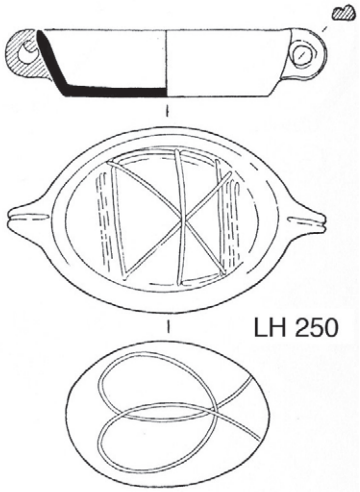
[97] WS 3.ii, 256, Fig. 82. For a chi-rho on a Roman tile from Winchester, see Foot 1992, 6–8, Fig. 1; Hassall and Tomlin 1994, 316–17; Zant 1993, 106, 126, Fig. 91.

[98] WS 3.ii, 429–30; Thomas 1981, 124, 127; cf. Booth et al. 2010, 521, who put the weight of their argument on one now disproved piece of evidence, namely that Feature 6 in its emphasis on family was different from an otherwise gender-oriented cemetery (see above, p. 133).

[99] For the spread of Mithraism and the other cults mentioned here, see Cumont 1909, *passim*.

world, found in both Gaul and Britain, seems to have influenced at least three burials at Lankhills. But unless an individual was an actual devotee of any one of these cults, the pagan habit of syncretism gave people a choice in what they believed. To judge by the deposition of some grave goods, even beliefs from Free Germany may have had an influence.[100]

In a time of anxiety and sudden demise, any act that provided a life after death could have been welcome, particularly for the rather unusual people buried at Lankhills.[101] Within that melange of ideas it might have been attractive to use ritual decapitation to take over the life force of one person's head to enable another to reach an afterlife.



Illus. 2.69. Markings on the inside and on the base of a dish from grave LH 250 (1 : 4). Possible evidence of Christianity?

[100] e.g. Cool 2010, 308–9; cf. ibid. 509–16.

[101] Lankhills seems to have been an unusual cemetery even within the context of Winchester: Ottaway et al. 2012, 343–4, 358, 367–70.

7
CATALOGUE OF THE BURIALS FROM THE LANKHILLS 1967–1972 EXCAVATIONS

i. THE INHUMATION BURIALS

This catalogue of the burials provides the following information for each inhumation burial where possible: grave number, sex, age, cranial index, stature, and pathology. Skeletal analysis was occasionally complicated by numbering errors on the bone boxes, or by admixture in the boxes of skeletal material that did not belong with the indicated burial. These problems were resolved as far as possible by careful checking of the box contents against original excavation records, and remaining cases of admixture are noted in the catalogue.

In the case of a few individuals, designation of sex has been taken from the earlier study by Harmon, as presented in Table 2 in WS 3.ii.[1] The sex designation of these individuals is marked with an asterisk (*), and the level of agreement between Harmon's work and the present study is discussed more fully on pp. 21–2.

Stature estimates are based on the maximum length of the left femur, using the formulae of Trotter and Gleser,[2] unless otherwise indicated.

LH 1. Female*, <20. Periostitis is present on both tibiae. Lesions on the right femur that resemble periostitis may be a post mortem artefact caused by cortical abrasion in the soil.

LH 2. Child, *c.*2½.

LH 3. Child, *c.*5–6. The unerupted lower left canine has two bands of LEH visible.

LH 4. Male, probably 25+.

LH 5. ?Male*, early 20s.

LH 6. Female, *c.*20.

LH 7. ?Female*, adult.

LH 8. Male, 25–30. A roughened area of uncertain origin is seen in the middle third of the anterior shaft of the left tibia. The right talus and both calcanei show moderate osteoarthritis. A thoracic vertebra, possibly T11 or T12, shows a compression fracture and moderate osteophytosis. T10 or T11 shows moderate osteophytosis but no collapse.

LH 9. Male, adult, possibly older. A fairly flat 'button' or 'ivory' osteoma, approximately 8 mm in diameter, is seen on the right frontal bone.

LH 10. Male, adult. Cranial index 74.1. The left first metatarsal shows moderate osteoarthritis of the distal articulation. Mild/moderate lipping is seen at the sacroiliac joint. The right proximal femur and acetabulum exhibit mild/moderate osteoarthritis. The tibia of a second larger adult is mixed in.

LH 11. Male, 22–30. Estimated stature 172.9 ± 3.94 cm. Cranial index 82.4. Although there is no sign of vertebral osteophytosis, the lumbar

[1] WS 3. ii, 23–95.

[2] Trotter and Gleser 1952, 1958.

vertebral bodies appear osteoporotic, with some compression and outward flaring at the margins, especially on L3. The M^1s show one band of LEH.

LH 12. Child, age and sex indeterminate.

LH 13. Male, 45+.

LH 14. Female, 25–30. Estimated stature 157.3 ± 3.72 cm. There are three auditory tori in left ear, including a large torus located posteriorly and two small tori located anteriorly in the external auditory meatus.

LH 15. Male, 35–40. Estimated stature 169.5 ± 3.94 cm. Cranial index 80.0. The superior aspect of the cranial vault is very thin, with an irregular pushed-out appearance posterior to bregma. The reason for this appearance is not clear. Most joints show mild to moderate osteoarthritis, including those of the right scapula, both proximal humeri, the proximal left ulna, the bones of the right wrist, the joints of the hips and knees, the posterior right calcaneus, and the inferior left talus. Moderate/severe osteoarthritis is also present at the sternoclavicular and costovertebral articulations.[3] Severe osteophytosis with possible fusion is seen in the costovertebral articulations of four thoracic vertebrae, although the vertebral bodies and articular facets are normal. Severe vertebral osteophytosis is present in the lower thoracic and upper lumbar vertebrae, with ankylosis of T11–12. A possible diagnosis is diffuse idiopathic skeletal hyperostosis (DISH). The characteristic sacral involvement of ankylosing spondylitis is not present.

LH 16. Male, 22–25. Estimated stature 174.6 ± 3.94 cm. Cranial index 74.4. Bilateral spondylolysis of L5 is present. Some compression and spreading at the margins of the vertebral body resulting in slight inclination to the right is seen in L3, and to a lesser extent in L2, L4, and L5. One band of LEH is visible on the PM^1s.

LH 17. Female, 30–35. Estimated stature 151.9 ± 3.72 cm. Cranial index 74.6. A flat button osteoma approximately 5 mm in diameter is present on the centre of the frontal bone. Mild to moderate vertebral osteophytosis is present in the spine from T6-L5, increasing in severity with progression down the spinal column, and is more pronounced on the right side. The articular facets of T11 exhibit moderate osteoarthritis. Two bands of LEH are visible on the lower right canine.

LH 18. Female, *c*.25. Both PM^1s are rotated posteriorly. One band of LEH is visible on the M^1s and M^2s.

LH 19. Female, 20–25. Cranial index 83.1. Marked LEH is visible on the lower central and lateral incisors and right M^1 in a narrow double band. Two more widely spaced bands are visible on the upper canines, and faint bands are present near the crowns of the PM^1s. Radiography reveals the left upper and lower M3s are present, but impacted.

LH 20. Male, 21–25. Estimated stature 167.8 ± 3.94 cm. Cranial index 70.0. A concavity of the articular surface of the trochlea of the right humerus with sclerotic margins probably represents a focus of osteochondritis dissecans (Illus. 2.35). Mild osteoarthritis is seen on the articular facets of the lumbar vertebrae. The lower central incisors are rotated. PM^1 and PM^2 are rotated posteriorly.

LH 21. Female, 20–25. Estimated stature 157.8 ± 4.24 cm (right radius).

LH 22. Female*, 25–30.

LH 23. Male, adult.

[3] Osteoarthritis is the most common abnormality seen in the sternoclavicular joint (Higginbotham and Kuhn 2005). See also LH 35, LH 277, and LH 309.

LH 24. Female, 30–40. Estimated stature 152.2 ± 3.72 cm. The deltoid muscle attachments of the humeri are greatly enlarged and roughened, giving the shaft a distorted appearance. Moderate osteoarthritis is present on the left humeral head, and in the right talus and calcaneus. One band of LEH is visible on the right M^1.

LH 25. Male, 30–35. Estimated stature 181.3 ± 3.94 cm. Cranial index 76.9. Slight pitting possibly representing porotic hyperostosis is present on the parietals and occipital. Large exostoses, probably of traumatic origin, are present on the distal right fibula and tibia. These may be the result of an old fracture, or calcification of the tendons. Moderate vertebral osteophytosis is present on L4 and L5. Some osteoarthritis is seen distally on the first proximal phalange of the left foot. Very wide bands of LEH are visible across the upper canines and all incisors, as well as the lower canines. The femur of a second individual is mixed in.

LH 26. Cremation. No remains located.

LH 27. Adult.

LH 28. Female, adult. Moderate osteophytosis is present on one fragmentary vertebral body.

LH 29. Female, 30–35.

LH 30. Adult, *c.*20–25.

LH 31. Female, 20–25. Estimated stature 154.9 ± 3.72 cm.

LH 32. Adult.

LH 33. ?Male, adult. Bones of LH 466 were recorded as in the fill, but were not seen in storage boxes.

LH 34. Child, *c.*2½. Severe enamel defects resulting in extensive hypoplastic pitting, mottling, and abnormally pointed cusps are present on all dm2s.

LH 35. Male, 25–35. Estimated stature 172.0 ± 3.94 cm (right femur). Cranial index 81.0. Moderate osteoarthritis is seen on the sternoclavicular and sternocostal articulations. The sternal articular surfaces of the clavicles are widened due to bony proliferation related to moderately advanced osteoarthritis, probably related to functional biomechanical stress. Mild degenerative changes are present on the left costal facet of T11. Mild vertebral osteophytosis is present on T12 only. The spinous process of the first sacral vertebra is unfused. A femur from a second individual is mixed in.

LH 36. Female, *c.*25. Estimated stature 157.1 ± 3.72 cm (right femur). Cranial index 80.8. A bony projection of uncertain origin is present on the conoid tubercle of both clavicles.

LH 37. Male, 25–30 (Illus. 2.62). Cranial index 76.0. A healed fracture of the left clavicle is present. A small bony projection approximately 1 cm long, and probably of traumatic origin, is present on the distal margin of the right radius. Mild to moderate osteoarthritis is seen in the sacroiliac articulation on the right pelvis. The acetabula appear normal. There is one band of LEH on M_1.

LH 38.

(1) Female, *c.*20. Estimated stature 147.7 ± 3.72 cm. Mild bilateral cribra orbitalia are seen. Original sexing as ?male[4] was probably due to the fact that the skulls for LH 37 and LH 38 were initially reversed.

(2) 5th–6th month fetus.

LH 39. Male, 25–30.

LH 40. No bones were located in storage, and may have disintegrated. Clarke lists as Infant/Child based on grave size.[5]

LH 41. Child, possibly *c.*9.

[4] WS 3.ii, 28.

[5] ibid.

LH 42. Child.

LH 43. Female, 35+.

LH 44. No bones were located in storage. Clarke[6] lists as child, age under 3.

LH 45. Female, 25–35. Estimated stature 155.9 ± 3.72 cm. There is a healed, misaligned fracture of the left clavicle. Distortion in the shaft of the left tibia is probably due to chronic biomechanical stress. No evidence of healed fracture or other pathology was detected upon radiography. Mild cribra orbitalia are seen in the right orbit.

LH 46. Child, *c*.9. The left dm^2 is abscessed (Illus. 2.21), and cavities are present in both right M1s (Illus. 2.19) and the left dm_2. Calculus is observed on the right M^1 and left dm_1, dm_2, and M_1.

LH 47. Male, 35–40. Estimated stature 167.7 ± 4.57 cm (left humerus). Cranial index 76.1. There is a well-aligned healed fracture of the right tibia (Illus. 2.30). The left femur shows a large symmetrical eroded area on the lateral aspect of the midshaft, which exhibits an expanded and lifted margin. Subsequent post mortem damage has removed the overlying bone. The most likely explanation for this lesion is an ossified subperiosteal haematoma that later underwent extensive post mortem erosion. A small button osteoma is present on the right parietal just anterior to euryon. Moderate to severe vertebral osteophytosis is seen on very fragmentary remains of L5 and the sacrum. L5 is collapsed, apparently as the result of compression fracture.

LH 48. Female, *c*.20. Mild cribra orbitalia are present bilaterally, although more strongly expressed in the right orbit. The left PM^1 is rotated mesially, and the upper left deciduous canine has been retained. Radiography reveals the permanent canine impacted horizontally in the maxilla above it. Two bands of mild LEH are seen near the root of the upper central incisor, while a single faint band of LEH is present on the PM1s, PM2s, M2s and M3s.

LH 49. No bones were located in storage. Clarke[7] lists as Adult.

LH 50. Female, *c*.20. Very slight cribra orbitalia are present in the left orbit.

LH 51. Male, 21–25. Estimated stature 174.3 ± 3.94 cm. Cranial index 83.8. The sacrum has six segments. Multiple bands of mild to moderate LEH are present on the lower incisors and all canines and PM_1s.

LH 52. Male, 50+. Estimated stature 171.3 ± 3.94 cm. Cranial index 77.8. Severe osteoarthritis with eburnation and joint deformation is present in both hips. The femoral heads are eroded and corresponding acetabula enlarged. Other large joints appear normal, but not all can be examined, due to post mortem erosion. Except for a few fragments, the vertebrae are absent.

LH 53. Female, *c*.30. Estimated stature 152.9 ± 3.72 cm. Cranial index 80.9. There is lumbarization of the first sacral vertebra with unilateral fusion on the right side. The upper left deciduous lateral incisor and canine have been retained, although the permanent canine is present and has erupted between them. Radiography shows that the permanent lateral incisor is congenitally absent. The M^3s are also absent.

LH 54. Male, *c*.21. Estimated stature 163.9 ± 3.94 cm (right femur). A single band of moderate LEH is present on the right M1s and M2s, and the right PM_1.

LH 55. Male, 45+. Cranial index 82.5. Perforations in the orbital roof may be the result of post mortem damage.

[6] WS 3.ii, 28.

[7] ibid. 30.

LH 56. No bones were located in storage. Clarke[8] lists as Adult based on the size of the grave.

LH 57. Child, 8–9.

LH 58. ?Male, *c.*25. A bony protuberance left of the midline of the mandible and to the right of the mental foramen is of uncertain origin, but may be associated with observed extensive periodontitis.

LH 59. Female, 30–35. Estimated stature 164.4 ± 4.24 cm (right radius). Cranial index 85.3. There is a bony prominence on the lateral aspect in the distal quarter of the shaft of the right tibia, which was probably in contact with the fibula. The distal fibula shaft appears flattened and depressed medially, with thick periosteal reaction within and inferior to the depression. The altered bone shape probably results from contact with the tibia in life. The abnormalities in these bones may reflect a possible broad-based osteochondroma. Two small button osteomata, approximately 5 mm in diameter, are present on the frontal bone of the skull.

LH 60. Cremation. See p. 200 below.

LH 61. Male, 25–30. Estimated stature 175.3 ± 3.94 cm. Cranial index 70.7. The left mastoid shows very tentative evidence of abscess. Mild osteoarthritis is seen in the acetabula and femoral heads of both hip joints. There is moderate degenerative activity in the lateral articulation of the left clavicle. Mild vertebral osteophytosis is present on T9–11. All other vertebrae are unaffected.

LH 62. Adult. Two small button osteomata with diameters of *c.*5 mm and 3 mm respectively are present on the frontal bone of the skull.

LH 63. Adult.

LH 64. Male, age 25–30. Estimated stature 170.4 ± 3.94 cm. The sex disagrees with Clarke,[9] but is based on clearly marked skull, pelvis, and a femoral head diameter of 50 mm.

LH 65. Infant, neonate.

LH 66. Age and sex indeterminate. Fragments of two adults and one child were found in the storage boxes, none of which can be associated clearly with this grave. Clarke[10] lists as Adult. The hip joints of one female adult exhibit an abnormally vertical femoral neck angle with some flattening of the femoral heads, and shallow acetabula. This may represent congenital bilateral hip dysplasia (Illus. 2.52a, b). The sacrum has spina bifida occulta superiorly to SV2.

LH 67. Male, 35–40. Estimated stature 168.8 ± 3.94 cm. Cranial index 79.6. Mild to moderate osteoarthritis is seen on the right scapula, acetabulum, the distal tibiae, fibulae, and both tali and calcanei. Both linea aspera of the femora are very roughened. There is some evidence of mild cribra orbitalia, which is more pronounced in the left orbit. One band of LEH is present on the PM^1s.

LH 68. No bones were located in storage. Clarke[11] lists as Adult.

LH 69. ?Female, age 25–30. Estimated stature 155.1 ± 3.72 cm (right femur). Observable sex characteristics are very mixed. Designation of sex was based on multiple regression analysis. Disagrees with Clarke,[12] which lists as Male.

LH 70. Female, 30–35.

LH 71. Child, 2–2½. Moderate to severe cribra orbitalia are present bilaterally. A second skull of an adult ?female is mixed in.

LH 72. Female, *c.*30.

[8] ibid. 30. [9] ibid. 32. [10] ibid.
[11] ibid. [12] ibid.

LH 73. Adult. This grave was only partially excavated in 1967–72, and subsequently was re-excavated by Oxford Archaeology in 2000–5 as their Inhumation Grave 242. They classified the skeleton as that of a female aged over 60.[13]

LH 74. Female, 20–25. Estimated stature 151.9 ± 3.72 cm.

LH 75. Female, *c.*20.

LH 76. Male, 35–40. Estimated stature 177.8 ± 3.94 cm. Cranial index 77.0. A large bony exostosis is present on the left mastoid. This may represent an osteoma, or more likely an ossified haematoma resulting from an earlier blow to the area. Reactive pitted bone in the right maxillary sinus indicates infection that is probably related to abscesses at the site of the right M^1, which was lost ante mortem. The palate also appears pitted, which is likely to be due to the dental and maxillary sinus infection as well. Moderate vertebral osteophytosis is present on T10-L5. T12 has a compression fracture, and the subsequent wedging of the vertebral body has resulted in mild kyphosis. The first four cervical vertebrae are stained green from the copper coin that was placed in the individual's mouth.[14] There are six sacral vertebrae.

LH 77. Number dropped.

LH 78. Male, 25–30. Estimated stature 178.3 ± 4.31 cm (right humerus + radius). The pelvis appears perforated and excessively vascularized around the acetabula and along the metaphyseal area of the iliac crest. The same pattern is observed at the extremities of the humeri and femora, the scapula, and the vertebrae. There is no clear explanation for these findings, although a systemic disturbance may be implicated. The right humerus appears perforated at the deltoid tuberosity, which is probably the result of biomechanical stress. A lytic defect of uncertain origin is seen on the anterior inferior border of one fragmentary lumbar vertebral body. The distal left fibula exhibits mild osteoarthritis.

LH 79. (1) Female, 20–25.
(2) 8th-month fetus.

LH 80. ?Female, adult. Estimated stature 155.6 ± 3.72 cm (right femur).

LH 81. Adult, 35–40. The parietal and occipital bones of the skull are flattened superiorly, and the lower occiput is extended posteriorly, creating the appearance of a deformed skull, although all sutures are normal. The unusual head shape does not appear to be the result of cultural practice, however, and more likely may be the result of post mortem taphonomic processes.

LH 82. Number dropped.

LH 83. ?Male, *c.*25.

LH 84. Infant, *c.*1.

LH 85. Child, *c.*5.

LH 86. Male, 30–35. Cranial index 80.4. Very mild cribra orbitalia are present. Although visible in the right orbit only, the lesion in the left orbit may be obscured by post mortem mineral accretions. Remains of a second individual, ?female, 15–18 years, is mixed in.

LH 87. Female, *c.*20. Estimated stature 151.7 ± 3.72 cm.

LH 88. Female, 20–25.

LH 89. Female, *c.*21. Estimated stature 152.9 ± 3.72 cm. One band of LEH is found on the lower left lateral incisors, and multiple bands are present on both lower canines.

LH 90. Child, 8–9. Very slight cribra orbitalia

[13] Booth et al. 2010, 78.

[14] WS 3.ii, 34–5.

are present. Carabelli's cusp is present on the M^1s and dm^2s. Calculus is present on the left M1s and dm2s. The sacrum and pelvis of an adult female are mixed in.

LH 91. Infant, *c.*15 months. Mild cribra orbitalia are present in the right orbit. The left orbit cannot be examined.

LH 92. Infant, *c.*6 months.

LH 93. Number dropped.

LH 94. Male, age 40–50. Estimated stature 181.3 ± 3.94 cm. Both femora appear bowed anteriorly and laterally. A bony prominence is present on the shaft of the right femur in the area of the attachment of vastus lateralis. Upon X-ray, a slight varus deformity of the right femur was observed. A sharp bony projection, possibly myositis ossificans traumatica, is present on the left humerus at mid-shaft over the deltoid tuberosity (Illus. 2.34a). Enthesophytes are seen on the radial tuberosities. All joints show some osteoarthritis, which is especially severe on the distal tibiae and fibulae at the interface between the two bones. Moderate osteoarthritis with lipping is seen in the shoulders, acetabulum, and femoral heads of both hips. Severe osteoarthritis with extensive bony proliferation is present on the right first metatarsal. Severe vertebral osteophytosis to the point of ankylosis is present from T12-L5, especially on the left side, with mild involvement of the cervical vertebrae. The neural arch of the atlas vertebra is unfused. Bilateral spondylolysis of L5 is present. Two bands of LEH are seen on the upper central incisors, while one band can be seen on the upper left lateral incisor. A single band of LEH is present on all lower incisors and PM_1, while the lower canines exhibit two bands of LEH.

LH 95. ?Male, 23–25.

LH 96. Male, 30–35. Estimated stature 182.2 ± 3.94 cm. Cranial index 75.0. Mild vertebral osteophytosis is seen on L3 and L4. Mild to moderate osteoarthritis is present on both first metatarsals distally and the first phalanges proximally.

LH 97. Male, 20–25. Estimated stature 168.6 ± 4.31 cm (left humerus + radius). Cranial index 74.1. Spina bifida occulta is present on the sacrum inferiorly up to SV2. Mild cribra orbitalia are present in the left orbit only. Multiple small bands of LEH are present on all teeth except the molars. The lower right canine is impacted and unerupted, with a retained deciduous canine (Illus. 2.24).

LH 98. Female, 23–25. Estimated stature 154.9 ± 3.72 cm. One band of LEH is present on the central incisors. The lower canines are rotated slightly.

LH 99. Adult. Partially excavated in 1967–72, this grave was re-excavated by Oxford Archaeology in 2000–5 as their Inhumation Grave 28 and classified as a ?Male, age 36–45.[15]

LH 100. Female, 22–25. Estimated stature 161.1 ± 3.72 cm.

LH 101. Female, *c.*45. Estimated stature 151.9 ± 3.72 cm. Cranial index 74.7. Moderate vertebral osteophytosis is present on C5–7 and the thoracic vertebrae. One thoracic vertebra shows a mild compression fracture and some lateral wedging as well. Moderate osteoarthritis is seen in the hips, knees, shoulders, and one tarsal. There are six sacral vertebral segments.

LH 102. No bones were located in storage. Clarke[16] lists as Infant/Child based on grave size.

LH 103. Adult.

LH 104. Male, 21–25. Estimated stature 177.4 ±

[15] Booth et al. 2010, 59.

[16] WS 3.ii, 36.

3.94 cm. Cranial index 76.9. There are six lumbar vertebrae, of which the sixth is partially ankylosed to the sacrum on the left side (Illus. 2.50). The upper right deciduous canine has been retained. The permanent canine is present, but is impacted in the jaw. Fragments of a second skull are present. The fragmentary second skull, which may belong to an adolescent or female, has moderate cribra orbitalia.

LH 105. Infant, 1–2. Mild to moderate cribra orbitalia are present.

LH 106. ?Female, 30–35. The cranial sutures appear prematurely fused.

LH 107. Male, 22–25. Estimated stature 173.9 ± 3.94 cm. Cranial index 76.3. The left ilium has a nail driven through it. Lack of iron staining in the surrounding bone indicates a recent post mortem origin for this event. Severe osteoarthritis is present in the right distal first metatarsal, which may be related to trauma. The femoral shafts appear abnormally curved medially, with abnormally straight femoral neck angle and shallow acetabula on the pelvis, suggesting a diagnosis of congenital bilateral hip dysplasia. Early osteoarthritic changes are seen in the left acetabulum. The sternum is unfused between the second and third sternal segments, although the sternum and manubrium are fused. Mild cribra orbitalia are present, more pronounced in the left orbit (Illus. 2.44).

LH 108. Infant, under 1 year.

LH 109. Male, 22–25. Estimated stature 172.7 ± 3.94 cm. The right lower canine is slightly rotated. Multiple fine bands of LEH are present on the lower lateral incisors, canine, PM_1, M_3s, and M^3.

LH 110. Male, *c.*30. Cranial index 76.1.

LH 111. Female, 20–25.

LH 112. Male, 22–25. Estimated stature 173.4 ± 3.94 cm. The vertebrae appear osteoporotic, with spreading and wedging anteriorly, especially T6, 11, 12, and L1–4. A deep depression of uncertain origin, but possibly an aneurism or leiomyoma, is present on the left side of the body of L2. Large bony spurs, probably the result of ossified ligaments, are present just below the articular facets of T12. The cause of these vertebral manifestations is unclear. Two oval slightly raised areas of ossification, 2.5 and 1.5 cm diameter respectively, are seen on the lateral surface of the ilium immediately inferior to the iliac crest. One moderately pronounced band of LEH is seen on the upper incisors, canine, and PM^1, along with several lighter bands (Illus. 2.22). A single light band is visible on the upper M^1.

LH 113. Child, 2½–3.

LH 114. Female, 20–25. Estimated stature 159.6 ± 3.72 cm. Cranial index 76.8.

LH 115. This grave was not wholly excavated and bones were not available. Clarke[17] lists as Adult, based on grave size. The grave was re-excavated by Oxford Archaeology in 2000–5 as their Inhumation Grave 313 and classified as Female, age 36–45.[18]

LH 116. ?Male*, adult. There is a shallow bony prominence on the upper 1/3 of the shaft of the left femur. Radiography shows a focus of post-traumatic cortical thickening. Only partially excavated in 1967–72, this grave was re-excavated by Oxford Archaeology in 2000–5 as their Inhumation Grave 150 and classified as Female, Adult.[19]

LH 117. Female, *c.*20.

LH 118. Female, adult. Estimated stature 159.1 ± 3.72 cm. There are six lumbar vertebrae, the

[17] WS 3.ii, 38–9. [18] Booth et al. 2010, 83. [19] ibid. 75.

sixth of which is ankylosed to the sacrum on the right side.

LH 119. Female, 20–25. Estimated stature 157.8 ± 3.72 cm. A healed nasal fracture is present (Illus. 2.26).

LH 120. Infant, *c.*18 months. The head was buried above the feet, outside the coffin, suggesting decapitation (Illus. 2.62).[20] In the original analysis Watt could find no osteological evidence for this practice.[21] However, more recent re-examination suggests the child was decapitated by a single blow through the left pedicle of C3, although the direction of the blow could not be determined.[22]

LH 121. Neonate.

LH 122. Child, 5–6.

LH 123. Male, 22–25. Estimated stature 172.9 ± 3.94 cm. Mild vertebral osteophytosis is present on L2 and L4. The sacrum has an unfused spinous process at S1, and spina bifida occulta inferiorly up to the level of S3.

LH 124. Male, adult.

LH 125. ?Female, 25–30.

LH 126. Adolescent, *c.*19.

LH 127. Adult.

LH 128. Male, *c.*40. Estimated stature 176.2 ± 3.94 cm. Cranial index 72.5. Large tori are present in both ears, almost completely blocking the auditory canal. Moderate osteophytosis of the cervical vertebrae is present. The right talus and calcaneus are ankylosed, most likely congenitally since there is no evidence for trauma or osteoarthritic activity. Several bands of mild LEH are seen on the canines.

LH 129. ?Male*, 20–25. Two bands of mild LEH are seen on the upper left canine.

LH 130. Male, *c.*25. Estimated stature 168.3 ± 3.94 cm (right femur). One band of LEH is seen on the canines and PM_1. The left PM^2 is rotated. The lower anterior dentition is overcrowded and misaligned.

LH 131. ?Female*, *c.*25.

LH 132. Child, *c.*3. Carabelli's cusp is observed on the dm^2, and can be seen on the forming crown of the unerupted M^1.

LH 133. Female, 20–25. Estimated stature 153.9 ± 3.72 cm. The right M^3 is a peg tooth.

LH 134. Child, *c.*8.

LH 135. ?Female, possibly older adult.

LH 136. Child, 9–10. Mild to moderate cribra orbitalia are present in the left orbit. The right orbit cannot be examined. A trace of Carabelli's cusp is seen on the M^1s. Caries is observed on the left dm^2. Very fragmentary postcranial remains of an adult are mixed in.

LH 137. Female, *c.*20. Cranial index 79.1. One band of LEH is seen on the right M^3. The mandible has a retained dm_2.

LH 138. ?Male, *c.*25. Moderate osteophytosis is present on the left side of two lumbar vertebrae.

LH 139. Female, 19–20. Moderate cribra orbitalia are present. The right femur has a large third trochanter and the upper third of the shaft is enlarged posteriorly, possibly related to unusual stresses on the tissues in that area. A smooth oval lesion with raised margins is located immediately below the lesser trochanter of the left femur, and may represent a calcified subperiosteal haematoma which was eroded post mortem. Fragments of a child aged 5–12 are mixed in.

LH 140. Male, 25–30. The left femur exhibits

[20] WS 3.ii, 41. [21] Watt 1979, 343. [22] See above, p. 101.

periostitis proximally all around the shaft just below the lesser trochanter.

LH 141. Male, 30–35. Estimated stature 166.2 ± 3.94 cm. Moderate osteoarthritis is present on the dens axis and associated atlas facet. Mild vertebral osteophytosis is seen on T5, 6, and 8, and a sharp projection is present on the spinous process of T9. All other vertebrae are normal. The sacrum exhibits spina bifida occulta superiorly to S2, and the spinous processes of S3 and S4 are vestigial. Fragmentary postcranial remains of a second individual are mixed in.

LH 142. ?Female, 12–20. Remains of a second individual are mixed in.

LH 143. ?Female, adult.

LH 144. No bones were located in storage. The disintegrated bones of this burial were found in LH 143 when excavated. Clarke[23] lists as Neonate.

LH 145. Adult.

LH 146. ?Female, adult. Estimated stature 155.1 ± 3.72 cm.

LH 147. No bones were located in storage. The disintegrated bones of this burial were found in LH 137 when excavated. Clarke[24] lists as Child, *c.*11.

LH 148. No bones found. Clarke[25] lists as Infant/Child, based on grave size.

LH 149. Female, adult. Estimated stature 163.0 ± 3.72 cm. Severe osteoarthritis, with eburnation, grooving, and deformation of the tibial spine present in the knees, especially the right knee. Other major joints cannot be evaluated.

LH 150. Male, age *c.*40. Cranial index 75.0. The left scapula shows a honeycomb-like defect on the dorsal and lateral aspect, just below acromion and the glenoid cavity. It is not clear whether this represents pathology or post mortem damage. The left tibia exhibits exostoses distally in the area adjoining the fibula. A small sharp bony projection *c.*1.5 cm long is present on the anterior tibial crest in the proximal 1/3 of the shaft. This may represent a focus of myositis ossificans traumatica.

LH 151. ?Female*, adult.

LH 152. Adolescent, 14–15.

LH 153. Child. Adult postcranial remains are mixed in.

LH 154. Child, *c.*2. The right femoral shaft exhibits a severe abnormal angulation in the distal third of the shaft, accompanied by periostitis near the metaphysis. The most likely diagnosis is rickets (Illus. 2.45). Carabelli's cusp is present on the dm2. Fragmentary adult remains are mixed in.

LH 155. Child, 10–11. Moderate cribra orbitalia are present. The upper M^1 exhibits a trace of Carabelli's cusp. The upper lateral incisors have pronounced shovelling.

LH 156. Female, 30+. Listed in Clarke[26] as a child, based on the size of the grave. The skull is clearly adult female, however, and the grave drawing appears compatible with an adult designation.

LH 157. No bones were located in storage. Clarke[27] lists as Child, based on grave size.

LH 158. Male, 30–35. Two very small button osteomata 4.5 mm and 2 mm in diameter are present on the upper frontal bone of the skull in the median line.

LH 159. ?Female, 20–25.

LH 160. Male, adult. Estimated stature 172.9 ±

23 WS 3.ii, 42. 24 ibid. 44. 25 ibid.
26 ibid. 27 ibid.

3.94 cm. Mild osteoarthritis is present on the first left distal metatarsal and proximal first phalanx. The first sacral vertebra appears partly lumbarized posteriorly. Due to breakage, it is not possible to tell whether this represents a transitional extra segment. Mild osteoarthritis is seen in the femoral heads and acetabula of both hips and on the articular facets of the lumbar vertebrae.

LH 161. Male, 25–30. Estimated stature 169.7 ± 3.94 cm. There is a healed, misaligned fracture of the right clavicle (Illus. 2.29). Mild osteoarthritis is present in both hip joints and the sacroiliac articulation, as well as the knees. Moderate/severe osteophytosis is present on the cervical vertebrae, especially C5 and C6. The osteophytes may have been fused at C5 and C6. The thoracic vertebrae are affected only mildly to moderately, especially on the right side, while there is only slight involvement of L5. The other lumbar vertebrae are normal. The muscle attachments on all long bones are very pronounced, and there is marked curvature of the femora, suggesting considerable biomechanical stress, especially on the femoral neck and the weight-bearing regions of the individual's lower body. One band of LEH is seen on the upper right canine. Portions of a second individual are mixed in.

LH 162. Child.

LH 163. Male, 20–25.

LH 164. Child, 9–10. The skull appears unusually small for this dental age, but is too fragmentary to permit measurement. LEH is seen on the central incisor, and Carabelli's cusp is present on M1.

LH 165. ?Female, 40–45.

LH 166. Male, 35+. A femur of a child is mixed in.

LH 167. Male*, 35+. A skull fragment of a second individual is mixed in.

LH 168. Female, 35+. Estimated stature 158.3 ± 3.72 cm. The manubrium and first ribs are fused. Severe vertebral osteophytosis and ossification of the anterior longitudinal ligament with fusion and partial collapse is present in T5–9, resulting in lateral scoliosis to the left side, as well as mild kyphosis. This probably represents a case of DISH. The cervical vertebrae are unaffected except for small bony protuberances next to the articular facets of atlas. Moderate/severe osteophytosis is present in the lumbar vertebrae. The left ilium has moderately pronounced enthesophytes on the iliac crest, and mild osteoarthritis is seen in the hips. The clavicles show mild/moderate osteoarthritis, with the right being more affected. The other joints are normal. There is an unfused spinous process on S1.

LH 169. Child, 4–5. Caries are present on both dm^1s.

LH 170. Female, 20–25. The innominate of a second immature individual is present.

LH 171. Female, 25–28. There is a partially healed fracture of the right clavicle. One marked and several fine bands of LEH are visible on the lower left canine.

LH 172. Female, 25+. Estimated stature 156.1 ± 3.72 cm (right femur). Clarke[28] lists as Child, based on grave size. Remains (postcranial only) are clearly those of an adult female, however.

LH 173. Infant, 0–2.

LH 174. Child.

LH 175. Female, 25–30.

LH 176. ?Male, adult. Estimated stature 162.0 ± 3.94 cm.

[28] ibid. 46.

LH 177. Child, *c.*5. The dm^2 exhibits Carabelli's cusp.

LH 178. Child.

LH 179. Female, 21–25. The dm2s have been retained, and all four PM2s appear to be congenitally absent. Remains of a child, age *c.*8, are mixed in. These belong to LH 189.

LH 180. Adult. Both tibiae show periostitis on the lateral aspect of the upper 2/3 of the shaft.

LH 181. Male, 30–35. Estimated stature 173.9 ± 3.94 cm. Cranial index 74.5. The right tibia appears slightly bowed laterally and flattened, which is probably the result of biomechanical stress. X-ray reveals no other abnormality. The skull appears bathrocephalic, with many large lambdoid ossicles and a very pronounced nuchal crest. Mild osteophytosis is present on the thoracic vertebrae, and is more pronounced on the right side, with possible scoliosis laterally to the left in the region of T1–6. Osteoarthritis is also present on the right costovertebral facets of the T6–9. Ossification of the ligamenta flava is seen on T8–12. Enthesophytes are present on the iliac crest. Moderate cribra orbitalia are seen in the left orbit. The right orbit cannot be evaluated.

LH 182. Female, 30+. The M^3s are peg teeth.

LH 183. Child, 3–7. Remains of a second infant, 0–3 months, are mixed in.

LH 184. Child, *c.*5.

LH 185. Child, *c.*3½–4. Skull fragments of a second child are mixed in.

LH 186. Male, *c.*25.

LH 187. ?Female, 20–25. One band of LEH is seen on the upper canine.

LH 188. Child, *c.*5. Carabelli's cusp is present on the dm^2. Caries, aspect unspecified, are present on the right dm^1 and dm^2.

LH 189. Child, *c.*8. Carabelli's cusp is seen on the dm^2s and M^1s, and calculus is found on the left dm^2. The bones were originally misidentified as belonging to LH 179.

LH 190. No bones were located in storage. Clarke[29] lists as Infant, based on grave size.

LH 191. Female, *c.* 25–30. Estimated stature 162.8 ± 3.72 cm.

LH 192. Male, *c.*25. Estimated stature 171.8 ± 3.94 cm. Both tibiae show small patches of periostitis medially in the distal 1/3 of the shaft (Illus. 2.47a).

LH 193. Female, 25–30.

LH 194. Female, 25–30. Estimated stature 163.8 ± 3.72 cm. Cranial index 76.8.

LH 195. No bones were located in storage. Clarke[30] lists as Child, based on grave size.

LH 196. Male, 25–30. Estimated stature 165.5 ± 3.94 cm. Mild osteophytosis is present on L5 and some thoracic vertebrae. The exact thoracic vertebrae cannot be specified further because of post mortem bone damage.

LH 197. Child, *c.*2½–3.

LH 198. Male, 24–25.

LH 199. Female, 15–17. Moderate to severe cribra orbitalia are present bilaterally. One band of LEH is seen on the incisors and PM1s, while two bands are visible on the M1s and canines. Portions of at least one younger individual are mixed in.

LH 200. Adult.

LH 201. Female, *c.*20. Estimated stature 156.4 ± 3.72 cm (left humerus). A bony protuberance on

[29] WS 3.ii, 48.

[30] ibid. 50.

the right side of the mandible appears to be an osteoma approximately 1 cm in diameter.

LH 202. Infant, *c.*6–9 months.

LH 203. Female, 22–25. Cranial index 78.4.

LH 204. Female, 22–25. Estimated stature 162.0 ± 3.72 cm. There is a poorly aligned, healed fracture of the distal third of the right tibial shaft (Illus. 2.57a,b).

LH 205. Child, *c.*7–10.

LH 206. No bones were located in storage. Clarke[31] lists and Infant/Child based on grave size.

LH 207. Child, *c.*3–4.

LH 208. Male, 35–40. Estimated stature 170.9 ± 3.94 cm. Cranial index 79.1. There is moderate to severe osteophytosis on the right side of T7–8, while T5, 6, 9, and 10 are mildly affected. Mild to moderate osteoarthritis is present in a number of costal vertebral articulations. The cervical and upper thoracic vertebrae are normal. Mild osteoarthritis is present in the hips.

LH 209. Number dropped.

LH 210. Child, *c.*5–6.

LH 211. Adult, *c.*35.

LH 212. Female, 35–40. Estimated stature 153.9 ± 3.72 cm (right femur). There is a healed Colles' fracture of the left radius. Mild osteoarthritis is present in the right acetabulum.

LH 213. Infant, *c.*1.

LH 214. Male, *c.*40. Estimated stature 166.0 ± 3.94 cm. Cranial index 80.0. A button osteoma measuring 9.5 mm on its long axis is seen on the right temporal bone. Mild osteoarthritis is present on the femoral heads and the left distal first metatarsal.

LH 215. ?Male*, adult.

LH 216. Adult.

LH 217. ?Male, 35–40. One faint band of LEH is seen on M^1, the upper lateral incisor, premolars, and M^3, while two bands are seen on the canine.

LH 218. Female, 35+. Estimated stature 150.2 ± 3.72 cm. Mild to moderate osteoarthritis is seen on the right humeral head and the right lateral clavicle. Severe osteoarthritis is present in the right knee, which is badly deformed, with eburnation and grooving of the condylar surfaces of the tibia and femur (Illus. 2.42). The right patella is also involved. The left knee is unaffected, suggesting this arthritis may have a traumatic origin. Mild bony proliferations are seen on the os trigonum of the left talus. The M_2s exhibit one band of LEH.

LH 219. Female, *c.*20.

LH 220. ?Female, *c.*25. Two bands of mild LEH are seen on the lower right canine.

LH 221. Number dropped.

LH 222. Male, *c.*25.

LH 223. Number dropped.

LH 224. Child, *c.*13. Clarke's[32] age designation of 9/10 is probably due to misinterpretation of a dental anomaly. Mild cribra orbitalia are present bilaterally. Except for the central incisors, M1s and M2s, all of which are fully erupted, all deciduous dentition has been retained (i.e. lateral incisors, canines, dm1s, and dm2s). The unerupted canines, with fully formed roots, and unerupted PM1s, can be seen in the alveolar bone.

LH 225. Male, 30–35. Estimated stature 167.4 ± 3.94 cm. Cranial index 77.9. A large button osteoma is present on the left parietal bone,

[31] ibid. 50.

[32] ibid. 52.

with a smaller one adjacent to it on the sagittal suture. A femur of a second adult and a femur of a child are mixed in.

LH 226. Male, 30–35. Estimated stature 166.2 ± 3.94 cm. Cranial index 82.1. The right femur exhibits a severe, incompletely healed intertrochanteric fracture of the femoral neck, with lateral and posterior 90° rotation of the shaft (Illus. 2.28). There is secondary osteoarthritis of the right hip joint. Moderate vertebral osteophytosis is seen in T9–12, with T8 mildly affected. The cervical and lumbar vertebrae are normal. Osteoarthritis of the apophyseal facets and partial ossification of the ligamenta flavia are present in T10–12.

LH 227. Male, 35–40. Estimated stature 166.0 ± 3.94 cm. Cranial index 73.8. The mandible appears to have a button osteoma on the left corpus posterior to the mental foramen and below M_1. T11 is partially compressed laterally, suggesting a compression fracture, and exhibits moderate to severe osteophytosis on the right side. Most other vertebral bodies are missing. Mild cribra orbitalia are present bilaterally. The right M_3 has a third distolingual cusp.

LH 228. Female, *c.*22. The calcaneus of a second adult is mixed in. Only partially excavated in 1967–72, this grave was re-excavated by Oxford Archaeology in 2000–5 and numbered Inhumation Grave 141. It was classified as Adult, sex indeterminate.[33]

LH 229. ?Male, 65+. Estimated stature 164.5 ± 4.57 cm (left humerus). Cranial index 75.7. All bones are extremely thin and osteoporotic. Moderate osteoarthritis is seen in the right shoulder joint, the acetabula of the hips, and the phalanges of the feet. There is extensive roughening on the right radial tuberosity.

LH 230. Number dropped.

LH 231. ?Female, probably *c.*20–25. A second skull of a male, 35–40, is mixed in. The male skull shows a healed fracture of the superior border of the right orbit (Illus. 2.27).

LH 232. Female, *c.*25.

LH 233. ?Male, probably *c.*40. Cranial index 78.4. A fully impacted wisdom tooth is clearly visible in the right mandible. The remaining M3s appear to have been lost due to pathology. Humeri from a second adult and child are mixed in.

LH 234. Adult, 25–30. Some material from LH 235 is mixed in.

LH 235. Female, *c.*25+. Estimated stature 148.5 ± 3.72 cm.

LH 236. No bones were located in storage. Clarke[34] lists as Child.

LH 237. Cremation. No remains found.

LH 238. Child, *c.*3.

LH 239. Female, 20–25.

LH 240. Child.

LH 241. Number dropped.

LH 242. No bones were located in storage. Clarke[35] lists as Infant, based on grave size.

LH 243. Female, *c.*25. Estimated stature 155.4 ± 3.72 cm. Cranial index 77.5.

LH 244. Adult, 25–35.

LH 245. Number dropped.

LH 246. No bones were located in storage. Clarke[36] lists as Adult, based on grave size.

LH 247. No bones were located in storage. Clarke[37] lists as Child, age ?2.

LH 248. Male, 25–30. Multiple small bands of

33 Booth et al. 2010, 73.
34 WS 3.ii, 54.
35 ibid.
36 ibid.
37 ibid.

LEH are present on both right canines. A single more pronounced band, accompanied by several smaller bands, is seen on the right M^1 and M^2.

LH 249. Female, age 45+. Estimated stature 151.4 ± 3.72 cm (right femur). Irregular deposition of bone on the lower endocranial surface of the frontal bone probably represents hyperostosis frontalis interna (Illus. 2.46). Mild vertebral osteophytosis is present on C3. The lower thoracic and lumbar vertebrae show severe osteophytosis with extended lipping and suggestion of prior ankylosis, which degraded post mortem. Severe osteoarthritis can be seen on the articular facets of at least one lumbar vertebra. The left ankle joint is severely deformed by osteoarthritis, especially the talus, which has been markedly compressed. The articular surfaces of the tibia and talus are eburnated and grooved, with extensive degenerative and proliferative bony changes. The right ankle exhibits mild osteoarthritis but otherwise appears normal. The asymmetry of osteoarthritis in the ankle joints suggests trauma as a possible aetiology in the left ankle. The articulations of the first metatarsals exhibit severe osteoarthritis with burnishing of the joint surfaces, while other bones of the hands and feet are mildly to moderately affected. Osteoarthritis is present in the acetabula of the pelvis and in the clavicles at the sternal articulation. The head of the right humerus exhibits osteoarthritis.

LH 250. Adolescent, 17–19 (Illus. 2.2c). A small Carabelli's cusp is seen on the M^1s, and a clear protostylid is visible on the M_3s.

LH 251. No bones were located in storage. Clarke[38] lists as Child.

LH 252. ?Male, adult. Severe periostitis is present on the left tibia antero-laterally in the distal third of the shaft. The proximal third of the shaft shows myositis ossificans traumatica laterally (Illus. 2.47b). The right tibia exhibits a milder degree of periostitis. Two small button osteomata are present exocranially on the frontal bone. A larger third osteoma is present endocranially on the frontal bone.

LH 253. No bones were located in storage. Clarke[39] lists as Child, based on grave size.

LH 254. Female, 40–45 (sex designation disagrees with Clarke[40]). There is a small osteoma on the anterior lingual surface of the mandible, lateral to the symphysis.

LH 255. Male, adult. Moderate vertebral osteophytosis is seen on the fragmentary lumbar vertebrae, and is more pronounced on the right side. Fragments of a second adult female are mixed in.

LH 256. Female, 21–25. Estimated stature 154.1 ± 4.45 cm (right humerus). Cranial index 74.7. There is possible (but unconfirmed) M3 agenesis. A larger fibula from a second individual is mixed in.

LH 257. Infant, *c.*9 months. A large Carabellli's cusp is present on the dm^2s.

LH 258. Female, 35–40.

LH 259. Infant, probably neonate.

LH 260. Male, 20–25. Cranial index 75.0. Periostitis is present on all leg bones, and is especially severe on the right tibia. Radiography reveals a chronic periosteal reaction with bone deposition. Both femoral shafts appear bowed medially, which may be due to biomechanical stress. A widening of the shaft, possibly related to trauma, is present on the distal third of the left femoral shaft in the area of the linea aspera.

LH 261. Male, 35–40. A healed misaligned

38 ibid. 56. 39 ibid. 40 ibid.

fracture of the distal 1/3 of the right tibia and fibula is present.

LH 262. Infant, 9–12 months.

LH 263. Adult, 30–35.

LH 264. Male*, *c.*21. One band of mild LEH is seen on the left PM^1, M^1, and M^2.

LH 265. Adolescent, 18–19. This grave was re-excavated as Inhumation Grave 178 by Oxford Archaeology in 2000–5. However, the skeleton had been lifted during Clarke's earlier excavations, and only a single *in situ* coffin nail remained.[41]

LH 266. Female, 23–25. Estimated stature 163.8 ± 3.72 cm. The upper left canine is a peg tooth. Mild vertebral osteophytosis is seen on C4–6. All other vertebrae are normal. An adult male femur is mixed in.

LH 267. Number dropped.

LH 268. No bones were located in storage. Clarke[42] lists as Child, based on size of grave.

LH 269. Adult. Clarke[43] lists as Child, based on grave size. The bones, however, are definitely adult, and the grave drawing appears to accord with this designation.

LH 270. Female, *c.*25. Estimated stature 156.1 ± 3.72 cm. Cranial index 69.8. The lower anterior dentition is crowded, with the left lateral incisor displaced slightly behind the canine. Mild osteoarthritis of the costovertebral facets is seen on one upper thoracic vertebra.

LH 271. Infant, 0–6 months.

LH 272.

(1) Female, 35–40. Estimated stature 156.1 ± 3.72 cm. Cranial index 81.6. Three small osteomata are present on the left parietal bone. There are six lumbar vertebrae. Mild osteoarthritis is present on both femoral heads, the medial condyle of the left tibia, and the acromioclavicular articulations of both clavicles. A bony protuberance on the shaft of the right humerus may represent myositis ossificans traumatica at the attachment of the pectoralis major. Moderate to severe vertebral osteophytosis is present on L5 and L6, especially on the right side. L6 appears to have a compression fracture. Mild osteoarthritis is seen on the articular processes of the lumbar vertebrae. C2–3 exhibit moderate osteoarthritis on the condyles, especially on the right.

(2) ?Male*, adult* (bones for this individual were not located).

LH 273. Female, 30–35. Estimated stature 155.4 ± 3.72 cm. Cranial index 79.0. There are six lumbar vertebrae. Moderate vertebral osteophytosis is seen on C6–7 and on T11–12, while it is mildly expressed on L4–6. Moderate osteoarthritis is present on the articular facets of C5–6, T12, L1, L4–6, and also on the costal facet on the process of T11. Other thoracic vertebrae are essentially normal. The lower left canine has a double root.

LH 274. Child, 7–8. Clarke[44] lists as Adult, based on grave size. The bones, however, clearly belong to a child.

LH 275. Number dropped.

LH 276. No bones were located in storage. Clarke[45] lists as Child, based on grave size.

LH 277. Male, 40–50. Estimated stature 173.9 ± 3.94 cm. This is a very robust male, with pronounced muscle attachments. There is moderate osteoarthritis of the right femoral head and acetabulum. Enthesophytes are present along the right iliac crest and osteophytes are seen in the sacroiliac joint. Mild/moderate osteoarthritis is

41 Booth et al. 2010, 75.
42 WS 3.ii. 58.
43 ibid.
44 ibid.
45 ibid. 60.

present at the sternal and scapular articulations of both clavicles, and the proximal right ulna. The dens epistrophei of the axis vertebra and articular facets of C2–4 exhibit moderate osteoarthritis. Moderate to severe osteophytosis is present in the lumbar vertebrae, while T8–12 exhibit severe osteophytosis. There is ankylosis of T8–11 on the right side.

LH 278. ?Male, *c.*25. The spinal column of a child, 6–8, is mixed in. This may belong with LH 378.

LH 279. Child, 7–8.

LH 280. No bones were located in storage. Clarke[46] lists as Infant/Child, based on grave size.

LH 281. Female, 35+. Estimated stature 169.4 ± 3.72 cm. The sacrum has six vertebral segments. There is spina bifida occulta superiorly to the second sacral vertebra. Mild osteophytosis is seen in C5–7. Mild to moderate osteophytosis is present in the thoracic vertebrae, except T7–9 which exhibit severe osteophytosis and probable ankylosis on the right side. There is severe osteophytosis of L4–5, especially on the left side. Mild osteoarthritis is seen in the hips and left shoulder.

LH 282. Infant, *c.*20–24 months.

LH 283. Male, 35+. Estimated stature 169.5 ± 3.94 cm. The glenoid fossa of the right scapula has a degenerative subarticular cyst adjacent to the anterior margin which has been exposed due to post mortem damage. A similar lesion seen on the posterior margin is the result of post mortem damage, as are the perforations seen on the surface of the glenoid fossa itself (Illus. 2.49a–c). There is a healed spiral fracture of the distal third of the right fibula, with moderate to severe secondary arthritic changes in the distal joint. A small bony prominence of probable traumatic origin is present on the distal anterior shaft of the right tibia, and there is some evidence for osteoarthritis in the right ankle joint. There is mild osteoarthritis in the right elbow and moderate osteoarthritis in the left elbow. The wrists and hips show mild osteoarthritis. There is severe osteophytosis of the lumbar vertebrae, especially L3–4, which may be ankylosed on the right side. Severe osteophytosis and anterior longitudinal ligament ossification is also seen on T4–9, especially on the right side, with contact and probable ankylosis of T6–7, and certain ankylosis of T7–8. These vertebral changes represent a case of DISH.

LH 284. Infant, *c.*14 months.

LH 285. Infant, *c.*14–16 months. Moderate cribra orbitalia are present in the right orbit. The left orbit cannot be observed.

LH 286. Female, 22–25. Estimated stature 152.4 ± 3.72 cm.

LH 287. Male, *c.*30. The upper deciduous lateral incisors and canines have been retained, although fully developed permanent canines are present, impacted in the jaw. The permanent lateral incisors appear to be congenitally absent.

LH 288. Female, probably 35+. Estimated stature 152.4 ± 3.72 cm.

LH 289. Infant, *c.*12–14 months.

LH 290. Child, *c.*5–6. Carabelli's cusp is present on the dm^2s.

LH 291. Male, *c.*30 (Illus. 2.2b). Estimated stature 169.9 ± 3.94 cm. There is a healed, misaligned spiral fracture of the distal right tibia and fibula. The left mastoid foramen is greatly enlarged. However, radiography indicates that the mastoid cells are normally aerated. Mild to moderate

[46] ibid. 60.

osteophytosis is present in the thoracic and lumbar vertebrae, with pronounced marginal lipping on the left side of L1–3. A raised irregular bony area of uncertain origin is present on the left innominate immediately superior to the acetabulum. There is a bony prominence on the medial caudal surface of the clavicle at the insertion of the costoclavicular ligament. This osseous proliferation may be related to heavy physical activity. There are six sacral segments. Mild cribra orbitalia are seen. The left M_1 has a fifth disto-buccal cusp.

LH 292. No bones were located in storage. Clarke[47] lists as neonate.

LH 293. Male, 25–28. Estimated stature 175.3 ± 3.94 cm. The cranial vault is pitted, especially on the posterior portion of the parietals. The palate is extremely osteoporotic. The right first cuneiform is badly deformed with osteoarthritis, possibly of traumatic origin, while mild osteoarthritis is present in the proximal right first metatarsal. Multiple bands of LEH are seen on the upper incisors, canines, premolars, and M^1. There is a socket for a peg tooth between M^2 and M^3 on the buccal surface of the maxilla. Cranial fragments of a second individual are mixed in.

LH 294.

(1) Child, *c*.6–7. Both tibiae are severely bowed anteriorly and exhibit a flattened cross-section, suggesting a possible case of rickets. The sternum could not be evaluated. Hypoplastic enamel formation seen on the lower M_1s, which are pitted in the upper half of the crown, would tend to support this diagnosis.

(2) Infant, *c*.2. Upon radiography the tibia shows a healed traumatic bowing fracture proximally with an anterior angulation deformity. Periostitis is present proximally at the healed fracture site. Periostitis is also seen on the proximal left femur.

LH 295. Female, 35–40. A bony prominence of indeterminate origin is present on the left side of the mandible. Mild ostephytosis is observed on L4 and in the sacroiliac articulation. Two individuals were inventoried under this LH number. Incomplete skeletal remains of a male, 18–20, are probably misnumbered. These remains do not accord with the LH plan as well as the female skeleton attributed to this grave.

LH 296. Male, 40+. Mild to moderate osteophytosis is present on the thoracic and lumbar vertebrae, which are very fragmentary. Mild osteoarthritis is seen in the left scapula and both acetabula.

LH 297. Female, 20–25. Estimated stature 153.6 ± 3.72 cm. At least two other individuals are mixed in, including the remains of an older child. The skull was approximately in anatomical position and decapitation was not originally suspected. A subsequent study has identified the primary burial as a decapitation with a posterior killing blow[48] (Illus. 2.38). There was a fracture and shortening of the right fifth metacarpal with a flexion contracture of the digit.[49]

LH 298. No bones were located in storage. Clarke[50] lists as Child, *c*.3.

LH 299. Male, 35–40. One small flat button osteoma is present on the centre of the frontal bone, along a full metopic suture.[51] The manubrium, body, and xiphoid process of the sternum are fused. The xiphoid process is perforated, which is a fairly common failure of ossification. Moderate osteoarthritis and osteopenia are seen on both clavicles and humeral heads, and both are more pronounced on the left side. Mild osteoarthritis is seen in the acetabula. All other

47 WS 3.ii, 62.
48 See above, p. 101 and Illus. 2.38.
49 Tucker 2012, 103.
50 WS 3.ii, 62.
51 See p. 123, n. 148, for the definitions of metopism used in this study.

major joints and the hands are normal. The sacrum is ankylosed to the pelvis on the right side, suggesting sacroiliitis of unknown aetiology. The thoracic spine from T6 to T12 shows thick continuous ossification of the anterior longitudinal ligament on the right side, indicating a case of DISH (Illus. 2.43). This resulted in anterior spinal curvature and lateral rotation to the left. Moderate/severe osteophytosis without ankylosis is present on the right side of the lumbar vertebrae. There is a transmetatarsal amputation of the phalanges and distal metatarsals on both feet (Illus. 2.36a, b).[52]

LH 300. Number dropped.

LH 301. Number dropped.

LH 302. Number dropped. Decapitated adult male from a partially excavated grave in an associated 1970 rescue excavation, not included in the original publication. Skeletal material was located and analysed more recently.[53]

LH 303. Number dropped.

LH 304. Male, *c.*27. Estimated stature 172.9 ± 3.94 cm. Severe osteoarthritis is present on the navicular facet of the right calcaneus, and a more moderate degree is seen on the talus. Other tarsals are mildly involved. The left foot is similarly affected but not as severely. The spine and all other joints are unaffected. The sacrum is unfused dorsally except at the level of S3 (Illus. 2.51). The maxilla from a second individual is mixed in.

LH 305. Male, *c.*25. Estimated stature 174.3 ± 3.94 cm.

LH 306. Male, 30–35. Estimated stature 165.8 ± 3.94 cm. Cranial index 78.1. The cranial sutures, although not fully fused, are hyperossified. There is a shallow depression running across the cranial vault that may have been created by the elevated nature of the coronal suture and portions of the sagittal suture. Alternatively, the depression may have been caused by pressure applied by some type of headgear, for example a strap to support weight, worn over long periods. The sacrum has six segments. One band of LEH is seen on the upper central incisor.

LH 307. Female, 35–40. Thickening of cranial bone suggests a possible case of Paget's Disease of bone. Slight osteoarthritis is present in the tarsals and some phalanges of the feet, and also one metacarpal. Lipping is seen on the right side of the superior vertebral articular facets of the sacrum.

LH 308 (Illus. 2.2a).

(1) Male, *c.*45. Estimated stature 161.3 ± 3.94 cm. Cranial index 81.6. Mild osteoarthritis is seen on the left femoral head. More pronounced osteoarthritis is seen on the right femoral head and acetabulum.

(2) Female adolescent, *c.*15. Caries, aspect unspecified, are present on both M^1s. Calculus is seen on the following teeth: upper left I1, upper right C, PM1, PM2, M1, lower left I1, C, PM1, M1, lower right C, M1, M2.

(3) Female, *c.*30–35. Mild osteophytosis is seen on the right side of the mid- and lower thoracic vertebrae. Possible mild cribra orbitalia are present, although accurate observation is made difficult by the eroded condition of the bone.

LH 309. Male, 45+. Estimated stature 178.5 ± 3.94 cm. Cranial index 70.1. Many bones of the skeleton are extremely osteoporotic. Pronounced degenerative changes are seen inferiorly on the sternal articulation of the right clavicle. Mild osteoarthritis is seen in the glenoid fossa of the scapulae, and moderate osteoarthritis is present in the left acetabulum. The proximal right tibia shows extensive degenerative changes including several bone spurs on the proximal posterior shaft

[52] Stuckert and Kricun 2011.

[53] See above, pp. 101–2 for details of the decapitation.

just below the metaphyseal area, as well as a deep groove in the area of the attachment of the patellar ligament. Osteophytosis is seen on L5, which is extremely osteoporotic and has an unfused articular facet on the right side. The sacrum also appears osteoporotic, with abnormally large foramina. The explanation for these findings is not clear.

LH 310. Female, adult.

LH 311. Infant, *c.*2–3 months.

LH 312. ?Male, *c.*25.

LH 313. No bones were located in storage. Partially excavated grave.[54]

LH 314. Adult.

LH 315. Female, 25–30. Periostitis is seen on all long bones, and is especially severe on the tibiae, which also appear bowed medially. The right clavicle and innominate are also affected, especially around the shoulder joint and acetabulum. Radiography shows no underlying bone destruction. The hands, feet, and spine are unaffected. The cause for this condition is unknown.

LH 316. Adult, 25–30.

LH 317. Child. Remains of the female adult from LH 310 are mixed in.

LH 318. Infant, 0–2 months.

LH 319. Male, age 30–35. Estimated stature 172.9 ± 3.94 cm. Cranial index 71.2. Severe osteophytosis is seen on the lower thoracic vertebrae, L1 and L2. Mild osteoarthritis is present on the lateral articulation of the left clavicle, and in both hips. Moderate osteoarthritis is present in both knees. There is an ovoid smooth osteoma on the floor of the left nasal passage.

LH 320. Female, 35+. A very small flat osteoma approximately 6 mm in diameter is present on the frontal bone. Fragments of at least one other individual are mixed in.

LH 321. No bones were found in storage. Clarke[55] lists as Child, based on grave size.

LH 322. Male*, adult.

LH 323. Child, *c.* 5.

LH 324. Infant, *c.*10 months.

LH 325. Number dropped.

LH 326. Adult, 20–25.

LH 327. Child, *c.*3.

LH 328. Female, adult. The skull of a female, *c.*25, is mixed in.

LH 329. No bones were located in storage. Clarke[56] lists as Adult, based on grave size.

LH 330. Female, 40+. Estimated stature 156.4 ± 4.45 cm (left humerus). Cranial index 76.5. An enlarged and depressed area approximately 1 cm wide and 50 mm deep is present around the right posterior condylar canal of the basal skull. This may be post mortem in origin, or it may represent erosion due to pressure from a soft tissue lesion such as a tumour, aneurysm, or cyst. Mild cribra orbitalia are present bilaterally. Severe osteophytosis is seen on all cervical vertebrae. C3 and C4 are ankylosed on the right transverse process. Mild osteoarthritis is present in both shoulders.

LH 331. Male, 50+. Estimated stature 180.8 ± 3.94 cm. Cranial index 71.8. There is a healed, significantly misaligned fracture of the left clavicle. Two small flat osteomata 5.5 mm and 4.5 mm in diameter are present on the right frontal bone near the coronal suture. Although the evidence is not completely clear due to breakage, the atlas may have been ankylosed to the right condyle of the skull. Moderate osteo-

[54] WS 3.ii, 64. [55] ibid. 66. [56] ibid. 68.

phytosis, more pronounced on the right side, is seen on the thoracic vertebrae and L2, 4–5. Mild/moderate osteoarthritis is present on the proximal right ulna, the scapulae, and in the sacroiliac joint. Mild osteoarthritis is seen on the tarsals and in the acetabula. Severe osteoarthritis is present on the distal phalanx of the right big toe. The site of the right PM^1 has a large abscess which extends to the palate of the maxilla and has destroyed much of it.

LH 332. Female, 22–23. Estimated stature 152.4 ± 3.72 cm. Periostitis is present on both tibiae and femora, and is more pronounced on the right side. Mild cribra orbitalia are present in the left orbit. The right orbit cannot be observed.

LH 333. Child, *c.*3–4.

LH 334. Infant, possibly neonate. The skull of LH 284 is mixed in.

LH 335.

(1) Male, 30–35. Estimated stature 169.7 ± 3.94 cm (right femur). The upper left lateral incisor is slightly rotated, while the lower right lateral incisor is severely rotated.

(2) Female, 20–25. An osteochondroma is present proximally just below the metaphysis on the lateral aspect of the left tibia.

LH 336. Child, *c.* 3.

LH 337. Child, 9–10 years. One band of mild LEH is seen on the M^1s.

LH 338. ?Male, adult.

LH 339. Male, adult. Mild bilateral cribra orbitalia are seen.

LH 340. Female, 24–25. Estimated stature 165.0 ± 3.72 cm. There is pronounced bowing of the tibial shafts medially, with anterior and medial rotation of the proximal epiphysis. This may be genetic, or it may be related to biomechanical stress. The lower canines are rotated and displaced slightly anteriorly to the lateral incisors.

LH 341. Infant, *c.*12 months.

LH 342. Adult. Portions of at least two individuals are mixed in.

LH 343. Female, *c.*20. Cranial index 72.4. Both tibiae exhibit mild bowing medially. Mild periostitis is seen along the lateral aspect of the right tibial shaft. The left tibial shaft shows periostitis along most of its length. Mild cribra orbitalia are present. The lower canines and left PM_2 are rotated. The upper left deciduous canine has been retained. The permanent canine is present, but is partially impacted into the anterior maxilla behind the central and lateral incisor, and is erupting through the palate. Multiple very faint bands of LEH are seen on the canines. Bones of the neonate from LH 470 and a child 1–3 years are mixed in.

LH 344. No bones were located in storage. Clarke[57] lists as Adult, based on grave size.

LH 345. Infant, *c.*20–24 months. An adult skull is mixed in.

LH 346. Infant, *c.*6 months.

LH 347. Adult, 20–25 (Illus. 2.65).

LH 348. Adolescent, 12–15. The placement of the head to the right of the knees suggests decapitation.[58] Since only the axis vertebra was present, however, Watt[59] was unable to find any substantiating osteological evidence.[60] (Illus. 2.39, 2.65)

LH 349. Male, age 35+. Estimated stature 172.5 ± 3.94 cm. The skull appears slightly keeled along the sagittal suture. Two small osteomata are present, one adjacent to the sagittal suture

[57] ibid. 72. [58] ibid. 73. [59] Watt 1979: 343.
[60] See p. 102 and Illus 2.39 for a re-evaluation of this material.

on the mid-right parietal bone, another on the anterior portion of the right parietal bone. Healed fractures are seen on four rib fragments (Illus. 2.31). There is a well-aligned healed fracture of the proximal right fibula. The fibula shows mild periostitis on the distal aspect, and roughening on the interosseous ligament surface. The fibular notch for the interosseous ligament on the right tibia also exhibits extensive bony proliferative activity. The femora have a hyper-robust linea aspera. The left patella appears bipartite. Mild osteophytosis is present on the cervical vertebrae. There is mild osteoarthritis in the right knee, and also in the first metatarso-phalangeal joints. Multiple bands of clearly marked LEH are seen on the canines. An infant tibia is mixed in.

LH 350. Adult. Tali of a second individual are present.

LH 351. Adult.

LH 352. Male, 22–23. Estimated stature 175.0 ± 3.94 cm. The right fibula is grossly enlarged distally, which may represent an old healed fracture, or soft tissue ossification following other trauma. There is abscess formation involving the left maxilla. The abscess cavity extends from PM^1 to M^1, penetrates the maxillary sinus, and probably penetrates the floor of the nasal passage as well, although post mortem damage makes this observation uncertain. The left M^3 is also abscessed, as is the left M_1 (Illus. 2.20). Two well-marked bands of LEH are seen on all canines.

LH 353. Number dropped.

LH 354. Infant, *c.*6 months.

LH 355. No bones for the primary burial were located in storage. Clarke[61] lists as Adult, based on grave size. An adolescent skull from LH 353 was present in the fill. The upper left deciduous canine of this individual was retained, although lost post mortem. The adult canine is impacted and partially erupted through the palate.

LH 356. ?Female, *c.*40. Estimated stature 167.3 ± 4.24 cm (left radius). The sex is based on multiple regression analysis, and disagrees with Clarke.[62] The humerus of a second individual is present.

LH 357. Male, *c.*40. Moderate osteophytosis is seen in the lumbar vertebrae. Osteoarthritis is present in the knees, which exhibit lipping and distortion of the tibial spine, with mild grooving of the femoral condyles. Mild osteoarthritis is seen in the joints of the foot. The left ilium appears porous. Mild osteoarthritis is present on the proximal right humerus and both scapulae.

LH 358. Female, 30+. Estimated stature 163.5 ± 3.72 cm. A small opening present in the distal right radius anteriorly and medially is suggestive of a subarticular cyst. Mild osteoarthritis is seen on the acetabulum of the right pelvis, and superiorly on the left ulna. Three bands of mild LEH are seen on the incisors. The right radius from a second individual is mixed in. The intrusive radius is abnormally bowed and rounded, possibly due to rickets.

LH 359. Cremation. See p. 201.

LH 360. Adult, 25–30.

LH 361. Cremation. See pp. 201–2.

LH 362. Male, *c.*35. Estimated stature 183.9 ± 3.94 cm. Cranial index 72.3. Bony proliferation on the distal left fibula may represent old trauma with resultant soft tissue calcification. The fibula was probably fused to the tibia. The skull appears bathrocephalic. Pronounced osteoarthritis is seen on the left sacroiliac joint, although the right side is normal. Mild osteo-

[61] WS 3.ii, 74.

[62] ibid.

arthritis is present in both hips, the glenoid fossa of the left scapula, and the distal right ulna. Moderate osteoarthritis is seen in the first right metatarsal distally. Mild/moderate osteophytosis is present on the lumbar vertebrae. Mild cribra orbitalia are seen. There are multiple bands of mild but clearly marked LEH on the lower canines and PM_1s.

LH 363. ?Male, 35+. Estimated stature 170.6 ± 3.94 cm. Cranial index 80.7. Mild osteoarthritis is seen in the hips and on the proximal right humerus. The distal right first metatarsal shows advanced osteoarthritis.

LH 364. Infant, *c.*3–6 months.

LH 365. Female, *c.*30. Estimated stature 151.2 ± 3.72 cm. Cranial index 77.4. C2 and C3 are fused as a result of osteophytosis and osteoarthritis, while the articular condyles of C4 are eburnated and pitted. Mild osteophytosis is seen on the thoracic vertebrae. Dental crowding has resulted in rotation of the lower right canine, lower left lateral incisor, and the PM^1s (Illus. 2.23).

LH 366. Adult.

LH 367. Female, 30+. Estimated stature 156.6 ± 3.72cm. Mild osteoarthritis is seen in the left proximal ulna and right distal humerus. Mild osteophytosis is found on the lumbar vertebrae, while moderate osteophytosis is present on the upper thoracic vertebrae, and is more pronounced on the right side.

LH 368. Adult. A second individual is mixed in.

LH 369. Adult.

LH 370. Infant, *c.*12 months.

LH 371. Infant, *c.*12 months.

LH 372. Child, *c.*3.

LH 373. Male, *c.*40.

LH 374. Female, 28–30. Estimated stature 156.4 ± 3.72 cm. Bony proliferation is present on the distal third of the right femoral shaft, especially posteriorly. This probably represents a focus of myositis ossificans traumatica (Illus. 2.34b). Very mild osteophytosis of the thoracic vertebrae is seen. There is a flattened supernumerary tooth in the maxilla just behind the central incisors.

LH 375. No bones were located in storage. Clarke[63] lists as Adult.

LH 376. Adult.

LH 377. Child, 11–12. A trace of Carabelli's cusp is seen on the M^1s. Calculus is present on the right M^1, left dm_1, and M_1.

LH 378. Child, 7–8 (Illus. 2.66). Moderate cribra orbitalia are present in the left orbit. The right orbit cannot be examined. The extra vertebrae found with LH 278 probably belong here.

LH 379. Female, 40–45. Estimated stature 159.8 ± 4.45 cm (left humerus). Moderate osteoarthritis of the articular condyles of L4 and L5 is seen. Other intact vertebrae appear normal. Upon burial the head was deposited to the left of the knees, suggesting decapitation (Illus 2.40, 2.66).[64] On examination, Watt found lesions on the mandible and C3, suggesting decapitation by a blow going from right to left.[65] The sex designation disagrees with Clarke. However, in his report on decapitations, Watt also sexes this individual as female.[66]

LH 380. Male, *c.*35. Estimated stature 177.4 ± 3.94 cm. This robust, heavy-boned individual exhibits severe osteoarthritis with destruction of the articular surface in the distal right 5th metatarsal. Moderate to severe osteophytosis is seen in the cervical, thoracic, and lumbar

[63] ibid. 78. [64] ibid. 81. [65] Watt 1979, 343.
[66] See pp. 102–3 for a reassessment of this decapitation (Illus. 2.40).

vertebrae. The degree of osteophytosis progresses in severity caudally in the thoracic spine, although the greatest degree of lipping is seen in T11–12. The lumbar vertebrae are less severely affected. Severe osteoarthritis is also present in the articular facets of L5. The xiphoid process is fused to the sternum. Moderate cribra orbitalia are present bilaterally.

LH 381. Adult, 35+. There is a large button osteoma on the left parietal.

LH 382. Child, 10–12.

LH 383. Child, *c.*10. The leg bones of a smaller child are mixed in.

LH 384. Child, 7–8. Calculus is seen on the right dm_1 and dm_2.

LH 385. Child, probably 2–3.

LH 386. Female, 35–40. Estimated stature 160.6 ± 3.72 cm. A rather flat button osteoma, *c.*1.2 cm in diameter, is seen on the right frontal bone near the coronal suture, with a small flat osteoma 4 mm in diameter posterior and medial to it. Mild to moderate osteoarthritis is seen on the head of the right femur and around the right acetabulum. Mild osteophytosis is present on several thoracic and lumbar vertebrae, most of which are very fragmentary. Sex designation disagrees with Clarke.[67] That designation of Male was probably based on male leg bones from LH 368, which are mixed in. The current designation is based on the reconstructed skull and properly associated postcranial material.

LH 387. Male, probably 30–35.

LH 388. Adult, 35+. Radiography reveals a healed fracture of the distal right tibia with an angular deformity and myositis ossificans traumatica at the fibular articulation posteriorly. One band of LEH is seen on the lower canines and PM_1s. The femoral shafts appear very bowed. The skull of child, *c.*7, is mixed in.

LH 389. Adult, 30–35. The right shoulder shows evidence of chronic dislocation, creating a new articular facet on the scapula immediately anterior and slightly inferior to the glenoid fossa (Illus. 2.33).

LH 390. No bones were located in storage. Clarke lists as Infant/Child, based on grave size.[68]

LH 391. No bones were located in storage. Clarke lists as Neonate.[69]

LH 392. Female, *c.*35.

LH 393. Male, *c.*30. Estimated stature 162.3 ± 3.94 cm. Moderate osteoarthritis with roughening and osteophytes is present on both femoral heads at the junction of the surgical neck.

LH 394. Number dropped.

LH 395. Male, *c.*25. Estimated stature 166.2 ± 3.94 cm. Very mild cribra orbitalia are seen in the left orbit only. The talus and calcanei of a second individual are mixed in.

LH 396. No bones were located in storage. Clarke[70] lists as Adult, based on grave size.

LH 397. Male, 30–35. Mild osteoarthritis is present on the articular facets of the axis vertebra. Several fine bands of LEH are seen on the canines and premolars. The lower anterior dentition is slightly crowded, with the canines overlapping the lateral incisors.

LH 398. Female, *c.*28.

LH 399. Male, 45+. Cranial index 76.4. A circular healed, depressed fracture is seen on the outer table of the frontal bone at the centre

[67] WS 3.ii, 80. [68] ibid. [69] ibid. [70] ibid. 82.

of the bone, with some residual pitting, suggesting inflammation. The inner table is also depressed inward, but healed. A well-aligned, healed spiral fracture of the distal third of the left tibia is also present. Moderate to severe osteoarthritis is seen in both acetabula and in the femoral heads, with eburnation on the right side. Moderate osteophytosis with severe lipping on the left side is seen in all lumbar vertebrae. Moderate osteoarthritis is also present on the lumbar articular facets. T7–10 are ankylosed and show loss of vertebral height and wedging, causing kyphosis. A possible diagnosis for this condition is DISH.

LH 400. Empty grave. Cenotaph (Illus. 2.59).

LH 401. Child.

LH 402. Female, 20–25. Estimated stature 158.1 ± 3.72 cm. Cranial index 76.1. Male innominate from a second individual is mixed in.

LH 403. ?Female*, adult.

LH 404. Male, adult. Estimated stature 174.6 ± 3.94 cm.

LH 405. Male, *c.*18. Ligamentous ossification is present in the proximal fibula.

LH 406. Infant, *c.*9 months.

LH 407. Male*, 20–30. The sacrum has six segments. Moderate osteophytosis, which is more pronounced on the left, is seen on T11–12. The single surviving lumbar vertebra is normal.

LH 408. Male, 35–40. Estimated stature 167.8 ± 3.94 cm. Cranial index 72.8. A healed fracture of the left fibula midshaft is seen. Mild osteoarthritis is present in the acetabula, and in the distal right tibia near the articulation with the fibula. Very mild osteophytosis is seen on L3–4. T8–10 show moderate osteophytosis on the right side, while mild lipping is present on C6 and 7. A wide band of LEH is seen on the canine and premolars.

LH 409. Child, *c.*10.

LH 410. Male, age 30–35. Estimated stature 165.8 ± 3.94 cm. A healed spiral fracture of the distal right tibia is present, with subsequent ankylosis to the fibula (Illus. 2.32). Radiography reveals that the distal portion of the shaft has been displaced laterally, and has been overridden medially by the shaft above it. The right fibula was fractured proximally, suggesting that the foot was turned outward, so the vector of the fracturing force commenced at the ankle medially, travelled up the leg, and exited at the proximal fibula fracture site laterally. The left ankle upon radiography also exhibits traumatic injury to the distal tibial articular surface, with superior displacement of the fibula and a lateral malleolar fracture, resulting in osseous proliferation and ankylosis of the tibia and fibula. A fall from a considerable height is one possible cause for this double leg injury. Virtually the entire vertebral column, including the sacrum, is fused at the anterior and right side of the vertebral bodies, leaving only a few cervical vertebrae unaffected. This may represent a possible case of DISH, although the age of the individual would not favour this diagnosis. There is mild osteoarthritis on both acetabula and the right femoral head. Moderate osteoarthritis is seen in the metatarsals and phalanges of both feet. The upper central and lateral incisors are absent, possibly congenitally. The canines have migrated slightly towards the midline, and have erupted at an angle with their tips pointing towards each other, thus filling the gap (Illus. 2.25).

LH 411. Male, age *c.*35. Estimated stature 163.4 ± 3.94 cm. Moderate osteophytosis is seen on the remains of some lumbar vertebrae.

LH 412. Male, *c.*30. Estimated stature 164.4 ± 3.94 cm. Cranial index 78.9.

LH 413. Male, 30–35. Estimated stature 177.1 ± 3.94 cm. Cranial index 77.2. One band of LEH is present on the canines. Portions of a second individual, female 35+, are mixed in. The intrusive female remains exhibit severe osteophytosis on all cervical and thoracic vertebrae. Two cervical vertebrae are ankylosed. The lumbar vertebrae exhibit only mild osteophytosis.

LH 414. Male, *c.*30. Estimated stature 168.3 ± 3.94 cm. The xiphoid process, which is fused to the sternum, appears to have a round perforation, probably due to a defect of ossification. A well-aligned healed spiral fracture of the proximal left fibula is seen. Moderate osteoarthritis is present in the distal left tibia laterally. Moderate vertebral ostetophytosis is seen on T8–10. The left inferior articular facet of L5 is unfused.

LH 415. Female, 20–25.

LH 416. Number dropped.

LH 417. No bones were located in storage. Clarke[71] lists as Adult, based on grave size.

LH 418. Male, 20–25.

LH 419. Infant, 0–1.

LH 420. Cremation. See pp. 202–3 below.

LH 421. Adult. This may be the ?female, *c.*40, found in boxes with bones from LH 456.

LH 422. ?Female, adult.

LH 423. Adult, *c.*35. Mild vertebral osteophytosis is seen on some fragmentary vertebrae.

LH 424. Child, 6–7.

LH 425. ?Female, 25–30.

LH 426. Adult.

LH 427. Male, 25–28. Estimated stature 175.0 ± 3.94 cm. Cranial index 76.4. The skull appears bathrocephalic. The sacrum is asymmetrical, resulting in an inclination of the base of the spinal column to the right. The head was buried to the right of the knees (Illus. 2.59).[72] Lesions found by Watt on C3 suggest decapitation from the front, probably after death.[73] The proximal phalanx of the index finger and medial phalanx of the fifth finger of the left hand had been amputated, either deliberately or through accident (Illus. 2.37).

LH 428. Female, *c.*25. Mild bilateral cribra orbitalia are seen.

LH 429. Dropped number.

LH 430. Female, *c.*35. Estimated stature 169.4 ± 3.72 cm.

LH 431. No bones were located in storage. Clarke[74] lists as Adult based on grave size.

LH 432. Female, 20–25.

LH 433. Dropped number.

LH 434. Child, probably 10–15.

LH 435. Adult.

LH 436. ?Female, 30–35. An osteoma is present in the nasal aperture arising from the middle ethmoid group of air cells on the left. It has resulted in widening of the nasal passage on the left at the expense of the right (Illus. 2.48).

LH 437. Male, 35+. Estimated stature 176.9 ± 3.94 cm (right femur). Cranial index 77.6.

LH 438. Adult. Portions of a second individual are mixed in.

LH 439. Adult *c.*30.

LH 440. ?Male*, adult.

LH 441. Female, age 35–40. Estimated stature 156.8 ± 4.24 cm (left radius). Cranial index 74.1.

[71] WS 3.ii, 84.
[72] ibid. 87.
[73] Watt 1979, 343. See p. 103 for a reassessment of this decapitation.
[74] WS 3.ii, 86.

The head was buried face down between the lower legs (Illus. 2.61).[75] Watt found evidence for at least three cuts on C4, suggesting post-mortem decapitation from the front.[76] Osteo-arthritis with eburnation is present on the dens axis and the articular facet on the atlas. From the shape of the remaining socket, the left M^3 appears to have been a peg tooth.

LH 442. Male, *c.*30. The sacrum is asymmetrical, being smaller on the right side. There is a compression fracture of L5 on the left. There is thus a scoliosis in the pelvis and lumbar region. Osteophytosis is present on L4 and L5. One band of LEH is seen on the canines.

LH 443. Male, *c.*20 (Illus. 2.61).

LH 444. Male, 20–25. Estimated stature 165.8 ± 3.94 cm.

LH 445. Female, age 30–35. Estimated stature 151.7 ± 4.45 cm (left humerus). Two small bands of LEH are seen on the canines. The head was placed on the right femur indicating decapitation (Illus. 2.41, 2.61).[77] Watt found evidence for trauma on C4, suggesting that decapitation was accomplished by slicing through the intervertebral disc.[78] Mild/moderate osteophytosis is seen in L3–5, with moderate osteoarthritis in the condyles.

LH 446. Female, 35+.

LH 447. Male, 40–45. Estimated stature 164.4 ± 3.94 cm (Illus. 2.60). Slight osteoarthritis is present on the distal left tibia, while the distal right fibula is severely affected by ligamentous ossification. Numerous bony proliferations are present along the popliteal line of the right tibia. The lower limbs have suffered severe post mortem damage, but may have represented a focus of myositis ossificans traumatica. Severe osteophytosis is seen on two cervical vertebrae, probably C6–7, with a lateral compression fracture of C7 on the right side. Moderate osteoarthritis of the articular facets is present on the lower cervical vertebrae. Mild osteo-arthritis is present in the left hip (the right cannot be examined) and in the tarsals.

LH 448. ?Male, 35–40. Estimated stature 166.2 ± 4.57 cm (left humerus). Moderate osteoarthritis is seen on the left humeral head and scapula. Mild osteoarthritis is present in the right acet-abulum.

LH 449. Age and sex indeterminate. Very fragmentary remains of several individuals are mixed together.

LH 450. Infant, 0–1.

LH 451. Male, 40–45. The head was buried between the femora, suggesting decapitation (Illus. 2.60). Watt found no signs of physical trauma to the first four cervical vertebrae.[79]

LH 452. Neonate.

LH 453. Adolescent. The bones were found in fill of LH 355.

LH 454. Cremation. See p. 203, below.

LH 455. No bones from the primary burial were located. Fragmentary remains from fill were present.

LH 456. No bones from the primary burial were located. Clarke[80] lists as Child, 7 years. Bones of a ?Female, *c.*40, inventoried under this number may belong to LH 421, but this attribution is not certain.

LH 457. Infant, 0–1.

[75] ibid. 89.
[76] Watt 1979, 344. See p. 103 for a reassessment of this decapitation.
[77] WS 3.ii, 89.
[78] Watt 1979, 344. See p. 104 for a reassessment of this decapitation
[79] ibid. 344. See p. 104 for a reassessment of this decapitation.
[80] WS 3.ii, 92.

LH 458. Infant, 0–1.

LH 459. Probably neonate or late term fetus.

LH 460. Neonate.

LH 461. No bones were located in storage. Clarke[81] lists as Adult.

LH 462. No bones were located in storage. Clarke[82] lists as Neonate.

LH 463. Neonate.

LH 464. Female, adult.

LH 465. Male, 20–25. The external auditory meatus of the left ear is completely blocked by bone. The right meatus cannot be observed.

LH 466. No bones were located in storage. Clarke[83] lists as destroyed grave.

LH 467. No bones were located in storage. Clarke[84] lists as destroyed grave.

LH 468. No bones were located in storage. Clarke[85] indicates only part of the fill was excavated.

LH 469. Neonate.

LH 470. Neonate. The bones were located in the fill of LH 343.

LH 471. No bones were located in storage. Clarke[86] lists as Child, age 5–8.

LH 472. No bones were located in storage. Clarke[87] lists as Child, age 4–5.

LH 473. Infant, 0–2.

ii. THE CREMATION BURIALS

The 1967–72 excavations at Lankhills produced seven cremation burials, although there may have been many more that did not survive.[88] Of the excavated cremation burials, three (LH 26, LH 237, and LH 361) were simple urned burials, two were cremation burials in the topsoil (LH 420 and LH 454), and two were cremation burials in an inhumation-sized pit (LH 60 and LH 359).[89]

When these remains were examined in 2011, no material could be found for two of the simple urned cremation burials, LH 26 and LH 237. There is a possibility they were never saved, as both urns were almost totally destroyed except for their bases.[90] The remaining five cremation burials are described below. Prior to examination they were wet-sieved through 10 mm, 5 mm, and 1 mm mesh screens.

LH 60. Cremation burial in an inhumation-sized pit, *c.*360–370

The pyre seems to have been built on material dug out of this pit, and certainly it was near the grave, for charcoal and burnt bones were scattered throughout the fill. The pyre was not, however, over or in the pit, for the sides had not been exposed to heat. When the burning had been completed and the embers were cool, some bone fragments and coffin nails were picked out and placed in an urn, the nails being made to form a lattice over the bones. The pit was then filled and, when it was nearly full, the urn was set in position and covered with a tile.[91]

Remains: One infant, probably <3 years, and one juvenile under the age of approximately 15, based on a pelvic fragment. Weight of surviving burnt bone, 319 g. Maximum fragment size, 42 mm × 32 mm based on a fragment of parietal,

[81] WS 3.ii, 92.
[82] ibid. 92.
[83] ibid. 94.
[84] ibid.
[85] ibid.
[86] ibid.
[87] ibid.
[88] ibid. 128.
[89] ibid. 128–9.
[90] ibid. 128.
[91] ibid. 129.

probably from the older child. The infant bone fragments were primarily yellow in colour, ranging to light grey and black, with minor linear cracking. The skull bones from the older juvenile were grey and black, while the remaining fragments varied from yellow to yellow-white. Identified bone for the infant included skull fragments and rib fragments, and for the older juvenile, fragments of parietal, innominate, long bones, two ?vertebral bodies, and ribs.

LH 359. Cremation burial in an inhumation-sized pit, *c*.350–370 (Illus. 270–1)

The burning seems to have taken place in or above the pit, for the ashes which lined its sides and bottom had been deposited while still hot. When the embers had cooled, the cremated material was sorted into piles. A pile of bones and a pile of hobnails were found, and it is possible that piles of coffin-nails and offerings had also been present, in parts of the grave destroyed by later burials. The pit was filled with material that was entirely free of burnt fragments.[92]

Remains: One adult, possibly middle-aged, sex indeterminate. Weight of surviving burnt bone, 742.1 g. Maximum fragment size, tibia fragment 66 mm × 31.5 mm, skull fragment 59 mm × 44 mm. Color primarily black/grey with some grey/white. Identified bone included fragments of skull, arm bones (unspecified), femur, tibia, ribs, patella, vertebrae, and possible metacarpals/metatarsals or phalanges. Pitting seen on the surface of the left parietal suggests possible healed porotic hyperostosis. Slight lipping and degenerative changes on the articular surfaces of surviving vertebral articular processes suggest osteoarthritis.

In addition, seven hobnails, two of which were fragmentary, weighing 10.3 g were found, as well as 18 fragments of animal bone, the largest a ?sheep/goat metapodial measuring 27 mm × 12 mm, and numerous specks of charcoal. Identification of animal bone supports Clarke's earlier speculation that offerings had been present.

Illus. 2.70. Possible vertebral osteoarthritis, cremation burial. LH 359, adult, possibly middle-aged.

LH 361. Simple urned cremation burial, *c*.370–410 (Illus. 2.72)

Grave 361 was cut into the boundary ditch, Feature 12, and had survived intact because the ditch was still a hollow when the burial was made. The urn was packed around with flints and tiles, and covered with a tile whose upper surface was probably at ground level when the grave was dug . . . only a token amount of cremated bone was placed in the urns, the rest perhaps being left at the pyre. There were no coffin-nails, hobnails, or other grave goods.[93]

Remains: One adult, age and sex indeterminate. Weight of surviving burnt bone, 337.5 g. Maximum fragment size, a long bone fragment 72 mm long, most other fragments extremely small. Colour grey, blue/grey, and some white, with many cracks and fissures. Identified bone included fragments of skull, long bones (unspecified), sacrum (S1), vertebrae, and one tooth (possibly a canine). Mixed in were an unburnt

[92] ibid. 129.

[93] ibid.

Illus. 2.71. Fragments of animal bone mixed in with a cremation burial. LH 359, adult, possibly middle-aged.

Illus. 2.72. Possibly pathological foramen completely penetrating a metatarsal from cremation burial LH 420, adult.

Illus. 2.73. Rust stains from hobnails on bone fragments from cremation burial LH 454, ?child.

immature rib fragment, a fragment of unglazed red pottery, and a shell fragment.

LH 420. Cremation burial in the topsoil, *c.*350–390 (Illus. 2.72).

This cremation burial consisted of a pile of burnt bone stratified in layers of topsoil in Feature 12 while that ditch was used for burial. It had probably been inserted under a

[94] WS 3.ii, 128.

layer of turf, as there was no evidence of a true pit.[94]

Remains: One adult, age and sex indeterminate. Weight of surviving burnt bone, 403 g. Maximum size of most fragments, 10 mm or less. Colour predominantly grey/white and some black, with cracks and fissures seen on white bone only. Identified bone included small fragments of long bone shafts, a tarsal (possibly the cuboid), a metatarsal (possibly M1), and a questionable fragment of humerus. The metatarsal has a large oval foramen which appears to be pathological in origin, completely penetrating the bone.

Mixed in were a thin metal wire, an animal bone fragment 48 mm long, and numerous small snail shells and chalk pebbles.

LH 454. Cremation burial in the topsoil, *c.*350–370 (Illus 2.73)

This cremation burial was similar to LH 420 in all respects, except that hobnails were found with it.[95]

Remains: One ?child, age indeterminate. Weight of surviving burnt bone, 189.2 g. Maximum fragment size 31 mm × 21 mm (skull fragment). Most fragments less than 10 mm long. Colour usually grey/white with cracking and fissuring, a few black, and many rust-stained.

Identified bone included skull, scapula, and long bone fragments. Mixed in were 26 hobnails and 16 other fragments of hobnails.

[95] ibid. 128–9.

PART 3
THE TRANSITION FROM ROMANO-BRITISH TO EARLY ANGLO-SAXON IN HAMPSHIRE

by CAROLINE M. STUCKERT

1
INTRODUCTION

This section documents the demography, physical characteristics, and dental data from Early Anglo-Saxon cemeteries in Hampshire and places them in a broader chronological framework in comparison to those of Roman Winchester. The Pooled Roman sample used here is comprised of data from both Lankhills 1967–72 and Victoria Road West. Data from the later Lankhills excavations and the other Romano-British cemeteries in Winchester were not available at the time the statistical analyses in this chapter were performed. More sites are now also available from the Anglo-Saxon period.[1] Similarly, since data on pathology were not collected in the original study, and since the Early Anglo-Saxon site publications vary greatly in their level of detail regarding pathology, no comparisons between the Roman and Early Anglo-Saxon periods have been attempted here.

[1] e.g. Dinwiddy 2011.

2
ARCHAEOLOGICAL BACKGROUND: THE EARLY ANGLO-SAXON SITES

For the purposes of this study, the Early Anglo-Saxon skeletal samples were divided into two groups termed Saxon 1 and Saxon 2, based primarily on chronology (Illus. 3.1). The earlier Saxon 1 sites tended to have a more northerly distribution inland, while the later Saxon 2 sites had a more southerly distribution nearer the coast. The Romano-British samples in Winchester were located between the two geographically, and also represented an urban population, whereas the Anglo-Saxon sites were all rural.[2]

i. THE SAXON 1 SITES (*c.*425–700): ALTON, DROXFORD, AND WORTHY PARK

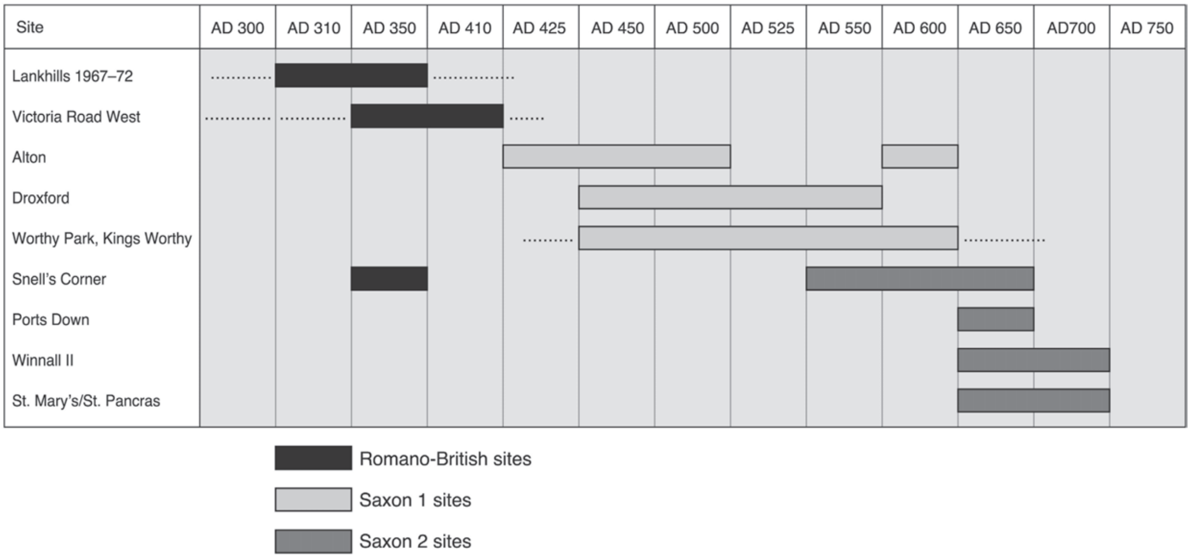
The Alton Anglo-Saxon cemetery was located on the south-eastern edge of the town on the high ground east of the modern cutting for the railroad line through Alton, and south of Mount Pleasant Road.[3] Excavations took place between 1960 and 1962. The area excavated included all or part of four gardens located behind the houses on the south side of Mount Pleasant Road. The approximate size of the excavated area was 50 × 40 metres. It yielded 46 cremation burials and 49 inhumations. Excavation was resumed in 1977 by a local group, but that work is not considered here.

Artefactual and stratigraphic evidence suggested that there were two periods of use, from approximately 425 to 525, and again from approximately 600 to 650, with a hiatus for most of the sixth century. However, while the limits of the cemetery were probably found on the east and south, one garden in the middle of the site was not excavated, and extension of burials to the north-west was almost certain. Thus, it is possible that the apparent hiatus was an artefact of excavation rather than a true reflection of use. Grave goods suggest affinities with Continental Saxons originating between the Elbe and Weser rivers, and some objects have parallels in Kent, Sussex, the Upper Thames, and Essex. There is also some late Romano-British material, suggesting continuity of contact.[4]

The skeletons of 38 individuals were available for examination in this study. In addition, two graves had no bones, and two other graves could not be fully excavated because of their location. Skeletal material from Graves 1 to 6 was missing, as was that from Grave 22. The condition of the skeletons ranged from moderate to poor, with considerable fragmentation, surface erosion, and breakage. Prior reconstruction had taken place, but some further repairs to travel damage were necessary after the skeletons were moved from London to Winchester for analysis. Some material was not clearly labelled, and thus could not be used, but may have belonged to the graves listed above as having missing skeletal material.

The Droxford Anglo-Saxon cemetery was located across the flood plain from the village of

[2] See Illus. 1.1 and 1.2. [3] Evison 1988. [4] ibid. 45.



Illus. 3.1. Chronological relationship of Romano-British and Early Anglo-Saxon cemeteries in Hampshire.

Droxford on the River Meon in south-east Hampshire, about 18 miles upstream from the river's mouth.[5] Two excavations took place, over 70 years apart. The exact extent of the earlier excavations between 1900 and 1902 cannot now be determined.[6] Partial excavation of the site in 1974 yielded 41 excavated graves as well as two probable grave outlines, although the excavator estimated that the total size of the cemetery may have comprised more than 300 graves.[7] The Droxford cemetery appears to have represented a time span of approximately 150 years during the late fifth and sixth centuries, or roughly 450–600. No cremation burials were documented. Of the 41 excavated graves, 37 had an east–west alignment, generally with the head to the west, while four were oriented north–south. The cemetery appeared to reflect use of a formal grave layout, at least for the east–west graves, which seemed to be arranged in groups containing up to six individuals.[8]

No swords were excavated in 1974, and only six were found in the earlier excavations, none of which were accompanied by decorated scabbard mounts. Of the 40 spearheads excavated, many were of types characterized by Swanton as representative of the Midlands, north, or Hampshire itself.[9] Brooches and pottery generally had parallels in the Midlands, the south, or locally in Hampshire. Based on the grave assemblages, Aldsworth suggested that the occupants were of rather modest social status.[10]

The Droxford skeletal series from the 1974 excavations was stored at the Hampshire County Museum Service, Chilcomb House, Winchester, but was subsequently moved to the City Rescue Archaeologist's Office for analysis. These skeletons were in the worst condition of any series used in this study. They were badly eroded and fragmented at the time of excavation. Since they were lifted using a block excavation technique, it was necessary to re-excavate feet, innominates, and some skulls in the laboratory, and to clean and reconstruct everything. The 41 graves in this site yielded 39 skeletons.

[5] Aldsworth 1979.
[6] Dale 1903, 1906.
[7] Aldsworth 1979, 175.
[8] ibid. 162.
[9] Swanton 1974.
[10] Aldsworth 1979, 164.

The Anglo-Saxon cemetery at Worthy Park, Kingsworthy, was initially discovered during World War II, but major excavations did not take place until 1961–2.[11] The site was located on the north side of the Itchen Valley roughly three miles upstream from Winchester on the false crest of a hill about 350 metres above the river, and a similar distance from the main Roman road from Winchester to Silchester. Over the two seasons of work 95 graves and 46 cremation burials were excavated. A portion of the northern boundary of the cemetery was located, but the excavator believed that that the entire site may have been at least twice the size of the excavated area.[12]

The portion of the site that was excavated appeared to have been in use for approximately 200 years, terminating in the mid-seventh century. There was evidence to suggest that the earliest burials in the site were in an unexcavated area on the eastern side, so that the actual starting date of the cemetery is uncertain.[13] Similarly, the latest date of the site may not have been firmly established. An inventory of each burial was given as part of the site report, but a comparative analysis of artefact types has not been published. There was, however, considerable differentiation in wealth and perhaps social stratification indicated by the grave furnishing, which ranged from spears, shield bosses, silver, beads, and other objects, to no grave goods at all.

The skeletons were stored at the Duckworth Laboratory, Cambridge University, and the analyses for this study took place there. Some of the material from eighteen graves originally excavated could not be located, so this study included only 78 skeletons from 77 graves. The condition of the skeletons varied greatly, and is given in the published inventory.[14]

ii. THE SAXON 2 SITES (*C.*550–750): SNELL'S CORNER, PORTS DOWN, WINNALL II, AND ST MARY'S AND ST PANCRAS IN WINCHESTER

The site of the Anglo-Saxon cemetery at Snell's Corner was located 1½ miles north of the village of Horndean, at an intersection of the A3, the main London to Portsmouth road.[15] The excavated portion of the site comprised an area of approximately 200 × 150 feet. The site was originally discovered in 1947 during construction of road improvements to the A3, and rescue excavation was subsequently undertaken by the then Ministry of Works.

Snell's Corner contained graves from many periods. The burials included one from the Early Bronze Age in a barrow, three from the Late Iron Age mixed in amongst the Anglo-Saxon burials, a small plot of six Romano-British burials which were spatially somewhat removed from the others, and 33 Anglo-Saxon burials. There were no cremation burials. The Anglo-Saxon burials were difficult to date with any precision. The graves generally were poorly furnished, and subsequent studies have suggested that most grave goods date to the late sixth or seventh century.[16] Both the spears and shield bosses represented typologically insular developments with wide areas of distribution. There were very few female ornaments from the site—no brooches, no silver, and few beads. While five individuals were buried with spears, and scramasax-shaped knives were found in 18 graves, there were no swords and only two shield bosses.

[11] Hawkes and Grainger 2003.
[12] ibid. 7.
[13] ibid. 9.
[14] ibid. 12–90.
[15] Knocker 1956.
[16] Evison 1963; Swanton 1973.

The skeletal series from Snell's Corner was housed at Southsea Castle, Portsmouth, and analysis was carried out there. It was possible to examine 25 individuals for this study: two Romano-British and 23 Anglo-Saxon. Frequent movement of the bones, reshelving, and box-labelling problems over the years resulted in a loss of data from 12 individuals who could not be located or identified with certainty. Numerous earlier repairs made with wax had come apart and were not possible to restore again, further reducing the data potential of the collection.

The prehistoric and Anglo-Saxon burial ground at Ports Down was located near Portsmouth at the junction of the then A333 and Portsdown Hill Road in Ports Down.[17] The maximum limits of excavation were contained within an area approximately 100 × 120 feet, but this was almost certainly only part of a larger site. Initial excavations took place in 1948 when the site was discovered, and were followed by a larger rescue excavation in 1956 when the road junction was extensively reconstructed. The Anglo-Saxon cemetery was dated to the last part of the seventh century based on the typology of the single knife and shield boss excavated, as well as the paucity of grave goods and the west–east orientation of the majority of graves.[18] The suggestion was made that this may have indicated Christian beliefs.

The small sample from this site, consisting of 17 skeletons from 13 graves, was located at Southsea Castle, Portsmouth, and data collection was carried out at that location. The skeletons were quite badly eroded. Some previous repairs had been made, but it was necessary to do considerable reconstruction.

Winnall II was chronologically the later of a pair of Early Anglo-Saxon cemeteries associated with the village of Winnall, situated on the east bank of the River Itchen.[19] While presently incorporated into the expanded Winchester city limits, it formerly stood approximately half a mile north-east of the east gate of Roman *Venta*. There was no surviving skeletal material from the nineteenth-century excavations at Winnall I, which probably dated from the sixth to mid-seventh century. The excavated area at Winnall II extended approximately 120 × 60 feet, and appeared to have reached its limits on three sides of the site. The site was discovered in 1955, but full excavation was not undertaken until 1957–8. A total of 45 graves was excavated. No cremation burials were found.

Winnall II appeared to have come into use at approximately the same time Winnall I was abandoned. Based on the typological associations of several styles of brooches and other objects, and by analogy with other similar sites, primarily in Kent, a period of use between the mid-seventh and mid-eighth centuries was suggested.[20] Hawkes pointed out that Winnall II was one of a series of double cemeteries including Leighton Buzzard, Long Wittenham, and Desborough, which all seem to have shifted locale at approximately the same time.[21] This was interpreted as representing a break in tradition caused by the introduction of Christianity. There is some supporting historical evidence for this interpretation at Winnall. An early king of Wessex, Cenwealh, built the first Anglo-Saxon Minster in Winchester *c.*650. Ten years later, in 660, Wini was appointed bishop of Winchester. Hawkes argued that these events signalled the new importance of Winchester to the West Saxons, and that the estate of Chilcomb, which was very large and included the hamlet of Winnall, was probably given to the church in Winchester at this time as a suitable gift marking either the

[17] Corney et al. 1967.
[18] ibid. 36.
[19] Meaney and Hawkes 1970.
[20] ibid.
[21] ibid. 53–4.

construction of the Minster or the appointment of Bishop Wini. It is not unreasonable to suppose that the residents of the estate were obliged to accept Christianity along with ecclesiastical overlordship. The abandonment of Winnall I (presumably pagan) and the founding of Winnall II (presumably Christian) in the same general area in the mid-seventh century can thus be seen in the light of an imposed change of religious custom. Since the change may have been forced rather than sought, the transitional nature of this and other contemporary cemeteries, including Ports Down and to a lesser extent Snell's Corner, should be expected.

The 45 skeletons that could be examined for this study were stored at Department of the Environment facilities in London and were brought to Winchester for analysis. The skeletons were quite fragmentary and extremely fragile. As they had been reconstructed previously, it was only necessary to make a few repairs.

The sites of St Mary's Church in Tanner Street and St Pancras Church were located in Winchester between modern Lower Brook Street and Middle Brook Street, known in medieval times as Tanner and Wongar Streets respectively. These sites were part of excavations conducted by the Winchester Excavations Committee in several locations in this area, and ultimately exposed a somewhat irregularly shaped surface extending approximately 300 feet north–south, and over 200 feet east–west, referred to as the Brooks Sites. One of numerous large and systematic excavations in Winchester, this area was revealed to be a highly complex urban agglomeration with an extremely long and complicated history. The excavations have been fully described in a series of interim reports.[22]

St Mary's and St Pancras were both excavated as part of the process of developing a fuller understanding of the Lower Brook Street area. Both churches were known from documentary and topographic sources, but neither was located on the ground until well into the course of the overall excavation programme. In spite of the fact that these two sites are named for the Anglo-Saxon/medieval churches whose architectural development and modification through time was such a strong focus of the archaeological work, they nonetheless revealed phases of activity between the fifth and eighth centuries which both reflected earlier conditions and shaped later ones.

The Lower Brook Street area occupied by St Mary's and the associated Anglo-Saxon and medieval houses has a long occupation history. In the Romano-British period alone four phases were identified. The earliest of these represented pre-Flavian activity, possibly of a military nature. This was succeeded by a Flavian period of house construction, probably associated with laying the first street grid and the establishment of urban conditions. Around AD 100 there appeared to have been some replanning, during which a temple was built on part of the site. In the final Romano-British phase of the third or fourth century, the temple was demolished and a workshop was built adjacent to its location. This building appeared to have survived into the fifth century, and to have become a dwelling late in its period of use. Portions of its structure may have remained standing for quite some time thereafter. The road received its final remetalling in the fourth century. The area may have been deserted between roughly 450 and 650.[23]

The road and land immediately to the west was low-lying, and thus the earliest signs of Anglo-Saxon activity were found there, where preservation was best. A small cemetery of four or five graves was cut into the surface of the street. One of these, Grave 23, contained an exceptionally rich

[22] Biddle and Quirk 1962; Biddle 1964, 1965, 1966, 1967, 1969, 1970, 1972, and 1975. See WS 5, in preparation.

[23] Biddle 1975, 295–303.

necklace with characteristics of other late Early Anglo-Saxon period cemeteries and is datable to the late seventh century but probably no later.[24] The burial pattern, like Winnall II, was consistent with Christian burial practice, and the cemetery's position within the walls, and use after the founding of the Old Minster *c.*648, may have indicated a period when the church had not established control over burial in the city by requiring interment in its own cemetery.

The excavations at St Pancras did not extensively investigate the Roman levels, which were reached only on the eastern part of the Lower Brook Street site.[25] However, excavation below the earliest church revealed a general destruction layer over the latest Roman levels, followed by a long period of agricultural activity with evidence of ploughing. The earliest church at this site was built over the last cultivated surface. Three burials of the 17 associated with the church belong to its first phase. The date of St Pancras Phase I and its associated burials is problematic. A date of construction in the early tenth century or before was suggested,[26] but more recent work has indicated that these burials should be dated to the eighth century.[27]

The five skeletons from these two sites that could be included were in the charge of the Winchester Research Unit. The bone was in an excellent state of preservation, but the proportion of the skeletons available for analysis was greatly reduced by the fact that large amounts of bone had been removed for radiocarbon analysis.

[24] WS 7.ii, 621–32.
[25] Biddle 1975, 318.
[26] ibid. 320.
[27] Biddle and Kjølbye-Biddle 2007, 195–9.

3
DEMOGRAPHY

i. THE HAMPSHIRE EARLY ANGLO-SAXON SITES

Skeletal samples from the sites of Worthy Park, Droxford, and Alton, generally dating from approximately 425–700, were grouped into a larger sample designated 'Saxon 1' in this study. The Saxon 1 mortality distribution, comprising 155 individuals, will be found in Table 3.1. The 'Saxon 2' pooled sample, dating from approximately 550–750, was derived from the sites of Winnall II, Snell's Corner, Portsdown Hill, and St Mary's and St Pancras in Winchester. Yielding a somewhat smaller sample of 90 individuals, the mortality distribution is presented in Table 3.2. Analysis of these samples can provide some indication of chronological demographic variation. However, because the sample sizes remained small even when pooled, a 'Combined Saxon' sample was constructed, using all the 245 skeletons from the Early Anglo-Saxon period that were available at the time of this study. The mortality distribution for this sample is found in Table 3.3, and will be used to make comparisons between the Winchester Romano-British samples as defined in the original study (Table 3.4) and the Early Anglo-Saxon samples as a group.

In examining the childhood mortality data for the Early Anglo-Saxon samples in Hampshire, it is immediately evident that infants under the age of six months are almost totally absent from these profiles. While the causes for this finding are not clear, it is unlikely that virtually all infants survived these early months only to die at an older age. In addition to questions of complete recovery archaeologically, or possible disposal of infants elsewhere, it is also possible that these infants were not recovered due to differential burial locations within a site. Few of these sites were excavated to their limits in more than one direction, if at all, creating the possibility that infant burials were present but not located.

Another aspect of the childhood mortality data requires comment. In both the Saxon 1 and Saxon 2 samples, mortality increases with increasing age, reaching a peak in the adolescent years. Since this pattern is consistent across both samples it may represent a genuine demographic trend in spite of excavation and sampling problems. A similar trend was identified at Blacknall Field, Wiltshire, a contemporary West Saxon site.[28]

Adults in the Anglo-Saxon samples comprise between 75 and 80% of the total. In the larger and earlier Saxon 1 sample adult females substantially outnumber adult males, respectively representing 41.9% and 24.5% of the sample, a ratio of almost two to one. In the Saxon 2 sample, however, males predominate, representing 38.9% as opposed to 28.9% for females. In the Combined Saxon sample females also predominate (males = 29.8%, females = 37.1%), but over 10% of the sample could not be sexed. Knowing the sex of those individuals might shift the percentages somewhat.

When the distributions of adult ages at death are compared, Table 3.5 shows that overall there are no significant differences between the Saxon 1 and Saxon 2 samples. A slightly different picture

[28] Stuckert 2010, 113.

TABLE 3.1

Mortality distribution, the Saxon 1 sites (table percentages)

Age	Subadult		Male		Female		Indeterminate		Total	
	N	%	N	%	N	%	N	%	N	%
0–6 months	2	1.3							2	1.3
7 months–6 years	9	5.8							9	5.8
7–13 years	12	7.7							12	7.7
14–19 years	10	6.5	3	1.9	1	0.6			14	9.0
Child	1	0.6							1	0.6
TOTAL	**34**	**21.9**			**3**	**1.9**	**1**	**0.6**	**38**	**24.5**
20–29 years			9	5.8	24	15.5	2	1.3	35	22.6
30–39 years			12	7.7	22	14.2	1	0.6	35	22.6
40–49 years			14	9.0	7	4.5	4	2.6	25	16.1
50–59 years			0	0	1	0.6	0	0	1	0.6
60+ years			0	0	0	0	0	0	0	0
Adult			3	1.9	11	7.1	7	4.5	21	13.5
TOTAL			**38**	**24.5**	**65**	**41.9**	**14**	**9.0**	**117**	**75.5**
TOTAL SAMPLE	**34**	**21.9**	**41**	**26.5**	**66**	**42.6**	**14**	**9.0**	**155**	**100.0**

TABLE 3.2

Mortality distribution, the Saxon 2 sites (table percentages)

Age	Subadult		Male		Female		Indeterminate		Total	
	N	%	N	%	N	%	N	%	N	%
0–6 months	0	0							0	0
7 months–6 years	5	5.6							5	5.6
7–13 years	5	5.6							5	5.6
14–19 years	5	5.6	1	1.1	1	1.1			7	7.8
Child	1	1.1							1	1.1
TOTAL	**16**	**17.8**	**1**	**1.1**	**1**	**1.1**			**18**	**20.0**
20–29 years			13	14.4	9	10.0	0	0	22	24.4
30–39 years			12	13.3	8	8.9	3	3.3	23	25.6
40–49 years			2	2.2	3	3.3	1	1.1	6	6.7
50–59 years			2	2.2	1	1.1	0	0	3	3.3
60+ years			0	0	0	0	0	0	0	0
Adult			6	6.7	5	5.6	7	7.8	18	20.0
TOTAL			**35**	**38.9**	**26**	**28.9**	**11**	**12.2**	**72**	**80.0**
TOTAL SAMPLE	**16**	**17.8**	**37**	**41.1**	**27**	**30.0**	**11**	**12.2**	**90**	**100.0**

emerges, however, when the sexes are examined separately. For males, the modal age at death in the Saxon 1 samples occurs between 40 and 49 years, with mortality gradually increasing in each of the preceding intervals. In the Saxon 2 samples, on the other hand, male mortality peaks between the ages of 20 and 29 years, and gradually declines thereafter. This difference is statistically significant at the $p = 0.05$ level, indicating a younger average age at death for Saxon 2 males. The significance of the results should not be pushed too far, however, since the samples are small and the level of significance is not great. For the Combined Saxon sample, the modal age at death also occurs in the 40 to 49 year age interval.

TABLE 3.3

Mortality distribution, Combined Saxon sites (table percentages)

Age	Subadult		Male		Female		Indeterminate		Total	
	N	%	N	%	N	%	N	%	N	%
0–6 months	2	0.8							2	0.8
7 months–6 years	14	5.7							14	5.7
7–13 years	17	6.9	17	6.9						
14–19 years	15	6.1	4	1.6	2	0.8			21	8.6
Child	2	0.8							2	0.8
TOTAL	**50**	**20.4**	**4**	**1.6**	**2**	**0.8**			**56**	**22.9**
20–29 years			22	9.0	33	13.5	2	0.8	57	23.3
30–39 years			24	9.8	30	12.2	4	1.6	58	23.7
40–49 years			16	6.5	10	4.1	5	2.0	31	12.7
50–59 years			2	0.8	2	0.8	0	0	4	1.6
60+ years			0	0	0	0	0	0	0	0
Adult			9	3.7	16	6.5	14	5.7	39	15.9
TOTAL			**73**	**29.8**	**91**	**37.1**	**25**	**10.2**	**189**	**77.1**
TOTAL SAMPLE	**50**	**20.4**	**77**	**31.4**	**93**	**38.0**	**25**	**10.2**	**245**	**100.0**

TABLE 3.4

Mortality distribution, Pooled Roman sample (table percentages)*

Age	Subadult		Male		Female		Indeterminate		Total	
	N	%	N	%	N	%	N	%	N	%
0–6 months	47	9.0							47	9.0
7 months–6 years	61	11.6							61	11.6
7–13 years	31	5.9							31	5.0
14–19 years	12	2.3	2	0.4	5	1.0			19	3.6
Child	12	2.3							12	2.3
TOTAL	**163**	**31.0**	**2**	**0.4**	**5**	**1.0**			**170**	**32.4**
20–29 years			61	11.6	81	15.4	7	1.3	149	28.9
30–39 years			53	10.1	37	7.0	10	1.9	100	19.0
40–49 years			17	3.2	9	1.7	0	0	26	5.0
50–59 years			6	1.1	1	0.2	0	0	7	1.4
60+ years			1	0.2	0	0	0	0	1	0.2
Adult			19	3.6	20	3.8	33	6.3	72	13.7
TOTAL			**157**	**29.9**	**148**	**28.2**	**50**	**9.5**	**355**	**67.6**
TOTAL SAMPLE	**163**	**31.0**	**159**	**30.3**	**153**	**29.1**	**50**	**9.5**	**525**	**100.0**

*Lankhills 1967–72 and Victoria Road West; see p. 205.

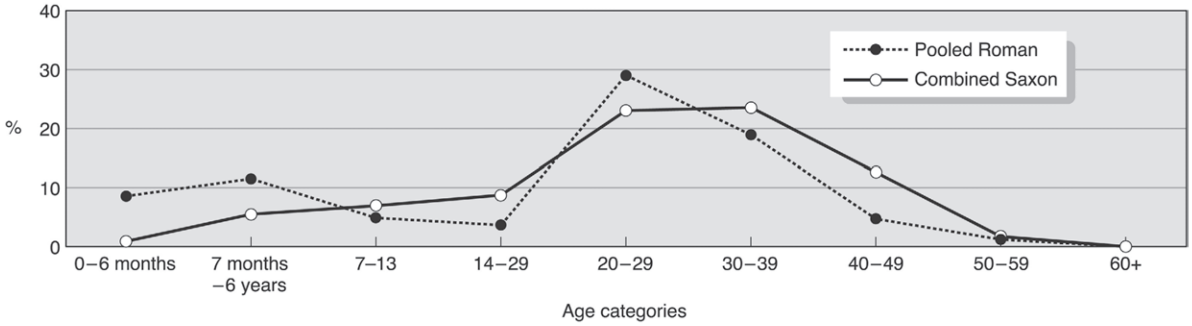
Adult females in the Saxon 1 and Saxon 2 samples show no significant differences in the distribution of ages at death. In both samples the modal age at death occurs in the 20 to 29 year interval, although Saxon 1 females have a slightly younger average age at death. In none of these samples did any individual clearly survive past the age of 60.

TABLE 3.5

Distribution of ages at death, Wilcoxon's t-test for ordered categories

Tests	Subadults		Males		Females		Adults	
	/t/	P	/t/	P	/t/	P	/t/	P
S1 v. S2	−0.25	NS	2.04	<0.05	−0.29	NS	0.98	NS
ROM v. S1	−4.63	<0.001	−2.35	<0.05	−2.27	<0.05	−2.79	<0.01
ROM v. S2	−3.68	<0.01	0.36	NS	−1.86	NS	−1.07	NS
CS v. ROM	5.52	<0.001	1.40	NS	2.64	<0.01	2.65	<0.01
LH v. CS	−5.26	<0.001	−1.59	NS	−2.66	<0.01	−2.82	<0.01

S1 = Saxon 1 S2 = Saxon 2 CS = Combined Saxon ROM = Lankhills 1967–72 + Victoria Road West
LH = Lankhills 1967–72



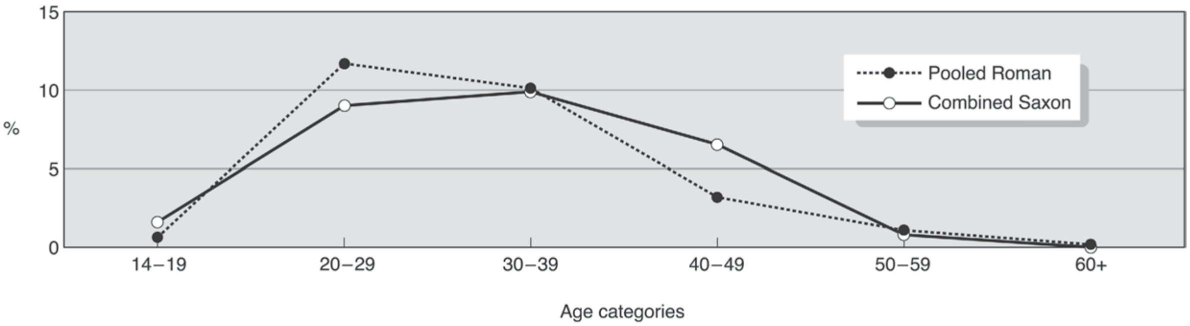
Illus. 3.2. Mortality distributions, Pooled Roman and Combined Saxon samples from Hampshire.

ii. ROMANO-BRITISH AND EARLY ANGLO-SAXON DEMOGRAPHY COMPARED

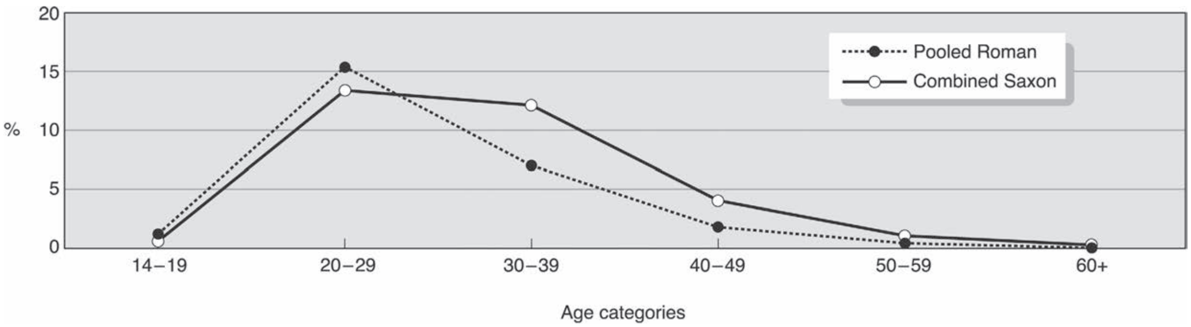
Demographic comparisons of the Romano-British samples in Winchester and Early Anglo-Saxon populations of Hampshire were made in two ways. First, the mortality distribution of the Pooled Roman sample was compared to the Combined Saxon sample (Illus. 3.2). Lankhills 1967–72 as an individual site was then compared with the Combined Saxon sample in order to place it within a broader temporal context in Hampshire.

As indicated in Table 3.5, there are highly significant differences between the Roman population of Winchester and all the Early Anglo-Saxon samples with regard to subadult mortality distributions. These differences are a reflection of the fact that many more infants occur in the Roman samples, and that both the average and modal age at death for children is much lower in the Roman period. In addition, subadults constitute a smaller percentage of the Early Anglo-Saxon samples, ranging from 20 to 24.5%, as opposed to 32.4% for the Pooled Roman sample. It must be stressed again that these results may indicate problems in the sample structure and archaeological recovery rather than a demographic shift through time. Changes in burial practices must also be considered.

Table 3.5 clearly indicates that there are also significant differences in the pattern of adult mortality. When the sexes are combined, it appears that the Roman population exhibits a younger average age at death, which reaches statistically significant levels when compared to the Saxon 1 ($p < 0.01$) and



Illus. 3.3. Mortality distributions, males, Pooled Roman and Combined Saxon samples from Hampshire.



Illus. 3.4. Mortality distributions, females, Pooled Roman and Combined Saxon samples from Hampshire.

Combined Saxon ($p < 0.01$) samples, although the differences between the Pooled Roman and Saxon 2 samples are not significant.

There is no significant difference in the pattern of ages at death for Roman males when compared to either the Combined Saxon or the Saxon 2 samples (Illus. 3.3). Males in the Pooled Roman sample generally die at a slightly younger average age, however, and the difference is marginally statistically significant when compared only to the Saxon 1 sample ($p < 0.05$).

Females exhibit stronger differences in the mortality patterns between the Roman and Early Anglo-Saxon periods. Females in the Pooled Roman sample die earlier than their Early Anglo-Saxon counterparts at statistically significant levels both when the samples are compared at the broadest possible range (Illus. 3.4), and also when the Pooled Roman sample is compared to the Saxon 1 sample. The differences do not reach meaningful levels in a comparison with the Saxon 2 sample.

When the Lankhills 1967–72 excavations are taken on their own and compared to the Combined Saxon samples (Table 3.5), a similar pattern emerges. Differences in the childhood mortality distributions are highly significant ($p < 0.001$). Among adults, females die at significantly earlier ages. This drives the results for the entire adult sample, although the differences in male mortality patterns do not reach significant levels.

These changes, while requiring cautious treatment, suggest that there is a detectable shift in patterns of adult mortality between the late Roman and Early Anglo-Saxon period populations in Hampshire. Although patterns of male mortality remain relatively stable, there is stronger evidence to suggest that females during the late Roman period were likely to die at an earlier age than their Early Anglo-Saxon counterparts. The fact that the Roman samples probably represent individuals living in a deteriorating urban environment, while the Early Anglo-Saxon individuals probably came from rural villages and farmsteads, may be relevant to understanding the causes behind this finding.

4
PHYSICAL CHARACTERISTICS

i. METHODS

Within the Winchester Roman samples, tests for possible statistically significant differences in stature, cranial index, or cranial measurements were limited to univariate analyses employing t-tests.[29] When the Winchester Roman and Hampshire Early Anglo-Saxon samples were compared, the database was expanded to include cranial non-metric traits as well.[30] Some of these traits have only a single expression, whereas others can be observed on either or both sides of the skull. The extent to which many of these traits are under genetic control is unclear, but since they occur with different frequencies in different populations, they constitute an important analytical tool.[31] In collecting data from these samples, no *a priori* assumptions were made regarding the equivalence of sides in bilaterally observable traits, and the sides of the skull were scored separately. Thus, this study includes both traits that were scored unilaterally, and traits that were scored bilaterally. In addition, the degrees of presence of each trait were also recorded where possible, although these degrees of presence were subsequently combined into simple presence-absence statements for statistical testing. If a trait was detectable at any level, it was considered present.

Quantitative testing employed both univariate and multivariate statistics designed to yield as much information as possible about sample structures and relationships. The SPSS programme 't-test' was used to perform all univariate analyses of cranial metric traits, while the programme 'Discriminant' was employed for multivariate stepwise discriminant function analysis of these same traits.[32] Since multivariate analysis requires much higher quality data than univariate analysis, it was necessary to reduce greatly the number of variables under consideration. The best data were available on measurements of the cranial vault, since the facial region was smashed beyond use in many individuals. To help compensate for this loss of information in the facial area, variables expressing different dimensions of the mandible were incorporated into every multivariate analysis. In addition, whenever possible variables that had shown statistically significant differences between samples in the univariate testing were included in the multivariate analyses in order to help maximize potential differences in the samples.

Univariate pair-wise comparisons of the non-metric traits were made in two ways. The unilateral traits were tested using the corrected chi-square statistic generated by SPSS. All other analyses were made using APL programs written for this study by the late Dr John S. de Cani, at that time chairman of the Statistics Department, Wharton School, University of Pennsylvania. In order to incorporate those individuals with missing observations on one side, probabilities were calculated for bilateral traits using the technique of Generalized Maximum Likelihood Estimation.[33] The pair-wise test statistic, X-square, was based on the natural logarithms of the resulting 2×2 contingency

[29] See above, pp. 49–55, 61–2.

[30] Berry and Berry 1967, Brothwell 1972.

[31] Brothwell 1981, 90. Since the present study was completed much further work has been done on the aetiology of epigenetic, or non-metric, traits. For a brief discussion, see below, p. 303, n. 1.

[32] Nie et al. 1975.

[33] Mood et al. 1974.

table cell frequencies. This statistic is approximately distributed like chi-square, and is included under that name in Tables 3.27 and 3.28.

Multivariate discriminant analysis of the non-metric traits was performed using Mahalanobis D^2 after making arcsine transformations on the sample proportions.[34] This method took into account the possible correlation of traits in the groups under consideration, and permitted the assumption that the covariance between traits was the same, whether or not the means were similar.

All analyses were made first by comparing the Pooled Roman sample to the Combined Saxon sample, to ascertain what differences may have been present at a gross level between these widely divergent cultural groups. The Saxon sample was then divided up, and comparisons were made between all three groups. Because the nature of the samples precluded great robusticity of results in any given analysis, repeated testing applying a variety of statistics to different classes of data was the favoured method of attack. If a consistent pattern of results emerged regardless of the type of analysis or class of variables employed, the inferences derived as a consequence should be greatly strengthened.

ii. POPULATION CONTINUITY INTO THE EARLY ANGLO-SAXON PERIOD IN HAMPSHIRE

Stature

Mean statures for the Pooled Roman and Early Anglo-Saxon samples are given in Table 3.6. As was true for the Pooled Roman period samples (Table 2.29), the stature differences between males and females in all the Hampshire Early Anglo-Saxon samples indicate highly significant levels of sexual dimorphism (Table 3.7). However, the mean difference between the sexes in height is slightly greater in the Early Anglo-Saxon samples (Illus. 3.5). A review of Table 3.8 indicates a trend towards slightly reduced (but still highly significant) levels of sexual dimorphism throughout the Roman period, followed by a reversal of this trend and an increase in levels of sexual dimorphism in the Early Anglo-Saxon period. However, the differences are so small that the possibility of random variation cannot be excluded.

When stature is examined by sex, some interesting differences in sample relationships through time emerge. Males show a pattern of continuous reduction in height during the Roman period (Table 2.30) which is sharply reversed in the Early Anglo-Saxon period (Table 3.6). The differences in the Roman samples are not significant (Table 2.32), nor are the differences between the two Early Anglo-Saxon samples (Table 3.9). Lankhills 1967–72 also does not differ significantly from Saxon 1, the earliest Anglo-Saxon sample. However, when Victoria Road West is added in, and the Pooled Romano-British sample is compared to the Early Anglo-Saxon samples, the differences are significant, and the level of significance increases with the passage of time.

This pattern was not followed in the female samples. Variations in mean stature are relatively smaller, are not statistically significant, and follow no consistent pattern, although there does appear to be a trend towards slightly increased height through time. Females in the Early Anglo-Saxon samples average 2.1 cm (slightly more than inch) taller than their Romano-British counterparts, but in these samples that difference is not statistically significant and could be due to random factors.

[34] This alteration to the traditional Mahalanobis D^2 was developed by the late John S. de Cani, Wharton School, University of Pennsylvania.

TABLE 3.6

Mean stature, Pooled Roman and Early Anglo-Saxon samples

Sample	Males				Females			
	N	Mean	S.D.	Range	N	Mean	S.D.	Range
Pooled Roman	82	171.1	5.48	154.6–183.9	56	157.0	5.36	144.5–169.4
Saxon 1	23	173.9	5.69	160.9–189.0	27	158.9	5.23	148.7–167.2
Saxon 2	21	175.7	5.90	162.3–186.6	12	159.6	5.07	152.4–169.9
Combined Saxon	44	174.8	5.86	160.9–189.0	39	159.1	5.19	148.7–169.9

TABLE 3.7

T-tests of stature, males v. females, Pooled Roman and Early Anglo-Saxon samples

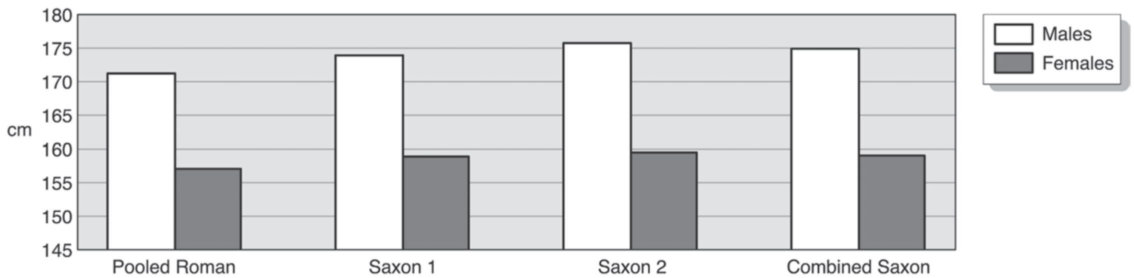
Sample	T	DF	P
Pooled Roman	14.85	136	0.000***
Saxon 1	9.54	48	0.000***
Saxon 2	7.72	31	0.000***
Combined Saxon	12.70	81	0.000***

* = $p < 0.05$ ** = $p < 0.01$ *** = $p < 0.001$

TABLE 3.8

Sexual dimorphism index (DI), Roman and Early Anglo-Saxon samples

Site	DI
Lankhills 1967–72, Area W	109.8
Lanhills 1967–72, Areas F, E, O	108.1
Victoria Road West	107.9
Pooled Roman	109.0
Saxon 1	109.4
Saxon 2	110.1
Combined Saxon	109.9



Illus. 3.5. Mean statures, Pooled Roman and Early Anglo-Saxon samples.

The most important point to grasp is that all these samples are essentially similar with regard to female stature, while Early Anglo-Saxon males are significantly taller than their Romano-British counterparts, and the differences appear to increase through time. Thus, the greater level of sexual

TABLE 3.9

T-tests of stature by sex, Pooled Roman and Early Anglo-Saxon samples

Sample	Males			Females		
	T	DF	P	T	DF	P
Lankhills 1967–72 v. Saxon 1	1.76	81	0.078	1.53	68	0.127
Lankhills 1967–72 v. Saxon 2	2.76	79	0.004**	1.53	53	0.127
Lankhills 1967–72 v. Combined Saxon	2.90	102	0.005**	1.88	80	0.061
Saxon 1 v. Saxon 2	1.00	42	0.675	0.35	37	0.727
Pooled Roman v. Saxon 1	2.15	103	0.032	1.48	81	0.138
Pooled Roman v. Saxon 2	3.36	101	0.001***	1.47	66	0.143
Pooled Roman v. Combined Saxon	3.48	124	0.001***	1.86	93	0.063

* = $p < 0.05$ ** = $p < 0.01$ *** = $p < 0.001$

TABLE 3.10

Cranial indices, Pooled Roman and Early Anglo-Saxon samples

Sample	Males				Females			
	N	Mean	S.D.	Range	N	Mean	S.D.	Range
Pooled Roman	69	76.5	3.32	69.8–83.9	34	77.5	3.72	69.8–85.3
Saxon 1	12	73.5	3.41	67.3–77.4	15	75.4	3.15	68.5–80.8
Saxon 2	9	73.1	2.60	69.4–76.5	9	76.5	4.33	70.7–83.7
Combined Saxon	21	73.3	3.02	67.3–77.4	24	75.8	3.58	68.5–83.7

TABLE 3.11

T-tests of cranial indices, males v. females, Pooled Roman and Early Anglo-Saxon samples

Sample	T	DF	P
Pooled Roman	−1.45	101	0.146
Saxon 1	−1.52	25	0.138
Saxon 2	−2.01	16	0.059
Combined Saxon	−2.50	43	0.015*

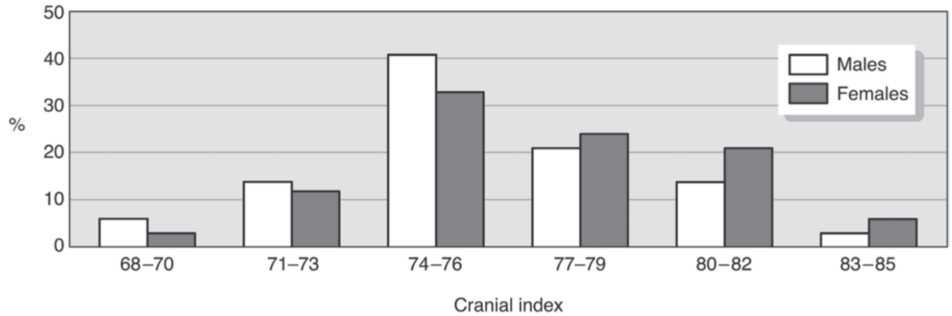
* = $p < 0.05$ ** = $p < 0.01$ *** = $p < 0.001$

dimorphism seen in the Early Anglo-Saxon samples is due almost entirely to the greater proportional increase in male stature.

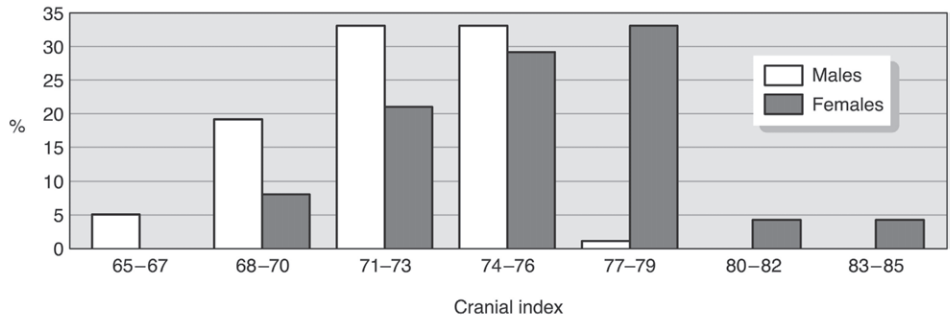
Cranial index

In both the Pooled Roman and Hampshire Early Anglo-Saxon samples females generally have larger mean cranial indices than males, indicating a somewhat rounder head shape (Table 3.10). While the difference in head shape between the sexes is not significant in any Roman sample, it does increase in the Early Anglo-Saxon samples. In the Combined Saxon sample, the dimorphism seen in the cranial index becomes significant at low levels (Table 3.11).

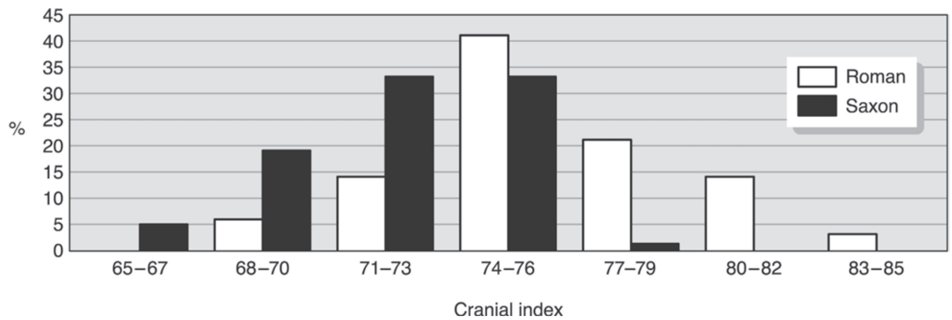
When analysed by sex, Roman males do not differ from each other significantly with regard to cranial index (Table 2.31), and neither do Early Anglo-Saxon males (Table 3.12). However, the Pooled Roman and Early Anglo-Saxon samples do differ from each other at significant levels. The Early



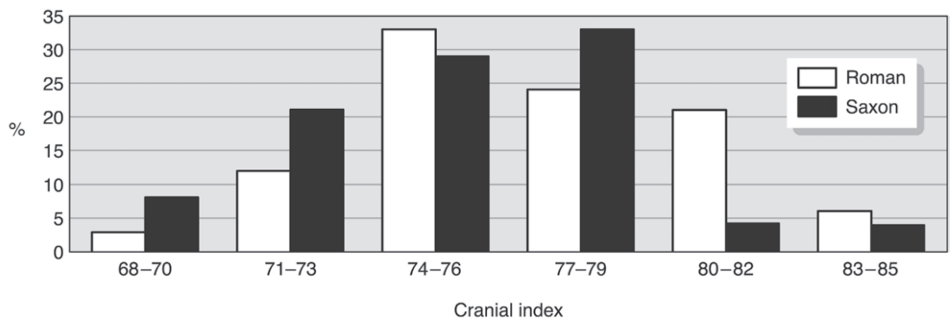
Illus. 3.6. Cranial indices, Pooled Roman sample.



Illus. 3.7. Cranial indices, Combined Saxon sample.



Illus. 3.8. Cranial indices, males, Pooled Roman and Combined Saxon samples.



Illus. 3.9. Cranial indices, females, Pooled Roman and Combined Saxon samples.

TABLE 3.12

T-tests of cranial indices by sex, Pooled Roman and Early Anglo-Saxon samples

Sample	Males			Females		
	T	DF	P	T	DF	P
Lankhills 1967–72 v. Saxon 1	2.83	56	0.007**	1.73	32	0.090
Lankhills 1967–72 v. Saxon 2	2.93	53	0.005**	0.66	26	0.525
Lankhills 1967–72 v. Combined Saxon	3.01	65	0.001***	1.52	41	0.133
Saxon 1 v. Saxon 2	0.3	19	0.764	−0.69	22	0.502
Pooled Roman v. Saxon 1	2.83	80	0.006**	1.89	46	0.062
Pooled Roman v. Saxon 2	2.92	77	0.005**	0.71	40	0.512
Pooled Roman v. Combined Saxon	3.06	89	0.000***	0.04	55	0.087

* = $p < 0.05$ ** = $p < 0.01$ *** = $p < 0.001$

TABLE 3.13

Cranial and mandibular measurements, Pooled Roman sample

Variable	Males				Females			
	N	Mean	S.D.	Range	N	Mean	S.D.	Range
Cranial Length	77	190.55	6.97	171–209	46	181.20	5.66	168–195
Cranial Breadth	75	145.35	5.16	135–160	37	140.62	6.02	128–152
Cranial Height	57	133.81	6.29	120–145	34	125.82	4.96	115–138
Auricular Height	61	117.46	4.46	108–127	32	113.22	3.94	104–123
Basion-Prosthion Length	41	93.29	4.94	82–102	20	89.15	4.68	80–96
Basion-Nasion Length	58	101.10	4.16	93–112	32	96.00	3.90	85–103
Minimum Frontal Breadth	82	98.77	4.57	88–111	53	95.36	3.99	88–105
Nasion-Prosthion Height	82	70.89	3.88	64–79	31	66.65	3.98	58–75
Zygomatic Breadth	30	132.50	5.22	116–141	11	126.18	5.12	118–135
Orbital Height	57	33.98	1.67	30–38	31	33.65	1.84	30–39
Orbital Breadth	55	42.07	1.77	39–48	31	40.61	1.98	38–47
Nasal Breadth	47	24.15	2.52	20–36	28	23.11	2.01	20–26
Nasal Length	52	52.40	2.49	48–59	29	49.21	2.24	45–54
Alveolar Breadth	30	63.47	3.15	57–70	22	59.96	2.70	56–67
Alveolar Length	48	53.60	4.65	46–76	28	50.29	3.83	42–57
Palatal Breadth	32	36.89	3.67	28–43	24	35.92	2.52	31–41
Palatal Length	43	42.98	2.93	36–47	27	40.89	2.39	37–45
Biasterionic Breadth	68	116.25	5.51	100–127	42	111.21	4.88	101–123
Simotic Chord	47	9.38	1.64	5–13	31	9.29	2.21	6–13
Nasion-Bregma Chord	81	113.74	4.64	100–122	50	108.00	4.61	99–115
Bregma-Lambda Chord	83	117.31	6.68	99–134	49	114.47	5.32	102–125
Lambda-Opisthion Chord	68	97.50	5.24	87–110	42	93.98	4.79	85–109
Frontal Arc	81	131.72	6.18	113–144	50	125.34	6.92	113–140
Parietal Arc	83	130.15	7.90	103–149	49	127.49	6.95	111–143
Occipital Arc	68	122.25	7.15	109–141	42	116.33	7.82	98–142
Mandibular Body Length	66	106.47	7.73	95–151	41	99.07	4.97	89–111
Bicondylar Breadth	47	123.11	5.67	111–137	28	116.57	6.11	103–131
Minimum Ramus Breadth	82	31.98	2.30	27–37	54	31.09	2.48	25–36
Ramus Height	77	64.47	4.67	53–76	49	56.67	3.57	48–64
Bigonial Breadth	53	102.81	5.37	90–117	29	94.21	7.06	82–109
Coronoid Height	80	67.04	5.57	54–79	48	59.08	4.08	50–70
Symphysis Height	61	33.51	2.98	27–40	48	30.48	2.74	25–40
Gonial Angle	66	121.32	6.22	107–133	37	123.32	5.09	112–134

TABLE 3.14

Cranial and mandibular measurements, Saxon 1 sample

Variable	Males				Females			
	N	Mean	S.D.	Range	N	Mean	S.D.	Range
Cranial Length	15	192.27	6.02	182–201	19	182.84	4.56	173–193
Cranial Breadth	12	142.42	5.63	134–152	15	138.20	6.20	124–147
Cranial Height	9	138.22	4.15	129–142	12	131.33	4.27	125–140
Auricular Height	9	120.56	3.28	114–126	9	112.67	4.24	107–120
Basion-Prosthion Length	5	96.60	7.96	85–105	4	91.00	0.82	90–92
Basion-Nasion Length	8	103.13	5.36	94–111	11	98.27	6.31	90–111
Minimum Frontal Breadth	15	101.07	4.35	95–112	18	96.67	5.34	86–105
Nasion-Prosthion Height	10	68.80	3.65	64–74	7	67.00	5.69	59–73
Zygomatic Breadth	2	141.50	3.54	139–144	4	126.00	1.41	124–127
Orbital Height	8	34.63	2.26	31–37	7	33.57	1.13	32–35
Orbital Breadth	6	43.17	1.72	40–45	7	39.43	1.13	38–41
Nasal Breadth	7	26.57	1.51	24–28	7	23.14	1.57	21–26
Nasal Length	8	53.50	3.02	48–57	7	48.86	3.02	46–53
Alveolar Breadth	5	65.80	2.95	61–68	4	59.00	1.41	57–60
Alveolar Length	5	54.60	1.52	53–57	4	52.75	2.63	49–55
Palatal Breadth	10	41.70	2.79	38–48	9	36.89	3.18	33–43
Palatal Length	6	46.83	3.31	43–52	7	44.43	2.76	40–48
Biasterionic Breadth	9	115.22	2.91	111–120	14	109.07	6.33	98–126
Simotic Chord	5	9.20	1.64	7–11	7	8.57	2.30	5–11
Nasion-Bregma Chord	14	112.57	3.88	105–119	18	109.50	5.89	101–125
Bregma-Lambda Chord	13	116.08	5.84	108–126	19	112.37	4.59	106–120
Lambda-Opisthion Chord	10	98.90	4.61	93–107	14	96.21	4.14	87–103
Frontal Arc	14	129.71	5.27	120–141	18	124.11	5.59	114–134
Parietal Arc	13	128.46	5.84	120–137	19	123.37	5.79	114–132
Occipital Arc	10	122.00	7.60	112–134	15	118.27	6.55	109–130
Mandibular Body Length	15	107.27	5.12	99–116	14	102.86	4.31	96–110
Bicondylar Breadth	16	124.31	7.09	113–139	17	114.94	5.27	106–126
Minimum Ramus Breadth	23	33.09	2.11	29–38	21	31.24	2.57	27–38
Ramus Height	21	63.00	5.04	53–73	21	56.19	3.96	49–62
Bigonial Breadth	17	102.47	9.03	84–116	17	97.82	4.75	92–107
Coronoid Height	21	65.71	4.22	55–74	21	57.57	5.17	50–69
Symphysis Height	17	31.53	2.53	28–36	15	30.00	3.16	23–34
Gonial Angle	20	120.55	5.74	112–130	19	124.79	7.49	110–138

Anglo-Saxon male samples are more long-headed than their Roman counterparts; the Combined Saxon male mean cranial index is 73.3, while that of the Pooled Roman male sample is 76.5. Illus. 3.6–3.9 show the percentage distribution of cranial indices for both sexes in the Roman and Early Anglo-Saxon samples, and indicate the shift in the range of distribution between these two groups.

Among females there is a tendency for Early Anglo-Saxon samples to be slightly longer-headed than the Roman samples. However, none of the differences are statistically significant, and females in these samples are characterized more by their uniformity than by their distinctiveness.

Cranial measurements

Descriptive statistics for cranial and mandibular measurements by sex in the Pooled Roman sample and the Hampshire Early Anglo-Saxon samples will be found in Tables 3.13–3.16. When the sexes are compared to each other using univariate analysis employing t-tests (Table 3.17), the Early Anglo-Saxon samples are shown to be similar to the Pooled Roman sample in that they are highly sexually dimorphic with regard to cranial measurements.

TABLE 3.15
Cranial and mandibular measurements, Saxon 2 sample

Variable	Males				Females			
	N	Mean	S.D.	Range	N	Mean	S.D.	Range
Cranial Length	13	195.92	4.66	187–204	12	183.17	6.74	166–191
Cranial Breadth	10	141.20	8.73	121–150	12	138.83	5.27	130–148
Cranial Height	5	139.20	5.81	130–144	5	130.00	4.85	122–134
Auricular Height	9	121.89	3.52	118–129	5	116.80	3.90	112–122
Basion-Prosthion Length	2	96.00	0.00	96–96	3	88.67	4.62	86–94
Basion-Nasion Length	6	101.83	3.13	98–106	5	97.40	7.16	86–104
Minimum Frontal Breadth	13	98.77	5.46	88–106	9	95.33	5.05	89–106
Nasion-Prosthion Height	4	70.50	5.80	63–76	5	63.68	2.49	62–67
Zygomatic Breadth	3	137.00	7.55	129–144	2	123.00	8.49	117–129
Orbital Height	5	31.80	2.17	29–35	4	32.50	1.00	31–33
Orbital Breadth	4	39.50	1.73	38–42	4	40.25	1.26	39–42
Nasal Breadth	3	24.67	2.52	22–27	3	24.67	1.53	23–26
Nasal Length	4	51.50	3.11	47–54	4	48.50	2.08	46–51
Alveolar Breadth	3	64.00	1.73	63–66	2	59.50	0.71	59–60
Alveolar Length	3	55.33	0.58	55–56	1	49.00	0.00	49–49
Palatal Breadth	3	39.33	3.22	37–43	3	36.33	1.53	35–38
Palatal Length	3	44.67	0.58	44–45	1	44.00	0.00	44–44
Biasterionic Breadth	12	115.00	3.84	111–122	8	113.25	3.54	110–120
Simotic Chord	3	9.00	1.00	8–10	3	8.00	1.00	7–9
Nasion-Bregma Chord	14	117.14	5.28	107–123	11	107.46	5.26	102–118
Bregma-Lambda Chord	14	121.71	4.95	113–132	11	114.73	6.65	108–129
Lambda-Opisthion Chord	9	100.11	2.57	98–104	6	95.50	3.15	91–100
Frontal Arc	13	136.46	7.59	117–144	10	123.30	6.62	116–138
Parietal Arc	14	135.43	7.06	123–148	11	128.18	8.39	120–146
Occipital Arc	9	124.78	6.72	116–135	6	117.67	5.32	111–123
Mandibular Body Length	12	109.75	7.33	95–120	8	99.75	3.77	96–105
Bicondylar Breadth	6	118.00	8.37	108–133	8	118.13	5.99	109–124
Minimum Ramus Breadth	19	32.74	3.11	28–38	12	30.42	2.84	26–35
Ramus Height	16	65.13	3.10	58–70	11	60.55	2.25	56–64
Bigonial Breadth	11	106.91	8.04	97–120	8	96.25	4.43	91–103
Coronoid Height	16	67.00	5.24	58–76	11	60.64	2.20	57–65
Symphysis Height	13	33.92	3.09	27–38	7	29.86	1.87	27–33
Gonial Angle	12	120.00	8.30	107–134	10	119.00	6.13	110–130

In the male samples, t-tests of Pooled Roman vs. Combined Saxon samples indicate significant differences in more dimensions than would be expected by chance alone (Table 3.18). When the sample is separated into its chronologically sequential parts, the results suggest gradually increasing differences in cranial dimensions through time. The Saxon 1 sample differs significantly from the Pooled Roman sample in six of 33 measurements, while the Saxon 2 sample differs from the Saxon 1 sample in seven of 33 measurements. When the Pooled Roman sample is compared to the Saxon 2 sample, the differences jump to 12 of 33 measurements. Overall, the Pooled Roman and Combined Saxon male samples differ from each other in eight of 33 measurements.

The t-test results for males indicate that cranial shape, as well as size, was changing. Cranial length and height were increasing through time and across samples, while cranial breadth was decreasing. Romano-British facial features were narrower, the nose shorter, and the back of the skull wider than in their Early Anglo-Saxon counterparts. Likewise, the Roman mandible was shorter in overall length, higher in the ascending ramus area, and generally less robust.

T-tests of the female samples (Table 3.19) reveal less variation than is present among the males. Overall, the number of traits showing significant differences is within the range that one could

TABLE 3.16

Cranial and mandibular measurements, Combined Saxon sample

Variable	Males				Females			
	N	Mean	S.D.	Range	N	Mean	S.D.	Range
Cranial Length	28	193.96	5.65	182–204	29	182.83	5.50	166–193
Cranial Breadth	22	141.87	7.05	121–152	25	138.60	5.92	124–148
Cranial Height	14	138.57	4.60	129–144	16	130.75	4.41	122–140
Auricular Height	18	121.22	3.37	114–129	13	114.15	4.65	107–122
Basion-Prosthion Length	7	96.43	6.50	85–105	6	89.33	2.66	86–92
Basion-Nasion Length	14	102.57	4.43	94–111	15	97.80	6.53	86–111
Minimum Frontal Breadth	28	100.00	4.94	88–112	27	96.56	4.99	86–106
Nasion-Prosthion Height	14	69.29	4.20	63–76	11	66.00	4.84	59–73
Zygomatic Breadth	5	138.80	6.14	129–144	5	124.20	4.21	117–127
Orbital Height	13	33.54	2.57	29–37	10	33.20	1.23	31–35
Orbital Breadth	10	41.70	2.50	38–45	10	39.50	0.97	38–41
Nasal Breadth	10	26.00	1.94	22–28	9	23.44	1.67	21–26
Nasal Length	12	52.83	3.07	47–57	10	48.80	2.74	46–53
Alveolar Breadth	8	65.13	2.59	61–68	6	59.17	1.17	57–60
Alveolar Length	8	54.88	1.25	53–57	5	52.00	2.83	49–55
Palatal Breadth	13	41.15	2.94	37–48	12	36.75	2.80	33–43
Palatal Length	9	46.11	2.85	43–52	8	44.38	2.56	40–48
Biasterionic Breadth	21	115.10	3.39	111–122	21	110.62	5.90	98–126
Simotic Chord	8	9.13	1.36	7–11	9	8.44	2.07	5–11
Nasion-Bregma Chord	28	114.86	5.10	105–123	28	108.57	5.70	101–125
Bregma-Lambda Chord	27	119.00	6.02	108–132	29	113.17	5.53	106–129
Lambda-Opisthion Chord	19	99.47	3.73	93–107	19	96.11	3.87	87–103
Frontal Arc	27	132.96	7.23	117–144	27	123.63	5.89	114–138
Parietal Arc	27	132.07	7.30	120–148	29	125.03	7.22	114–146
Occipital Arc	19	123.32	7.14	112–135	20	118.35	6.14	109–130
Mandibular Body Length	27	108.37	6.20	95–120	22	101.73	4.31	96–110
Bicondylar Breadth	22	122.59	7.80	108–139	25	115.96	5.59	106–126
Minimum Ramus Breadth	42	32.93	2.58	28–38	33	30.94	2.66	26–38
Ramus Height	37	63.92	4.39	53–73	32	57.69	4.02	49–64
Bigonial Breadth	28	104.21	8.78	84–120	25	97.32	4.62	91–107
Coronoid Height	37	66.27	4.66	55–76	32	58.63	4.58	50–69
Symphysis Height	30	32.57	2.99	27–38	22	29.96	2.77	23–34
Gonial Angle	32	120.34	6.69	107–134	29	122.79	7.48	110–138

expect to find due solely to random factors. When the smaller chronological samples are examined separately, the greatest number of metric trait differences is noted between the Roman and Saxon 1 samples (4/33). These differences are still considerably fewer than those found in the males, however.

The pattern of trait differences indicates that Pooled Roman and Early Anglo-Saxon female skulls are more similar in size and shape than their male counterparts, although the same general trend towards increased length and height, and reduced breadth is present at very low, insignificant levels.

Because univariate t-tests do not account for the correlation of traits, the use of multivariate analyses that do account for these correlations is extremely helpful. A number of stepwise discriminant functions were run, and the results are given in Table 3.20. Slightly different combinations of variables were used, which produced slightly different subsamples, depending on missing data. Although sample sizes are small, the pattern of the results is very consistent.

Pooled Roman and Combined Saxon males differ significantly from each other at the p= 0.05 level. The measurements making the greatest contribution to this difference include cranial length, cranial breadth, bregma-lambda chord, minimum ramus breadth, and ramus height, both latter

TABLE 3.17

T-tests of cranial and mandibular measurements, males v. females, Pooled Roman and Early Anglo-Saxon samples

Variable	Pooled Roman			Saxon 1			Saxon 2			Combined Saxon		
	T	DF	P	T	DF	P	T	DF	P	T	DF	P
Cranial Length	7.71	121.0	0.000***	5.20	32.0	0.000***	5.54	23.0	0.000***	7.64	57.0	0.000***
Cranial Breadth	4.31	110.0	0.000***	1.83	25.0	0.080	0.79	20.0	0.442	1.86	47.0	0.070
Cranial Height	6.31	89.0	0.000***	3.70	19.0	0.002**	2.72	8.0	0.026*	4.74	29.0	0.000***
Auricular Height	4.53	91.0	0.000***	4.41	16.0	0.000***	2.50	12.0	0.028*	5.11	30.0	0.000***
Basion-Prosthion Length	3.13	59.0	0.003**	1.38	7.0	0.208	2.13	3.0	0.123	2.49	11.0	0.029*
Basion-Nasion Length	5.69	88.0	0.000***	1.76	17.0	0.093	1.38	9.0	0.201	2.29	27.0	0.029*
Minimum Frontal Breadth	4.44	133.0	0.000***	2.56	31.0	0.016*	1.49	20.0	0.148	2.57	53.0	0.012*
Nasion-Prosthion Height	4.79	82.0	0.000***	0.80	15.0	0.437	2.36	7.0	0.051	2.06	24.0	0.050*
Zygomatic Breadth	3.45	39.0	0.001***	8.32	4.0	0.001***	1.95	3.0	0.147	4.41	9.0	0.002**
Orbital Height	0.87	86.0	0.385	1.11	13.0	0.286	−0.59	7.0	0.573	0.45	17.3	0.659
Orbital Breadth	3.52	84.0	0.001***	4.69	11.0	0.001***	−0.70	6.0	0.510	2.27	12.6	0.041*
Nasal Breadth	1.86	73.0	0.067	4.16	12.0	0.001***	0.00	4.0	1.00	2.98	18.0	0.008**
Nasal Length	5.73	79.0	0.000***	2.97	13.0	0.011*	1.60	6.0	0.160	3.44	21.0	0.002**
Alveolar Breadth	4.22	50.0	0.000***	4.20	7.0	0.004**	3.35	3.0	0.042*	5.21	12.0	0.000***
Alveolar Length	3.20	74.0	0.002**	1.33	7.0	0.224	9.50	2.0	0.011*	2.55	11.0	0.027*
Palatal Breadth	1.10	54.0	0.277	3.51	17.0	0.003**	1.46	4.0	0.218	3.83	23.0	0.001***
Palatal Length	3.11	68.0	0.003**	1.43	11.0	0.181	1.00	2.0	0.423	1.31	15.0	0.208
Biasterionic Breadth	4.86	108.0	0.000***	3.16	19.5	0.005**	1.03	18.0	0.317	3.14	34.3	0.003**
Simotic Chord	0.21	76.0	0.832	0.52	10.0	0.614	1.22	4.0	0.288	0.89	16.0	0.387
Nasion-Bregma Chord	6.90	129.0	0.000***	1.68	30.0	0.103	4.56	23.0	0.000***	4.29	55.0	0.000***
Bregma-Lambda Chord	2.54	130.0	0.012*	2.01	30.0	0.053	3.01	23.0	0.006**	3.80	55.0	0.000***
Lambda-Opisthion Chord	3.54	108.0	0.001***	1.50	22.0	0.149	3.12	13.0	0.008**	2.88	37.0	0.007**
Frontal Arc	5.48	129.0	0.000***	2.88	30.0	0.007**	4.35	21.0	0.000***	5.16	53.0	0.000***
Parietal Arc	1.95	130.0	0.053	2.44	30.0	0.021*	2.35	23.0	0.028*	3.63	55.0	0.001***
Occipital Arc	4.07	108.0	0.000***	1.31	23.0	0.203	2.17	13.0	0.049*	2.49	38.0	0.017*
Mandibular Body Length	6.02	104.8	0.000***	2.42	27.0	0.023*	3.52	20.0	0.002**	4.22	49.0	0.000***
Bicondylar Breadth	4.69	73.0	0.000***	4.31	31.0	0.000***	0.22	14.0	0.827	3.52	47.0	0.001***
Minimum Ramus Breadth	2.12	134.0	0.036*	2.50	42.0	0.016*	2.23	31.0	0.033*	3.29	75.0	0.002**
Ramus Height	10.57	119.7	0.000***	5.66	40.0	0.000***	4.74	27.0	0.000***	6.99	69.7	0.000***
Bigonial Breadth	6.19	80.0	0.000***	1.94	21.4	0.066	3.71	19.0	0.001***	3.83	42.0	0.000***
Coronoid Height	9.27	120.9	0.000***	6.46	40.0	0.000***	4.34	20.6	0.000***	7.55	69.0	0.000***
Symphysis Height	5.45	107.0	0.000***	1.90	30.0	0.067	3.54	19.0	0.002**	3.77	51.0	0.000***
Gonial Angle	−1.67	101.0	0.097	−2.23	37.0	0.032*	0.00	22.0	1.00	−1.68	61.0	0.098
TESTS SIG./TOTAL TESTS			27/33			19/33			17/33			28/33

* = $p < 0.05$ ** = $p < 0.01$ *** = $p < 0.001$

measurements taken on the left side. When the Combined Saxon sample is separated and the Pooled Roman, Saxon 1, and Saxon 2 samples are all compared, the increasing differentiation between chronological groups through time is apparent. In no case do Roman males differ significantly from Saxon 1 males. Roman males do, however, differ significantly from Saxon 2 males. Of equal interest is the fact that Saxon 2 males differ significantly from Saxon 1 males in most cases, although at lower levels. The very small sample sizes suggest caution in the interpretation of the results, but the consistency in patterning can be taken to indicate a real difference.

The females again present a somewhat different picture. There are no significant differences between any of the groups, indicating great homogeneity among the samples.

Cranial non-metric traits

Tables 3.21–3.25 present the raw observational data for the unilateral and bilateral cranial non-metric traits used in testing differences in these samples. These data were used to calculate the

TABLE 3.18

T-tests of cranial and mandibular measurements, males, Pooled Roman and Early Anglo-Saxon samples

Variable	S1 v. S2			ROM v. S1			ROM v. S2			ROM v. CS		
	T	DF	P	T	DF	P	T	DF	P	T	DF	P
Cranial Length	−1.78	26.0	0.088	−0.84	89.0	0.402	−2.63	87.0	0.010**	−2.26	102.0	0.026*
Cranial Breadth	0.40	20.0	0.897	1.86	84.0	0.066	1.50	9.9	0.165	2.61	94.0	0.010**
Cranial Height	−0.37	12.0	0.719	−2.07	63.0	0.043*	−1.87	59.0	0.066	−2.70	68.0	0.009**
Auricular Height	−0.83	16.0	0.418	−1.98	67.0	0.052	−2.82	67.0	0.006**	−3.27	76.0	0.002**
Basion-Prosthion Length	0.10	5.0	0.921	−1.32	44.0	0.190	−0.76	40.0	0.450	−1.48	46.0	0.141
Basion-Nasion Length	0.52	12.0	0.610	−1.22	63.0	0.226	−0.40	61.0	0.689	1.15	69.0	0.256
Minimum Frontal Breadth	1.24	26.0	0.227	−1.78	94.0	0.078	0.01	92.0	0.995	−1.19	107.0	0.237
Nasion-Prosthion Height	−0.67	12.0	0.515	1.54	60.0	0.128	0.17	54.0	0.862	1.32	64.0	0.191
Zygomatic Breadth	0.76	3.0	0.503	−2.38	30.0	0.024*	−1.38	31.0	0.179	−2.44	33.0	0.020*
Orbital Height	2.22	11.0	0.048*	−0.99	62.0	0.324	2.69	59.0	0.009**	0.57	14.5	0.578
Orbital Breadth	3.29	8.0	0.011**	−1.40	58.0	0.166	2.81	56.0	0.007**	0.60	62.0	0.551
Nasal Breadth	1.52	8.0	0.167	−2.44	51.0	0.018*	−0.34	47.0	0.736	−2.16	54.0	0.036*
Nasal Length	1.07	10.0	0.309	−1.11	57.0	0.273	0.69	53.0	0.495	−0.50	61.0	0.618
Alveolar Breadth	0.95	6.0	0.381	−1.85	31.0	0.073	−0.49	29.0	0.629	−1.72	34.0	0.095
Alveolar Length	−0.78	6.0	0.463	−0.63	49.0	0.530	−2.74	27.7	0.011*	−1.96	40.3	0.057
Palatal Breadth	1.25	11.0	0.237	−4.21	38.0	0.000***	−1.32	31.0	0.196	−4.14	41.0	0.000***
Palatal Length	1.09	7.0	0.313	−3.03	46.0	0.004**	−1.03	43.0	0.309	−2.99	49.0	0.004**
Biasterionic Breadth	0.14	19.0	0.886	0.55	75.0	0.585	0.75	78.0	0.454	1.16	55.0	0.252
Simotic Chord	0.19	6.0	0.857	0.24	50.0	0.813	0.40	48.0	0.692	0.42	53.0	0.675
Nasion-Bregma Chord	−2.61	26.0	0.015*	0.88	92.0	0.380	−2.47	92.0	0.015*	−1.07	106.0	0.289
Bregma-Lambda Chord	−2.71	25.0	0.012	0.65	93.0	0.519	−2.32	94.0	0.022*	−1.13	107.0	0.260
Lambda-Opisthion Chord	−0.70	17.0	0.496	−0.79	75.0	0.432	−2.43	18.9	0.025*	−1.52	84.0	0.133
Frontal Arc	−2.70	25.0	0.012*	1.14	92.0	0.258	−2.47	91.0	0.015*	−0.86	105.0	0.393
Parietal Arc	−2.78	25.0	0.010**	0.75	93.0	0.456	−2.32	94.0	0.023*	−1.09	107.0	0.276
Occipital Arc	−0.84	17.0	0.413	0.19	75.0	0.850	−0.92	74.0	0.361	−0.46	84.0	0.647
Mandibular Body Length	−0.96	24.0	0.345	−0.37	76.0	0.710	−1.33	74.0	0.187	−1.12	88.0	0.265
Bicondylar Breadth	1.81	19.0	0.086	−0.69	58.0	0.494	2.12	49.0	0.040*	0.35	29.2	0.732
Minimum Ramus Breadth	0.43	39.0	0.671	−1.91	98.0	0.060	−1.10	95.0	0.276	−1.90	117.0	0.060
Ramus Height	−1.21	34.0	0.235	0.92	92.0	0.415	−0.52	88.0	0.601	0.27	108.0	0.768
Bigonial Breadth	−1.19	25.0	0.247	−0.01	18.2	0.992	−2.09	61.0	0.040*	−0.91	36.3	0.371
Coronoid Height	−0.51	34.0	0.612	0.72	46.6	0.477	−0.02	92.0	0.987	0.37	112.0	0.711
Symphysis Height	−2.12	27.0	0.044*	2.11	74.0	0.038*	−0.50	71.0	0.621	1.11	87.0	0.271
Gonial Angle	0.08	29.0	0.934	0.76	81.0	0.449	0.69	74.0	0.493	0.93	93.0	0.357
TESTS SIG./TOTAL TESTS			7/33			6/33			12/33			8/33

* = $p < 0.05$ ** = $p < 0.01$ *** = $p < 0.001$

maximum likelihood estimates employed in the univariate tests of significance. In addition, the data were converted to simple statements of trait frequencies, found in Table 3.26. These frequencies are not used in any further calculations, but are presented only to facilitate comparison with data taken from other sites where the individual rather than the side of the skull has been the unit of observation.

The univariate analyses of non-metric traits show uniformly lower levels of variation than do the cranial measurements. As Table 3.27 indicates, there is much less sexual dimorphism evident; no more than two out of 22 traits in any sample are significantly different, and not necessarily the same two traits in each sample.

Table 3.28 shows the results of chi-square tests between the samples, by sex. Again the number of traits that differ significantly between any pair of samples is relatively small. The greatest number of differences for both males and females occurs when the Saxon 1 and Saxon 2 samples are compared; three of 18 tests for the males, and three of 17 for females. As was true when the sexes were

TABLE 3.19

T-tests of cranial and mandibular measurements, females, Pooled Roman and Early Anglo-Saxon samples

Variable	S1 v. S2			ROM v. S1			ROM v. S2			ROM v. CS		
	T	DF	P	T	DF	P	T	DF	P	T	DF	P
Cranial Length	−0.16	29.0	0.874	−1.11	64.0	0.271	−1.02	57.0	0.310	−1.36	76.0	0.179
Cranial Breadth	−0.28	25.0	0.781	1.30	51.0	0.200	0.91	48.0	0.367	1.43	63.0	0.159
Cranial Height	0.57	15.0	0.580	−2.99	45.0	0.004**	−1.49	38.0	0.143	−3.17	50.0	0.003**
Auricular Height	−1.79	12.0	0.098	0.44	40.0	0.660	−1.84	36.0	0.074	−0.62	45.0	0.539
Basion-Prosthion Length	0.86	2.1	0.478	−1.47	23.0	0.155	0.25	22.0	0.807	−0.33	26.0	0.747
Basion-Nasion Length	0.45	13.0	0.662	−1.41	41.0	0.162	−0.39	4.4	0.716	−1.18	45.0	0.242
Minimum Frontal Breadth	−0.90	25.0	0.618	−1.07	70.0	0.290	0.17	60.0	0.984	−1.16	78.0	0.246
Nasion-Prosthion Height	1.17	10.0	0.270	−0.10	37.0	0.918	1.61	35.0	0.116	0.80	42.0	0.428
Zygomatic Breadth	0.50	1.0	0.707	0.07	13.0	0.946	0.75	11.0	0.468	0.48	15.0	0.637
Orbital Height	1.57	9.0	0.152	0.16	37.0	0.873	1.27	34.0	0.213	0.86	41.0	0.396
Orbital Breadth	−1.11	9.0	0.294	1.56	37.0	0.128	0.37	34.0	0.712	1.43	41.0	0.159
Nasal Breadth	1.41	8.0	0.195	−0.01	34.0	0.995	−1.29	30.0	0.206	−0.66	37.0	0.512
Nasal Length	0.21	9.0	0.840	0.44	35.0	0.664	0.67	32.0	0.508	0.69	39.0	0.494
Alveolar Breadth	−0.45	4.0	0.674	0.68	24.0	0.508	0.23	22.0	0.813	0.69	26.0	0.503
Alveolar Length	1.28	3.0	0.292	−1.20	31.0	0.238	0.36	28.0	0.723	−0.91	32.0	0.371
Palatal Breadth	0.28	10.0	0.782	−0.71	32.0	0.486	−0.13	26.0	0.894	−0.66	35.0	0.512
Palatal Length	0.15	6.0	0.889	−3.39	32.0	0.002**	−1.28	26.0	0.213	−3.57	33.0	0.001***
Biasterionic Breadth	−1.71	20.0	0.103	1.32	54.0	0.193	−1.12	48.0	0.268	0.46	62.0	0.650
Simotic Chord	0.40	8.0	0.697	0.77	36.0	0.445	0.99	32.0	0.329	1.14	39.0	0.262
Nasion-Bregma Chord	0.94	27.0	0.354	−1.01	67.0	0.316	0.42	60.0	0.676	−0.52	78.0	0.605
Bregma-Lambda Chord	−1.15	28.0	0.260	1.53	67.0	0.132	−0.15	59.0	0.885	1.00	78.0	0.322
Lambda-Opisthion Chord	0.38	18.0	0.711	−1.53	55.0	0.132	−0.72	47.0	0.473	−1.61	61.0	0.112
Frontal Arc	0.34	26.0	0.733	0.74	67.0	0.461	0.91	59.0	0.368	1.06	77.0	0.294
Parietal Arc	−1.86	28.0	0.073	2.31	67.0	0.024*	−0.29	59.0	0.770	1.46	78.0	0.149
Occipital Arc	0.20	19.0	0.845	−0.74	56.0	0.465	−0.32	47.0	0.750	−0.76	62.0	0.447
Mandibular Body Length	1.45	23.0	0.160	−2.43	55.0	0.019*	−0.68	50.0	0.500	−2.16	65.0	0.034
Bicondylar Breadth	−0.91	26.0	0.373	0.90	45.0	0.372	−0.18	37.0	0.857	0.56	55.0	0.578
Minimum Ramus Breadth	1.00	34.0	0.322	−0.36	75.0	0.717	0.88	67.0	0.380	0.22	89.0	0.826
Ramus Height	−3.50	33.0	0.001***	0.81	70.0	0.423	−3.17	61.0	0.002**	−0.93	83.0	0.353
Bigonial Breadth	1.28	26.0	0.211	−1.75	46.0	0.087	−0.26	38.0	0.794	−1.42	56.0	0.161
Coronoid Height	−2.69	30.6	0.011*	1.54	69.0	0.129	−1.88	38.4	0.068	0.55	82.0	0.586
Symphysis Height	0.21	22.0	0.836	0.86	63.0	0.393	0.93	55.0	0.356	1.15	71.0	0.253
Gonial Angle	1.95	30.0	0.060	−0.91	56.0	0.369	1.95	48.0	0.057	0.24	68.0	0.808
TESTS SIG./TOTAL TESTS			2/33			4/33			1/33			2/33

* = $p < 0.05$ ** = $p < 0.01$ *** = $p < 0.001$

compared with each other, in the sample comparisons by sex there is little consistency regarding which traits differ significantly.

On first inspection, it might appear that the univariate analyses indicate more trait differences between these samples than could be due to chance alone. However, when the multivariate functions calculated using Mahalanobis D^2 with arcsine transformation were run, these differences were shown to be more apparent than real. The multivariate functions were run using primarily those variables that showed significant differences between samples in the chi-square tests. This should have had the effect of maximizing any genuine differences between these groups. However, as seen in Table 3.29, the results are notable primarily for their lack of significance, and the very close relationships that are indicated between the groups. There are no significant differences between any of the groups of males, and the picture generally is similar for the females.

TABLE 3.20

Stepwise multivariate discriminant functions, cranial metric traits, Pooled Roman and Early Anglo-Saxon samples

TESTS OF SIGNIFICANCE

MALES

1. Pooled Roman v. Combined Saxon

Roman = 40	Combined Saxon = 11	
$F_{10,40}$ = 2.14971*		

2. Pooled Roman v. Combined Saxon

Roman = 40	Combined Saxon = 11	
$F_{5,45}$ = 3.93201*		

3. Pooled Roman v. Saxon 1, Pooled Roman v. Saxon 2, Saxon 1 v. Saxon 2

Roman = 47	Saxon 1 = 6	Saxon 2 = 7
	Roman	*Saxon 1*
Saxon 1 ($F_{3,55}$) =	1.82337	
Saxon 2 ($F_{3,55}$) =	4.68970**	1.30355

4. Pooled Roman v. Saxon 1, Pooled Roman v. Saxon 2, Saxon 1 v. Saxon 2

Roman = 40	Saxon 1 = 6	Saxon 2 = 5
	Roman	Saxon 1
Saxon 1 ($F_{4,45}$) =	1.46026	
Saxon 2 ($F_{4,45}$) =	6.79804***	3.93139**

5. Pooled Roman v. Saxon 1, Pooled Roman v. Saxon 2, Saxon 1 v. Saxon 2

Roman = 45	Saxon 1 = 6	Saxon 2 = 6
	Roman	*Saxon 1*
Saxon 1 ($F_{4,51}$) =	1.57056	
Saxon 2 ($F_{4,51}$) =	5.54579**	3.59855*

6. Pooled Roman v. Saxon 1, Pooled Roman v. Saxon 2, Saxon 1 v. Saxon 2

Roman = 45	Saxon 1 = 6	Saxon 2 = 6
	Roman	*Saxon 1*
Saxon 1 ($F_{5,50}$) =	1.5316	
Saxon 2 ($F_{5,50}$) =	4.56428**	2.82641*

FEMALES

7. Pooled Roman v. Combined Saxon

Roman = 23	Combined Saxon = 19	
$F_{4,37}$ = 1.44492 (n.s.)		

8. Pooled Roman v. Combined Saxon

Roman = 23	Combined Saxon = 19	
$F_{3,38}$ = 1.87546 (n.s.)		

9. Pooled Roman v. Saxon 1, Roman v. Saxon 2, Saxon 1 v. Saxon 2

Roman = 23	Saxon 1 = 13	Saxon 2 = 6
	Roman	*Saxon 1*
Saxon 1 ($F_{4,36}$) =	1.48527 (n.s.)	
Saxon 2 ($F_{4,36}$) =	1.91391 (n.s.)	2.16927 (n.s.)

* = $p < 0.05$ ** = $p < 0.01$ *** = $p < 0.001$

VARIABLES INCORPORATED IN EACH TEST

1. 10 listed, all used (cranial length, cranial breadth, min. frontal breadth, nasion-bregma chord, bregma-lambda chord, frontal arc, parietal arc, mandibular body length, min. ramus breadth, ramus height)
2. 10 listed, 5 used (cranial length, cranial breadth, bregma-lambda chord, min. ramus breadth, ramus height)
3. 4 listed, 3 used (cranial length, cranial breadth, min. ramus breadth)
4. 10 listed, 4 used (frontal arc, cranial breadth, min. ramus breadth, ramus height)
5. 5 listed, 4 used (cranial breadth, frontal arc, min. ramus breadth, ramus height)
6. 5 listed, all used (cranial breadth, frontal arc, minimum ramus breadth, mandibular body length, ramus height)
7. 4 listed, all used (cranial length, cranial breadth, minimum ramus breadth, ramus height)
8. 4 listed, 3 used (cranial length, cranial breadth, ramus height)
9. 4 listed, all used (cranial length, cranial breadth, minimum ramus breadth, ramus height)

TABLE 3.21

Non-metric traits scoring system

PP	Trait presesent, both sides
PA	Trait present, right side, absent left side
AP	Trait present, left side, absent right side
AA	Trait absent, both sides
PN	Trait present, right side, no observation possible, left side
AN	Trait absent, right side, no observation possible, left side
NP	No observation possible, right side, trait present, left side
NA	No observation possible, right side, trait absent, left side
NN	No observation possible, either side
RL	Number of observations on both right and left sides
R.	Number of observations, right side only
o.L	Number of observations, left side only

TABLE 3.22

Cranial non-metric traits, Pooled Roman sample, distribution of observations

Trait	PP	PA	AP	AA	PN	AN	NP	NA	NN	RL	R.	.L
MALES												
Metopic suture	13			106					25	119		
Palatine torus	9			86					49	95		
Coronal Wormian bones	4			108					32	112		
Bregmatic bone	1			116					31	117		
Sagittal Wormian bones	2			108					34	110		
Lambdoid Wormian bones	64			45					35	109		
Ossicle at lambda	11			97					36	108		
Highest nuchal line	28			66					50	94		
Supraorbital foramen complete	8	13	15	62	1	9	1	5	30	98	10	6
Frontal notch/foramen	21	13	20	44	3	7	4	2	30	98	10	6
Zygomatic-facial foramen	62	7	9	10	14	1	6	1	34	88	15	7
Maxillary torus	1	0	0	41	2	6	0	9	85	42	8	9
Anterior condylar canal double	7	8	8	42	0	12	1	7	59	65	12	8
Occipital condyle double	1	0	1	48	0	16	0	9	69	50	16	9
Parietal foramen	34	20	10	47	2	2	1	0	28	111	4	1
Parietal notch bone	2	7	7	65	1	10	2	12	38	81	11	14
Ossicle at asterion	4	8	7	63	3	7	1	12	39	82	10	13
Auditory torus	4	2	83	1	9	3	8	28	95	10	11	
Foramen of Huschke	3	3	1	79	2	11	1	12	32	86	13	13
Mastoid foramen	62	1	9	4	9	3	16	0	40	76	12	16
Mandibular torus	6	1	1	51	0	2	0	5	78	59	2	5
Accessory mental foramen	2	4	6	60	0	5	0	4	63	72	5	4
FEMALES												
Metopic suture	12			91					34	103		
Palatine torus	9			59					69	68		
Coronal Wormian bones	4			82					51	86		
Bregmatic bone	1			91					45	92		
Sagittal Wormian bones	3			81					53	84		
Lambdoid Wormian bones	49			35					53	84		
Ossicle at lambda	8			76					53	84		
Highest nuchal line	10			48					79	58		
Supraorbital foramen complete	6	8	11	54	3	10	0	3	42	79	13	3
Frontal notch/foramen	25	10	13	31	7	6	0	3	42	79	13	3
Zygomatic-facial foramen	46	4	9	3	10	6	6	1	52	62	16	7
Maxillary torus	0	0	0	38	0	11	0	8	80	38	11	8
Anterior condylar canal double	4	6	11	41	0	1	4	3	67	62	1	7
Occipital condyle double	0	0	0	39	0	9	0	14	75	39	9	14
Parietal foramen	28	14	16	29	0	0	0	2	48	87	0	2
Parietal notch bone	2	5	1	48	2	12	0	12	55	56	14	12
Ossicle at asterion	1	1	0	55	0	11	0	14	55	57	11	14
Auditory torus	1	1	1	71	0	13	1	9	40	74	13	10
Foramen of Huschke	3	4	4	56	1	15	0	11	43	67	16	11
Mastoid foramen	36	4	4	7	11	9	8	5	53	51	20	13
Mandibular torus	4	1	0	35	3	3	0	7	84	40	6	7
Accessory mental foramen	0	2	3	51	0	1	0	6	74	56	1	6

TABLE 3.23

Cranial non-metric traits, Saxon 1 sample, distribution of observations

Trait	PP	PA	AP	AA	PN	AN	NP	NA	NN	RL	R.	o.L
MALES												
Metopic suture	4			20					20	24		
Palatine torus	3			13					28	16		
Coronal Wormian bones	1			20					23	21		
Bregmatic bone	1			21					22	22		
Sagittal Wormian bones	4			18					22	22		
Lambdoid Wormian bones	13			8					23	21		
Ossicle at lambda	3			19					22	22		
Highest nuchal line	1			14					29	15		
Supraorbital foramen complete	2	3	3	9	1	4	0	1	21	17	5	1
Frontal notch/foramen	3	2	1	11	2	3	1	0	21	17	5	1
Zygomatic-facial foramen	8	1	1	0	3	0	4	0	27	10	3	4
Maxillary torus	1	0	0	16	0	0	0	0	27	17	0	0
Anterior condylar canal double	1	1	3	6	0	0	0	1	32	11	0	1
Occipital condyle double	0	0	0	7	0	0	0	3	34	7	0	3
Parietal foramen	7	4	0	11	0	0	0	0	22	22	0	0
Parietal notch bone	1	2	1	9	1	4	1	3	22	13	5	4
Ossicle at asterion	1	0	1	9	1	1	0	3	28	11	2	3
Auditory torus	0	1	1	19	0	1	0	2	20	21	1	2
Foramen of Huschke	0	1	1	12	1	1	0	2	26	14	2	2
Mastoid foramen	8	2	1	0	2	0	3	1	27	11	2	4
Mandibular torus	3	0	0	17	0	0	0	1	23	20	0	1
Accessory mental foramen	0	1	0	15	0	0	0	0	28	16	0	0
FEMALES												
Metopic suture	3			34					23	37		
Palatine torus	2			19					39	21		
Coronal Wormian bones	0			32					28	32		
Bregmatic bone	0			32					28	32		
Sagittal Wormian bones	2			28					30	30		
Lambdoid Wormian bones	14			14					32	28		
Ossicle at lambda	1			32					27	33		
Highest nuchal line	5			26					29	31		
Supraorbital foramen complete	3	3	6	19	0	1	0	1	27	31	1	1
Frontal notch/foramen	9	5	6	11	0	1	1	0	27	31	1	1
Zygomatic-facial foramen	20	4	1	2	9	0	1	0	23	27	9	1
Maxillary torus	0	0	0	16	0	5	0	3	36	16	5	3
Anterior condylar canal double	0	2	3	16	2	6	0	0	31	21	8	0
Occipital condyle double	0	0	0	17	0	4	0	2	37	39	9	14
Parietal foramen	15	6	3	11	0	1	2	0	22	35	1	2
Parietal notch bone	0	2	0	15	1	7	2	6	27	17	8	8
Ossicle at asterion	1	2	1	14	0	6	0	4	32	18	6	4
Auditory torus	0	0	0	29	0	5	0	3	23	29	5	3
Foramen of Huschke	0	1	0	19	1	7	0	4	28	20	8	4
Mastoid foramen	16	2	1	1	2	1	2	3	32	20	3	5
Mandibular torus	3	0	0	17	0	0	0	1	39	20	0	1
Accessory mental foramen	0	0	1	16	0	0	0	0	43	17	0	0

TABLE 3.24

Cranial non-metric traits, Saxon 2 sample, distribution of observations

Trait	PP	PA	AP	AA	PN	AN	NP	NA	NN	RL	R.	.L
MALES												
Metopic suture	4			23					13	27		
Palatine torus	1			18					21	19		
Coronal Wormian bones	3			22					15	25		
Bregmatic bone	0			26					14	26		
Sagittal Wormian bones	5			21					14	26		
Lambdoid Wormian bones	14			10					16	24		
Ossicle at lambda	3			21					16	24		
Highest nuchal line	3			18					19	21		
Supraorbital foramen complete	2	4	1	16	0	0	0	2	15	23	0	2
Frontal notch/foramen	1	5	4	13	0	0	2	0	15	23	0	2
Zygomatic-facial foramen	7	3	4	2	3	2	3	0	16	16	5	3
Maxillary torus	0	0	0	8	0	2	1	2	27	8	2	3
Anterior condylar canal double	2	2	1	7	0	3	0	0	25	12	3	0
Occipital condyle double	0	0	0	10	0	4	0	1	25	10	4	2
Parietal foramen	5	8	4	8	2	0	0	0	13	25	2	0
Parietal notch bone	0	2	0	8	1	6	2	3	18	10	7	5
Ossicle at asterion	1	0	3	9	2	3	0	2	20	13	5	2
Auditory torus	1	0	0	15	0	2	0	6	16	16	2	6
Foramen of Huschke	1	0	0	12	0	3	1	6	17	13	3	7
Mastoid foramen	7	0	2	2	5	1	5	0	18	11	6	5
Mandibular torus	0	0	0	12	0	0	0	2	26	12	0	2
Accessory mental foramen	0	0	1	17	0	0	0	1	21	18	0	1
FEMALES												
Metopic suture	4			18					8	22		
Palatine torus	0			9					21	9		
Coronal Wormian bones	3			19					8	22		
Bregmatic bone	0			22					8	22		
Sagittal Wormian bones	1			22					7	23		
Lambdoid Wormian bones	9			10					11	19		
Ossicle at lambda	1			19					10	20		
Highest nuchal line	6			13					11	19		
Supraorbital foramen complete	0	6	3	9	0	3	0	1	8	18	3	1
Frontal notch/foramen	2	2	4	10	1	2	0	1	8	18	3	1
Zygomatic-facial foramen	10	0	0	2	1	0	1	3	13	12	1	4
Maxillary torus	0	0	0	4	0	1	0	6	19	4	1	6
Anterior condylar canal double	1	0	3	7	0	1	0	3	15	11	1	3
Occipital condyle double	0	0	0	9	0	1	0	2	18	9	1	2
Parietal foramen	2	5	3	12	1	0	0	0	7	22	1	0
Parietal notch bone	0	2	0	10	0	5	0	3	10	12	5	3
Ossicle at asterion	0	0	0	10	0	3	0	3	14	10	3	3
Auditory torus	0	0	0	15	1	2	0	0	12	15	3	0
Foramen of Huschke	0	0	0	11	1	5	1	0	12	11	6	1
Mastoid foramen	4	1	2	1	4	0	1	1	16	8	4	2
Mandibular torus	0	0	0	11	0	1	0	0	18	11	1	0
Accessory mental foramen	0	0	1	12	0	0	0	0	17	13	0	0

TABLE 3.25

Cranial non-metric traits, Combined Saxon samples, distribution of observations

Trait	PP	PA	AP	AA	PN	AN	NP	NA	NN	RL	R.	.L
MALES												
Metopic suture	8			43					33	51		
Palatine torus	4			31					49	35		
Coronal Wormian bones	4			42					38	46		
Bregmatic bone	1			47					36	48		
Sagittal Wormian bones	9			39					36	48		
Lambdoid Wormian bones	27			18					39	45		
Ossicle at lambda	6			40					38	46		
Highest nuchal line	4			32					48	36		
Supraorbital foramen complete	4	7	4	25	1	4	0	3	36	40	5	3
Frontal notch/foramen	4	7	5	24	2	3	3	0	36	40	5	3
Zygomatic-facial foramen	15	4	5	2	6	2	7	0	43	26	8	7
Maxillary torus	1	0	0	24	0	2	1	2	54	25	2	3
Anterior condylar canal double	3	3	4	13	0	3	0	1	57	23	3	1
Occipital condyle double	0	0	0	17	0	4	0	4	59	17	4	4
Parietal foramen	12	12	4	19	2	0	0	0	35	47	2	0
Parietal notch bone	1	4	1	17	2	10	3	6	40	23	12	9
Ossicle at asterion	2	0	4	18	3	4	0	5	48	24	7	5
Auditory torus	1	1	1	34	0	3	0	8	36	37	3	8
Foramen of Huschke	1	1	1	24	1	4	1	8	43	27	5	9
Mastoid foramen	15	2	3	2	7	1	8	1	45	22	8	9
Mandibular torus	3	0	0	29	0	0	0	3	49	32	0	3
Accessory mental foramen	0	1	1	32	0	0	0	1	49	34	0	1
FEMALES												
Metopic suture	7			52					31	59		
Palatine torus	2			28					60	30		
Coronal Wormian bones	3			51					36	54		
Bregmatic bone	0			54					36	54		
Sagittal Wormian bones	3			50					37	53		
Lambdoid Wormian bones	23			24					34	47		
Ossicle at lambda	2			51					37	53		
Highest nuchal line	11			39					40	50		
Supraorbital foramen complete	3	9	9	28	0	4	0	2	35	49	4	2
Frontal notch/foramen	11	7	10	21	1	3	1	1	35	49	4	2
Zygomatic-facial foramen	30	4	1	4	10	0	2	3	36	39	10	5
Maxillary torus	0	0	0	20	0	6	0	9	55	20	6	9
Anterior condylar canal double	1	2	6	23	2	7	0	3	46	32	9	3
Occipital condyle double	0	0	0	26	0	5	0	4	55	26	5	4
Parietal foramen	17	11	6	23	1	1	2	0	29	57	2	2
Parietal notch bone	0	4	0	25	1	12	2	9	37	29	13	11
Ossicle at asterion	1	2	1	24	0	9	0	7	46	28	9	7
Auditory torus	0	0	0	44	1	7	0	3	35	44	8	3
Foramen of Huschke	0	1	0	30	2	12	1	4	40	31	14	5
Mastoid foramen	20	3	3	2	6	1	3	4	48	28	7	7
Mandibular torus	3	0	0	28	0	1	0	1	57	31	1	1
Accessory mental foramen	0	0	2	28	0	0	0	0	60	30	0	0

TABLE 3.26
Cranial non-metric trait frequencies, Pooled Roman and Early Anglo-Saxon samples

Trait	Roman		Comb. Saxon		Saxon 1		Saxon 2	
	M	F	M	F	M	F	M	F
Metopic suture	0.11	0.12	0.16	0.12	0.15	0.08	0.15	0.18
Palatine torus	0.09	0.13	0.11	0.07	0.19	0.10	0.05	0.00
Coronal Wormian bones	0.04	0.05	0.09	0.06	0.05	0.00	0.12	0.14
Bregmatic bone	0.01	0.01	0.02	0.00	0.05	0.00	0.00	0.00
Sagittal Wormian bones	0.02	0.04	0.19	0.06	0.18	0.07	0.19	0.04
Lambdoid Wormian bones	0.59	0.58	0.60	0.49	0.62	0.50	0.58	0.47
Ossicle at lambda	0.10	0.10	0.13	0.04	0.14	0.03	0.13	0.05
Highest nuchal line	0.30	0.17	0.11	0.22	0.07	0.16	0.14	0.32
Supraorbital foramen complete	0.33	0.29	0.33	0.38	0.39	0.36	0.28	0.41
Frontal notch/foramen	0.54	0.58	0.44	0.55	0.39	0.64	0.48	0.41
Zygomatic-facial foramen	0.88	0.88	0.90	0.87	1.00	0.95	0.83	0.71
Maxillary torus	0.05	0.00	0.07	0.00	0.06	0.00	0.08	0.00
Anterior condylar canal double	0.28	0.36	0.37	0.25	0.42	0.24	0.33	0.27
Occipital condyle double	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Parietal foramen	0.58	0.65	0.61	0.61	0.50	0.68	0.70	0.48
Parietal notch bone	0.18	0.12	0.23	0.13	0.27	0.15	0.23	0.10
Ossicle at asterion	0.22	0.02	0.25	0.09	0.19	0.14	0.13	0.00
Auditory torus	0.14	0.04	0.06	0.02	0.08	0.00	0.04	0.06
Foramen of Huschke	0.09	0.13	0.12	0.08	0.17	0.06	0.09	0.11
Mastoid foramen	0.93	0.75	0.90	0.83	0.94	0.82	0.86	0.86
Mandibular torus	0.12	0.15	0.09	0.09	0.14	0.14	0.00	0.00
Accessory mental foramen	0.15	0.08	0.06	0.07	0.06	0.06	0.05	0.08

The following formula was used to calculate the frequencies of bilateral traits: p = 1–(AA + AN + NA) / (RL + R. + .L)

TABLE 3.27
Univariate chi-square tests of significance, cranial non-metric traits, males v. females, Pooled Roman and Early Anglo-Saxon samples

Trait	Comb. Roman	DF	Saxon 1	DF	Saxon 2	DF	Saxon	DF
Metopic suture	0.0001	1	0.3762	1	0.0417	1	0.1392	1
Palatine torus	0.2871	1	0.1075	1	0.6552	1	0.0745	1
Coronal Wormian bones	0.0027	1	0.0459	1	0.1463	1	0.0729	1
Bregmatic bone	0.3059	1	0.0362	1	–	–	0.0060	1
Sagittal Wormian bones	0.1116	1	0.7137	1	1.5699	1	3.2048	1
Lambdoid Wormian bones	0.0153	1	0.2904	1	0.1758	1	0.7468	1
Ossicle at lambda	0.0215	1	0.9099	1	0.1872	1	1.8864	1
Highest nuchal line	2.0475	1	0.1818	1	0.5657	1	0.8902	1
Supraorbital foramen complete	0.3864	3	0.6610	3	5.3701	2	1.8141	3
Frontal notch/foramen	2.8597	3	3.4572	3	0.7630	3	2.3109	3
Zygomatic-facial foramen	2.8228	3	2.5720	2	9.1646**	1	7.8649*	3
Maxillary torus	4.1132	3	1.7968	3	–	–	3.1670	3
Anterior condylar canal double	1.5964	3	2.5394	3	3.2401	2	1.7590	3
Occipital condyle double	2.5175	3	–	–	–	–	–	–
Parietal foramen	3.7937	3	5.0216	2	2.9919	3	1.1518	3
Parietal notch bone	4.7858	3	1.2461	2	–	–	2.5563	2
Ossicle at asterion	18.787***	3	1.5058	2	8.0325*	2	6.1600*	2
Auditory torus	6.7090	3	–	–	–	–	2.1386	1
Foramen of Huschke	2.5426	3	2.2484	1	0.0665	1	1.2714	1
Mastoid foramen	15.159**	3	1.9509	2	3.2962	2	1.0904	3
Mandibular torus	2.8683	3	–	–	–	–	–	–
Accessory mental foramen	3.2270	3	–	–	0.0764	1	1.7792	1
Total significant	2/22		0/18		2/16		2/20	

* = $p < 0.05$ ** = $p < 0.01$ *** = $p < 0.001$

TABLE 3.28

Univariate chi-square tests of significance by sex, cranial non-metric traits, Pooled Roman and Early Anglo-Saxon samples

Trait	Rom v. Saxon 1	DF	Saxon1 v. Saxon 2	DF	Rom v. Saxon 2	DF	Rom v. Comb Sax	DF
MALES								
Metopic suture	0.2000	1	0.0417	1	0.0560	1	0.3726	1
Palatine torus	0.4494	1	0.5128	1	0.0219	1	0.0000	1
Coronal Wormian bones	0.1310	1	0.1174	1	1.5085	1	0.8747	1
Bregmatic bone	0.1127	1	0.0071	1	0.6484	1	0.0224	1
Sagittal Wormian bones	7.8571**	1	0.0775	1	9.7370**	1	12.292***	1
Lambdoid Wormian bones	0.0009	1	0.0037	1	0.0038	1	0.0011	1
Ossicle at lambda	0.0097	1	0.1049	1	0.0011	1	0.0562	1
Highest nuchal line	2.4562	1	0.0321	1	1.3815	1	3.9383*	1
Supraorbital foramen complete	0.6025	3	2.3005	3	2.9570	3	1.3702	3
Frontal notch/foramen	2.7629	3	3.3960	3	4.0187	3	3.0309	3
Zygomatic-facial foramen	3.4604	2	6.5870*	2	5.7640	3	3.1867	3
Maxillary torus	0.0164	1	0.3585	1	0.4473	1	0.0915	1
Anterior condylar canal double	1.2140	3	1.1565	3	0.4742	3	0.6595	3
Occipital condyle double	0.5726	2	–	–	0.7170	2	1.2014	2
Parietal foramen	3.9302	2	7.6568*	2	4.3791	3	1.4837	3
Parietal notch bone	1.9258	3	0.3753	2	0.9066	2	2.1725	3
Ossicle at asterion	1.5898	2	1.0997	2	3.1438	2	3.5665	2
Auditory torus	3.5172	2	3.9348	2	2.9405	1	2.5239	3
Foramen of Huschke	2.9973	2	–	–	1.8309	1	0.8726	3
Mastoid foramen	8.0657	2	6.4259*	1	1.5269	2	3.8892	3
Mandibular torus	1.1358	2	–	–	0.7549	2	1.7170	2
Accessory mental foramen	3.1823	1	–	–	2.8653	1	3.1136	2
Total Significant	1/22		3/18		1/22		1/22	
FEMALES								
Metopic suture	0.1038	1	0.3762	1	0.0846	1	0.0304	1
Palatine torus	0.0089	1	0.0515	1	0.4981	1	0.4544	1
Coronal Wormian bones	0.4720	1	2.1206	1	0.7883	1	0.0564	1
Bregmatic bone	0.2977	1	–	–	0.5086	1	0.0577	1
Sagittal Wormian bones	0.0276	1	0.0264	1	0.2739	1	0.0060	1
Lambdoid Wormian bones	0.3201	1	0.0153	1	0.4270	1	0.7786	1
Ossicle at lambda	0.6905	1	0.1946	1	0.1189	1	1.0299	1
Highest nuchal line	0.0085	1	0.5358	1	0.5136	1	0.0358	1
Supraorbital foramen complete	0.6730	3	5.9180	2	6.7183*	2	2.0587	3
Frontal notch/foramen	0.5155	3	3.2649	3	4.3631	3	1.7244	3
Zygomatic-facial foramen	6.8023	3	5.0857*	1	9.0655**	1	9.7507*	3
Maxillary torus	–	–	–	–	–	–	–	–
Anterior condylar canal double	2.8043	2	3.9893*	1	1.9377	2	0.9290	3
Occipital condyle double	–	–	–	–	–	–	–	–
Parietal foramen	2.3641	3	8.0883*	3	5.8830	3	1.4537	3
Parietal notch bone	0.4528	2	2.4083	2	1.4667	1	–	–
Ossicle at asterion	6.0179*	2	3.8537	3	0.7196	2	3.8132	2
Auditory torus	2.6449	3	–	–	–	–	1.5423	1
Foramen of Huschke	3.5806	1	3.3183	2	1.4168	1	1.7837	2
Mastoid foramen	1.8277	3	1.1999	3	1.5155	3	2.0927	3
Mandibular torus	1.4320	2	–	–	0.8448	2	2.0406	2
Accessory mental foramen	1.0853	2	0.0385	1	0.9747	1	1.8251	1
Total Significant		1/20		3/17		2/19		1/20

* = $p < 0.05$ ** = $p < 0.01$ *** = $p < 0.001$

TABLE 3.29

Multivariate analyses of cranial non-metric traits, Pooled Roman and Early Anglo-Saxon samples

TESTS OF SIGNIFICANCE

MALES		FEMALES	
1. Pooled Roman v. Combined Saxon		9. Pooled Roman v. Combined Saxon	
Roman = 69	Combined Saxon = 19	Roman = 24	Combined Saxon = 12
$F_{6,81} = 1.7063$ (n.s.)		$F_{8,27} = 1.3321$ (n.s.)	
2. Pooled Roman v. Combined Saxon		10. Pooled Roman v. Saxon 1	
Roman = 39	Combined Saxon = 10	Roman = 24	Saxon 1 = 9
$F_{8,40} = 0.5866$ (n.s.)		$F_{8,24} = 0.6538$ (n.s.)	
3. Pooled Roman v. Saxon 1		11. Saxon 1 v. Saxon 2	
Roman = 65	Saxon 1 = 10	Saxon 1 = 15	Saxon 2 = 9
$F_{5,69} = 2.1378$ (n.s.)		$F_{6,17} = 0.7907$ (n.s.)	
4. Saxon 1 v. Saxon 2		12. Pooled Roman v. Saxon 2	
Saxon 1 = 5	Saxon 2 = 8	Roman = 40	Saxon 2 = 9
$F_{5,7} = 0.4962$ (n.s.)		$F_{6,42} = 1.1237$ (n.s.)	
5. Saxon 1 v. Saxon 2			
Saxon 1 = 5	Saxon 2 = 8		
$F_{4,8} = 0.3088$ (n.s.)			
6. Pooled Roman v. Saxon 2			
Roman = 67	Saxon 2 = 12		
$F_{4,74} = 1.0087$ (n.s.)			
7. Pooled Roman v. Saxon 2			
Roman = 63	Saxon 2 = 12		
$F_{5,69} = 1.2850$ (n.s.)			
8. Pooled Roman v. Saxon 2			
Roman = 61	Saxon 2 = 12		
$F_{6,66} = 1.1172$ (n.s.)			

VARIABLES INCORPORATED IN EACH TEST

1. Metopic suture, sagittal wormians, lambdoid wormians, supraorbital foramen complete, zygomatic-facial foramen, parietal foramen.
2. Metopic suture, sagittal wormians, lambdoid wormians, supraorbital foramen complete, zygomatic-facial foramen, anterior condylar canal double, parietal foramen, ossicle at asterion.
3. Metopic suture, sagittal wormians, lambdoid wormians, parietal foramen, ossicle at asterion.
4. Metopic suture, sagittal wormians, zygomatic-facial foramen, parietal foramen, mastoid foramen.
5. Metopic suture, zygomatic-facial foramen, parietal foramen, mastoid foramen.
6. Metopic suture, sagittal wormians, supraorbital foramen complete, ossicle at asterion.
7. Metopic suture, sagittal wormians, supraorbital foramen complete, parietal foramen, ossicle at asterion.
8. Metopic suture, sagittal wormians, lambdoid wormians, supraorbital foramen complete, parietal foramen, ossicle at asterion.
9. Metopic suture, sagittal wormians, lambdoid wormians, supraorbital foramen complete, zygomatic-facial foramen, anterior condylar canal double, parietal foramen, mastoid foramen.
10. Metopic suture, sagittal wormians, lambdoid wormians, supraorbital foramen complete, zygomatic-facial foramen, anterior condylar canal double, parietal foramen, mastoid foramen.
11. Metopic suture, sagittal wormians, lambdoid wormians, zygomatic-facial foramen, parietal foramen.
12. Metopic suture, sagittal wormians, lambdoid wormians, supraorbital foramen complete, zygomatic-facial foramen, parietal foramen.

5

DENTITION

i. THE POOLED ROMAN SAMPLE

Caries, abscesses, ante mortem tooth loss (Tables 3.30–3.32)

THE COMBINED samples reflect an overall caries frequency of 12% for the Pooled Roman sample from Winchester, distributed almost equally between males and females. There are no meaningful differences between the presence of caries in the maxillary and mandibular dentition, and no consistent pattern of side preference. The anterior dentition generally exhibits very low frequencies of caries (3–6%), while levels in the posterior teeth are much higher (10–25%). The first molar was the most frequently affected tooth in both sexes (25%).

The Pooled Roman sample naturally reflects the similarities in the Lankhills 1967–72 and Victoria Road West abscess rates. Overall, the site of the first molar is the most frequently abscessed (7%), and separately this is true for each sex as well. The site of the central incisor is least frequently affected (1%). There is, however, no clear pattern of marked differentiation in frequency of abscessing between the anterior and posterior dentition.

The Pooled Roman sample yields an overall ante mortem loss frequency of 14%, almost equally distributed among men (14%) and women (13%). Frequency of loss is very slightly greater in maxillae than mandibles, with no consistency by side. First molars have been lost ante mortem in 30% of the sample, while canines (3%) are least affected. There is a gradient from anterior dentition (3–9%) to posterior dentition (14–30%).

Congenital absence, M3 (Table 3.33)

In the Pooled Roman sample, the overall absence figure of 15% is seen, with females (19%) more frequently lacking third molars than males (13%). The distribution between upper and lower dentition is fairly even in males (maxilla 14%, mandible 12%), whereas third molars are more frequently absent in female mandibles (21%).

ii. THE EARLY ANGLO-SAXON SAMPLES

Caries, abscesses, and ante mortem tooth loss

In the Saxon 1 sample there were a total of 1,364 teeth, of which 565 came from males and 799 were from females. By tooth type 214 central incisors, 286 lateral incisors, 362 canines, 370 first premolars, 338 second premolars, 340 first molars, 331 second molars, and 236 third molars could be examined. The Saxon 2 sample was smaller, yielding a total of 712 teeth, of which 389 were from males, and 323 were from females. There were 68 central incisors, 88 lateral incisors, 99 canines, 99 first premolars, 98 second premolars, 102 first molars, 90 second molars, and 70 third molars.

Caries (Tables 3.34–3.36)

The Saxon 1 sample exhibits a caries frequency rate of 5% for both males and females, with even distribution (also 5%) between the upper and

TABLE 3.30

Frequency (TPR) of caries in adults, Pooled Roman sample

MALES	I1	I2	C	PM1	PM2	M1	M2	M3	TOTAL	FEMALES	I1	I2	C	PM1	PM2	M1	M2	M3	TOTAL
MAXILLA, RIGHT										MAXILLA, RIGHT									
No. observations	44	58	69	66	62	59	58	38	454	No. observations	26	38	50	51	45	52	46	29	337
No. caries	2	3	5	7	3	17	19	5	61	No. caries	0	2	1	4	4	9	12	6	38
% caries	5	5	7	11	5	29	33	13	13	% caries	0	5	2	8	9	17	26	21	11
MAXILLA, LEFT										MAXILLA, LEFT									
No. observations	48	54	75	72	69	58	58	42	476	No. observations	30	48	54	50	49	51	48	27	357
No. caries	2	1	5	9	10	15	14	8	64	No. caries	0	0	3	2	9	8	14	7	43
% caries	4	2	7	13	15	26	24	19	14	% caries	0	0	6	4	18	16	29	26	12
Total no. observ.	92	112	144	138	131	117	116	80	930	Total no. observ.	56	76	104	101	94	103	94	56	684
Total no. caries	4	4	10	16	13	32	33	13	125	Total no. caries	0	2	4	6	13	17	26	13	81
Total % caries	4	4	7	12	10	27	29	16	13	Total % caries	0	3	4	6	14	17	28	23	12
MANDIBLE, RIGHT										MANDIBLE, RIGHT									
No. observations	38	54	63	68	62	59	65	57	466	No. observations	32	50	48	56	46	51	58	38	379
No. caries	0	2	0	3	5	13	13	19	55	No. caries	1	0	0	1	4	14	11	5	36
% caries	0	4	0	4	8	22	20	33	12	% caries	3	0	0	2	9	28	19	13	10
MANDIBLE, LEFT										MANDIBLE, LEFT									
No. observations	45	59	71	71	72	64	63	54	499	No. observations	41	44	59	58	57	49	50	31	389
No. caries	1	1	1	2	8	16	11	7	47	No. caries	2	2	2	2	4	20	8	7	47
% caries	2	2	1	3	11	25	18	13	9	% caries	5	5	3	3	7	41	16	23	12
Total no. observ.	83	113	134	139	134	123	128	111	965	Total no. observ.	73	94	107	114	103	100	108	69	768
Total no. caries	1	3	1	5	13	29	24	26	102	Total no. caries	3	2	2	3	8	34	19	12	83
Total % caries	1	3	1	4	10	24	19	23	11	Total % caries	4	2	2	3	8	34	18	17	11
TOTAL OBSERV.	175	225	278	277	265	240	244	191	1895	TOTAL OBSERV.	123	170	211	215	197	203	202	125	1446
TOTAL NO. CARIES	5	7	11	21	26	61	57	39	227	TOTAL NO. CARIES	3	4	6	9	21	51	45	25	164
TOTAL % CARIES	**3**	**3**	**4**	**8**	**10**	**25**	**23**	**20**	**12**	**TOTAL % CARIES**	**2**	**2**	**3**	**4**	**11**	**25**	**22**	**20**	**11**
TOTAL NUMBER OF OBSERVATIONS, SEXES COMBINED											298	395	489	492	462	443	446	316	3341
TOTAL NUMBER OF CARIES, SEXES COMBINED											8	11	17	30	47	112	102	64	391
TOTAL % CARIES, SEXES COMBINED											**3**	**3**	**4**	**6**	**10**	**25**	**23**	**20**	**12**

TABLE 3.31

Frequency (TPR) of abscesses in adults, Pooled Roman sample

MALES	I1	I2	C	PM1	PM2	M1	M2	M3	TOTAL
MAXILLA, RIGHT									
No. observations	91	91	90	91	89	88	84	77	701
No. abscesses	1	4	4	7	4	9	10	1	40
% abscesses	1	4	4	8	5	10	12	1	6
MAXILLA, LEFT									
No. observations	92	90	97	100	94	91	86	81	731
No. abscesses	0	3	6	7	7	10	2	2	37
% abscesses	0	3	6	7	8	11	2	3	5
No. observations	183	181	187	191	183	179	170	158	1432
No. abscesses	1	7	10	14	11	19	12	3	76
% abscesses	1	4	5	7	6	11	7	2	5
MANDIBLE, RIGHT									
No. observations	84	85	89	90	91	93	93	94	719
No. abscesses	1	1	3	1	3	4	6	1	20
% abscesses	1	1	3	1	3	4	7	1	3
MANDIBLE, LEFT									
No. observations	84	87	89	93	94	92	91	91	721
No. abscesses	0	2	1	0	1	5	3	2	14
% abscesses	0	2	1	0	1	5	3	2	2
No. observations	168	172	178	183	189	185	184	185	1444
No. abscesses	1	3	4	1	4	9	9	3	34
% abscesses	1	2	2	1	2	5	5	2	2
Total no. observ.	351	353	365	374	372	364	354	343	2876
Total no. abscess	2	10	14	15	15	28	21	6	111
Total % abscess	**1**	**3**	**4**	**4**	**4**	**8**	**6**	**2**	**4**

FEMALES	I1	I2	C	PM1	PM2	M1	M2	M3	TOTAL
MAXILLA, RIGHT									
No. observations	60	65	69	70	69	70	67	65	535
No. abscesses	1	3	0	2	2	9	4	1	22
% abscesses	2	5	0	3	3	13	6	2	4
MAXILLA, LEFT									
No. observations	64	66	69	70	69	67	60	55	520
No. abscesses	1	2	3	5	4	3	2	3	23
% abscesses	2	3	4	7	6	5	3	6	4
No. observations	124	131	138	140	138	137	127	120	1055
No. abscesses	2	5	3	7	6	12	6	4	45
% abscesses	2	4	2	5	4	9	5	3	4
MANDIBLE, RIGHT									
No. observations	77	76	73	73	71	78	76	76	600
No. abscesses	0	2	3	1	0	4	2	1	13
% abscesses	0	3	4	1	0	5	3	1	2
MANDIBLE, LEFT									
No. observations	78	78	76	75	75	74	72	69	597
No. abscesses	1	3	1	1	0	4	3	2	15
% abscesses	1	4	2	1	0	5	4	3	3
No. observations	155	154	149	148	146	152	148	145	1197
No. abscesses	1	5	4	2	0	8	5	3	28
% abscesses	1	3	3	1	0	5	3	2	2
Total no. observ.	279	285	287	288	284	289	275	265	2252
Total no. abscess	3	10	7	9	6	20	11	7	73
Total % abscess	**1**	**4**	**2**	**3**	**2**	**7**	**4**	**3**	**3**
TOTAL OBSERVATIONS, SEXES COMBINED	630	638	652	662	656	653	629	608	5128
TOTAL NO. ABSCESSES, SEXES COMBINED	5	20	21	24	21	48	32	13	184
TOTAL % ABSCESSES, SEXES COMBINED	**1**	**3**	**3**	**4**	**3**	**7**	**5**	**2**	**4**

TABLE 3.32

Frequency (TPR) of ante mortem tooth loss in adults, Pooled Roman sample

MALES	**I1**	**I2**	**C**	**PM1**	**PM2**	**M1**	**M2**	**M3**	**TOTAL**	**FEMALES**	**I1**	**I2**	**C**	**PM1**	**PM2**	**M1**	**M2**	**M3**	**TOTAL**
MAXILLA, RIGHT										MAXILLA, RIGHT									
No. observations	95	97	99	96	92	94	90	85	748	No. observations	70	72	75	76	73	73	71	66	576
No. AM loss	5	5	3	11	12	28	22	14	100	No. AM loss	4	3	3	10	14	17	16	12	79
% AM loss	5	5	3	12	13	30	24	17	13	% AM loss	6	4	4	13	19	23	23	18	14
MAXILLA, LEFT										MAXILLA, LEFT									
No. observations	95	95	100	103	99	96	91	88	767	No. observations	71	73	73	75	75	74	70	63	574
No. AM loss	7	5	6	9	13	34	28	24	126	No. AM loss	4	3	5	12	15	19	17	13	88
% AM loss	7	5	6	9	13	35	31	27	16	% AM loss	6	4	7	16	20	26	24	21	15
No. observations	190	192	199	199	191	190	181	173	1515	No. observations	141	145	148	151	148	147	141	129	1150
No. AM loss	12	10	9	20	25	62	50	38	226	No. AM loss	8	6	8	22	29	36	33	25	167
% AM loss	6	5	5	10	13	33	28	22	15	% AM loss	6	4	5	15	20	25	23	19	15
MANDIBLE, RIGHT										MANDIBLE, RIGHT									
No. observations	90	93	94	94	94	96	96	97	754	No. observations	80	81	81	78	76	80	79	76	631
No. AM loss	9	6	2	6	12	33	20	19	107	No. AM loss	5	3	2	3	9	24	17	13	76
% AM loss	10	7	2	6	13	34	21	20	14	% AM loss	6	4	3	4	12	30	22	17	12
MANDIBLE, LEFT										MANDIBLE, LEFT									
No. observations	91	94	96	96	96	95	95	95	758	No. observations	82	84	84	81	80	76	76	71	634
No. AM loss	7	4	2	5	9	26	25	20	98	No. AM loss	5	1	1	4	10	25	21	10	77
% AM loss	8	4	2	5	9	27	26	21	13	% AM loss	6	1	1	5	13	33	28	14	12
No. observations	181	187	190	190	190	191	191	192	1512	No. observations	162	165	165	159	156	156	155	147	1265
No. AM loss	16	10	4	11	21	59	45	39	205	No. AM loss	10	4	3	7	19	49	38	23	153
% AM loss	9	5	2	6	11	31	24	20	14	% AM loss	6	2	2	5	12	31	25	16	12
Total no. observ.	371	379	389	389	381	381	372	365	3027	Total no. observ.	303	310	313	310	304	303	296	276	2415
Total no. AM loss	28	20	13	31	46	121	95	77	431	Total no. AM loss	18	10	11	29	48	85	71	48	320
Total % AM loss	**8**	**5**	**3**	**8**	**12**	**32**	**26**	**21**	**14**	**Total % AM loss**	**6**	**3**	**4**	**9**	**16**	**28**	**24**	**17**	**13**
TOTAL OBSERVATIONS, SEXES COMBINED											674	689	702	699	685	684	668	641	5442
TOTAL NO. AM LOSS, SEXES COMBINED											46	30	24	60	94	206	166	125	751
TOTAL % AM LOSS, SEXES COMBINED											**7**	**4**	**3**	**9**	**14**	**30**	**25**	**20**	**14**

TABLE 3.33

Frequency of congenital absence, M3, adults, Pooled Roman sample

	MAXILLA			MANDIBLE			SAMPLE TOTAL
	R. M3	L. M3	TOTAL	R. M3	L. M3	TOTAL	
MALES							
No. observations	85	88	173	97	95	192	365
No. absent	15	9	24	11	11	22	46
% absent	**18**	**10**	**14**	**11**	**12**	**12**	**13**
FEMALES							
No. observations	66	63	129	76	71	147	276
No. absent	10	11	21	17	14	31	52
% absent	**15**	**18**	**16**	**22**	**20**	**21**	**19**
TOTAL NO. OBSERVATIONS	151	151	302	173	166	339	641
TOTAL NO. ABSENT	25	20	45	28	25	53	98
TOTAL % ABSENT	**17**	**13**	**15**	**16**	**15**	**16**	**15**

lower jaw in both sexes. There is no clear pattern regarding side. The second molar has the highest overall frequency of caries (12%). As might be expected, the anterior dentition has substantially less caries (1–3%) than the posterior dentition (8–12%).

In the Saxon 2 sample the overall frequency of caries rises slightly (6%), and differences between males (4%) and females (8%) are more apparent. Since the sample sizes are so small, however, these differences should not be regarded as particularly meaningful. The pattern of distribution of caries around the dental arcade is very uneven. Males have a higher frequency in the mandible while females have a higher frequency in the maxilla, and neither sex shows a consistent pattern by side. These data may, in part, reflect irregularities generated by small sample size. The most frequently carious teeth are M2, M3, and the central incisors (9–10%), while the lateral incisors and M1 are the least affected. The fact that a high proportion of M1s were abscessed or lost ante mortem may have influenced the low caries rate seen in this tooth.

The Combined Saxon samples show an overall caries frequency of 5%, with slightly higher female rates (6%). Distribution between mandible and maxilla is relatively even, but there is little consistency by side. The second molar is the most frequently affected individual tooth (10%). The differences in frequency between anterior and posterior dentition are more pronounced in females than in males.

Abscesses (Tables 3.37–3.39)

In the Saxon 1 samples a total of 2% of all dental sites that could be examined show evidence of abscess. The frequency is identical for both males and females. There is no clear pattern to the distribution by side, although distribution between the mandible and maxilla is very similar. The site of the first molar is most often affected (7%), while a number of teeth have abscess rates of only 1%.

The frequency of abscess shows a very slight increase in the Saxon 2 samples, to a level of 3%, evenly distributed between males and females. In both sexes there are slightly higher percentages of abscess in the maxilla than in the mandible, but there is no clear pattern by side. The first molar is most frequently affected (9%), while in this sample none of the third molar sites are abscessed. Once the first molar is accounted for, there is very little difference between anterior and posterior dentition in frequency of abscess.

TABLE 3.34

Frequency (TPR) of caries in adults, Saxon 1 sample

MALES	I1	I2	C	PM1	PM2	M1	M2	M3	TOTAL
MAXILLA, RIGHT									
No. observations	7	15	18	18	15	18	18	11	120
No. caries	0	0	0	2	1	0	3	2	8
% caries	0	0	0	11	7	0	17	18	7
MAXILLA, LEFT									
No. observations	15	15	20	18	18	18	16	13	133
No. caries	0	0	0	0	0	2	3	0	5
% caries	0	0	0	0	0	11	19	0	4
Total no. observ.	22	30	38	36	33	36	34	24	253
Total no. caries	0	0	0	2	1	2	6	2	13
Total % caries	0	0	0	6	3	6	18	8	5
MANDIBLE, RIGHT									
No. observations	15	17	19	22	23	24	23	19	162
No. caries	1	0	0	0	1	4	1	1	8
% caries	7	0	0	0	4	17	4	5	5
MANDIBLE, LEFT									
No. observations	13	19	18	20	21	22	21	16	150
No. caries	1	1	0	0	0	2	1	1	6
% caries	8	5	0	0	0	9	5	6	4
Total no. observ.	28	36	37	42	44	46	44	35	312
Total no. caries	2	1	0	0	1	6	2	2	14
Total % caries	7	3	0	0	2	13	5	6	5
TOTAL OBSERV.	50	66	75	78	77	82	78	59	565
TOTAL NO. CARIES	2	1	0	2	2	8	8	4	27
TOTAL % CARIES	**4**	**2**	0	**3**	**3**	**10**	**10**	**7**	**5**

FEMALES	I1	I2	C	PM1	PM2	M1	M2	M3	TOTAL
MAXILLA, RIGHT									
No. observations	20	22	22	22	29	26	23	16	180
No. caries	0	0	0	0	1	3	2	1	7
% caries	0	0	0	0	4	12	9	6	4
MAXILLA, LEFT									
No. observations	21	21	26	26	28	28	24	20	194
No. caries	0	1	1	2	1	3	4	1	13
% caries	0	5	4	8	4	11	17	5	7
Total no. observ.	41	43	48	48	57	54	47	36	374
Total no. caries	0	1	1	2	2	6	6	2	20
Total % caries	0	2	2	4	2	11	13	6	5
MANDIBLE, RIGHT									
No. observations	16	20	25	29	30	28	31	27	206
No. caries	0	0	0	1	0	4	3	2	10
% caries	0	0	0	4	0	14	10	4	5
MANDIBLE, LEFT									
No. observations	17	28	31	29	29	31	33	21	219
No. caries	0	0	0	0	1	1	6	3	11
% caries	0	0	0	0	3	3	18	14	5
Total no. observ.	33	48	56	58	59	59	64	48	425
Total no. caries	0	0	0	1	1	5	9	5	21
Total % caries	0	0	0	2	2	9	14	10	5
TOTAL OBSERV.	74	91	104	106	116	113	111	84	799
TOTAL NO. CARIES	0	1	1	3	3	11	15	7	41
TOTAL % CARIES	**0**	**1**	**1**	**3**	**3**	**10**	**14**	**8**	**5**
TOTAL NUMBER OF OBSERVATIONS, SEXES COMBINED	124	157	179	184	193	195	189	143	1364
TOTAL NUMBER OF CARIES, SEXES COMBINED	2	2	1	5	5	19	23	11	68
TOTAL % CARIES, SEXES COMBINED	**2**	**1**	**1**	**3**	**3**	**10**	**12**	**8**	**5**

TABLE 3.35

Frequency (TPR) of caries in adults, Saxon 2 sample

MALES	I1	I2	C	PM1	PM2	M1	M2	M3	TOTAL	FEMALES	I1	I2	C	PM1	PM2	M1	M2	M3	TOTAL
MAXILLA, RIGHT										MAXILLA, RIGHT									
No. observations	6	7	9	11	9	13	11	5	71	No. observations	5	12	9	11	12	11	7	8	75
No. caries	0	0	0	0	0	0	2	0	2	No. caries	0	0	1	2	1	2	2	0	8
% caries	0	0	0	0	0	0	18	0	3	% caries	0	0	11	18	8	18	29	0	11
MAXILLA, LEFT										MAXILLA, LEFT									
No. observations	5	8	12	10	15	13	12	9	84	No. observations	3	7	11	10	10	12	9	4	66
No. caries	0	0	0	0	0	0	2	1	3	No. caries	0	0	0	0	1	1	1	0	3
% caries	0	0	0	0	0	0	17	11	4	% caries	0	0	0	0	10	8	11	0	5
Total no. observ.	11	15	23	21	24	26	23	14	157	Total no. observ.	8	19	20	21	22	23	16	12	141
Total no. caries	0	0	0	0	0	0	4	1	5	Total no. caries	0	0	1	2	2	3	3	0	11
Total % caries	0	0	0	0	0	0	17	7	3	Total % caries	0	0	5	10	9	13	19	0	8
MANDIBLE, RIGHT										MANDIBLE, RIGHT									
No. observations	11	13	17	18	14	12	15	13	113	No. observations	9	12	9	12	10	12	13	11	88
No. caries	0	0	1	0	0	1	2	4	8	No. caries	0	0	0	0	4	0	0	1	5
% caries	0	0	6	0	0	8	13	31	7	% caries	0	0	0	0	40	0	0	9	6
MANDIBLE, LEFT										MANDIBLE, LEFT									
No. observations	15	17	16	14	16	16	15	12	121	No. observations	14	12	14	13	12	13	8	8	94
No. caries	1	0	1	1	0	0	0	1	4	No. caries	5	2	1	1	0	1	0	0	10
% caries	7	0	6	7	0	0	0	8	3	% caries	36	17	7	8	0	8	0	0	11
Total no. observ.	26	30	33	32	30	28	30	25	234	Total no. observ.	23	24	23	25	22	25	21	19	182
Total no. caries	1	0	2	1	0	1	2	5	12	Total no. caries	5	2	1	1	4	1	0	1	15
Total % caries	4	0	6	3	0	4	7	20	5	Total % caries	22	8	4	4	18	4	0	5	8
TOTAL OBSERV.	37	45	56	53	54	54	53	39	391	TOTAL OBSERV.	31	43	43	46	44	48	37	31	323
TOTAL NO. CARIES	1	0	2	1	0	1	6	6	17	TOTAL NO. CARIES	5	2	2	3	6	4	3	1	26
TOTAL % CARIES	**3**	**0**	**4**	**2**	**0**	**2**	**11**	**15**	**4**	**TOTAL % CARIES**	**16**	**5**	**5**	**7**	**14**	**8**	**8**	**3**	**8**
TOTAL NUMBER OF OBSERVATIONS, SEXES COMBINED											68	88	99	99	98	102	90	70	714
TOTAL NUMBER OF CARIES, SEXES COMBINED											6	2	4	4	6	5	9	7	43
TOTAL % CARIES, SEXES COMBINED											**9**	**2**	**4**	**4**	**6**	**5**	**10**	**10**	**6**

TABLE 3.36

Frequency (TPR) of caries in adults, Combined Saxon sample

MALES	I1	I2	C	PM1	PM2	M1	M2	M3	TOTAL
MAXILLA, RIGHT									
No. observations	13	22	27	29	24	31	29	16	191
No. caries	0	0	0	2	1	0	5	2	10
% caries	0	0	0	7	4	0	17	13	5
MAXILLA, LEFT									
No. observations	20	23	32	28	33	31	28	22	217
No. caries	0	0	0	0	0	2	5	1	8
% caries	0	0	0	0	0	7	18	5	4
Total no. observ.	33	45	59	57	57	62	57	38	408
Total no. caries	0	0	0	2	1	2	10	3	18
Total % caries	0	0	0	4	2	3	18	8	4
MANDIBLE, RIGHT									
No. observations	26	30	36	40	37	36	38	32	275
No. caries	1	0	1	0	1	5	3	5	16
% caries	4	0	3	0	3	14	8	16	6
MANDIBLE, LEFT									
No. observations	25	34	34	36	35	38	38	31	271
No. caries	2	1	0	0	1	3	1	2	10
% caries	8	3	0	0	3	8	3	7	4
Total no. observ.	51	64	70	76	72	74	76	63	546
Total no. caries	3	1	1	0	2	8	4	7	26
Total % caries	6	2	1	0	3	11	5	11	5
TOTAL OBSERV.	84	109	129	133	129	136	133	101	954
TOTAL NO. CARIES	3	1	1	2	3	10	14	10	44
TOTAL % CARIES	**4**	**1**	**1**	**2**	**2**	**7**	**11**	**10**	**5**

FEMALES	I1	I2	C	PM1	PM2	M1	M2	M3	TOTAL
MAXILLA, RIGHT									
No. observations	25	34	31	33	41	37	30	24	255
No. caries	0	0	1	2	2	5	4	1	15
% caries	0	0	3	6	5	14	13	4	6
MAXILLA, LEFT									
No. observations	24	28	37	36	38	40	33	24	260
No. caries	0	1	1	2	2	4	5	1	1
% caries	0	4	3	6	5	10	15	4	6
Total no. observ.	49	62	68	69	79	77	63	48	515
Total no. caries	0	1	2	4	4	9	9	2	31
Total % caries	0	2	3	6	5	12	14	4	6
MANDIBLE, RIGHT									
No. observations	25	32	34	41	40	40	44	38	294
No. caries	0	0	0	1	4	4	3	3	15
% caries	0	0	0	2	10	10	7	8	5
MANDIBLE, LEFT									
No. observations	25	36	44	41	42	45	45	35	313
No. caries	0	0	1	0	2	2	8	8	21
% caries	0	0	2	0	5	4	18	23	7
Total no. observ.	50	68	78	82	82	85	89	73	607
Total no. caries	0	0	1	1	6	6	11	11	36
Total % caries	0	0	1	1	7	7	12	15	6
TOTAL OBSERV.	99	130	146	151	161	162	152	121	1122
TOTAL NO. CARIES	0	1	3	5	10	15	20	13	67
TOTAL % CARIES	**0**	**1**	**2**	**3**	**6**	**9**	**13**	**11**	**6**
TOTAL NUMBER OF OBSERVATIONS, SEXES COMBINED	183	239	275	284	290	298	285	222	2076
TOTAL NUMBER OF CARIES, SEXES COMBINED	3	2	4	7	13	25	34	23	111
TOTAL % CARIES, SEXES COMBINED	2	1	2	3	5	8	12	10	5

TABLE 3.37

Frequency (TPR) of abscesses in adults, Saxon 1 sample

MALES	**I1**	**I2**	**C**	**PM1**	**PM2**	**M1**	**M2**	**M3**	**TOTAL**	**FEMALES**	**I1**	**I2**	**C**	**PM1**	**PM2**	**M1**	**M2**	**M3**	**TOTAL**
MAXILLA, RIGHT										MAXILLA, RIGHT									
No. observations	17	18	17	18	18	19	18	17	142	No. observations	27	32	34	34	33	33	31	24	248
No. abscesses	0	0	0	0	0	0	1	1	2	No. abscesses	1	1	0	0	1	2	1	0	6
% abscesses	0	0	0	0	0	0	6	6	1	% abscesses	4	3	0	0	3	6	3	0	2
MAXILLA, LEFT										MAXILLA, LEFT									
No. observations	19	19	19	18	18	18	17	15	143	No. observations	30	30	33	33	35	34	30	27	252
No. abscesses	0	0	0	0	0	3	1	0	4	No. abscesses	1	1	0	1	1	1	2	1	8
% abscesses	0	0	0	0	0	17	6	0	3	% abscesses	3	3	0	3	3	3	7	4	3
No. observations	36	37	36	36	36	37	35	32	285	No. observations	57	62	67	67	68	67	61	51	500
No. abscesses	0	0	0	0	0	3	2	1	6	No. abscesses	2	2	0	1	2	3	3	1	14
% abscesses	0	0	0	0	0	8	6	3	2	% abscesses	4	3	0	2	3	5	5	2	3
MANDIBLE, RIGHT										MANDIBLE, RIGHT									
No. observations	24	24	25	24	24	24	25	25	195	No. observations	28	28	30	33	34	34	35	33	255
No. abscesses	1	0	1	1	0	3	0	0	6	No. abscesses	1	0	0	0	0	1	0	0	2
% abscesses	4	0	4	4	0	13	0	0	3	% abscesses	4	0	0	0	0	3	0	0	1
MANDIBLE, LEFT										MANDIBLE, LEFT									
No. observations	25	25	25	26	26	26	26	26	205	No. observations	30	32	33	34	35	36	36	34	270
No. abscesses	1	0	0	0	0	3	0	0	4	No. abscesses	0	0	1	0	1	2	0	0	4
% abscesses	4	0	0	0	0	12	0	0	2	% abscesses	0	0	3	0	3	6	0	0	2
No. observations	49	49	50	50	50	50	51	51	400	No. observations	58	60	63	67	69	70	71	67	525
No. abscesses	2	0	1	1	0	6	0	0	10	No. abscesses	1	0	1	0	1	3	0	0	6
% abscesses	4	0	2	2	0	12	0	0	3	% abscesses	2	0	2	0	2	4	0	0	1
Total no. observ.	85	86	86	86	86	87	86	83	685	Total no. observ.	115	122	130	134	137	137	132	118	1025
Total no. abscess	2	0	1	1	0	9	2	1	16	Total no. abscess	3	2	1	1	3	6	3	1	20
Total % abscess	**2**	**0**	**1**	**1**	**0**	**10**	**2**	**1**	**2**	**Total % abscess**	**3**	**2**	**1**	**1**	**2**	**4**	**2**	**1**	**2**
TOTAL OBSERVATIONS, SEXES COMBINED											200	208	216	220	223	224	218	201	1710
TOTAL NO. ABSCESSES, SEXES COMBINED											2	2	2	2	3	15	5	2	33
TOTAL % ABSCESSES, SEXES COMBINED											**3**	**1**	**1**	**1**	**1**	**7**	**2**	**1**	**2**

TABLE 3.38

Frequency (TPR) of abscesses in adults, Saxon 2 sample

MALES	I1	I2	C	PM1	PM2	M1	M2	M3	TOTAL
MAXILLA, RIGHT									
No. observations	16	17	16	16	16	15	14	12	122
No. abscesses	0	2	1	0	1	2	2	0	8
% abscesses	0	12	6	0	6	13	14	0	7
MAXILLA, LEFT									
No. observations	18	19	18	18	21	19	18	15	146
No. abscesses	1	0	0	2	1	0	2	0	6
% abscesses	6	0	0	11	5	0	11	0	4
No. observations	34	36	34	34	37	34	32	27	268
No. abscesses	1	2	1	2	2	2	4	0	14
% abscesses	3	6	3	6	5	6	13	0	5
MANDIBLE, RIGHT									
No. observations	19	19	18	20	20	18	18	18	150
No. abscesses	0	0	0	0	0	2	0	0	2
% abscesses	0	0	0	0	0	11	0	0	1
MANDIBLE, LEFT									
No. observations	20	20	20	20	20	21	22	22	165
No. abscesses	0	0	0	0	0	2	0	0	2
% abscesses	0	0	0	0	0	10	0	0	1
No. observations	39	39	38	40	40	39	40	40	315
No. abscesses	0	0	0	0	0	4	0	0	4
% abscesses	0	0	0	0	0	10	0	0	1
Total no. observ.	73	75	72	74	77	73	72	67	583
Total no. abscess	1	2	1	2	2	6	4	0	18
Total % abscess	**1**	**3**	**1**	**3**	**3**	**8**	**6**	**0**	**3**

FEMALES	I1	I2	C	PM1	PM2	M1	M2	M3	TOTAL
MAXILLA, RIGHT									
No. observations	15	15	15	15	15	14	13	11	113
No. abscesses	0	0	1	0	1	1	1	0	4
% abscesses	0	0	7	0	7	7	8	0	4
MAXILLA, LEFT									
No. observations	11	14	15	16	16	15	14	11	112
No. abscesses	0	1	0	2	2	0	0	0	5
% abscesses	0	7	0	13	13	0	0	0	5
No. observations	26	29	30	31	31	29	27	22	225
No. abscesses	0	1	1	2	3	1	1	0	9
% abscesses	0	4	3	7	10	4	4	0	4
MANDIBLE, RIGHT									
No. observations	15	15	15	20	17	18	17	18	135
No. abscesses	0	0	0	0	2	3	0	0	5
% abscesses	0	0	0	0	12	17	0	0	4
MANDIBLE, LEFT									
No. observations	15	15	16	17	18	18	17	17	133
No. abscesses	0	0	0	0	0	3	0	0	3
% abscesses	0	0	0	0	0	17	0	0	2
No. observations	30	30	31	37	35	36	34	35	268
No. abscesses	0	0	0	0	2	6	0	0	8
% abscesses	0	0	0	0	6	17	0	0	3
Total no. observ.	56	59	61	68	66	65	61	57	493
Total no. abscess	0	1	1	2	5	7	1	0	17
Total % abscess	**0**	**2**	**2**	**3**	**8**	**11**	**2**	**0**	**3**
TOTAL OBSERVATIONS, SEXES COMBINED	129	134	133	142	143	138	133	124	1076
TOTAL NO. ABSCESSES, SEXES COMBINED	1	3	2	4	7	13	5	0	35
TOTAL % ABSCESSES, SEXES COMBINED	**1**	**2**	**2**	**3**	**5**	**9**	**4**	**0**	**3**

TABLE 3.39

Frequency (TPR) of abscesses in adults, Combined Saxon sample

MALES	I1	I2	C	PM1	PM2	M1	M2	M3	TOTAL	FEMALES	I1	I2	C	PM1	PM2	M1	M2	M3	TOTAL
MAXILLA, RIGHT										MAXILLA, RIGHT									
No. observations	33	35	33	34	34	34	32	29	264	No. observations	42	47	49	49	48	47	44	35	361
No. abscesses	0	2	1	0	1	2	3	1	10	No. abscesses	1	1	1	0	2	3	2	1	11
% abscesses	0	6	3	0	3	6	9	4	4	% abscesses	2	2	2	0	4	6	5	3	3
MAXILLA, LEFT										MAXILLA, LEFT									
No. observations	37	38	37	36	39	37	35	30	289	No. observations	41	44	48	49	51	49	44	38	364
No. abscesses	1	0	0	2	1	3	3	0	10	No. abscesses	1	1	0	3	3	1	2	1	12
% abscesses	3	0	0	6	3	8	9	0	4	% abscesses	2	2	0	6	6	2	5	3	3
No. observations	70	73	70	70	73	71	67	59	553	No. observations	83	91	97	98	99	96	88	73	725
No. abscesses	1	2	1	2	2	5	6	1	20	No. abscesses	2	2	1	3	5	4	4	2	23
% abscesses	1	3	1	3	3	7	9	2	4	% abscesses	2	2	1	3	5	4	5	3	3
MANDIBLE, RIGHT										MANDIBLE, RIGHT									
No. observations	43	43	43	44	44	42	43	43	345	No. observations	43	43	45	50	51	52	52	51	387
No. abscesses	1	0	1	1	0	5	0	0	8	No. abscesses	1	0	0	0	2	4	0	0	7
% abscesses	2	0	2	2	0	12	0	0	2	% abscesses	2	0	0	0	4	8	0	0	2
MANDIBLE, LEFT										MANDIBLE, LEFT									
No. observations	41	45	45	46	46	47	48	48	366	No. observations	45	47	49	51	53	54	53	51	403
No. abscesses	1	0	0	0	0	5	0	0	6	No. abscesses	0	0	1	0	1	5	0	0	7
% abscesses	2	0	0	0	0	11	0	0	2	% abscesses	0	0	2	0	2	9	0	0	2
No. observations	84	88	88	90	90	89	91	91	711	No. observations	88	90	94	101	104	106	105	102	790
No. abscesses	2	0	1	1	0	10	0	0	14	No. abscesses	1	0	1	0	3	9	0	0	14
% abscesses	2	0	1	1	0	11	0	0	2	% abscesses	1	0	1	0	3	9	0	0	2
Total no. observ.	154	161	158	160	163	160	158	150	1264	Total no. observ.	171	181	191	199	203	202	193	175	1515
Total no. abscess	3	2	2	3	2	15	6	1	34	Total no. abscess	3	2	2	3	8	13	4	2	37
Total % abscess	**2**	**1**	**1**	**2**	**1**	**9**	**4**	**1**	**3**	**Total % abscess**	**2**	**1**	**1**	**2**	**4**	**6**	**2**	**1**	**2**
TOTAL OBSERVATIONS, SEXES COMBINED											325	342	349	359	366	362	351	325	2779
TOTAL NO. ABSCESSES, SEXES COMBINED											6	4	4	6	10	28	10	3	71
TOTAL % ABSCESSES, SEXES COMBINED											**2**	**1**	**1**	**2**	**3**	**8**	**3**	**1**	**3**

The Combined Saxon sample yields an overall abscess frequency of 3%, which is slightly higher for males (3%) than for females (2%). In this larger sample there is also a tendency in both sexes for abscesses to be found more frequently in the maxilla than in the mandible, although the differences are quite small. The distribution by side is absolutely even. Overall, the first molar is affected in 8% of all possible sites. Frequencies for all other teeth are extremely low, however.

Ante mortem tooth loss (Tables 3.40–3.42)

In the Saxon 1 sample, 7% of all teeth were lost before death, with females (7%) showing slightly higher frequencies than males (6%). In males loss is rather evenly distributed between the maxilla and mandible, but females have higher ante mortem loss frequencies in the maxilla (10%). Neither sex shows consistent patterning by side. The first molar is most frequently lost ante mortem overall (14%). This figure, however, is driven by the female sample (17%), for in males the third molar is the tooth lost most frequently ante mortem (14%). Overall, the canine is least often lost ante mortem. Generally, molars show higher rates of loss (11–14% overall) than do other teeth.

The slightly higher frequency of ante mortem tooth loss seen in the Saxon 2 sample (10%) is almost evenly distributed between males and females, although in this case males show a slightly greater frequency (11%) than do females. Distribution is almost evenly divided between maxilla and mandible for both sexes. While there is no consistent pattern by side in females, males show consistently higher frequencies of ante mortem tooth loss on the left side. The first molar is most frequently lost (22%) overall, and generally much higher loss rates are seen in the molars (14–22%) than in the other teeth.

When the samples are pooled, the Combined Saxon sample exhibits an 8% overall frequency of ante mortem tooth loss, with males (9%) slightly predominating over females (8%). In both sexes ante mortem loss is seen slightly more frequently in the maxilla than in the mandible. There is a clear preponderance of loss on the left side in males. Overall the first molar is lost most frequently (17%), and molar rates, which vary from 12 to 17%, are considerably higher than those found in other teeth.

Congenital Absence, M3 (Tables 3.43–3.45)

In the Saxon 1 sample, an overall total of 13% of all third molars appear to be congenitally absent, with females (16%) showing substantially higher frequencies than males (8%). In both sexes M3s are more frequently absent in the mandible than the maxilla, but there is no consistent patterning by side.

A slightly lower overall rate of 10% is seen in the Saxon 2 sample, and in this case males (13%) exhibit a higher frequency of congenital M3 absence than do females (7%). There is no consistent patterning by side, or between the mandible and maxilla, in this sample.

The Combined Saxon sample yields a larger sample size that may have produced more consistent figures, although the number of cases is still relatively small. In this pooled sample 12% of the third molars appear to be congenitally absent, with females (13%) showing higher frequencies than males (10%). There is no clear consistency or patterning by location in the dental arcade.

iii. CHANGE THROUGH TIME IN DENTAL PATHOLOGY

There are some notable differences in dental pathology between the Hampshire-based Romano-British and Early Anglo-Saxon samples in this study, possibly reflecting differences in

TABLE 3.40

Frequency (TPR) of ante mortem tooth loss in adults, Saxon 1 sample

MALES	I1	I2	C	PM1	PM2	M1	M2	M3	TOTAL
MAXILLA, RIGHT									
No. observations	20	20	21	21	21	21	21	19	164
No. AM loss	0	0	0	1	2	2	2	4	11
% AM loss	0	0	0	5	10	10	10	21	7
MAXILLA, LEFT									
No. observations	21	21	21	21	21	21	20	19	165
No. AM loss	0	0	0	1	2	2	2	2	9
% AM loss	0	0	0	5	10	10	10	11	6
No. observations	41	41	42	42	42	42	41	38	329
No. AM loss	0	0	0	2	4	4	4	6	20
% AM loss	0	0	0	5	10	10	10	16	6
MANDIBLE, RIGHT									
No. observations	26	26	26	25	25	25	25	25	203
No. AM loss	2	0	0	0	1	1	2	3	9
% AM loss	8	0	0	0	4	4	8	12	4
MANDIBLE, LEFT									
No. observations	26	26	25	26	26	26	26	26	207
No. AM loss	2	1	1	2	3	3	3	3	18
% AM loss	8	4	4	8	12	12	12	12	9
No. observations	52	52	51	51	51	51	51	51	410
No. AM loss	4	1	1	2	4	4	5	6	27
% AM loss	8	2	2	4	8	8	10	12	7
Total no. observ.	93	93	93	93	93	93	92	89	739
Total no. AM loss	4	1	1	4	8	8	9	12	47
Total % AM loss	**4**	**1**	**1**	**4**	**9**	**9**	**10**	**14**	**6**

FEMALES	I1	I2	C	PM1	PM2	M1	M2	M3	TOTAL
MAXILLA, RIGHT									
No. observations	28	30	32	33	33	34	29	27	246
No. AM loss	3	3	1	1	3	6	4	3	24
% AM loss	11	10	3	3	9	18	14	11	10
MAXILLA, LEFT									
No. observations	29	29	31	32	33	34	31	29	248
No. AM loss	1	2	1	0	2	7	7	3	23
% AM loss	3	7	3	0	6	21	23	10	9
No. observations	57	59	63	65	66	68	60	56	494
No. AM loss	4	5	2	1	5	13	11	6	47
% AM loss	7	9	3	2	8	19	18	11	10
MANDIBLE, RIGHT									
No. observations	34	33	35	35	36	36	37	37	283
No. AM loss	2	0	0	0	2	6	3	1	14
% AM loss	6	0	0	0	6	17	8	3	5
MANDIBLE, LEFT									
No. observations	35	37	37	37	38	39	38	38	299
No. AM loss	1	0	0	1	3	5	3	5	18
% AM loss	3	0	0	3	8	13	8	13	6
No. observations	69	70	72	72	74	75	75	75	582
No. AM loss	3	0	0	1	5	11	6	6	32
% AM loss	4	0	0	1	7	15	8	8	6
Total no. observ.	126	129	135	137	140	143	135	131	1076
Total no. AM loss	7	5	2	2	10	24	17	12	79
Total % AM loss	**6**	**4**	**2**	**2**	**7**	**17**	**13**	**9**	**7**
TOTAL OBSERVATIONS, SEXES COMBINED	219	222	228	230	233	236	227	220	1815
TOTAL NO. AM LOSS, SEXES COMBINED	11	6	3	6	18	32	26	24	126
TOTAL % AM LOSS, SEXES COMBINED	**5**	**3**	**1**	**3**	**8**	**14**	**12**	**11**	**7**

TABLE 3.41

Frequency (TPR) of ante mortem tooth loss in adults, Saxon 2 sample

MALES	I1	I2	C	PM1	PM2	M1	M2	M3	TOTAL	FEMALES	I1	I2	C	PM1	PM2	M1	M2	M3	TOTAL
MAXILLA, RIGHT										MAXILLA, RIGHT									
No. observations	17	17	17	18	17	16	14	13	129	No. observations	16	16	16	16	15	15	14	11	119
No. AM loss	1	0	0	2	3	2	2	0	10	No. AM loss	0	0	0	1	0	3	3	1	8
% AM loss	6	0	0	11	18	13	14	0	8	% AM loss	0	0	0	6	0	20	21	9	7
MAXILLA, LEFT										MAXILLA, LEFT									
No. observations	20	21	22	22	22	21	19	17	164	No. observations	13	16	15	16	16	15	15	12	118
No. AM loss	1	1	1	3	5	6	5	4	26	No. AM loss	1	0	0	1	2	2	4	2	12
% AM loss	5	5	5	14	23	29	26	24	16	% AM loss	8	0	0	6	12	13	27	17	10
No. observations	37	38	39	40	39	37	33	30	293	No. observations	29	32	31	32	31	30	29	23	237
No. AM loss	2	1	1	5	8	8	7	4	36	No. AM loss	1	0	0	2	2	5	7	3	20
% AM loss	5	3	3	13	21	22	21	13	12	% AM loss	4	0	0	6	7	17	24	13	8
MANDIBLE, RIGHT										MANDIBLE, RIGHT									
No. observations	20	20	21	21	20	19	18	18	157	No. observations	18	18	18	18	18	18	18	18	144
No. AM loss	0	0	0	1	1	6	3	3	14	No. AM loss	1	0	0	1	0	5	3	3	13
% AM loss	0	0	0	5	5	32	17	17	9	% AM loss	6	0	0	6	0	28	17	17	9
MANDIBLE, LEFT										MANDIBLE, LEFT									
No. observations	21	21	21	21	21	21	22	22	170	No. observations	18	18	18	18	18	18	17	16	141
No. AM loss	0	0	0	1	4	5	5	3	18	No. AM loss	1	1	1	2	0	3	3	2	13
% AM loss	0	0	0	5	19	24	23	14	11	% AM loss	6	6	6	11	0	17	17	11	9
No. observations	41	41	42	42	41	40	40	40	327	No. observations	36	36	36	36	36	36	35	34	285
No. AM loss	0	0	0	2	5	11	8	6	32	No. AM loss	2	1	1	3	0	8	6	5	26
% AM loss	0	0	0	5	12	28	20	15	10	% AM loss	6	3	3	8	0	22	17	15	9
Total no. observ.	78	79	81	82	80	77	73	70	620	Total no. observ.	65	68	67	68	67	66	64	57	522
Total no. AM loss	2	1	1	7	13	19	15	10	68	Total no. AM loss	3	1	1	5	2	13	13	8	46
Total % AM loss	**3**	**1**	**1**	**9**	**16**	**25**	**21**	**14**	**11**	**Total % AM loss**	**5**	**2**	**2**	**7**	**3**	**20**	**20**	**14**	**9**
TOTAL OBSERVATIONS, SEXES COMBINED											143	147	148	150	147	143	137	127	1142
TOTAL NO. AM LOSS, SEXES COMBINED											5	2	2	12	15	32	28	18	114
TOTAL % AM LOSS, SEXES COMBINED											**4**	**1**	**1**	**8**	**10**	**22**	**20**	**14**	**10**

TABLE 3.42

Frequency (TPR) of ante mortem tooth loss in adults, Combined Saxon sample

MALES	I1	I2	C	PM1	PM2	M1	M2	M3	TOTAL	FEMALES	I1	I2	C	PM1	PM2	M1	M2	M3	TOTAL
MAXILLA, RIGHT										MAXILLA, RIGHT									
No. observations	37	37	38	39	38	37	35	32	293	No. observations	44	46	48	49	48	49	43	38	365
No. AM loss	1	0	0	3	5	4	4	4	21	No. AM loss	3	3	1	2	3	9	7	8	36
% AM loss	3	0	0	8	13	11	11	13	7	% AM loss	7	7	2	4	6	18	16	21	10
MAXILLA, LEFT										MAXILLA, LEFT									
No. observations	41	42	43	43	43	42	39	36	329	No. observations	42	45	46	48	49	49	46	41	366
No. AM loss	1	1	1	4	7	8	7	6	35	No. AM loss	2	2	1	1	4	9	11	5	35
% AM loss	2	2	2	9	16	19	18	17	11	% AM loss	5	4	2	2	8	18	24	12	10
No. observations	78	79	81	82	81	79	74	68	622	No. observations	86	91	94	97	97	98	89	79	731
No. AM loss	2	1	1	7	12	12	11	10	56	No. AM loss	5	5	2	3	7	18	18	13	71
% AM loss	3	1	1	9	15	15	15	15	9	% AM loss	6	6	2	3	7	18	20	17	10
MANDIBLE, RIGHT										MANDIBLE, RIGHT									
No. observations	46	46	47	46	45	44	43	43	360	No. observations	52	51	53	53	54	54	55	55	427
No. AM loss	2	0	0	1	2	7	5	6	23	No. AM loss	3	0	0	1	2	11	6	4	27
% AM loss	4	0	0	2	4	16	12	14	6	% AM loss	6	0	0	2	4	20	11	7	6
MANDIBLE, LEFT										MANDIBLE, LEFT									
No. observations	47	47	46	47	47	47	48	48	377	No. observations	53	55	55	55	56	57	55	54	440
No. AM loss	2	1	1	3	7	8	8	6	36	No. AM loss	2	1	1	2	3	8	6	4	27
% AM loss	4	2	2	6	15	17	17	13	10	% AM loss	4	2	2	4	5	14	11	7	6
No. observations	93	93	93	93	92	91	91	91	737	No. observations	105	106	108	108	110	111	110	109	867
No. AM loss	4	1	1	4	9	15	13	12	59	No. AM loss	5	1	1	3	5	19	12	8	54
% AM loss	4	1	1	4	10	17	14	13	8	% AM loss	5	1	1	3	5	17	11	7	6
Total no. observ.	171	172	174	175	173	170	165	159	1359	Total no. observ.	191	197	202	205	207	209	199	188	1598
Total no. AM loss	6	2	2	11	21	27	24	22	115	Total no. AM loss	10	6	3	6	12	37	30	21	125
Total % AM loss	**4**	**1**	**1**	**6**	**12**	**16**	**15**	**14**	**9**	**Total % AM loss**	**5**	**3**	**2**	**3**	**6**	**18**	**15**	**11**	**8**
TOTAL OBSERVATIONS, SEXES COMBINED											362	369	376	380	380	379	364	347	2957
TOTAL NO. AM LOSS, SEXES COMBINED											16	8	5	17	33	64	54	43	240
TOTAL % AM LOSS, SEXES COMBINED											**4**	**2**	**1**	**5**	**9**	**17**	**15**	**12**	**8**

TABLE 3.43

Frequency of congenital absence, M3, adults, Saxon 1 sample

	MAXILLA			MANDIBLE			SAMPLE
	R. M3	L. M3	TOTAL	R. M3	L. M3	TOTAL	TOTAL
MALES							
No. observations	19	19	38	25	26	51	89
No. absent	1	1	2	2	3	5	7
% absent	5	5	5	8	12	10	8
FEMALES							
Number of observations	27	29	56	37	38	75	131
Number absent	4	4	8	5	8	13	21
% absent	15	14	14	13	21	17	16
TOTAL NO. OBSERVATIONS	46	48	94	62	64	126	220
TOTAL NO. ABSENT	5	5	10	7	11	18	28
TOTAL % ABSENT	11	10	11	11	17	14	13

TABLE 3.44

Frequency of congenital absence, M3, adults, Saxon 2 sample

	MAXILLA			MANDIBLE			SAMPLE
	R. M3	L. M3	TOTAL	R. M3	L. M3	TOTAL	TOTAL
MALES							
No. observations	13	17	30	18	22	40	70
No. absent	3	3	6	1	2	3	9
% absent	23	18	20	6	9	8	13
FEMALES							
No. observations	11	12	23	18	16	34	57
No. absent	0	1	1	2	1	3	4
% absent	0	8	4	11	6	9	7
TOTAL NO. OBSERVATIONS	24	29	53	36	38	74	127
TOTAL NO. ABSENT	3	4	7	3	3	6	13
TOTAL % ABSENT	13	14	13	8	8	8	10

TABLE 3.45

Frequency of congenital absence, M3, adults, Combined Saxon sample

	MAXILLA			MANDIBLE			SAMPLE
	R. M3	L. M3	TOTAL	R. M3	L. M3	TOTAL	TOTAL
MALES							
No. observations	32	36	68	43	48	91	159
No. absent	4	4	8	3	5	8	16
% absent	13	11	12	7	10	9	10
FEMALES							
No. observations	38	41	79	55	54	109	188
No. absent	4	5	9	7	9	16	25
% absent	11	12	11	13	17	15	13
TOTAL NO. OBSERVATIONS	70	77	147	98	102	200	347
TOTAL NO. ABSENT	8	9	17	10	14	24	41
TOTAL % ABSENT	11	12	12	10	14	12	12

health, diet, and nutritional status. The caries rate drops precipitously from 12 to 5%, and the distributional pattern changes as well. Whereas M1 is the most common site of caries in the Winchester Roman samples, the principal focus of caries attack moves back to M2 in the Early Anglo-Saxon samples. Further, while the frequency of caries is evenly distributed between the sexes in the Roman period, in the Combined Saxon sample women are slightly more frequently affected than men, a finding driven primarily by a wide difference in the small Saxon 2 sample. These results are consistent with the findings of other studies.[35]

The findings regarding abscess and ante mortem tooth loss are very similar. Rates decline from the Roman to the Early Anglo-Saxon period, especially regarding ante mortem tooth loss, which in the Saxon 1 sample exhibits only one-third the frequency found in the Victoria Road West sample. With regard to these three categories of dental pathology, the Early Anglo-Saxon samples resemble the Romano-British samples from Colchester, Trentholme Drive (York) and Cirencester more than they do their Winchester predecessors.[36]

The picture is somewhat different regarding third molar agenesis. The frequency of occurrence declines slowly through time, from 15% at Lankhills 1967–72 and Victoria Road West to 10% in the Saxon 2 sample, with an overall frequency of 12% for the Combined Saxon sample. With the exception of the rather small Saxon 2 sample, where the size of the sample itself may have affected results, M3 agenesis is more commonly found in females in all these samples.

[35] Brothwell 1961; Moore and Corbett 1973.

[36] See above, pp. 87–9.

6
DISCUSSION

The people of Winchester and the surrounding regions of Hampshire were subjected to enormous social and cultural changes between the fourth and eighth centuries. The mortality profiles generated from the samples examining change in this transitional period do reveal some alterations from the pattern found in late Roman Winchester. The most notable difference is the greatly reduced numbers of subadults, and almost total absence of small infants in the Early Anglo-Saxon samples. Secondarily, the pattern of childhood mortality shifts, exhibiting very low mortality levels in early childhood, but gradually rising to a peak in adolescence. These differences in the Roman and Early Anglo-Saxon patterns are statistically highly significant. The clear under-representation of children, especially infants, in the Early Anglo-Saxon sites is undoubtedly heavily affected by the nature of the sites themselves, incomplete excavation, and perhaps by cultural practices as well.

Among adults, the tendency to an increasing average age at death for both sexes continues into the Early Anglo-Saxon period. When the Pooled Roman and Combined Saxon samples are compared, the difference for males is simply a trend, and does not reach statistically significant levels. For females, however, the difference is highly significant. The important observation is not that Early Anglo-Saxon females lived long lives—on the whole they did not. The notable fact is that late Romano-British females from Winchester died exceptionally young in comparison with Anglo-Saxon females, or with males from either period.

The data regarding dental pathology is also consistent with a continuity of pattern extending from the Iron Age through the medieval period, except for a peak in frequency of caries expression during the Roman period.[37] Clearly the explanation for the increases in the Roman period must lie with environmental factors, and diet is most frequently cited.[38] While many of the same foodstuffs continued to be available and used in both the Roman and Early Anglo-Saxon periods, there were also differences. Molleson has pointed out that there was evidence for Roman cooking techniques at Poundbury.[39] Hardwick indicated that for the richer classes in an urban setting fine-ground flour and sweet-tasting delicacies would be available.[40] Thus while the culinary choices of the Romanized urban population may have been culturally enhancing to their lifestyle, they may have been ultimately detrimental to their dental health and general well-being. In the Early Anglo-Saxon period the dispersed, farm-based populations essentially returned to an Iron Age dietary pattern.

The analyses in this chapter have argued strongly for population continuity through time in Hampshire as the dominant factor in a shifting, interacting mosaic also involving limited, primarily male, immigration and altered physiological responses to the differential environmental pressures created by changed cultural and economic patterns.

[37] Moore and Corbett 1973, 139.
[38] Hardwick 1960.
[39] Molleson 1993, 184.
[40] Hardwick 1960, 11.

Based on the evidence from the statistical tests one cannot reasonably reject the hypothesis that the females in the Roman, Saxon 1, and Saxon 2 groups represent samples drawn from essentially the same population. There are no significant differences between any of the groups with regard to stature, cranial index, multivariate cranial metric analyses, or multivariate cranial non-metric analyses. Significant differences in the far less powerful univariate cranial metric and non-metric tests are at a level that probably can be accounted for by chance alone.

The situation with the males is more complicated. Multivariate non-metric testing reveals no significant differences in any of the samples, and strongly suggests an underlying genetic continuity in the male samples. However, multivariate metric analyses indicate a significant difference between the Pooled Roman and Combined Saxon male samples. This discrepancy may not be quite the conundrum it seems. When the Saxon samples are divided up and the subgroups retested, it becomes apparent that the results are being driven by the Saxon 2 sample, which differs significantly from both the Pooled Roman and Saxon 1 samples. In other words, the greatest hypothetical change in the genetic structure of the population was coming not in the earliest phase of a major cultural transition, but slightly *after* that transition had got under way. In the two other data classes, however—stature and cranial index—the first evidence of significant differences was found at the approximate time of cultural transition between Roman and Saxon 1.

These data suggest that while we cannot confidently reject the hypothesis of underlying genetic continuity in the male samples, there were other factors working to create the pattern of results seen here. One of these factors may have been the introduction of a small, predominantly but not exclusively male group of foreigners whose numbers were augmented by a steady trickle of new mostly male immigrants into Hampshire as the years progressed. Some foreigners were already in Winchester during the Roman period. Based on archaeological data, Clarke[41] isolated two groups, one dating to the second half of the fourth century, and possibly from the middle Danube region, the other dating to post-390, and possibly of Saxon origin. Subsequent work based on isotopic analysis of teeth has supported the foreign origin of some individuals in the first group, although from more widely scattered locations.[42]

The presence of limited but increasing numbers of foreign males in Roman Winchester and Early Anglo-Saxon Hampshire could account for the fact that immediate changes were seen in stature and cranial index, but the cumulative effect of these differences did not appear in the more robust multivariate statistics until a later time period when, perhaps, some sort of quantitative threshold in the proportion of native to foreign males had been crossed. One would have to postulate that the proportion of foreign males remained sufficiently small that the multivariate non-metrics were not affected, although metric traits were. The pattern of findings regarding M3 agenesis, which is under strong genetic control, tends to support the pattern revealed in the metric and non-metric variants. It is consistent with a stable regional gene pool through time which was experiencing low-level, increasing additions of genetic variants from another population, primarily through the males.

Postulating a small group of incoming males can only be part of the answer, however. The pattern lacks consistency, and it accounts neither for a similar low-level secular trend seen in females, nor for the information available from

[41] WS 3.ii.

[42] Evans et al. 2006.

the data on sexual dimorphism. When the stature data were examined, it became clear that sexual dimorphism decreased steadily during the Roman period. The magnitude of the decrease was not great, but the trend was clear. It was being caused by the fact that female statures stayed the same while male statures decreased. This pattern was reversed during the Early Anglo-Saxon period. Female statures increased slightly, but male statures increased markedly, and the amount of sexual dimorphism increased.

Thus, it is possible that the Romano-British and Early Anglo-Saxon data were revealing a decline in the generally good nutritional status in the Roman samples, and that these deficits were substantially ameliorated in the Early Anglo-Saxon period, especially in childhood, with consequent increases in stature and sexual dimorphism. Since the Roman samples came from the later phases of a declining urban environment, while the majority of individuals in the Early Anglo-Saxon samples probably lived in agriculturally self-sufficient small rural villages, hamlets, and farms, this interpretation has a certain logic to it, although it is not necessarily comprehensive. It is also possible that these nutritional effects based on changed environment and subsistence strategies were interacting with small levels of predominantly male immigration, and that the arriving males may have been taller as a group than the native males.

The tools of DNA genetic research were not available at the time this study was completed. However, in recent years increasing amounts of work have been undertaken using female mitochondrial DNA and male Y-chromosome DNA in an attempt to unravel the mysteries of the Romano-British/Anglo-Saxon transition. Most of these studies have used DNA from modern populations, but at least one study was based on archaeologically-derived skeletons.[43] A question thus arises. Do the results of an older study such as this one, using more traditional methods, accord with more recent findings based on molecular genetics? The answer is that on the whole they do.[44] It has long been known, based on differences in burial practices and artefact typologies, that different Germanic tribes were represented in different parts of the country. Thus, the sequence and mechanisms of the transition from Roman Britain to Anglo-Saxon England certainly varied both geographically and chronologically, and levels of native population retention or alteration may have differed greatly from one location to another. DNA findings tend to confirm this view, with the degree of population replacement or genetic continuity varying systematically across regions.[45] Weale and his colleagues have argued, based on Y-chromosome data, for a mass immigration of Germanic males into Central England over a period of several generations, affecting at least 50% of the male gene pool.[46] However, the study points out the possibility that the data could in fact represent an Iron Age immigration, possibly of the Belgae, since the 95% confidence interval of the findings extends back to 425 BC.[47] Another study found some, but very little, Continental male input in a different region, Southern England, which appeared to be predominantly native.[48]

Although mitochondrial DNA results tend

[43] Topf et al. 2006.

[44] A recent study by Herrera et al. (2014) has shown that cranial metric and non-metric data were linked, and that they provided excellent proxies for genetic data, with high correlations specifically between mtDNA and cranial metrics, and between Y-chromosome data and non-metrics. They were careful to point out that their findings may be population specific, although work by other authors they cited (Cheverud 1988; Relethford 1994; Sparks and Jantz 2002; Carson 2006a, 2006b; Martinez-Abadias et al. 2009; Ricaut et al. 2010) suggests that these findings are valid over a broad range of samples.

[45] Capelli et al. 2003.

[46] Weale et al. 2002.

[47] Weale et al. 2002, 1019.

[48] Capelli et al. 2003, 982.

to be less robust, studies also support the position that there was great continuity in the genetic makeup of the female population between the Romano-British and Early Anglo-Saxon periods.[49] Additional support comes from negative evidence. Forster et al. (2004) found that a specific Continental Saxon genetic marker had a very low frequency in native females, indicating a contribution ranging from zero to no more than 25%.[50] Additional work in genetics could, of course, change this picture, but for the moment it would appear that most lines of evidence do little to contradict this study's findings of essential population continuity in Hampshire with small amounts of predominantly male immigration that may have experienced some increase through time.

While it must now be conceded that the majority of the population in Hampshire remained biologically native, the conversion to a completely Anglo-Saxon culture over a period of several centuries nonetheless requires explanation. It is important to reiterate that change in this part of the country may have been quite different from other parts of the country, or indeed, from other parts of Wessex, both in terms of absolute numbers of incoming Germanic groups and in terms of assimilation. Our research originally proposed a two-phase process of large-scale political change imposed on an essentially unaltered, although redistributed, group of natives by a small, predominantly male, group of newcomers operating in a context of increasing internal instability and disorganization.[51] The first phase occurred roughly in the mid-fifth and sixth centuries. By this time Winchester was largely abandoned, but there is no reason to think the area was completely depopulated, and some form of overlordship or authority may have continued to be exercised from Winchester itself.[52] Rather, the overall homogeneity of the samples in this study suggests that the population was redistributed, and reappeared in both our Early Anglo-Saxon samples in a rural, Germanic cultural context. The first Germanic arrivals may have been so few in number that they are almost, but not quite, invisible in the Saxon 1 sample. The data would suggest that these arrivals were predominantly, if not almost exclusively male. There is no biological evidence to suggest that significant numbers of females accompanied them. From place-name and topographic evidence, it appears they may have based themselves in rural areas near Roman roads, and within easy reach of the decaying urban areas. They would have quickly gained political control, if not cultural assimilation.

The second phase of this process may be manifested in the seventh century—the Saxon 2 phase of these samples. The data indicate that this period, not the earlier one, may in fact have represented the heaviest influx of predominantly male Germanic groups, and produced the greatest shift in the structure of the population in Hampshire. It may be relevant to note that the Saxon 2 sites also happen to be those which generally have a more southerly distribution, closer to the coast or major coastal river valleys.[53] It is reasonable to expect to find the heaviest concentration of newcomers in locations such as these.

When this study was first completed, acceptance of the idea that there was great underlying continuity of population was by no means a given. In the years since, the topic has continued to be debated, but there is wider recognition of the role native Britons played in these massive cultural changes.[54] However, a number of alternative or more refined interpretations have been

[49] Topf et al. 2006.
[50] Forster et al. 2004, cited in Oppenheimer 2006, 488.
[51] Stuckert 1980a, 1980b, 1982.
[52] Biddle and Kjølbye-Biddle 2007, 203.
[53] See Illus. 1.1.
[54] Arnold 1984; Hodges 1989.

put forward to explain the dynamics of interacting biological and cultural shifts. Both the two-phase model suggested by Härke[55] and the 'war band' interpretation developed at Stretton-on-Fosse (Warwickshire),[56] are relevant to understanding the process of culture change in Hampshire. Härke envisaged an initial fifth/sixth-century ethnically-divided conquest society with little intermarriage, resulting in a form of apartheid, followed by increasing acculturation in the seventh/eighth centuries. The 'war band' interpretation inferred the influx of a group of males, assumed to be Germanic, who seized control and intermarried with native women. The data from our study supports a two-phase approach such as Härke's, as well as the concept of early roving male war bands, but does not support the notion of an initial phase of 'apartheid' with no intermarriage. Since the female populations in the Early Anglo-Saxon samples are consistently homogenous with the earlier Roman period samples, implying very little female immigrant genetic input, one must consider the possibility that early Germanic invaders were intermarrying or otherwise interbreeding with local women.

This study does not address the question of absolute numbers of immigrant Germanic groups, and was not intended to do so. However, the suggestion that they may have represented approximately 10 to 20% of the native population is not unreasonable.[57] The percentage would certainly have been smaller in the fifth/sixth centuries than in the later seventh/eighth centuries, whether because of increased immigration, as hypothesized here, or because of greater Germanic reproductive advantage.[58] It has been pointed out that under certain conditions the genetic contribution of immigrant groups to the overall population can rise from under 10% to over 50% in as little as five generations simply due to more favourable reproductive conditions.[59] Over time, the small politically and militarily dominant Germanic groups absorbed the native Britons into their cultural and linguistic orbit, possibly by these means, and merged by the seventh/eighth centuries into a common Anglo-Saxon identity, spurred on by both the spread of Christianity and the consolidation of Wessex as a Christian kingdom.

Most recently, a study using haplotype-based statistical methods to analyse genome-wide SNPs (single nucleotide polymorphisms) gathered from modern individuals has looked at a series of migration events into Britain to identify fine-scale genetic variation in group origins.[60] Using both British and Continental data, the authors were able to distinguish immigrant sources in great detail, especially for the Orkneys and Wales. The central/south England DNA cluster extended geographically over most of the area that had been under Roman control. Unlike the Orkney and Welsh samples, it was internally homogeneous, with between ~10% and ~40% of the DNA attributable to Saxon or Saxon and Danish immigration, depending on the test conducted.[61] When the Saxon data alone was examined, the amount of genetic contribution was estimated at ~10%.[62]

Two of the challenges faced by Leslie et al. in explaining their results were the lack of fine-structure differentiation in their central/south England sample, and their estimated date of 858[63] for the invasion of the Saxons, calculated

[55] Härke 2011. The 'apartheid' model, originally presented in 2006 (Thomas et al. 2006) was challenged by Pattison (2008), with rebuttal by Thomas et al. (2008)

[56] Ford 2002 and unpublished data, cited in Härke 2011, 14.

[57] Härke 2011, 19.

[58] Thomas et al. 2006, 2655; Härke 2011, 15–16.

[59] Thomas et al. 2006, 2656.

[60] Leslie et al. 2015.

[61] ibid. 313.

[62] ibid. 'Methods'.

[63] ibid. 313.

based on a single immigration event rather than multiple arrivals over time. With regard to the uniformity of the central/south England sample, the authors believe that population structure may exist, but there has been sufficient population movement since the last invasions to make it homogeneous. They point out that this does not require large population movements, but could be achieved through much smaller relocations over many generations, as their methodology cannot distinguish between large movements over a short period of time, or movements of smaller numbers over longer periods.[64]

The estimated date of 858 for the Saxon immigration proposed by Leslie et al. is problematic, as they admit, since it occurs approximately 400 years after the known commencement of that event. They point out that the date of admixture cannot be earlier than the arrival of the Saxons, but it can be later if mixing with the natives did not occur for some period after arrival, or mixing took place gradually, and initially at a relatively slow rate.[65]

The data we have presented in this volume, while using very different methodology, does not conflict with the study by Leslie et al. In fact, at least with regard to Hampshire it may shed some light on their findings. We have proposed an initially small immigration that increases through time, which is entirely consistent with Leslie et al.'s hypothesis of gradual mixing. Since we saw little evidence for immigration of Saxon females (and thus mating restricted to members of the Saxon community), their alternative explanation of non-mixing with natives is less likely. The lower end of the 95% confidence interval around their date of 828 for the Saxon immigration event occurs in 802.[66] This date is close to the estimated terminal date range for our Saxon 2 samples, and may suggest that the spread of Saxon genes uniformly throughout the native central and southern English population was well under way at the end of this period, although with local variations. Our data suggests that Hampshire might have been on the lower end of the range of ~10% to ~40% Saxon contribution to the native gene pool proposed by Leslie et al., at least during the period of the Saxon 1 samples. It would be reasonable to see this percentage increase through time via the mechanisms discussed earlier.[67]

[64] Leslie et al. 2015, 312–13.
[65] ibid., 'Supplementary Information', 18.
[66] ibid. 313.
[67] See above, pp. 258–9.

PART 4
ANGLO-SAXON AND MEDIEVAL POPULATIONS FROM THE OLD AND NEW MINSTER AND CATHEDRAL CEMETERIES

by THEYA MOLLESON, ROSEMARY POWERS, †JOHN PRICE, *and* PAULINE SHEPPARD
Edited by CAROLINE M. STUCKERT

I

INTRODUCTION: THE CATHEDRAL GREEN CEMETERIES

i. THE MATERIAL

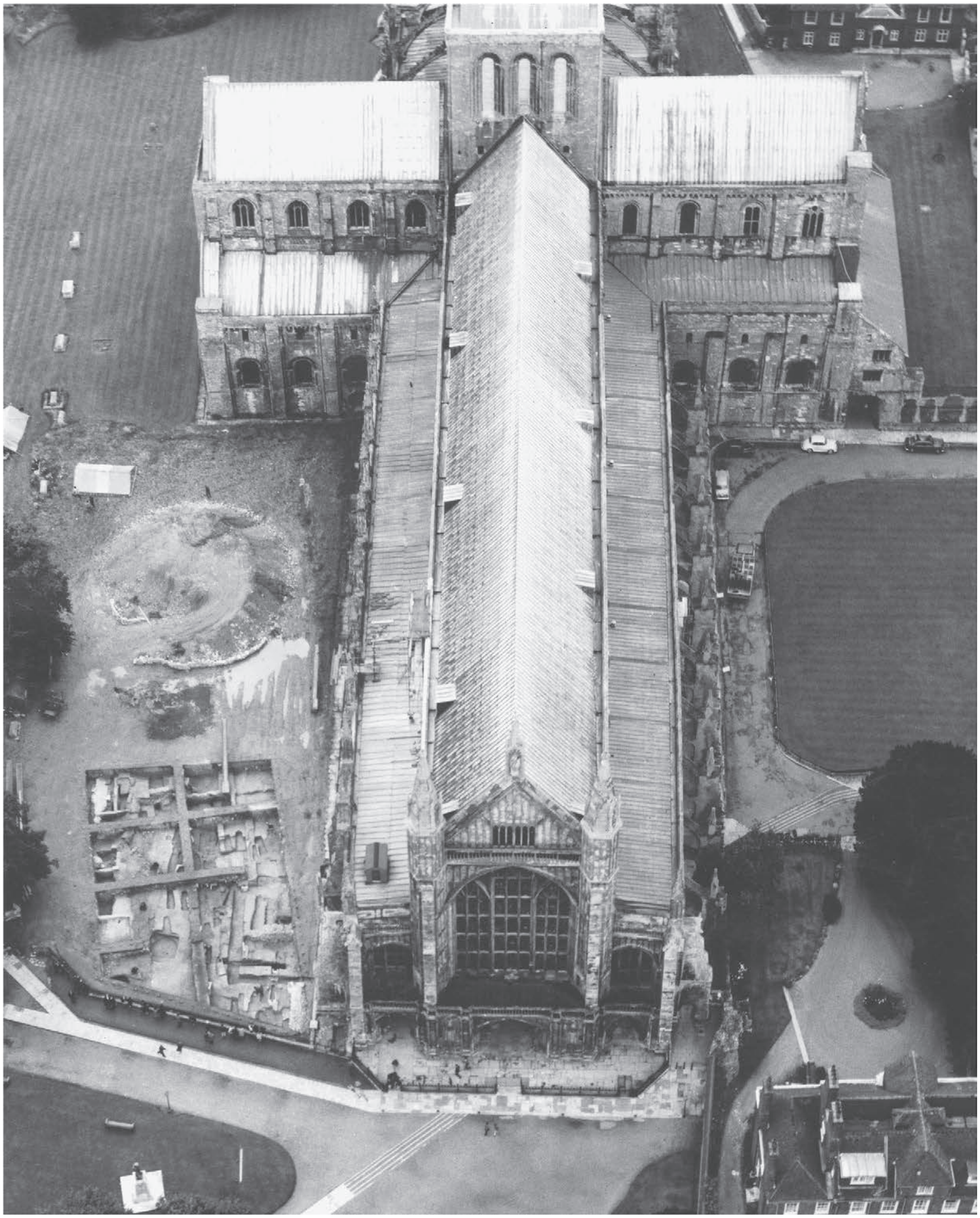
by Martin Biddle *and* †Birthe Kjølbye-Biddle

THE EXCAVATIONS on Cathedral Green at Winchester in 1962–70 uncovered a medieval cemetery overlying the demolished remains of the Anglo-Saxon cathedral church known as Old Minster.

Since Old Minster was surrounded by its own graves, there were in fact two superimposed cemeteries, the one Anglo-Saxon, the other medieval. The word 'medieval' is used here and throughout Part 4 for convenience sake in its narrower meaning to refer to the period from *c.*1100 to the Dissolution of the monasteries in the mid-sixteenth century. 'Anglo-Saxon' is used to denote the period between the foundation of Old Minster *c.*650 and the dedication of the new Norman cathedral in 1093, and (where relevant) the foundation of New Minster in 901–3 and its demolition *c.*1110.

The graves were assigned to the Anglo-Saxon or medieval periods at the time of excavation, and the medieval graves were further subdivided on the basis of burial type into earth graves and cist graves (Illus. 4.3).[1] The medieval earth graves could not all be excavated in the time available and

[1] For the distinction between 'cist' and 'earth' graves, and for the burial of priests, see below, p. 267.



Illus. 4.1. Winchester Cathedral: the excavation of Old Minster below the Cathedral Green, looking east, 1966.

ILLUS. 4.2. Anglo-Saxon burials at Old Minster: (a) burials of the ninth century and older covered by the north wing added to Old Minster in *c.*903–5, looking west, and (b) long bones and skulls from the Anglo-Saxon charnel of over a thousand bodies laid in the 1090s in the robber-trench from which the foundations of the westwork of Old Minster had been removed in 1093–4, looking south-east.

ILLUS. 4.3. Winchester Cathedral: chalk-built 'cist' graves of the thirteenth to sixteenth centuries clustering around the walls (lower left) of St Swithun's chapel to the north of the cathedral nave, looking north, 1966

many of the children's graves are recorded on size alone, the skeleton not being made available for study (Table 4.1).

The chronology of the cemeteries has since been studied in detail and lists of the successive generations of graves will be found below.[2] Here the Anglo-Saxon graves have been considered as one series. The burials made in and around New Minster, founded *c*.901–3 and demolished *c*.1110, have been included with them.

During the building of the Norman cathedral in the years between 1079 and *c*.1100 part of the Anglo-Saxon cemetery of Old Minster had to be cleared to make way for the foundations of the new Norman cathedral. The disinterred bones were collected and reburied in a trench that had been excavated to rob the westwork of Old Minster of its building stone (Illus. 4.2b). This collection of skulls and postcranial material of Anglo-Saxon date has been treated throughout as a separate sub-population and referred to as burials from the 'Anglo-Saxon charnel'.

The medieval burials span the period from *c*.1200 to *c*.1540. Burial ceased on the site after the

[2] See below, p. 266.

Dissolution of 1539, except to the north of Paradise Wall in the area formerly occupied by New Minster, where graves continued to be dug down into the nineteenth century. The post-medieval skeletons were not retained and do not form part of this study.

Thus the skeletons referred to as 'Anglo-Saxon', whether from individual graves or from the charnel, represent interments over about 450 years, while those referred to as 'medieval' represent some 350 years of burial. As might be expected in an assemblage from a cemetery which was in use for so many centuries, bone preservation was variable. Some burials survived as more or less complete skeletons, but others consisted of only a few pieces of bone (Illus. 4.2a), while the disarticulated remains in the Anglo-Saxon charnel, although numerous (Illus. 4.2b), had been much fragmented as a result of their exhumation and reburial.

Burial 'generations' in the analysis of a cemetery

The concept 'burial generation'

A dense cemetery, such as that around the Anglo-Saxon Old and New Minsters, or that which developed after 1200 on the site of the demolished Old Minster, presents many problems in excavation and analysis.[3] The graves can cut into and separate one from another structures which might otherwise have been stratigraphically linked, but since the intercutting graves themselves present a stratigraphic sequence, this can be used to link structures which might otherwise have had no direct connection. Because the graves in these cemeteries were excavated stratigraphically (i.e. the grave-cuts were identified at the highest possible level and each grave pit was excavated separately, the graveyard not simply being cleared to the level of the skeletons), it was possible to work out the relationships of the graves in each area, and to compare such relative sequences from area to area. This comparison is sometimes guided only by the length and nature of the sequences, but sometimes distinctive layers, or the walls and robbings of a structure, are available to guide the linkage.

Each such 'stratum' of graves has been called a generation. There was usually a different number of generations in each area of the excavation, but when the areas were compared across the whole site an overall sequence of generations could be constructed. This has been numbered from the bottom: Generation 1 being the earliest and Generation 22 the latest. This interpretation of the Anglo-Saxon cemetery was undertaken without any preconceived ideas, without even such a possibly reasonable assumption that the earliest graves lay nearest the church. The fact that this was in fact the case emerged independently.

A shorter time span seemed reasonable for the more crowded generations, and a span of 20 years was allowed. The total span of the first ten generations is thus from *c.*675 to *c.*890. Since the tenth generation lies below a layer datable to *c.*901–3 on historical grounds, this seemed satisfactory.

The use of the graveyard in interpreting the structural development of the Old Minster church proved vital, for only in this way was it possible to estimate the date and relative sequence of some of the additions to the church. Interpretation of the cemetery in some cases radically altered previous ideas of the architectural evolution of Old Minster, but one must be conscious that the degree of interpretation is high, sometimes very high.

[3] Kjølbye-Biddle 1975.

Anglo-Saxon grave generations (*c.*675–1093)

The Anglo-Saxon burials have been assigned to the following grave generations:

Old Minster (grave generations 1–22)

- Grave generation 1 (*c.*675–700)
- Grave generation 2 (*c.*700–25)
- Grave generation 3 (*c.*725–50)
- Grave generation 4 (*c.*750–70)
- Grave generation 5 (*c.*770–90)
- Grave generation 6 (*c.*790–810)
- Grave generation 7 (*c.*810–30)
- Grave generation 8 (*c.*830–50)
- Grave generation 9 (*c.*850–70)
- Grave generation 10 (*c.*870–90)
- Grave generation 11 (*c.*890–910)
- Grave generation 12 (*c.*905–17)
- Grave generation 12/13 (*c.*910–30)
- Grave generation 13 (*c.*917–29)
- Grave generation 14 (*c.*929–41)
- Grave generation 14/15 (*c.*930–50)
- Grave generation 15 (*c.*941–53)
- Grave generation 16 (*c.*953–965/70)
- Grave generation 17 (*c.*970–80)
- Grave generation 18a (*c.*980–92)
- Grave generation 18b–c (*c.*990–1010)
- Grave generation 19 (*c.*1010–30)
- Grave generation 20 (*c.*1030–50)
- Grave generation 21–2 (*c.*1050–90)

New Minster (generations I–VIII)

- Grave generation I (*c.*905–30)
- Grave generation II (*c.*930–55)
- Grave generation III (*c.*955–80)
- Grave generation IV (*c.*980–1005)
- Grave generation V (*c.*1005–30)
- Grave generation VI (*c.*1030–55)
- Grave generation VII (*c.*1055–80)
- Grave generation VIII (*c.* 1080–1105)

Medieval grave generations (*c.*1200 to *c.*1520)

The medieval burials lay within the walled burial ground called 'Paradise', lying along the north side of the cathedral nave.[4] Burial began here *c.*1200 but continued on a large scale only after 1280 until the dissolution of the cathedral priory in 1539. The excavated burials, over a thousand in total [1069 actually numbered], have been assigned to eight burial 'generations' of which Generation 4 (*c.*1320 to *c.*1360) equates with the time of the Black Death.[5] The number of burials assigned to each forty-year generation is as follows:

Grave generation 1 (*c.*1200–*c.*1240)	40
Grave generation 2 (*c.*1240–*c.*1280)	42
Grave generation 3 (*c.*1280–*c.*1320)	101
Grave generation 4 (*c.*1320–*c.*1360)	171
Grave generation 5 (*c.*1360–*c.*1400)	155
Grave generation 6 (*c.*1400–*c.*1440)	222
Grave generation 7 (*c.*1440–*c.*1480)	32
Grave generation 8 (*c.*1480–*c.*1520)	264[6]

These figures and the attribution of numbers of burials to the individual arbitrary 'generations' raise many problems. There is a steep rise in burial between Generations 1–2 (82) and 3–4 (272) and a fall between Generations 5–6 (377), and 7–8 (296). In other words, three times as many burials were made here between *c.*1280 and *c.*1360 compared to the previous eighty years, but the rise in numbers continues at a lower rate in generations 5–6 before falling in 7–8. There may be some reflection of the plague years in Generations 4 and 5, but nothing which suggests that the 'Paradise' cemetery, the social and ecclesiastical status of which is unclear (except in so far as it was an

[4] WS 2, 569–80, Fig. 65.

[5] See below, p. 272.

[6] WS 4.i, Part VI, Chapters I and III, Figs. 34–7.

enclosed area in proximity to the site of the original grave of St Swithun and to the chapel which marked the spot) was under exceptional pressure in these years.[7] For plague burials, perhaps *en masse*, one would probably have to turn to the 'open' cemetery north of 'Paradise' and to the burial grounds of the suburban parish churches.

'Cist' and 'earth' graves and the burial of priests

The burials in the medieval cemetery north of the cathedral nave were of two structurally distinct types, cist graves and earth graves. In the area excavated, 401 cist graves and 632 earth graves were identified. In the former, the body was placed in a tapered or bowed cist or box of small slabs of stone, usually chalk, built in the grave pit and set closer together at the west end to form a niche for the head; the whole covered from head to foot by six or seven slabs resting on the vertical slabs of the sides and ends. In the latter the body was laid directly into a grave pit dug with straight vertical sides, without a niche cut in the earth to take the head.

The distinction between earth graves and cist graves was dramatically clear on excavation (Illus. 4.3) and suggested the possibility that cist graves might have been relatively more 'important' in social terms than the apparently simpler earth graves.[8] The presence in a grave of a pewter chalice (with or without a paten), a certain indication of the burial of a priest, runs counter to any such easy assumption: 14 chalices were found in earth graves, only five in cists (Illus. 4.4b).[9] The one factor which may reflect some underlying difference is that cist graves were more numerous close to St Swithun's Chapel, marking the site of the saint's original burial, and to the north wall of the Norman cathedral (Illus. 4.3).

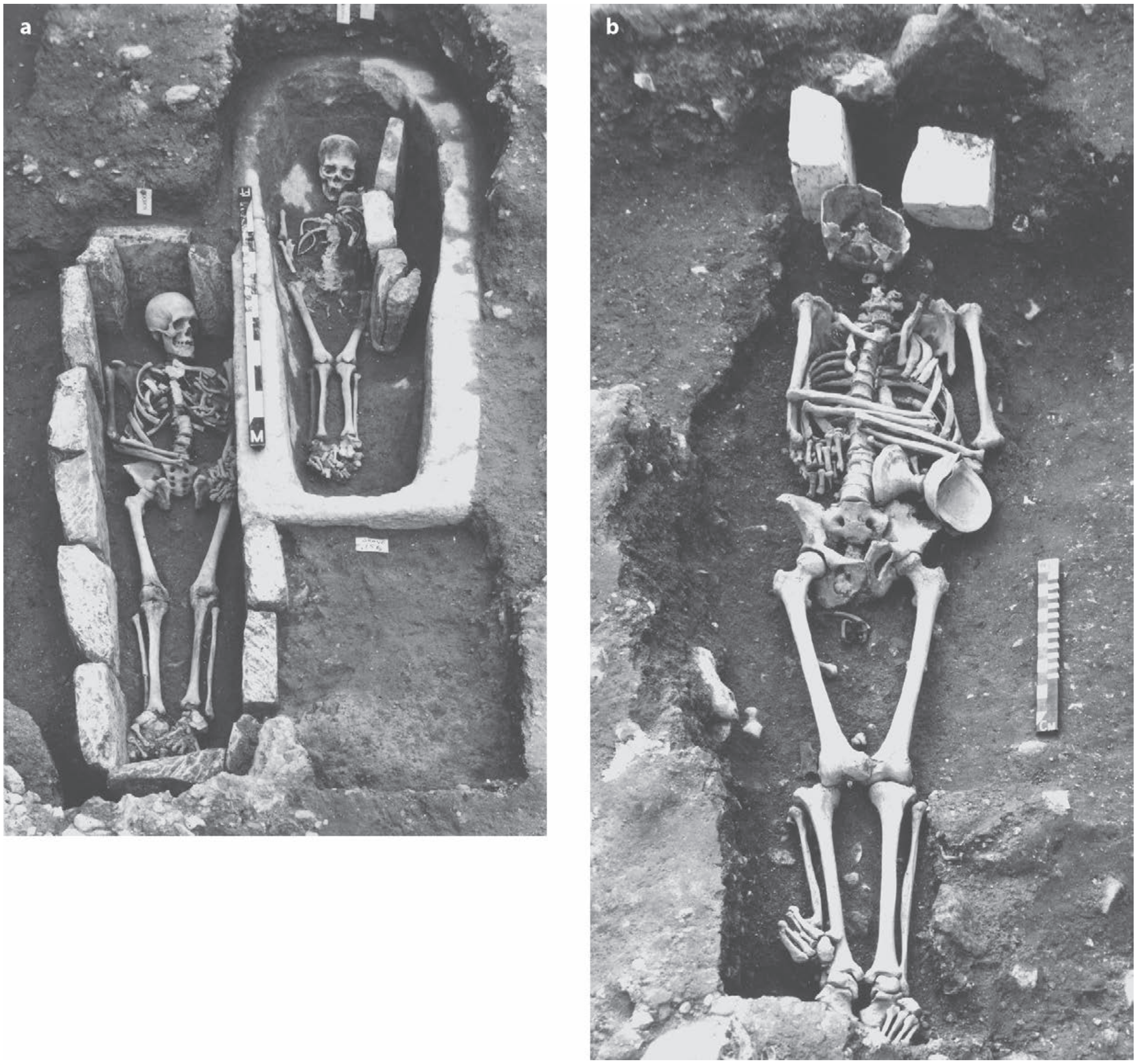
ii. THE METHODS

As in any cemetery which has been used intensively over a long period of time, many graves had been disturbed by later burials. This can lead to difficulties in establishing the precise number of individuals present; in addition, part of the assemblage is a charnel deposit. The burials are, therefore, quantified in several different ways.[10] The minimum number of individuals represented by the most common bone from the Cathedral Green site as a whole (the right mandible at M_1, including M_2 or its site if the jaw is broken at M_1) is used as the basis for the demographic analysis, but alternative totals, derived from counting other elements within burial groups, are also given.

In most of the analyses, the Anglo-Saxon burials from individual graves and the disarticulated bones from the Anglo-Saxon charnel are treated as two separate burial groups. So too, because the methods of excavation were different, the medieval burials from earth graves and from cist graves are treated separately. To amalgamate the samples would have biased the results. In some tables (e.g. Tables 4.2 and 4.3) totals for the Anglo-Saxon period and the medieval period are also shown.

Age estimation and sex determination were based on the standard methods outlined by Brothwell,[11] and were undertaken wherever the condition of the skeletal material permitted. The degree of dental attrition on the molar teeth of both upper and lower jaws was scored using a modified version (see Illus. 4.5) of the grades proposed by Brothwell[12] and was taken to be the best

[7] WS 4.i, Part VI, Chapter III.
[8] For the physiological differences between the skeletal samples in the earth graves and the cist graves, see Part 5, pp. 413–14.
[9] WS 7.ii, 792. [10] cf. Table 4.1. [11] Brothwell 1981, 64–72. [12] ibid.

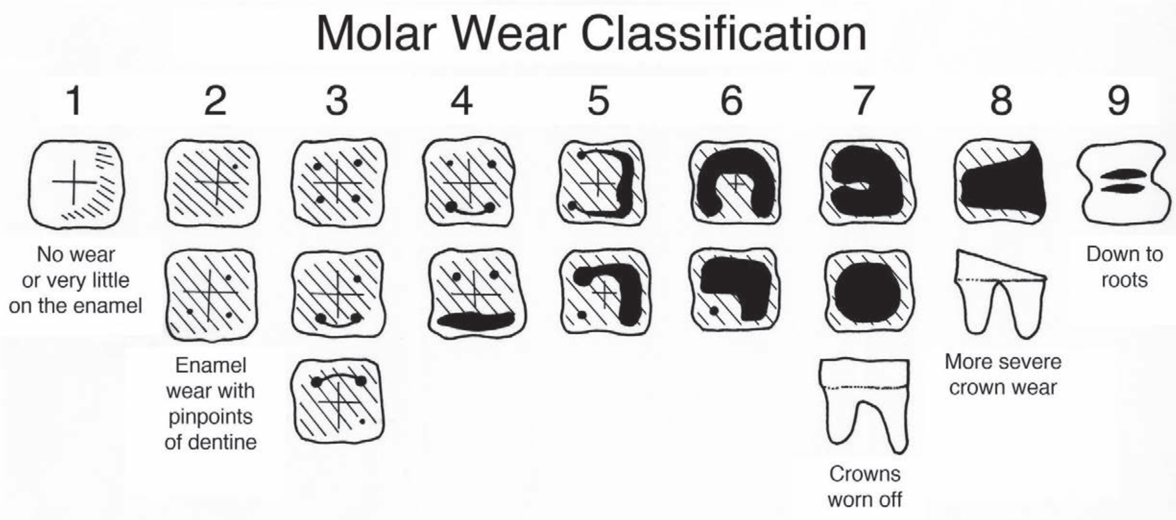


Illus. 4.4. Medieval burials in the cemetery to the north of the cathedral 1966 looking west: (a), to left, Grave MG 256 in a cist of chalk slabs; to the right, Grave MG 255 in a partial cist of chalk slabs built into and reusing an Anglo-Saxon stone coffin (ASG 156) still in place from the demolished westwork of Old Minster; (b), Grave MG 155, the burial of a priest with his pewter chalice and paten, his head supported by chalk blocks

indicator of age, but the state of cranial suture closure and the degree of vertebral arthropathy were also taken into consideration. By scoring the difference in attrition grade on the first and second molars, it is possible to compensate for different rates of attrition in different populations. The second molar erupts about six years after the first and thus the amount of wear on the first molar when the second erupts represents attrition sustained during six years of wear. This can be used to calibrate the attrition scale.[13]

The degree of confidence that could be placed on the determination of the sex of an individual

[13] Miles 1963. Strictly this is abrasion but attrition is used here for historical reasons.



Illus. 4.5. Grading of attrition of the occlusal surface of the molar teeth. Cross-hatching represents areas of wear (abrasion) to the enamel. Black represents areas of exposed dentine.

depended to a large extent on the quality of preservation of the bones and on how many of the sexually diagnostic characters were available for evaluation. Sex distribution in the disarticulated burials from the Anglo-Saxon charnel is based on individuals represented by crania with the left maxilla attached rather than as elsewhere by the right mandible, because for this group only the cranium was both aged and sexed. The reliability of the sexing of skeletal material has been variously stated as being subject to a 5% to 20% error,[14] but only rarely in this assemblage was the physical determination of sex in obvious conflict with the evidence from the (admittedly infrequent) grave goods. For example, the individual in MG 234, a medieval cist grave, was buried with a chalice and was presumably a priest and therefore male. Examination of the skull suggested an aged female. On recent re-examination of the postcranial bones, male characteristics were noted and thus we conclude that this is an example of a rather gracile old man who was a priest.

Standard biometric measurements, as described and illustrated in Brothwell,[15] were recorded for cranial and postcranial bones (excluding distorted skulls and severely pathological bones). Cranial measurements were subjected to multivariate analysis, discussed below.[16] The stature of individuals was estimated using the formulae of Trotter and Gleser for Europeans given in Brothwell.[17] The left bone was measured in preference to the right, and the femur and tibia together were used in stature calculations whenever possible. Failing this, the femur alone, or the tibia, radius, ulna, or humerus were used to calculate the height of females; and the humerus, radius, or ulna were used to calculate the height of males. The stature quoted is the maximum, not corrected for age. Fourteen non-metric traits were also scored in these samples on a simple presence/absence basis, without regard to side, and are discussed in Chapter 4 below, as are dental anomalies and other skeletal variants. Data code numbers (DCN) were given to burials during study by the Natural History Museum. These data records are kept in the Winchester Excavations Committee archive now in the care of the Hampshire Cultural Trust in Winchester.

[14] Krogman 1962, 149.

[15] Brothwell 1981, 77–87.

[16] See pp. 297–302, Illus. 4.20–30, Table 4.2.

[17] Brothwell 1981, 77–87.

2

DEMOGRAPHY

i. EVIDENCE FROM DOCUMENTARY SOURCES

FOR ALL the reservations that historians place on the reliability of documentary sources or the inferences that can be made from them, they must remain the best evidence for population and mortality in historic times. Skeletal evidence cannot begin to compete, but does provide a different order of vital statistics. A great deal of information as to population size and death rates can in fact be elicited from the relevant sources and we are fortunate that in recent years a number of such studies have been made.

Death rate and average age at death

Most important for our understanding of death rates in the Hampshire area during the thirteenth and first half of the fourteenth centuries is the work of Postan and Titow.[1] They analysed the records of the bishopric of Winchester for eighty-three years over a period of one hundred and ten years and, by comparing figures of heriots (death tax) with comments about grain prices, wetness of season, or other indicators of good or bad harvest, they have been able to suggest the extent to which harvests affected death rates and whether the effect was direct or indirect.

Postan and Titow give crude adult death rates between 40 and 52 per thousand for some of the Winchester manors during the period 1245 to 1347.[2] They add that the English population of the late thirteenth and early fourteenth centuries probably grew relatively slowly and that the crude mortality would be relatively high merely as a result of greater proportions of persons in older age groups.

Another analysis by Hatcher, based on rather small numbers, shows that the death rate for the monks of Christ Church priory, Canterbury, ranges from the mid-twenties per thousand in the healthiest decades to the mid-forties in the unhealthy decades, and that the average is 30 per thousand in the 110 years analysed.[3]

Frequently, however, neither death rates nor the average age at death can be estimated from documentary data of the medieval period. At Christ Church priory, Canterbury, the average age at death was 50.[4] The mortality level of the 25–34 group was often in excess of that of the 35–44 and even the 45–54 age groups. This was, of course, an adult population; most figures giving average age at death probably include the children of the population in the sample, but it is usually impossible to tell whether all children are included. For instance, for more recent times, Hatcher quotes average ages at death of 25 and 27 years for seventeenth- and eighteenth-century populations from Colyton (Devon) and Crûlai (Orne) respectively.[5]

[1] Postan 1973; Postan and Titow 1959; Titow 1960.
[2] Postan and Titow 1959.
[3] Hatcher 1977, 29.
[4] Hatcher 1977.
[5] ibid.

Famine

In the Anglo-Saxon period, the year 873 is supposed to have been a time of great famine on the Continent, probably extending to Britain.[6] In later times, between 1252 and 1253, prices for wheat and death rates rose simultaneously. The chroniclers record that 1270–1 was a wet year followed by the exceptionally wet spring of 1271 in which crops were ruined. The following autumn was apparently also wet and was followed in the summer of 1272 by a drought which brought famine and death to the whole of western Europe.

Death rates in 1287–8 and 1288–9 soared, although grain prices were low. Most chroniclers report that in the summer of 1288 drought was so continuous and the heat so intense that a multitude of people died. Postan adds that the presumption is that the deaths were caused by epidemics characteristic of prolonged drought and heat in an era of poor water supplies and primitive sanitation and, if this was so, that mortality is likely to have been higher in towns, such as Winchester, than in the surrounding countryside.[7]

There was an upward tendency in the number of deaths in the country as a whole between 1290 and 1349. Deaths rose to a peak during the years of the disastrous harvests at the end of the second and the beginning of the third decades of the fourteenth century, but then the peak levelled out and death rates declined below the maximum attained in 1317–18, although they still kept above the level at which they stood in the early 1290s. Presumably these trends were reflected in the death rates for the city of Winchester.

The years 1312 and 1313 saw a pronounced reduction in deaths, but in 1316 there was a disastrous famine and exceptionally high death rates. The summer of 1316 was so bad that there was not even enough good weather to shear the sheep;[8] in 1318 the ground was so dry that ploughshares snapped off in the hard ground.[9] Another year of unprecedented drought was 1326–7 and it is probable that the drought of the late summer was accompanied by an epidemic. That the very high mortality of these years had carried away a large proportion of the population is shown by the complaints of Winchester bailiffs over the shortage of men for harvest work. The year 1342 may also have been one of pestilence, for the grain prices and deaths as measured in the heriot tax diverged markedly. On the whole, prices and deaths fluctuated in parallel, suggesting that a bad harvest brought in its wake deaths from the consequences of famine.

Postan concludes that a society in which every appreciable failure of harvests could result in large increases in deaths is a society balanced on the margin of subsistence.[10] There is a suggestion of an extreme degree of rural over-population and, if he is correct, there must have been a fairly constant flow of people into towns like Winchester. Here the death rate would have been at least as high as in the rural areas and would possibly have shown an exaggerated response to famine and epidemics.

No shortage of food is recorded in the fifteenth century though labour was short. With the possible exception of the 1430s and some years in the 1470s, death due to famine must have been rare.

[6] Le Roy Ladurie 1972. [7] Postan 1973. [8] Le Roy Ladurie 1972.
[9] Titow 1970. [10] Postan 1973.

Epidemics

Titow makes clear that it is not primarily crop failures and famine which bring about large-scale death but epidemics, perhaps taking their heaviest toll where the resistance of the impoverished was lowered.[11] The yearly death toll can be deduced from the records of the heriot tax collected by the Bishop of Winchester on all dead.[12] Juxtaposition of the variation in crop yield, mortality figures, and the data on weather conditions often suggests an epidemic following a dry summer as in the years 1272, 1287, 1308, 1311, and 1342. The year 1300 had a fairly high overall mortality, although the crop yield for that year was not particularly low, and the years 1331 and 1332 also had crop yields above average but high mortality figures.

The Black Death, which killed a quarter of the people of Europe in the years 1348–50, reached England by December 1348,[13] and Winchester in 1349. Epidemics recurred in 1360, 1369, and 1375,[14] although it is not clear how many of these directly affected the Winchester population.

Gottfried's study of wills registered in East Anglia provides indirect evidence for conditions in England during the fifteenth century.[15] Epidemic disease, primarily plague, was the major factor controlling population in eastern (and presumably the rest of) England. Towns in particular were affected and could only maintain their populations by immigration. The 1430s, 1460s, and 1470s were decades of almost continual national epidemics and inordinately high mortality.

It appears that some infectious diseases were not more lethal among children than among adults until *c.*1470. Yet in the 1470s, when epidemic disease was as frequent and virulent as it had been at any other time in the fifty-year period 1430–80, child replacement ratios were generally well above their previous forty-year levels and average family size rose to 4.4 for rural elite and 4.1 for London elite in the 1470s.

The population of Winchester

Immigration and population origins are indicated by the local bynames occurring in the twelfth-century Winchester surveys. Most of them refer to localities in Hampshire but they range from Devon in the west to Kent in the east; they also include a fair scattering of names from northern France.[16] The expansion of the population of Winchester in the tenth and eleventh centuries is reflected in the subdivision of tenements, and records of the rent-payers give us some insight into its composition. In the middle of the eleventh century, 85% of the personal names of the property-holders were of old English origin and the population of Winchester was probably almost entirely composed of Englishmen, many of whom may have been relatively recent immigrants from the villages of Hampshire and the rest of Wessex.[17] There is some evidence however of alien influences because 3.5% of the property-holders were named after the Scandinavian fashion (although these names could have been adopted by English members of Winchester society), 8% had Germanic names (but may have been English by birth), and one had a French name and may thus be identified as a foreigner. The total of Germanic-Scandinavian names at 11.5% seems notably high, and if for any reason there had been reproductive differentials in favour of much larger families, then there could have been considerable gene replacement.

[11] Titow 1960, 360–407. [12] Postan and Titow 1959. [13] Langer 1964.
[14] Scott and Duncan 2001, 112. [15] Gottfried 1978.
[16] WS 1, 197–8, Fig. 3. [17] WS 1, 463.

The social impact of the conquest of 1066 is reflected in the personal names, and by about 1110 the number of English names in the Winchester records had dropped from 85% to under 30%. There is a corresponding increase in the number of Germanic names to nearly 60%. It is uncertain whether this reflects change in the composition of the population, or change in fashion, but osteometric evidence of increasing brachycephalization in medieval British populations as a whole might reflect immigration to this country from the Continent, although there could be other explanations. By *c.*1110, Normans had replaced Anglo-Saxons as payers of landgable in 19% of the separately enumerated properties in Winchester's Survey I.[18] A further 42% of the property-holders had Norman names and although they are not specifically identified as Norman in the survey, some at least must have been of Norman stock. Only just over 27% of the property-holders are certainly English. They seem to have been ousted from the High Street and were concentrated outside West Gate, in *Brudenestret*, *Tannerestret*, and, above all, in *Bucchestret.* An overall impression of prosperity is provided by the survey of *c.*1110. Apparently it is a prosperity of long standing, which may be reflected in the general lack of deficiency disease observed in the bones from the Anglo-Saxon burials.

The city of 1148 portrayed in Survey II is a thriving one with a population of probably more than eight thousand, but the sieges of 1216 and 1217 caused considerable destruction in the suburbs and some permanent depopulation. By the middle of the thirteenth century there is evidence of a drop in population and thereafter a slow decline in the wealth of Winchester.[19]

ii. EVIDENCE FROM THE SKELETONS

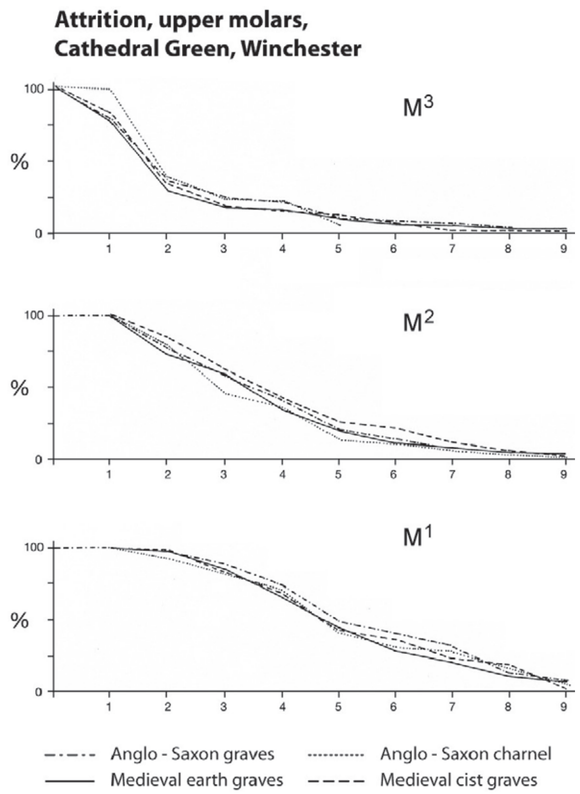
Estimation of rate of death

The interpretation of cemetery data is fraught with difficulties. First there is the problem, referred to above, of ageing and sexing the skeletal material. Second, the estimation of death rates from what are after all cohort data can be highly ambiguous. A cemetery may have been exploited over several centuries by a fluctuating population of unknown size, with an unknown birth rate, and subject to an unknown number of epidemics. Significant sections of the population may not be included in the sample because they could not afford the death dues, died away from home, or were disqualified by reason of age, disease, religion, or default.

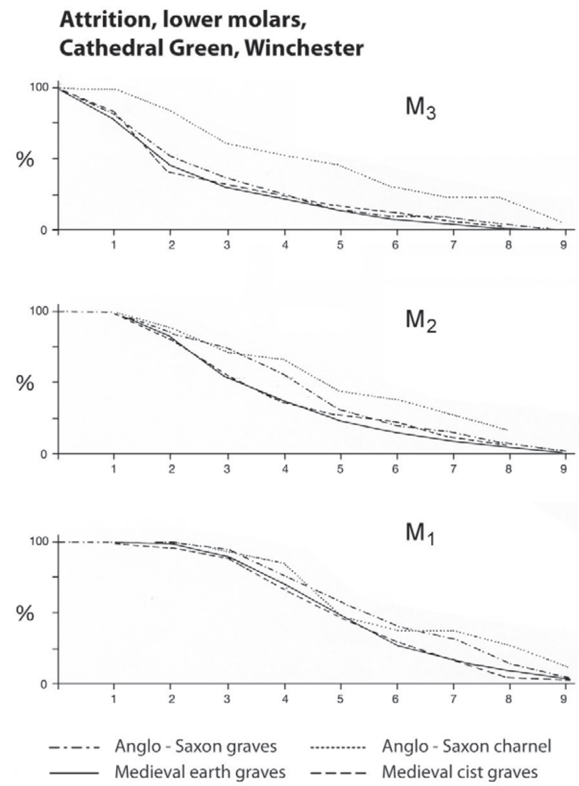
It is too simplistic to assume a death rate constant either with age or through time. On the other hand, comparison of cemetery data with empirically defined curves can be informative. If a 30% newborn mortality and subsequent 3% per annum (30 per 1000) mortality is assumed, of any one hundred persons born fewer than 50 enter their teens, 40 survive adolescence to attain an age at which they are likely to reproduce, 30 will enter their thirtieth year, 22 their fortieth, only 12 will reach 60, and even fewer 70 years. A death rate of 30 per thousand is very high and not actually reached by any modern population however remote, primitive, or far removed from the benefits of medicine or hygiene,[20] but is within the range indicated by Postan and Titow.

Analysis of the published data from Lankhills suggests, however, a much higher death rate for young adults,[21] with very few people indeed surviving beyond 40.[22] Those findings have been essentially confirmed by this study, as outlined in Part 2, Chapter 2. The reasons for this

[18] ibid. 475. [19] ibid. 493–5. [20] WHO 2011, 45, Table 1.
[21] WS 3.ii, 123–6; see above, pp. 23–7. [22] Molleson 1981, 15–32.



Illus. 4.6. Cumulative curves of attrition grades on the upper molar teeth for the Winchester populations. Differences in attrition can be made apparent by presenting the frequency of each grade of attrition, scaled from 0–9 in a cumulative curve. One hundred per cent of adults will have, or have had, grade 0 of attrition on the first molar. About 75% show grade 3 or more on the second molar.



Illus. 4.7. Cumulative curves of attrition grades on the lower molar teeth for the Winchester populations. The differences between the Anglo-Saxon and medieval samples are most clearly seen in the wear patterns for the second molar. All the adults had at least grade 1 attrition, 75% of the Anglo-Saxons attained grade 3 or more, but only 55% of the medieval molars show this grade.

extraordinarily high death rate are of some interest. There is a possibility that conventional methods used to estimate age at death underscore to a considerable degree. This must be borne in mind in the following discussion, which considers mortality in the Winchester Cathedral Green populations.

Cumulative curves of attrition grades on the molar teeth of the Anglo-Saxon and medieval populations give some indication of the proportion of deaths in each age group. The differences between the Anglo-Saxon and medieval populations (Illus. 4.6 and 4.7) are most clearly seen in the wear patterns for the lower second molar, which shows a lower attrition grade (i.e. a younger age) at death in the medieval burials than in the Anglo-Saxon samples.

In the dental section of this study, Table 4.26 shows the range of attrition on all three molars for the Winchester samples. As might be expected, mean attrition grades are less for M2 than for M1 and less for M3 than for M2 on males as well as females (except where sample sizes are so small as to be valueless). Although there is no significant difference between mean attrition grades recorded for teeth from the medieval earth and cist graves, there is a definite overall indication that the average attrition grade was less in the medieval populations than in the Anglo-Saxons. The impression gained is that the average age at death was lower in the medieval populations than in the Anglo-Saxon. However, wear seems to have been greater on the lower than on the upper teeth in the Anglo-Saxon grave and Anglo-Saxon charnel groups. This may reflect sampling error and therefore any inference as to greater age at death of the Anglo-Saxons should be treated with caution. The variation in mean attrition grades for the Anglo-Saxon grave and charnel samples is not consistent and there is no indication that the two groups differ greatly. The Anglo-Saxon charnel mean attrition grades are more often like the Anglo-Saxon grave mean values and the sample shows greatest similarity to the Anglo-Saxon graves.

The highest mean attrition grades on M3 are recorded for the Anglo-Saxon and charnel populations. This suggests that they survived to a considerably greater age than did the medieval population.

Cause of death

It is usually impossible to ascertain the cause of death from the condition of the bones of a skeleton. In cases of fatal injury, death will have intervened before healing processes are manifest on the bone, even where the bone itself has been injured, and a number of unhealed injuries of the type sustained in battle have been noted.[23] Cases of fatal bone disease are rare. The very few cases noted have been described elsewhere,[24] but evidence for leprosy, syphilis, and metastases of malignant solid neoplasm (carcinomata and sarcomata, with secondary lesions) was on the whole lacking, except for several possible cases of leprosy and one possible case of metastatic cancer. Recognized lepers would probably have been excluded from the town during life and in death buried elsewhere.

A relatively large number of bones showed signs of disease, whether of an infectious or nutritional nature, from which the individual had recovered. The occurrence of healed tuberculosis and rickets suggests that these diseases were a fairly constant drain on the population. Many people could have died of tuberculosis without any bony stigmata.

It is most likely, and documentary evidence lends support to this suggestion, that at times the largest number of deaths in adults was brought about by outbreaks of epidemics of a sort that leave little or no trace on the bone.[25]

The hundred years spanning the second half of the fourteenth and the first half of the fifteenth century is the period of the longest decline in, and stagnation of, population in recorded English history. The fall in the population began in the 1320s and continued until the 1460s or 1470s and there is evidence of frequent and virulent outbreaks of plague during the fifteenth century over and above the major outbreaks which occurred on a national scale. The numbers dying in the towns exceeded those dying in the country and England's population may have declined by two-thirds in the century after 1348–9, due to the Black Death, whether bubonic plague or anthrax, and subsequent outbreaks of plague and other epidemics.[26]

Bubonic plague was fatal in 50 to 80% of cases and outbreaks occurred in late summer and early autumn. Pneumonic plague was common during the winter months. It was directly contagious via inhalation of droplets coughed out from the airways of victims, ran its course in three days, and

[23] See below, pp. 364–7, Illus. 4.87–9.
[24] See below, pp. 345–6, 363.
[25] Postan 1973; Titow 1970; Gottfried 1978; Hatcher 1977.
[26] Langer 1964.

Illus. 4.8. A late medieval sickroom: the deathbed of Godfrey de Bouillon, king of Jerusalem (1099–1100), a monk holding a lighted candle above him, in a late fifteenth-century manuscript illumination from the South Netherlands (?Bruges) (London, British Library, Royal MS 15 E. 1, f. 150v). By permission of the British Library Board.

seems to have been 100% fatal.[27] Septicaemic plague was also 100% fatal, killing within hours, although outbreaks were rare. All types were caused by *Yersinia pestis*.

Gottfried records that significant numbers of deaths were brought about by flux or blood flux (dysentery) in 1411 and 1473 and by the English sweat (?influenza) in 1485 and thereafter.[28] Typhus and smallpox are also suspected of being important killers at various times. Between 1430 and 1480 there were 11 outbreaks and 18 years of national epidemics, and at least 20 other outbreaks and 15 other years of epidemics on a local scale.

The Black Death of 1348–50 and subsequent years was of major importance in influencing death rates in Winchester during the later part of the medieval period. The first deaths from the Black Death in Hampshire seem to be reflected in raised mortality from October 1348, but the worst months were in the first half of 1349. During the second half of the year deaths as reflected in the appointment of new clergy in the Winchester diocese declined.[29]

Already in October 1348 the bishop of Winchester, William Edington, had written to the prior and chapter of Winchester and the clergy of his diocese: '. . . we are struck by terror lest . . . the brutal disease should rage in any part of our city or diocese'. The bishop was right to be fearful. In

[27] Gottfried 1978. [28] ibid. [29] James 1999, 2–9.

Illus. 4.9. Burial in time of plague: The Black Death at Tournai, manuscript illumination by Gilles de Muisit, after 1349 (Brussels, Bibliothèque Royale, MS 13076–77, f. 24v). By permission of the Bibliothèque Royale.

the event 44% of the monks and 49% of the beneficed clergy in his diocese died, a figure not exceeded by any other diocese in England.[30]

Winchester was as severely affected as any other large town in the country. The evidence suggests that in 1148 the population of the city may have been as high as 12,000 or even 13,000.[31] By *c.*1300 this figure may have been reduced to somewhere between 10,000 and 12,000, but by 1417 the population appears to have been no more than about 7,500, suggesting an actual loss in population as high as 30%, allowing for some recovery in the 70 years since the height of the plague.[32] The total of plague deaths would seem to have been between 3,000 and 4,000 souls, a probably conservative estimate.

By January 1349 deaths were already running at such a level that the cemetery north of the cathedral, the city's only major burial ground within the walls, was becoming overcrowded. Tension between the citizens, who had been encroaching on the cemetery for shops and houses, and the cathedral which needed the land so that burials could be made in consecrated ground, rose to such a pitch that a special agreement had to be made allowing the cathedral to reclaim some of the lost burial ground.[33] There is no record that plague pits were dug outside the city walls, but the cemeteries of the suburban churches on all four sides of the city must have been equally subject to overcrowding.

Age at death

In a cemetery where the newborn were not interred, we can expect half the sample to be under 25 and half to be over, using the 3% per annum mortality model given above. Infants would account

[30] James 1999, 2–3. [31] Biddle 1987, 329–30. [32] WS 2, 139–47, 366–70. [33] ibid. 579–80, Fig. 65.

for at least 15%, another 10% pre-adolescent, 15% adolescent, 20% young adult (up to 25), 30% between 25 and 40, and 10% over 40. In such a cemetery the average age at death is 25, but the deviation is large and the average age at death of adults would be just over 40.

The population structure which derives from this kind of mortality rate is typical of most pre-industrial societies. In modern Western societies the death rate is much lower at all ages until senescence at around 70 years when there is a marked increase and the proportion of old to young people in the population is therefore greater.

With archaeological material, the tendency has been to suggest a mortality rate much higher than is currently found either in pre-industrial societies, or indeed in cemetery material where age at death is given. At St Brides (London), for example, the average age at death for adults is over 60, and at Christ Church Spitalfields it is 56 years. At this last site it has been possible to compare the age structure of the crypt sample with that of mortality in contemporary London, and the greater age at death of the selected crypt sample is not significant.[34]

iii. DEMOGRAPHIC ANALYSIS

Some considerable time has elapsed since the excavation and study of the Cathedral Green burials, and various people have been involved at different stages of the analysis. This section of the report was one of the last to be written and is based on the information which was available at the time of writing.

Number of burials

The maximum possible number of individuals available for study, based on the number of excavated graves, is shown in Table 4.1, but poor preservation and other factors have considerably reduced the actual number which could be analysed. Many excavated graves had been partly or almost wholly disturbed by the digging of later burials, leaving only a few bones in position,[35] so that of a possible total of 861 bodies from Anglo-Saxon graves, a minimum of only 296 individuals are represented by the right side of the mandible. The number of individuals represented by this element forms a greater proportion of the possible total from the medieval cemetery, but these samples also reflect to a certain extent the effect of taphonomic processes.

The commonest partial bone from the Cathedral Green site is the right side of the mandible, but different methods of quantifying the burials give different results (Table 4.1), and more individuals from the Anglo-Saxon charnel are represented by the frontal bone than by the right side of the mandible. Most of the demographic analyses which follow are based on those individuals who are represented by the right mandible; only analyses of the distribution of age and sex in the Anglo-Saxon charnel are based on the cranium including the left maxilla.

Adult/subadult ratio

The proportion of adults and subadults in the samples is shown in Table 4.2. Adults comprise 41% of the excavated burials from the Anglo-Saxon graves, and adults greatly outnumber subadults in the other three burial groups. It is likely that differential preservation has favoured the survival of

[34] Molleson, Cox 1993. [35] Kjølbye-Biddle 1975, 98–100.

TABLE 4.1
Number of individuals available for study, Cathedral Green, Winchester

Anglo-Saxon and medieval graves	Anglo-Saxon graves	Medieval earth graves	Medieval cist graves
Maximum possible, based on number of excavated graves	861	632	403
Minimum number of individuals represented by the right mandible	296	152	106
Number of individuals for whom the cranial index has been calculated	114	68	147
Number of individuals represented by long bones measured for height estimation	148	157	108

Anglo-Saxon charnel	
Number of individuals represented by frontal bones	
Min.	1019
Max.	1067
Minimum number of individuals represented by the right mandible	705
Minimum number of individuals represented by the cranium including the left maxilla	112
Number of individuals for whom the cranial index has been calculated	164

TABLE 4.2
Adult : Subadult ratio in the burials represented by the right mandible, Cathedral Green, Winchester

	Adult	Subadult (< 20 yrs)	Total
(a) the four burial groups separately			
Anglo-Saxon graves	122 (41)	174 (59)	296
Anglo-Saxon charnel	607 (86)	98 (14)	705
Medieval earth graves	142 (93)	10 (7)	152
Medieval cist graves	93 (88)	13 (12)	106
(b) samples combined			
Anglo-Saxon samples combined	729 (73)	272 (27)	1001
Medieval samples combined	235 (91)	23 (9)	258

Row percentages in brackets

adult bones in the reburied population in the Anglo-Saxon charnel, and that the exigencies of excavation adversely influenced the recovery of children from the medieval earth graves.[36] The scarcity of children from the medieval cist graves presumably indicates that few children were buried in cists in the excavated part of the medieval cemetery.

[36] Ibid, 88–91.

TABLE 4.3

Adult sex distribution based on right mandible or cranium including left maxilla (Anglo-Saxon charnel only), Cathedral Green, Winchester

	Male	?Male	Female	?Female	Sex indet.	Total
(a) the four burial groups separately						
Anglo-Saxon graves	62	7	39	9	5	122
Anglo-Saxon charnel	57	6	20	7	15	105
Medieval earth graves	79	6	44	12	1	142
Medieval cist graves	46	4	35	5	3	93
Total	244	23	138	33	24	462

	Male + ?Male	Female + ?Female	Sex indet.	Total
(b) the four burial groups separately				
Anglo-Saxon graves	69 (56)	48 (39)	5	122
Anglo-Saxon charnel	63 (60)	27 (26)	15	105
Medieval earth graves	85 (60)	56 (39)	1	142
Medieval cist graves	50 (54)	40 (43)	3	93

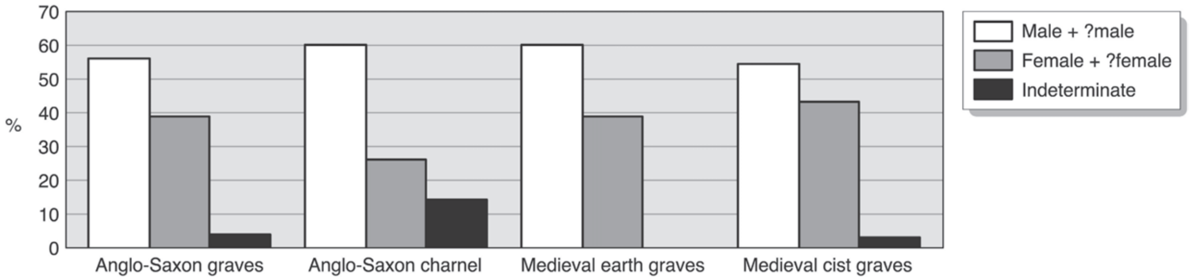
	Male + ?Male	Female + ?Female	Sex indet.	Total
(c) samples combined				
Anglo-Saxon samples combined	132 (58)	75 (33)	20	227
Medieval samples combined	135 (57)	96 (41)	4	235

Row percentages in brackets

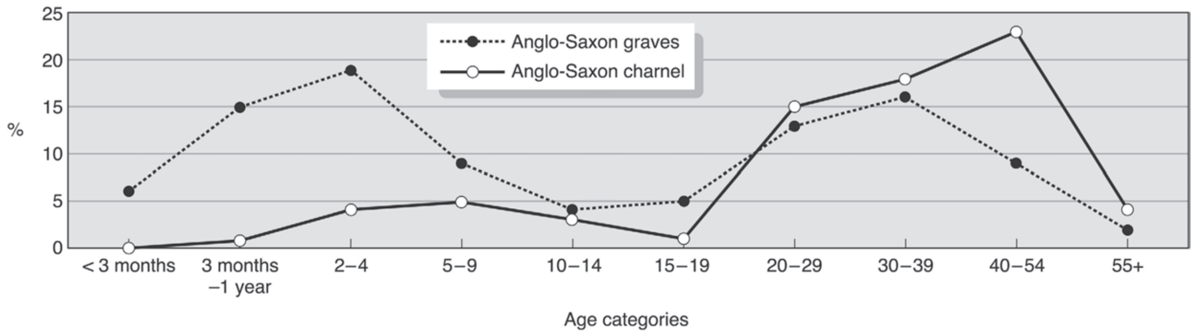
Sex distribution

The criteria on which the determination of sex was based varied between burial groups. Many of the individuals from the Anglo-Saxon graves and the medieval cist graves were represented by more or less complete skeletons and for them a total morphological assessment was possible. On the other hand, sex determination of the individuals from the medieval earth graves was often based on fragmentary and disarticulated bones. For the Anglo-Saxon charnel the sex distribution was based on only those individuals represented by the cranium including the left maxilla, a much smaller number than was represented by isolated right sides of mandibles. Nevertheless, between 86 and 99% of the adults in these samples were sexed with a greater or lesser degree of confidence (Table 4.3).

Males outnumber females overall and, if probable males are included in the total, males form between 54 and 60% of the adults in the four burial groups (Illus. 4.10). Females and probable females comprise only 26% of the sexed adults from the Anglo-Saxon charnel, compared with between 39% and 43% from the other three burial groups. However, the figures for the charnel are based on crania, not mandibles, and it is likely that female crania survived exhumation, reburial, and subsequent excavation less well than the more robust male crania. The age distribution discussed below in the individuals from the Anglo-Saxon charnel and the medieval earth graves suggests that taphonomic factors were of major importance in determining the composition of these samples and that it would be unwise to draw detailed demographic conclusions from them.



Illus. 4.10. Sex distribution, Anglo-Saxon and medieval adult samples, Cathedral Green, Winchester.



Illus. 4.11. Age distribution, Anglo-Saxon samples, Cathedral Green, Winchester.

Age distribution

Age estimation was achieved for 98.3% of the individuals from the Anglo-Saxon graves, for 74.0% from the Anglo-Saxon charnel, for 78.9% from medieval earth graves, and for 88.7 % from medieval cist graves (Tables 4.4–4.7). Adult mortality apparently was highest in the third decade of life in burials from the medieval cemetery (Tables 4.6, 4.7), and in the fourth decade in burials from Anglo-Saxon graves (Table 4.5), with few people in either period surviving beyond 60 years of age.

The burials from Anglo-Saxon graves show a mortality distribution which is characteristic of pre-industrial populations, except for a depressed figure for the youngest age group (Tables 4.4 and 4.5, and Illus. 4.12). A peak in the number of young children is followed by a decline in burials of older children and a rise in early adulthood. Thereafter, the number of people in the higher age groups declines steadily from a peak in the fourth through the fifth and sixth decades of life. Only two males and one female were apparently aged over 60 at the time of death. This small number is most unlikely to have been the case, and once more emphasizes the difficulties of correctly ageing older adults.[37]

Expressed as a percentage, 6% of all individuals from the Anglo-Saxon graves who could be aged died before the age of three months, and 21% of individuals born did not reach the age of one year (Table 4.4). It could be argued, on the basis of documentary evidence and twentieth-century figures from developing countries,[38] that fetuses and neonates are under-represented in this sample and

[37] See Mays 2010, 51–76 for an extended discussion of recent ageing techniques.
[38] Brass et al. 1968; Chen (ed.) 1973.

TABLE 4.4

Age distribution, Anglo-Saxon samples, Cathedral Green, Winchester

Age	Anglo-Saxon graves	Anglo-Saxon charnel
<3 months	18 (6)	0 (0)
3 months–1 year	45 (15)	6 (<1)
2–4	55 (19)	28 (4)
5–9	28 (9)	37 (5)
10–14	13 (4)	18 (3)
15–19	15 (5)	9 (11)
Total subadult	174 (59)	98 (14)
20–29	37 (13)	109 (15)
30–39	48 (16)	128 (18)
40–54	26 (9)	161 (23)
55+	6 (2)	25 (4)
Indeterminate	5 (2)	184 (26)
Total adult	122 (41)	607 (86)
Total	296 (100)	705 (100)

Column percentages in brackets represent per cent of the total sample

TABLE 4.5

Age and sex distribution in individuals represented by the right mandible, Anglo-Saxon graves, Cathedral Green, Winchester

Age	Subadult	Male	?Male	Female	?Female	?Sex	Total
Fetus–<6 months	23 (7.7)						23 (7.7)
6 months–6 years	109 (36.8)						109 (36.8)
7–13	22 (7.4)						22 (7.4)
14–19	20 (6.8)						20 (6.8)
20–29		18 (6.1)	4 (1.3)	11 (3.7)	2 (0.7)	2 (0.7)	37 (12.5)
30–39		25 (8.4)	1 (0.3)	16 (5.4)	5 (1.7)	1 (0.3)	48 (8.4)
40–49		10 (3.4)	2 (0.7)	8 (2.7)	1 (0.3)	1 (0.3)	22 (7.4)
50–59		5 (1.7)		2 (0.7)			7 (2.4)
60+		2 (0.7)		1 (0.3)			3 (1.0)
Indeterminate		2 (0.7)		1 (0.3)	1 (0.3)	1 (0.3)	5 (1.7)
Total	174 (58.8)	62 (20.9)	7 (2.4)	39 (13.2)	9 (3.0)	5 (1.7)	296 (100)

Table percentages in brackets

that a figure in the region of 30% for the 0–1 year age group would be more realistic; if this were so, overall mortality in individuals under five years old would be correspondingly higher.

The group of burials from the Anglo-Saxon charnel shows a markedly different age distribution although the burials are of the same date and, presumably, drawn from the same population as those buried in graves. Table 4.4 and Illus. 4.11 illustrate clearly the effect reburial has had on this sample. Infants under the age of one year represent less than 1% of the sample, and the overall proportion of subadults is low. A significantly larger percentage of adults appears to have died between the ages of 40 and 54 than was recorded for the Anglo-Saxon graves, and over a quarter of the sample could not be aged at all.

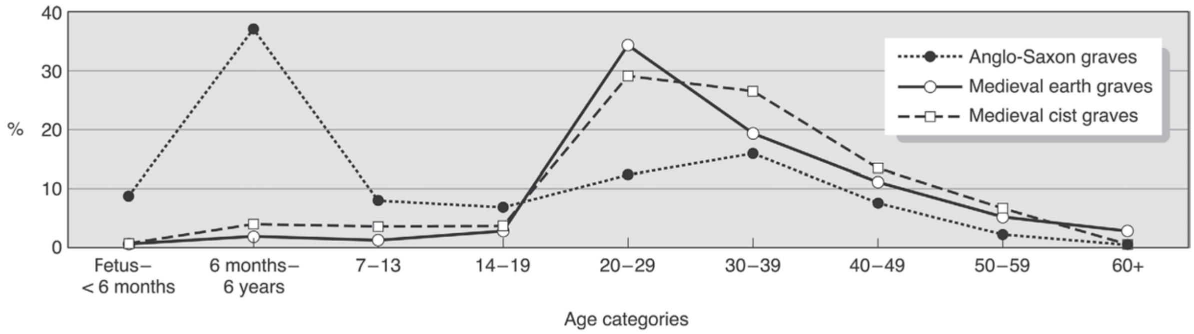
The scarcity of children in the samples from the medieval cemetery is striking, and clearly these

TABLE 4.6

Age and sex distribution in individuals represented by the right mandible, medieval earth graves, Cathedral Green, Winchester

Age	Subadult	Male	?Male	Female	?Female	Sex indet.	Total
Fetus–<6 months	0 (0)						0 (0)
6 months–6 years	3 (2)						3 (2)
7–13	2 (1.3)						2 (1.3)
14–19	5 (3.3)						5 (3.3)
20–29		26 (17.1)	2 (1.3)	18 (11.8)	6 (3.9)		52 (34.2)
30–39		17 (11.2)	3 (2)	6 (3.9)	3 (2)		29 (19.1)
40–49		10 (6.6)		7 (4.6)			17 (11.2)
50–59		8 (5.3)					8 (5.3)
60+		3 (2)		1 (0.7)			4 (2.6)
Indeterminate		15 (9.9)	1 (0.7)	12 (7.9)	3 (2)	1 (0.7)	32 (21.1)
Total	10 (6.6)	79 (52)	6 (3.9)	44 (28.9)	12 (7.9)	1 (0.7)	152 (100)

Percentages in brackets



Illus. 4.12. Age distribution, Anglo-Saxon and medieval graves, Cathedral Green, Winchester.

samples do not provide a basis from which to draw conclusions about the living population of medieval Winchester. The procedures adopted in excavation[39] have undoubtedly contributed to this under-representation, as have differential preservation and taphonomy, especially in the medieval earth graves, where only 6.6% of the individuals are under the age of 20, and there are no infants at all under the age of six months. Although the percentage of subadults is somewhat higher amongst the Anglo-Saxon cist graves (12.3%), the overall pattern is the same. Only one infant under the age of six months is reported.

Although adults from both medieval earth graves and medieval cist graves appear to have died younger than their Anglo-Saxon counterparts, the adult mortality pattern between the two medieval groups differs slightly (Table 4.7). Individuals in cist graves appear to have lived slightly longer lives. While 34.2% of individuals in earth graves died in their third decade of life and 19.1% died in their fourth decade, in the cist graves only 29.2% died in their third decade while 26.4% died in their fourth decade. However, these differences may not be meaningful given the challenges inherent in excavation and analysis. In both these samples taken together, fewer than 2% of individuals survived beyond the age of 60.

[39] Kjølbye-Biddle 1975, 88–91; see also above, pp. 261–7.

TABLE 4.7
Age and sex distribution in individuals represented by the right mandible, medieval cist graves, Cathedral Green, Winchester

Age	Subadult	Male	?Male	Female	?Female	Sex indet.	Total
Fetus–<6 months	1 (0.9)						1 (0.9)
6 months–6 years	4 (3.8)						4 (3.8)
7–13	4 (3.8)						4 (3.8)
14–19	4 (3.8)						4 (3.8)
20–29		12 (11.3)	2 (1.9)	14 (13.2)	3 (2.8)		31 (29.2)
30–39		15 (14.2)	1 (0.9)	12 (11.3)			28 (26.4)
40–49		7 (6.6)	1 (0.9)	5 (4.7)	1 (0.9)		14 (13.2)
50–59		6 (5.7)				1 (0.9)	7 (6.6)
60+		1 (0.9)					1 (0.9)
Indeterminate		5 (4.7)		4 (3.8)	1 (0.9)	2 (1.9)	12 (11.3)
Total	13 (12.3)	46 (43.4)	4 (3.8)	35 (33.0)	5 (4.7)	3 (2.8)	106 (100)

Percentages in brackets

3
PHYSICAL VARIATION

i. CRANIAL DIMENSIONS, STATURE, AND SEXUAL DIMORPHISM

As most of the skeletons excavated at Cathedral Green presented no obvious sign of pathology, the bones have been taken as representative of a normal population and could be used to derive information about the people who lived in Winchester at different times.

Many of the variables which contribute to the differentiation of one population from another, such as head shape or stature, are complex in nature and often exist in a continuum which can be measured. The frequency distribution of components describing size or shape will usually be bell-shaped and, although the curve may be somewhat skewed, 60% of any population normally falls within a fairly narrow band. Extremes of size or shape may tail off into the abnormal, and those members of the population that fall into the extremes of the range may have actually been physically handicapped in the performance of the normal activities of their group. Some social occupations or activities—fighting men, for example—may have been selected for a certain physique. The nature of the burials at Cathedral Green was not usually conducive to the analysis of sub-groups such as priests or fighting men, either because membership in those groups could not be ascertained or because the groups were too small, although in certain instances the samples may have been biased by such classes within the population.

Summaries of cranial dimensions for males and females in the Anglo-Saxon graves, Anglo-Saxon charnel, and medieval earth graves and cists combined will be found in Tables 4.8–4.13.

Cranial shape can be highly characteristic of a population. The distribution of cranial indices for the Anglo-Saxon and medieval populations from Cathedral Green is shown in Illus. 4.13–4.16. There appears to be a trend towards brachycephaly in later medieval times, a trend that has been noted for other medieval populations in Britain.[1] It may reflect immigration of people from the Continent with different cranial shapes, or, and this seems more probable, reflects changing environmental conditions. A similar pattern has been noted in other European samples.[2] The average cranial index for males from the medieval cist graves was 78.97 (44 individuals) and for females 80.6 (33 individuals). These indices are not significantly different. The lowest cranial index (66) recorded for a cist grave was for a male skull from MG 300. This skull was unusually narrow, having a breadth of only 124 mm, and fell well outside the normal distribution for the medieval population (Illus. 4.16).

Summaries of postcranial dimensions for males and females in the Anglo-Saxon graves, Anglo-Saxon charnel, medieval earth graves, and medieval cist graves will be found in Tables 4.14—4.19. The stature of individuals was calculated from long bone measurements and the range, mean, and standard deviation for each population are given in Table 4.20. Too few complete long bones were recovered from the Anglo-Saxon charnel for this group to be included in the table. Illus. 4.17–4.19 present in histogram form the statures for males and females in each group. Only the heights for Anglo-Saxon

[1] Brothwell 1963, 88–9. [2] Stuckert 1985, 209–12.

TABLE 4.8

Cranial measurements in millimetres, males from Anglo-Saxon graves, Cathedral Green, Winchester

Biometric dimension	Biometric symbol	Number of individuals	Mean	Variance	Standard deviation	Standard error of mean
Maximum cranial length	L	63	193.70	60.73	7.79	0.98
Maximum breadth	B	59	145.19	63.50	7.97	1.04
Minimum frontal breadth	B'	69	100.07	27.27	5.22	0.63
Maximum frontal breadth	B"	66	124.42	39.35	6.27	0.77
Basi-bregmatic height	H'	26	135.27	26.84	5.18	1.02
Basi-nasal length	LB	24	102.96	29.00	5.38	1.10
Frontal arc	S1	56	128.68	33.71	5.81	0.78
Parietal arc	S2	54	129.04	56.07	7.49	1.02
Occipital arc	S3	51	125.37	66.84	8.17	1.14
Frontal chord	S'1	57	112.51	19.83	4.45	0.59
Parietal chord	S'2	58	116.14	34.58	5.88	0.77
Occipital chord	S'3	53	101.32	48.26	6.95	0.95
Biasteronic breadth	Biast B	49	114.29	43.12	6.57	0.94
Bregmatic-sphenoid arc	P2	17	110.94	45.56	6.75	1.64
Bregmatic-asterion arc	P3	49	171.47	63.55	7.97	1.14
Lambda-asterion arc	O7	47	105.51	56.25	7.50	1.09
Basion-asterion chord	O9L	29	77.41	47.04	6.86	1.27
Maximum temporal length	T1	50	91.48	19.48	4.41	0.62
Sphenoid breadth	S4	27	73.37	32.47	5.70	1.10
Upper facial height	G'H	18	73.56	30.38	5.51	1.30
Basi-alveolar length	GL	14	102.29	27.91	5.28	1.41
Bimaxillary breadth	GB	23	97.13	21.21	4.60	0.96
Palatal breadth	G2	27	43.06	8.82	2.97	0.57
Palatal length	G'1	30	48.15	17.44	4.18	0.76
Bizygomatic breadth	J	13	134.54	60.60	7.78	2.16
Orbital breadth	O'1	20	39.08	7.60	2.76	0.62
Orbital height	O2	24	34.27	4.16	2.04	0.42
Foraminal length	FL	36	36.46	13.32	3.65	0.61
Foraminal breadth	FB	42	30.88	5.80	2.41	0.37
Malar height	MH	54	49.10	8.06	2.84	0.39
Nasal breadth	NB	49	24.79	3.40	1.18	0.26
Nasal height	NH'	24	53.18	36.86	6.07	1.24
Simotic chord	SC	40	9.44	3.06	1.75	0.28
Superior nasal breadth	NB4	45	12.00	4.95	2.22	0.33
Bidacryonic chord	DC	30	26.57	5.22	2.28	0.42
Bicondylar breadth	W1	19	119.00	181.22	13.46	3.09
Bimentalia breadth	ZZ	57	45.96	6.90	2.63	0.35
Ramus breadth	RB	58	32.79	7.73	2.78	0.36
Symphysial height	H1	52	32.97	10.03	3.17	0.44
Projective mandibular length	ML	15	107.47	54.84	7.40	1.91
Projective ramus length	RL	16	68.56	27.06	5.20	1.30
Height at M2	M2H	46	30.12	9.98	3.16	0.47
Condyle length	CYL	37	21.93	3.32	1.82	0.30
Coronoid height	CrH	48	66.65	63.81	7.99	1.15
Mandibular angle	M<	26	120.92	37.11	6.09	1.19
Incisura height	IH	49	51.35	24.86	4.99	0.71
Mandibular breadth at M2	G'2	41	46.32	9.42	3.07	0.48

males showed evidence of a skewed distribution. While this may be evidence for incorrect sexing, the lack of short males in the Anglo-Saxon sample suggests that men during this period attained their potential height. There were few very tall or very short people in any of the samples.

Carter gives a modern average of 68 inches (174 cm) with a standard deviation of 2.6 inches (6 cm) for fully-grown young men in south-east England.[3] He adds that this is one of the regions

[3] Carter 1977, 105.

TABLE 4.9

Cranial measurements in millimetres, females from Anglo-Saxon graves, Cathedral Green, Winchester

Biometric dimension	Biometric symbol	Number of individuals	Mean	Variance	Standard deviation	Standard error of mean
Maximum cranial length	L	33	185.45	36.13	6.01	1.05
Maximum breadth	B	29	140.97	45.39	6.74	1.25
Minimum frontal breadth	B'	38	96.84	27.54	5.25	0.85
Maximum frontal breadth	B"	39	118.51	33.68	5.80	0.93
Basi-bregmatic height	H'	17	130.18	22.53	4.75	1.15
Basi-nasal length	LB	15	98.87	16.70	4.09	1.05
Frontal arc	S1	37	123.81	40.16	6.34	1.04
Parietal arc	S2	40	126.38	54.39	7.38	1.17
Occipital arc	S3	32	119.91	20.22	4.50	0.79
Frontal chord	S'1	39	109.51	43.73	6.61	1.06
Parietal chord	S'2	42	113.98	41.44	6.44	0.99
Occipital chord	S'3	32	99.03	43.52	6.60	1.17
Biasteronic breadth	Biast B	30	111.63	49.41	7.03	1.28
Bregmatic-sphenoid arc	P2	12	112.58	38.63	6.22	1.79
Bregmatic-asterion arc	P3	22	166.73	63.54	7.97	1.70
Lambda-asterion arc	O7	28	102.36	78.39	8.85	1.67
Basion-asterion chord	O9L	16	73.44	7.20	2.68	0.67
Maximum temporal length	T1	33	85.85	32.76	5.72	1.00
Sphenoid breadth	S4	17	68.41	40.76	6.38	1.55
Upper facial height	G'H	8	72.63	106.27	10.31	3.64
Basi-alveolar length	GL	8	95.00	27.14	5.21	1.84
Bimaxillary breadth	GB	15	92.13	15.98	4.00	1.03
Palatal breadth	G2	18	40.89	11.40	3.38	0.80
Palatal length	G'1	14	45.57	12.26	3.50	0.94
Bizygomatic breadth	J	9	127.00	21.75	4.66	1.55
Orbital breadth	O'1	10	39.60	7.82	2.80	0.88
Orbital height	O2	15	33.67	5.52	2.35	0.61
Foraminal length	FL	22	35.27	4.21	2.05	0.44
Foraminal breadth	FB	24	30.17	5.97	2.44	0.50
Malar height	MH	41	46.24	12.29	3.51	0.55
Nasal breadth	NB	27	25.00	6.38	2.53	0.49
Nasal height	NH'	12	49.00	6.91	2.63	0.76
Simotic chord	SC	23	8.82	1.94	1.39	0.29
Superior nasal breadth	NB4	27	11.59	5.48	2.34	0.45
Bidacryonic chord	DC	16	25.38	3.85	1.96	0.49
Bicondylar breadth	W1	13	118.23	29.36	5.42	1.50
Bimentalia breadth	ZZ	37	44.00	17.17	4.14	0.68
Ramus breadth	RB	43	31.02	7.12	2.67	0.41
Symphysial height	H1	30	29.97	7.55	2.75	0.50
Projective mandibular length	ML	11	99.81	25.96	5.10	1.54
Projective ramus length	RL	13	61.00	22.67	4.76	1.32
Height at M2	M2H	29	28.14	16.62	4.08	0.76
Condyle length	CYL	27	20.18	3.44	1.85	0.36
Coronoid height	CrH	32	60.41	38.77	6.23	1.10
Mandibular angle	M<	16	126.69	34.90	5.91	1.48
Incisura height	IH	26	45.65	28.00	5.29	1.04
Mandibular breadth at M2	G'2	22	43.95	10.24	3.20	0.68

with the tallest men in the British Isles. The men from the Anglo-Saxon graves were thus on average slightly more than one centimetre taller than their modern counterparts. The large standard deviations in the Winchester samples suggest that this difference should not be emphasized.

Sexual dimorphism was most marked in the height of males and females. During the Anglo-Saxon period in Winchester, when average height for males was 175.1 cm (5′ 9″) and the tallest

TABLE 4.10

Cranial measurements in millimetres, males from the Anglo-Saxon charnel, Cathedral Green, Winchester

Biometric dimension	Biometric symbol	Number of individuals	Mean	Variance	Standard deviation	Standard error of mean
Maximum cranial length	L	118	191.68	38.85	6.23	0.57
Maximum breadth	B	115	143.31	40.91	6.40	0.60
Minimum frontal breadth	B'	127	98.77	24.14	4.91	0.44
Maximum frontal breadth	B"	132	123.52	35.99	6.00	0.52
Basi-bregmatic height	H'	36	133.93	41.58	6.45	1.07
Basi-nasal length	LB	36	102.76	34.43	5.87	0.98
Frontal arc	S1	132	129.55	42.17	6.49	0.57
Parietal arc	S2	134	130.71	66.60	8.16	0.70
Occipital arc	S3	87	124.92	80.68	8.98	0.96
Frontal chord	S'1	133	112.97	27.25	5.22	0.45
Parietal chord	S'2	134	117.70	53.95	7.35	0.63
Occipital chord	S'3	86	101.51	56.25	7.50	0.81
Biasteronic breadth	Biast B	115	114.61	30.70	5.54	0.52
Bregmatic-sphenoid arc	P2	42	115.95	45.75	6.76	1.04
Bregmatic-asterion arc	P3	113	169.97	83.70	9.15	0.86
Lambda-asterion arc	O7	116	103.07	46.64	6.83	0.63
Basion-asterion chord	O9L	40	78.12	14.37	3.79	0.60
Maximum temporal length	T1	86	91.27	20.32	4.51	0.49
Sphenoid breadth	S4	48	73.83	14.30	3.78	0.55
Upper facial height	G'H	17	71.86	19.49	4.41	1.07
Basi-alveolar length	GL	14	98.06	16.75	4.09	1.09
Bimaxillary breadth	GB	13	94.30	28.10	5.30	1.47
Palatal breadth	G2	23	41.43	10.64	3.26	0.68
Palatal length	G'1	25	46.57	12.95	3.60	0.72
Bizygomatic breadth	J	6	132.67	52.27	7.23	2.95
Orbital breadth	O'1	19	39.08	10.69	3.27	0.75
Orbital height	O2	18	34.38	5.84	2.42	0.57
Foraminal length	FL	47	35.87	6.81	2.61	0.38
Foraminal breadth	FB	59	30.33	8.61	2.93	0.38
Malar height	MH	58	49.72	6.26	2.50	0.33
Nasal breadth	NB	29	25.44	3.90	1.98	0.37
Nasal height	NH'	15	54.34	99.92	10.00	2.58
Simotic chord	SC	43	9.85	2.77	1.66	0.25
Superior nasal breadth	NB4	59	12.91	3.77	1.94	0.25
Bidacryonic chord	DC	24	26.04	4.56	2.14	0.44
Bicondylar breadth	W1	3	131.90	35.83	5.99	3.46
Bimentalia breadth	ZZ	8	46.34	1.94	1.39	0.49
Ramus breadth	RB	9	31.72	2.94	1.72	0.57
Symphysial height	H1	10	33.50	6.94	2.64	0.83
Projective mandibular length	ML	3	107.00	75.00	8.66	5.00
Projective ramus length	RL	2	69.00	32.00	5.66	4.00
Height at M2	M2H	7	31.29	25.65	5.07	1.91
Condyle length	CYL	6	22.55	3.07	1.75	0.72
Coronoid height	CrH	5	69.08	16.13	4.02	1.80
Mandibular angle	M<	2	118.50	24.50	4.95	3.50
Incisura height	IH	7	55.56	5.31	2.30	0.87
Mandibular breadth at M2	G'2	7	47.43	10.95	3.31	1.25

man recorded was 188 cm (6′ 2″) tall, the average height of women was 161.2 cm (5′ 3½″), although a few attained 183 cm (6′ 0″). This rather short average height for women was maintained during medieval times (161.6 cm or 5′ 4″), while men seemed to be slightly shorter (172.3 cm or 5′ 8½″) than their Anglo-Saxon counterparts. Sexual dimorphism is most marked when environmental conditions are good, males attain their potential height and females start to

TABLE 4.11

Cranial measurements in millimetres, females from the Anglo-Saxon charnel, Cathedral Green, Winchester

Biometric dimension	Biometric symbol	Number of individuals	Mean	Variance	Standard deviation	Standard error of mean
Maximum cranial length	L	51	183.51	34.17	5.85	0.82
Maximum breadth	B	54	139.01	29.87	5.47	0.74
Minimum frontal breadth	B'	70	96.70	35.04	5.92	0.71
Maximum frontal breadth	B"	70	118.53	35.91	5.99	0.72
Basi-bregmatic height	H'	14	129.57	25.65	5.06	1.35
Basi-nasal length	LB	11	96.55	25.67	5.07	1.53
Frontal arc	S1	67	126.27	48.90	6.99	0.85
Parietal arc	S2	73	125.12	67.22	8.20	0.96
Occipital arc	S3	40	120.80	34.16	5.85	0.92
Frontal chord	S'1	66	109.70	24.26	4.93	0.61
Parietal chord	S'2	71	112.80	44.11	6.64	0.79
Occipital chord	S'3	41	97.75	21.69	4.66	0.73
Biasteronic breadth	Biast B	55	110.82	41.95	6.48	0.87
Bregmatic-sphenoid arc	P2	26	110.88	37.71	6.14	1.20
Bregmatic-asterion arc	P3	55	163.49	43.92	6.63	0.89
Lambda-asterion arc	O7	61	100.13	27.48	5.24	0.67
Basion-asterion chord	O9L	14	74.59	36.69	6.06	1.62
Maximum temporal length	T1	44	86.38	20.58	4.54	0.68
Sphenoid breadth	S4	21	72.27	17.11	4.14	0.90
Upper facial height	G'H	5	65.80	3.70	1.92	0.86
Basi-alveolar length	GL	2	88.25	1.13	1.06	0.75
Bimaxillary breadth	GB	9	90.12	12.66	3.56	1.19
Palatal breadth	G2	11	39.77	6.38	2.53	0.76
Palatal length	G'1	5	45.18	1.66	1.29	0.58
Bizygomatic breadth	J	1	130.00	–	–	–
Orbital breadth	O'1	4	35.75	0.92	0.96	0.48
Orbital height	O2	6	33.92	7.64	2.76	1.13
Foraminal length	FL	11	35.18	6.59	2.57	0.77
Foraminal breadth	FB	19	29.50	4.65	2.16	0.49
Malar height	MH	22	46.39	5.12	2.26	0.48
Nasal breadth	NB	12	24.42	3.01	1.74	0.50
Nasal height	NH'	6	54.13	88.85	9.43	3.85
Simotic chord	SC	18	9.49	2.61	1.62	0.38
Superior nasal breadth	NB4	36	11.78	6.29	2.51	0.42
Bidacryonic chord	DC	14	25.66	7.61	2.76	0.74
Bicondylar breadth	W1	0	–	–	–	–
Bimentalia breadth	ZZ	2	–	–	–	–
Ramus breadth	RB	1	–	–	–	–
Symphysial height	H1	2	–	–	–	–
Projective mandibular length	ML	0	–	–	–	–
Projective ramus length	RL	0	–	–	–	–
Height at M2	M2H	2	–	–	–	–
Condyle length	CYL	0	–	–	–	–
Coronoid height	CrH	0	–	–	–	–
Mandibular angle	M<	0	–	–	–	–
Incisura height	IH	0	–	–	–	–
Mandibular breadth at M2	G'2	2	–	–	–	–

reproduce early. Climatic conditions in England fluctuated, but only began to deteriorate seriously with the onset of the 'Little Ice Age' and increase in famine and pestilence discussed above.[4] By medieval times the town was more urbanized, more densely populated, and frequented by artisans and craftsmen.

[4] See above, pp. 271–2.

TABLE 4.12

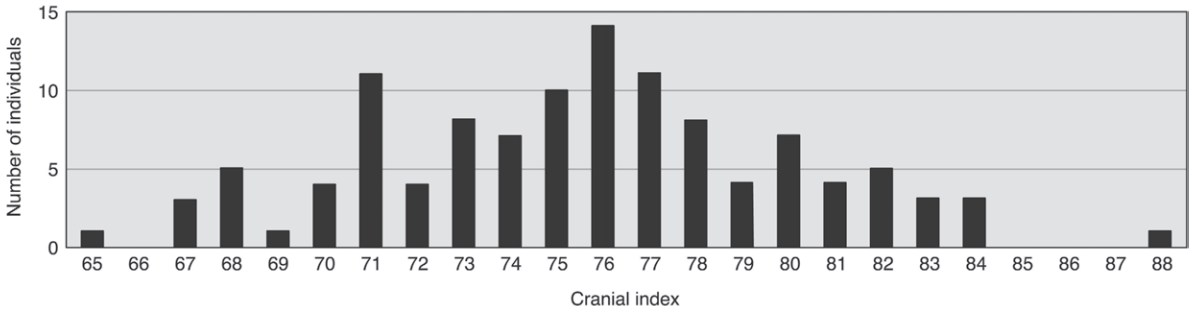
Cranial measurements in millimetres, males from medieval earth and cist graves, Cathedral Green, Winchester

Biometric dimension	Biometric symbol	Number of individuals	Mean	Variance	Standard deviation	Standard error of mean
Maximum cranial length	L	135	185.80	54.00	7.35	0.63
Maximum breadth	B	140	147.64	56.39	7.51	0.63
Minimum frontal breadth	B'	151	99.85	21.16	4.60	0.37
Maximum frontal breadth	B"	151	124.87	59.70	7.73	0.63
Basi-bregmatic height	H'	86	135.03	37.65	6.14	0.66
Basi-nasal length	LB	75	101.63	21.35	4.62	0.53
Frontal arc	S1	139	129.65	48.14	6.94	0.59
Parietal arc	S2	147	126.15	60.00	7.74	0.64
Occipital arc	S3	113	120.81	58.87	7.67	0.72
Frontal chord	S'1	138	112.90	36.59	6.05	0.51
Parietal chord	S'2	149	113.06	40.39	6.36	0.52
Occipital chord	S'3	114	99.36	39.69	6.30	0.59
Biasteronic breadth	Biast B	127	114.90	40.69	6.38	0.57
Bregmatic-sphenoid arc	P2	26	114.12	64.27	8.02	1.57
Bregmatic-asterion arc	P3	119	170.97	93.84	9.69	0.89
Lambda-asterion arc	O7	130	100.55	72.35	8.51	0.75
Basion-asterion chord	O9L	74	77.40	28.03	5.29	0.62
Maximum temporal length	T1	95	90.94	27.25	5.22	0.54
Sphenoid breadth	S4	69	75.59	15.87	3.98	0.48
Upper facial height	G'H	56	69.93	41.56	6.45	0.86
Basi-alveolar length	GL	43	95.57	32.06	5.66	0.86
Bimaxillary breadth	GB	47	100.88	116.37	10.79	1.57
Palatal breadth	G2	70	42.92	13.43	3.67	0.44
Palatal length	G'1	77	48.11	18.64	4.32	0.49
Bizygomatic breadth	J	38	135.27	33.79	5.81	0.94
Orbital breadth	O'1	49	39.84	8.07	2.84	0.41
Orbital height	O2	60	34.63	8.02	2.83	0.37
Foraminal length	FL	87	35.97	8.14	2.85	0.31
Foraminal breadth	FB	92	30.68	5.95	2.44	0.25
Malar height	MH	102	49.54	8.54	2.92	0.29
Nasal breadth	NB	79	25.59	3.31	1.82	0.20
Nasal height	NH'	57	52.73	26.23	5.12	0.68
Simotic chord	SC	85	10.44	4.40	2.10	0.23
Superior nasal breadth	NB4	93	13.37	5.54	2.35	0.24
Bidacryonic chord	DC	39	27.26	11.10	3.33	0.53
Bicondylar breadth	W1	54	123.67	87.87	9.37	1.28
Bimentalia breadth	ZZ	100	46.09	10.68	3.27	0.33
Ramus breadth	RB	116	33.45	9.33	3.05	0.28
Symphysial height	H1	86	32.80	8.97	2.99	0.32
Projective mandibular length	ML	16	100.97	107.88	10.39	2.60
Projective ramus length	RL	11	67.64	44.85	6.70	2.02
Height at M2	M2H	74	30.43	7.95	2.82	0.33
Condyle length	CYL	82	21.80	5.33	2.31	0.25
Coronoid height	CrH	77	67.73	32.63	5.71	0.65
Mandibular angle	M<	23	119.04	56.77	7.53	1.57
Incisura height	IH	89	50.44	23.08	4.80	0.51
Mandibular breadth at M2	G'2	66	46.45	13.33	3.65	0.45

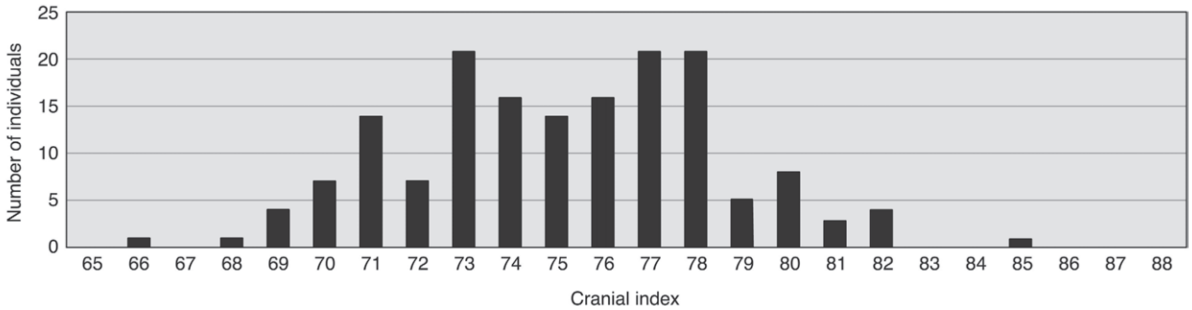
TABLE 4.13

Cranial measurements in millimetres, females from medieval earth and cist graves, Cathedral Green, Winchester

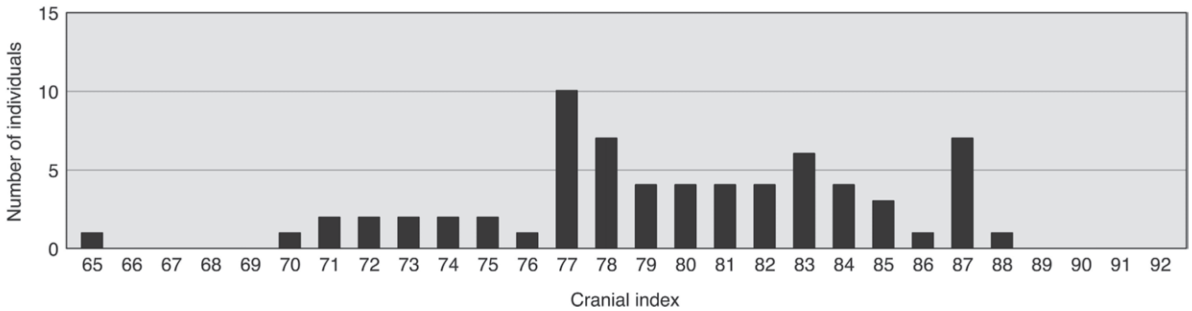
Biometric dimension	Biometric symbol	Number of individuals	Mean	Variance	Standard deviation	Standard error of mean
Maximum cranial length	L	88	178.03	58.13	7.62	0.81
Maximum breadth	B	88	142.52	35.69	5.97	0.64
Minimum frontal breadth	B'	82	96.90	17.60	4.19	0.46
Maximum frontal breadth	B"	84	120.34	41.72	6.46	0.70
Basi-bregmatic height	H'	54	129.06	43.07	6.56	0.89
Basi-nasal length	LB	50	96.30	21.33	4.62	0.65
Frontal arc	S1	81	124.56	47.18	6.87	0.76
Parietal arc	S2	87	120.38	87.94	9.38	1.01
Occipital arc	S3	78	117.33	72.00	8.48	0.96
Frontal chord	S'1	82	108.44	22.58	4.75	0.52
Parietal chord	S'2	88	108.58	50.02	7.07	0.75
Occipital chord	S'3	80	96.18	31.91	5.65	0.63
Biasteronic breadth	Biast B	86	111.03	27.56	5.25	0.57
Bregmatic-sphenoid arc	P2	31	113.32	57.23	7.56	1.36
Bregmatic-asterion arc	P3	73	163.96	107.93	10.39	1.22
Lambda-asterion arc	O7	80	97.78	67.44	8.21	0.92
Basion-asterion chord	O9L	45	72.55	25.85	5.08	0.76
Maximum temporal length	T1	68	86.51	27.41	5.24	0.63
Sphenoid breadth	S4	44	72.16	17.88	4.23	0.64
Upper facial height	G'H	34	66.83	25.29	5.03	0.86
Basi-alveolar length	GL	28	92.06	30.99	5.57	1.05
Bimaxillary breadth	GB	34	94.26	55.10	7.42	1.27
Palatal breadth	G2	46	40.72	10.55	3.25	0.48
Palatal length	G'1	54	45.38	13.85	3.72	0.51
Bizygomatic breadth	J	24	126.94	19.44	4.41	0.90
Orbital breadth	O'1	33	38.61	10.60	3.26	0.57
Orbital height	O2	39	34.52	6.87	2.62	0.42
Foraminal length	FL	55	34.63	6.79	2.61	0.35
Foraminal breadth	FB	54	29.32	5.73	2.39	0.33
Malar height	MH	70	46.56	7.25	2.69	0.32
Nasal breadth	NB	56	24.41	2.56	1.60	0.21
Nasal height	NH'	37	49.96	16.96	4.12	0.68
Simotic chord	SC	48	9.51	4.45	2.11	0.30
Superior nasal breadth	NB4	57	12.66	5.75	2.40	0.32
Bidacryonic chord	DC	20	25.85	5.24	2.29	0.51
Bicondylar breadth	W1	44	118.11	56.89	7.54	1.14
Bimentalia breadth	ZZ	67	44.01	8.46	2.91	0.36
Ramus breadth	RB	76	31.01	9.33	3.05	0.35
Symphysial height	H1	55	29.55	7.14	2.67	0.36
Projective mandibular length	ML	12	99.79	31.52	5.61	1.62
Projective ramus length	RL	10	59.30	28.46	5.33	1.69
Height at M2	M2H	51	26.74	7.94	2.82	0.39
Condyle length	CYL	61	19.91	2.91	1.71	0.22
Coronoid height	CrH	59	60.07	39.24	6.26	0.82
Mandibular angle	M<	16	125.88	23.58	4.86	1.21
Incisura height	IH	62	45.08	28.97	5.38	0.68
Mandibular breadth at M2	G'2	42	45.10	9.48	3.08	0.48



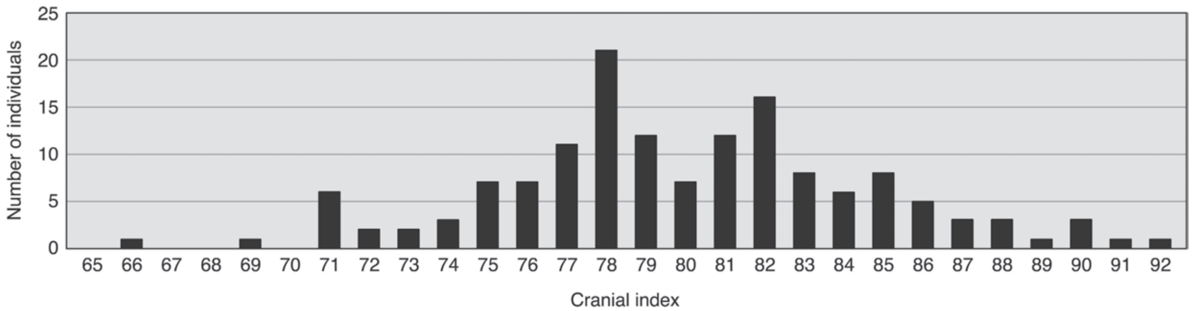
Illus. 4.13. Cranial index, Anglo-Saxon graves, Cathedral Green, Winchester.



Illus. 4.14. Cranial index, Anglo-Saxon charnel, Cathedral Green, Winchester.



Illus. 4.15. Cranial index, medieval earth graves, Cathedral Green, Winchester.



Illus. 4.16. Cranial index, medieval cist graves, Cathedral Green, Winchester.

TABLE 4.14

Postcranial measurements in millimetres, males from Anglo-Saxon graves, Cathedral Green, Winchester

Biometric dimension	Biometric symbol	Number of individuals	Mean	Variance	Standard deviation	Standard error of mean
Maximum length of femur	FeL_1	59	475.42	618.70	24.87	3.24
Minimum A-P diameter	FeD_1	94	28.44	4.76	2.18	0.22
Transverse diameter	FeD_2	96	34.73	6.01	2.45	0.25
Femur head diameter	–	72	49.55	7.51	2.74	0.32
Maximum length of tibia	TiL_1	63	384.56	695.61	26.37	3.32
Maximum A-P diameter	TiD_1	80	35.31	9.22	3.04	0.34
Transverse diameter	TiD_2	77	26.34	7.65	2.76	0.31
Maximum length of humerus	HuL_1	38	337.63	233.64	15.28	2.48
Maximum diameter	HuD_1	33	23.69	3.99	2.00	0.35
Minimum diameter	HuD_2	33	19.24	4.66	2.16	0.38
Maximum length of radius	RaL_1	36	257.72	177.41	13.32	2.22
Maximum length of ulna	UlL_1	42	276.31	209.78	14.48	2.23

TABLE 4.15

Postcranial measurements in millimetres, females from Anglo-Saxon graves, Cathedral Green, Winchester

Biometric dimension	Biometric symbol	Number of individuals	Mean	Variance	Standard deviation	Standard error of mean
Maximum length of femur	FeL_1	35	426.17	555.15	23.56	3.98
Oblique length of femur	FeL_2	25	424.56	566.17	23.79	4.76
Minimum A-P diameter	FeD_1	56	24.38	4.45	2.11	0.28
Transverse diameter	FeD_2	56	32.13	6.75	2.60	0.35
Femur head diameter	–	39	42.58	5.01	2.24	0.36
Maximum length of tibia	TiL_1	34	342.81	485.82	22.04	3.78
Maximum A-P diameter	TiD_1	51	30.99	6.16	2.48	0.35
Transverse diameter	TiD_2	51	22.75	5.09	2.26	0.32
Maximum length of humerus	HuL_1	29	309.03	318.39	17.84	3.31
Maximum diameter	HuD_1	28	21.36	3.95	1.99	0.38
Minimum diameter	HuD_2	28	16.83	2.70	1.64	0.31
Maximum length of radius	RaL_1	30	226.30	267.88	16.37	2.99
Maximum length of ulna	UlL_1	23	247.26	189.75	13.77	2.87

TABLE 4.16

Postcranial measurements in millimetres, males from the Anglo-Saxon charnel, Cathedral Green, Winchester

Biometric dimension	Biometric symbol	Number of individuals	Mean	Variance	Standard deviation	Standard error of mean
Maximum length of femur	FeL_1	14	470.07	517.30	22.74	6.08
Minimum A-P diameter	FeD_1	27	29.15	5.07	2.25	0.43
Transverse diameter	FeD_2	28	34.95	8.43	2.90	0.55
Femur head diameter	–	23	50.22	4.91	2.22	0.46
Maximum length of tibia	TiL_1	11	398.64	248.25	15.76	4.75
Maximum A-P diameter	TiD_1	15	36.00	12.57	3.55	0.92
Transverse diameter	TiD_2	14	25.29	4.22	2.05	0.55

TABLE 4.17

Postcranial measurements in millimetres, females from the Anglo-Saxon charnel, Cathedral Green, Winchester

Biometric dimension	Biometric symbol	Number of individuals	Mean	Variance	Standard deviation	Standard error of mean
Maximum length of femur	FeL_1	16	433.69	1007.30	31.74	7.93
Minimum A-P diameter	FeD_1	23	25.96	1.94	1.39	0.29
Transverse diameter	FeD_2	22	32.40	4.38	2.09	0.45
Femur head diameter	–	19	43.71	9.15	3.02	0.69
Maximum length of tibia	TiL_1	11	353.82	589.76	24.29	7.32
Maximum A-P diameter	TiD_1	14	31.82	4.14	2.03	0.54
Transverse diameter	TiD_2	14	23.57	5.03	2.24	0.60

TABLE 4.18

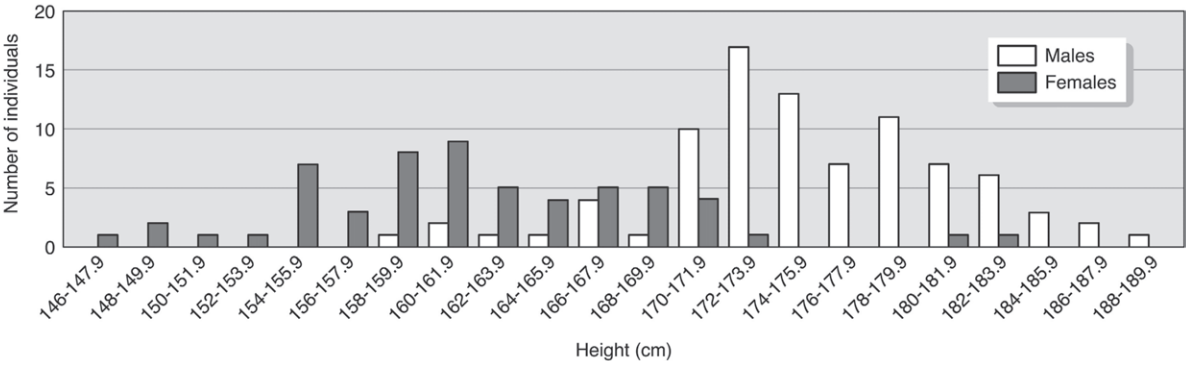
Postcranial measurements in millimetres, males from medieval earth and cist graves, Cathedral Green, Winchester

Biometric dimension	Biometric symbol	Number of individuals	Mean	Variance	Standard deviation	Standard error of mean
Maximum length of femur	FeL_1	157	460.01	626.58	25.03	2.00
Minimum A-P diameter	FeD_1	256	28.86	5.65	2.38	0.15
Transverse diameter	FeD_2	257	34.67	7.10	2.66	0.17
Femur head diameter	–	206	48.87	7.85	2.80	0.20
Maximum length of tibia	TiL_1	249	366.33	553.75	23.53	1.49
Maximum A-P diameter	TiD_1	364	36.05	8.61	2.93	0.15
Transverse diameter	TiD_2	359	26.10	6.09	2.47	0.13
Maximum length of humerus	HuL_1	226	328.60	366.52	19.14	1.27
Maximum diameter	HuD_1	231	23.72	3.22	1.79	0.12
Minimum diameter	HuD_2	229	19.76	2.99	1.73	0.11
Maximum length of radius	RaL_1	132	247.80	199.61	14.13	1.23
Maximum length of ulna	UlL_1	127	264.60	365.88	19.13	1.70

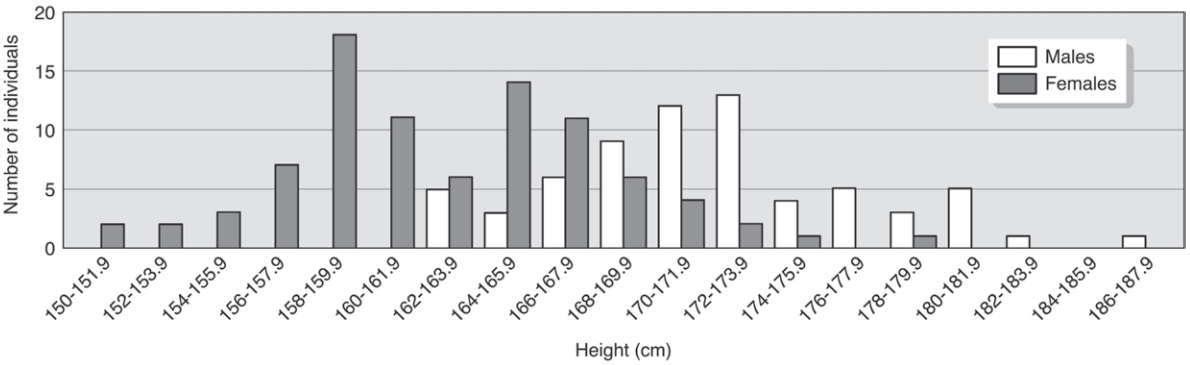
TABLE 4.19

Postcranial measurements in millimetres, females from medieval earth and cist graves, Cathedral Green, Winchester

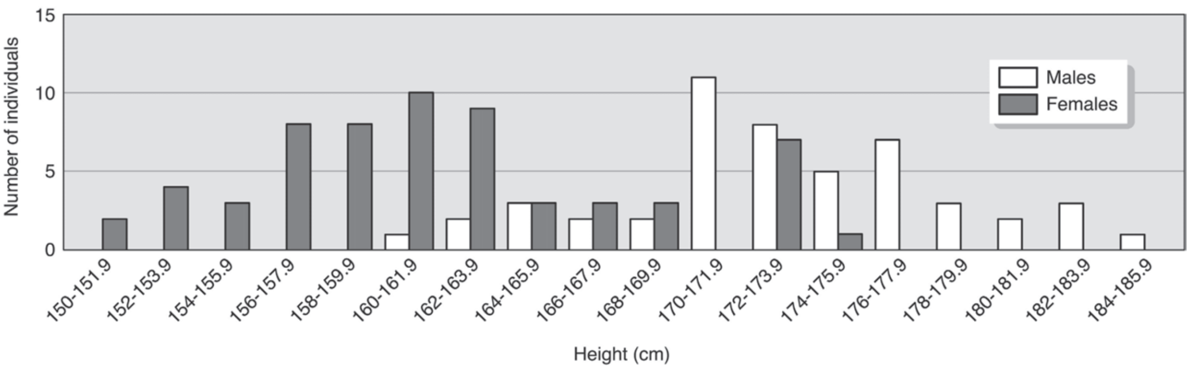
Biometric dimension	Biometric symbol	Number of individuals	Mean	Variance	Standard deviation	Standard error of mean
Maximum length of femur	FeL_1	114	431.52	551.58	23.49	2.20
Minimum A-P diameter	FeD_1	213	25.08	3.83	1.96	0.13
Transverse diameter	FeD_2	215	31.77	6.30	2.51	0.17
Femur head diameter	–	182	43.46	7.89	2.81	0.21
Maximum length of tibia	TiL_1	179	344.17	405.63	20.14	1.51
Maximum A-P diameter	TiD_1	278	31.75	10.52	3.24	0.19
Transverse diameter	TiD_2	278	23.09	4.68	2.16	0.13
Maximum length of humerus	HuL_1	161	305.38	302.39	17.39	1.37
Maximum diameter	HuD_1	163	21.39	4.52	2.13	0.17
Minimum diameter	HuD_2	163	17.17	3.35	1.83	0.14
Maximum length of radius	RaL_1	97	227.86	219.65	14.82	1.50
Maximum length of ulna	UlL_1	88	253.80	307.29	17.53	1.87



Illus. 4.17. Stature, Anglo-Saxon graves, Cathedral Green, Winchester.



Illus. 4.18. Stature, medieval earth graves, Cathedral Green, Winchester.



Illus. 4.19. Stature, medieval cist graves, Cathedral Green, Winchester.

TABLE 4.20

Stature, males and females, Cathedral Green, Winchester

Sample	Sex	Number	Mean stature (cm)	Standard deviation	Range (cm)
Anglo-Saxon graves	males	87	175.1 (5′9″)	5.86	158 (5′2″)–188 (6′2″)
	females	61	161.2 (5′3½″)	7.27	146.5 (4′9½″)–183 (6′0″)
Medieval earth graves	males	67	171.8 (5′7 ½″)	5.34	162 (5′4″)–186 (6′1″)
	females	90	162.4 (5′4″)	6.02	143 (4′8″)–179 (5′10½″)
Medieval cist graves	males	50	172.8 (5′8″)	5.48	160.5 (5′3″)–184 (6′0½″)
	females	58	160.8 (5′3½″)	5.77	150 (4′11″)–174 (5′8½″)

TABLE 4.21

Samples used for multivariate analysis in Chapter 3 (Illus. 4.20–4.30), Chapter 4 (Illus. 4.47–4.49), and Chapter 8 (Illus. 4.110–4.113) *

In the illustrations cited above, the samples have the abbreviated names printed here in bold

Iron Age	**English**	English pooled sample
	Yorkshire	Yorkshire pooled sample
Romano-British	**Winchester**	Winchester pooled sample (excluding Lankhills)**
	Ancaster	Ancaster (Lincs.) cemetery
	Cannington	Cannington [Dark Age] (Somerset) cemetery
	Cirencester	Cirencester (Glos.) cemetery
	Frilford	Frilford (Berks.) cemetery
	Poundbury	Poundbury (Dorset) cemetery
	Roman	Roman pooled sample
	S. England	South England pooled sample (Dorset to Kent)
	York	York cemeteries pooled sample
Anglo-Saxon	**Winchester AS graves**	Winchester, Cathedral Green, Anglo-Saxon graves
	Winchester AS charnel	Winchester, Cathedral Green, Anglo-Saxon charnel
	Abingdon	Abingdon (Berks.) cemetery
	Alton	Alton (Hants) cemetery
	Barton	Barton Bendish (Norfolk) cemetery
	Berinsfield	Berinsfield (Oxon) cemetery
	Bidford	Bidford-on-Avon, cemetery (Warwicks.)
	Burwell	Burwell cemetery (Cambs.)
	Empingham	Empingham (Rutland) cemetery
	Hampshire	Hampshire pooled sample (Alton, Winnall II, Worthy Park)
	Kent	Kent pooled sample
	Raunds	Raunds (Northants) cemetery
	Sedgeford	Sedgeford (Norfolk) cemetery
	S. England	South England pooled sample (Dorset to Kent)
	Wiltshire	Wiltshire pooled sample
	Winnall II	Winnall II (Hants) cemetery
	Worthy Park	Worthy Park, Kingsworthy (Hants) cemetery
	Yorkshire	Yorkshire pooled sample
Medieval	**Winchester Med earth graves**	Winchester, Cathedral Green, medieval earth graves
	Winchester Med cist graves	Winchester, Cathedral Green, medieval cist graves
	Winchester Med graves combined	Winchester, Cathedral Green. earth and cist graves
	Cambridge	Cambridge pooled sample
	Carlisle	Carlisle (Cumbs.) cathedral cemetery
	Chelmsford	Chelmsford Essex) series
	Chichester	Chichester (Sussex) St James and St Mary Magdalene leper cemetery
	Clopton	Clopton (Cambs.) cemetery
	Cuddington	Cuddington (Surrey) cemetery
	Dunstable	Dunstable (Beds.) Galley Hill, execution cemetery
	E. Anglia	East Anglia pooled sample
	English	English pooled sample
	Fishergate	York, Fishergate (Period 6), Gilbertine Priory cemetery
	Gallen Priory	Gallen Priory (Offaly, Ireland), cemetery
	Guildford	Guildford (Surrey) Dominican friary cemetery
	Huntingdon	Huntingdon (Hunts) Spittal's Link leper cemetery
	Hythe	Hythe (Kent) charnel house
	Ipswich	Ipswich (Suffolk) Dominican friary cemetery
	Jewbury	York, Jewbury
	Oxfordshire	Oxfordshire pooled sample
	Pontefract	Pontefract Priory (Yorks.)
	St Helen	York, St Helen-on-the-Walls cemetery
	Scarborough	Scarborough (Yorks.) series
	Spitalfields	Spitalfields (London) St Mary Spital priory cemetery
	Stratford	Stratford Langthorpe (London) abbey cemetery
	Wharram Percy	Wharram Percy (Yorks.)

* The data from these sites were all collected directly or assembled by Professor Don Brothwell.
** The 'Winchester pooled sample' listed here refers only to data collected before 1974.

ii. MULTIVARIATE EVALUATION OF THE WINCHESTER SAMPLES[5]

While some differences between samples can be seen at a univariate or selected bivariate level, the most sensitive evaluation of biological affinities of the Winchester and comparative groups can be made by recourse to the multivariate appraisal of their biological distances. With the assistance of the Department of Statistics at Rothamstead Experimental Station, and employing the *Genstat* statistical programme, the Winchester data was considered by canonical analysis at a series of 'levels'. These levels grouped the osteometric data in various ways:

1. A general analysis of commonly occurring dimensions.
2. A consideration of cranial vault measurements only.
3. Variation in the occipital and cranial base regions only.
4. Differences in the frontal and parietal areas.
5. Evidence for facial variation (excluding the mandible).
6. Variation in the mandible.

The rationale behind this regional anatomical consideration of the data was that it gave an opportunity to consider in more detail the differing importance of parts of the skull in providing evidence of variation and change in these earlier British groups. Table 4.21 lists the samples used in the multivariate analyses in this and following chapters.

1. General analysis of common cranial variables

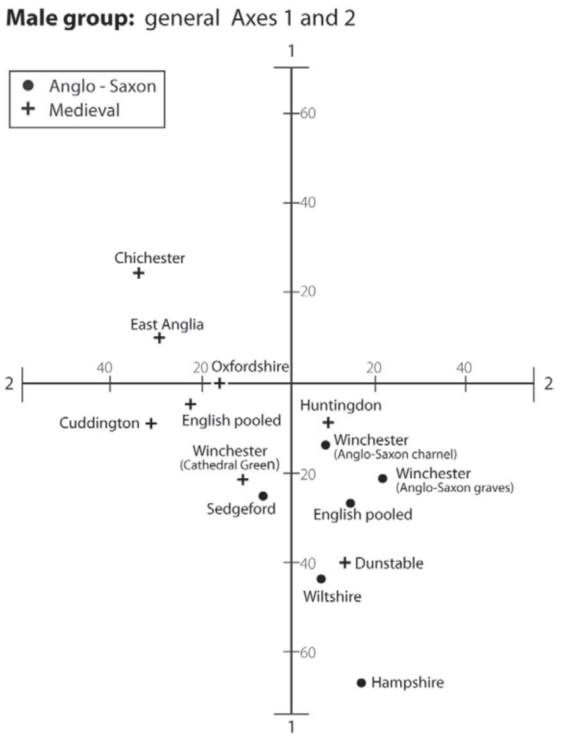
As already outlined in an earlier analysis by Brothwell and Krzanowski,[6] Anglo-Saxon and medieval populations appear to be distinctive when evaluated using the canonical analysis of common skull measurements. As seen in Illus. 4.20 (males, Axes 1 and 2), Anglo-Saxon and medieval groups show separate clustering. Although smallness of samples may have distorted affinities to some extent, it is also possible that this is evidence of the influence of founder effect or social and regional differentials, as well as a time difference of over 200 years in cemetery samples. While the medieval and Anglo-Saxon groups in general remain clearly distinctive, the Winchester Anglo-Saxon charnel material behaves somewhat enigmatically and occupies a position slightly closer to the medieval groups. Discrimination between Anglo-Saxon and medieval groups is slightly better using male osteometric dimensions than using female dimensions (Illus. 4.20 and 4.21).

2. Vault measurements only

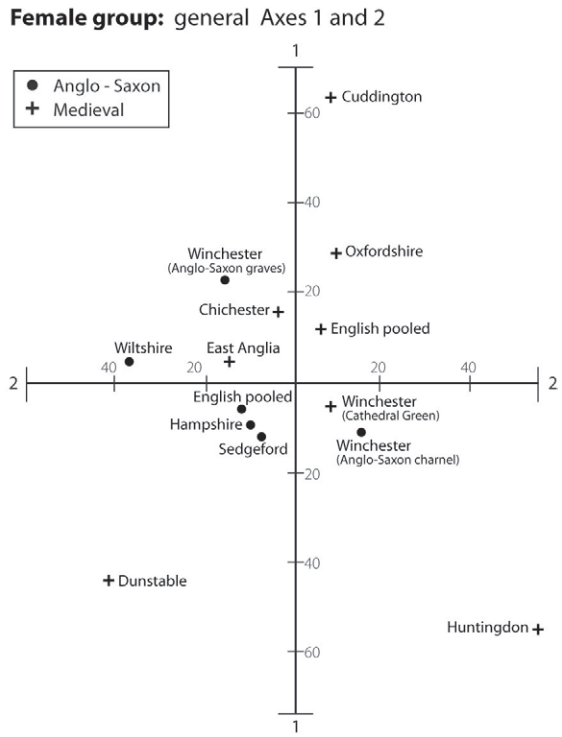
Again, the various southern English Anglo-Saxon and medieval groups separate out, with the Winchester Anglo-Saxon charnel sample occupying a somewhat closer position to the Anglo-Saxon samples (Illus. 4.22 and 4.23). This is the case for both males and females.

[5] The data analyses in this section were supplied by Professor Don Brothwell, whom the editors thank for his generous contribution of this material.

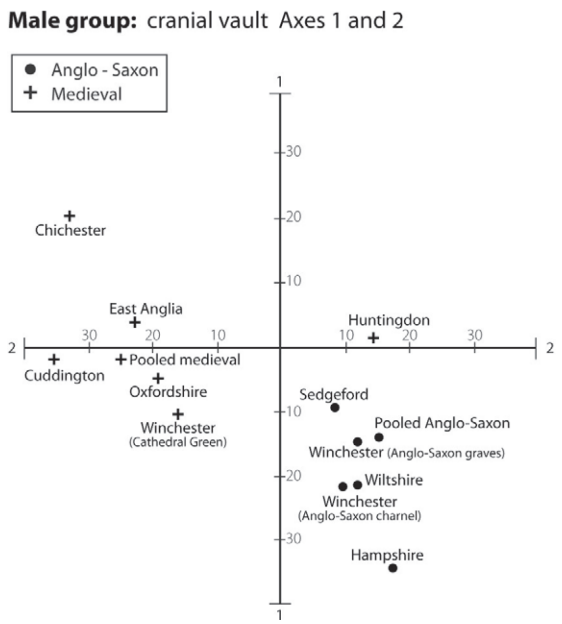
[6] Brothwell and Krzanowski 1974. Cranial measurements cited in that article include maximum length, maximum breadth, minimum frontal breadth, maximum frontal breadth, frontal arc, parietal arc, frontal chord, parietal chord, biasterionic breadth, bregma-asterion arc, and lambda-asterion arc.



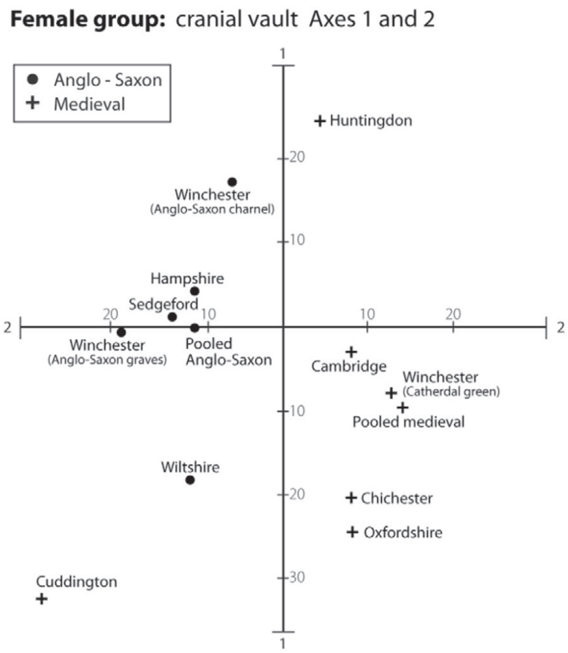
Illus. 4.20. General canonical analysis of selected Anglo-Saxon and medieval groups, males



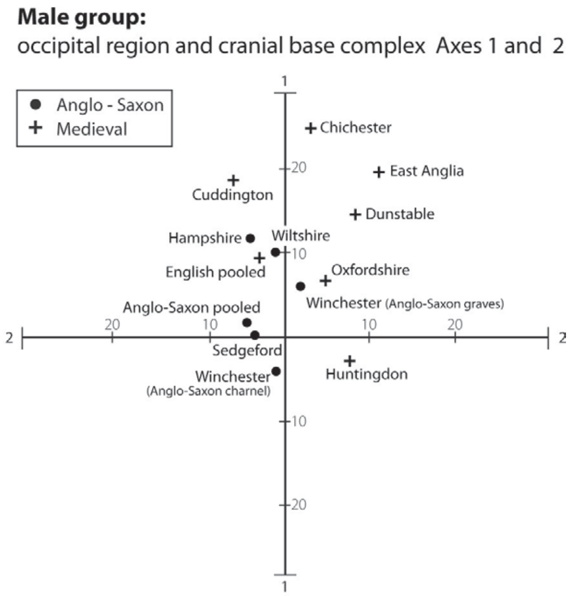
Illus. 4.21. General canonical analysis of selected Anglo-Saxon and medieval groups, females.



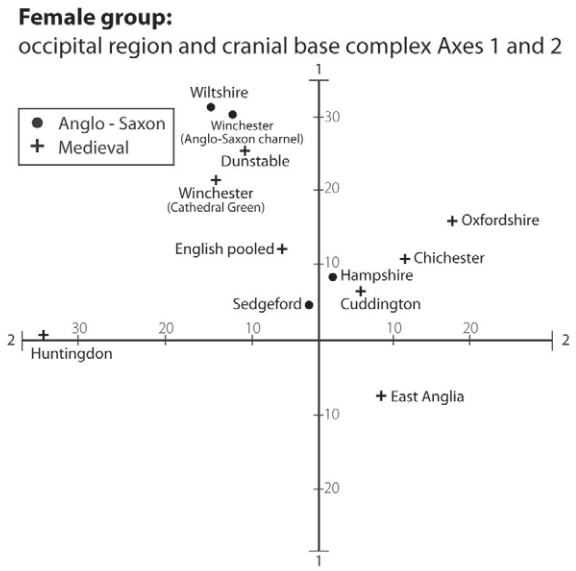
Illus. 4.22. Canonical analysis of a series of cranial vault measurements for Winchester samples and comparative series, males.



Illus. 4.23. Canonical analysis of a series of cranial vault measurements for Winchester samples and comparative series, females.



Illus. 4.24. Occipital and cranial base variation in males.



Illus. 4.25. Occipital and cranial base variation in females.

3. Variation in the occipital and cranial base

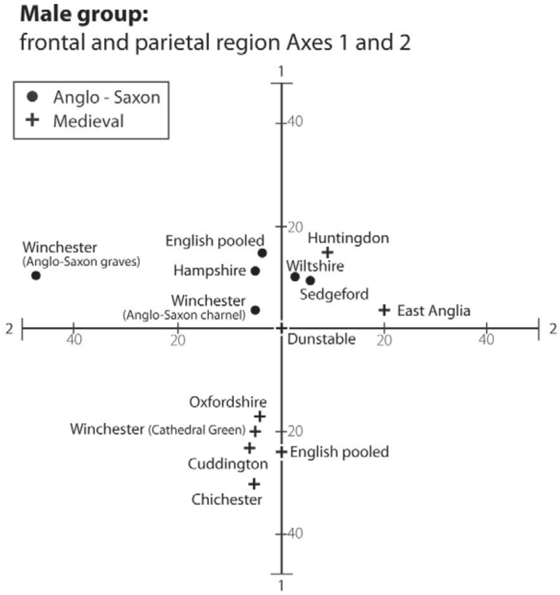
In an attempt to understand the variation in some detail, more limited regional growth areas were considered. In the case of the more basal and posterior part of the cranial vault, variation in group distribution for both males and females (Illus. 4.24 and 4.25) was perhaps most influenced by Axis 1 with a major size component. Most variation was to be seen in the medieval groups, with the Winchester Anglo-Saxon charnel position being closest to the Anglo-Saxon groups in males.

4. Differences in the frontal and parietal areas

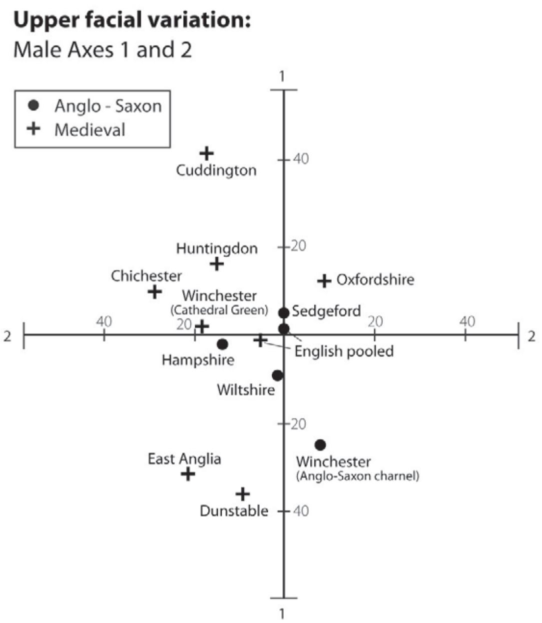
While not expecting to find much separation of the groups on the limited number of dimensions from this part of the skull, there was in fact sensible separation of the Anglo-Saxon and medieval groups—at least for the males (Illus. 4.26). Moreover, it was notable that the pooled Hampshire Anglo-Saxons and Winchester charnel material were close in position, while along Axis 2 which describes shape there was a clear separation of the Winchester Anglo-Saxon graves from the rest. This could be more a reflection of sample size than actual biological distance.

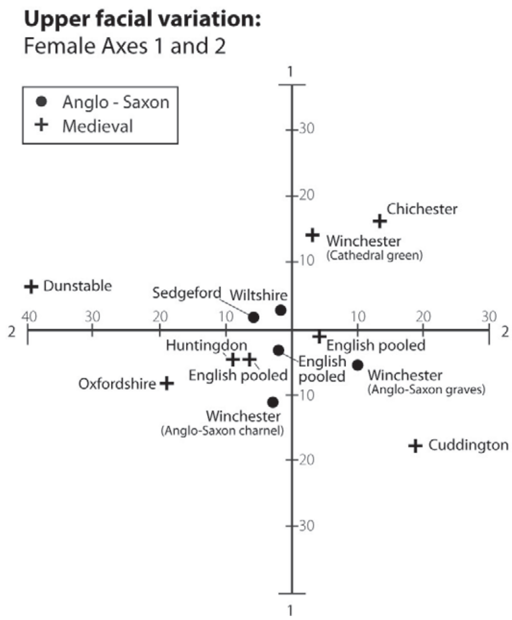
5. Evidence for upper facial variation

Simply by the visual inspection of the facial region of earlier historic populations, it is possible to distinguish considerable variation. Some of these differences, in shape terms, are subtle and of course need not be detectable by measurement. This region in fact, and in contrast to much of the other osteometric evidence, shows apparent overlap between Anglo-Saxon and medieval groups, with the maximum variation separating out along Axis 2 for Anglo-Saxon groups (especially in the females, Illus. 4.28). In this respect, the results suggest that there is more regional variation in facial morphology than of facial change through time.



Illus. 4.26. Fronto-parietal variation for Winchester and comparative groups, males.



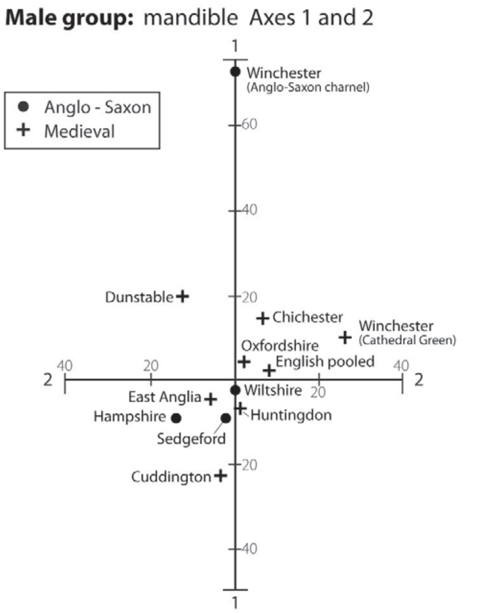


Illus. 4.27. Upper facial variation for Winchester and comparative groups, males.

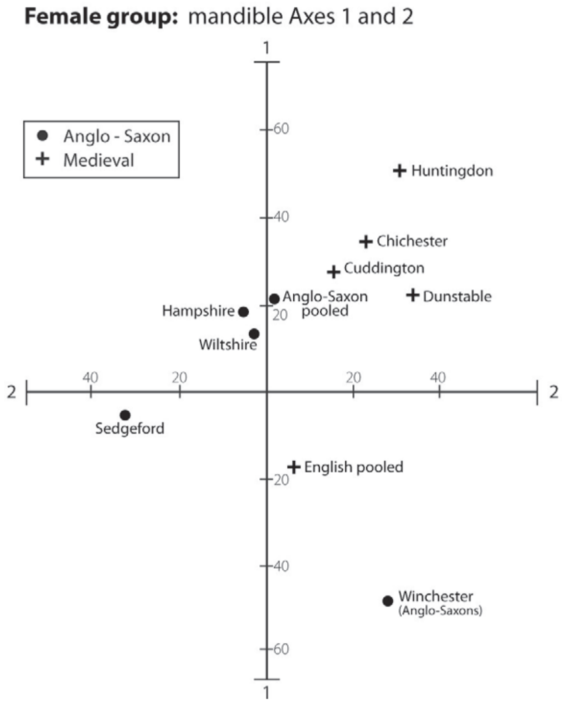
Illus. 4.28. Upper facial variation for Winchester and comparative groups, females.

6. Variation in the mandible

Again, as in the upper face, there is no evident separation of the Anglo-Saxon and medieval groups from one another. Along the 'shape' Axis 2 in particular (for both sexes), there is considerable separation of some of the groups. For males (Illus. 4.29), the Winchester and Chichester medieval



Illus. 4.29. Mandible variation in males for Winchester and comparative groups.



Illus. 4.30. Mandible variation in females for Winchester and comparative groups.

samples are distinctive. So also are the Winchester Charnel Anglo-Saxons, but specifically in relation to Axis 1 (size influenced). In the case of the females (Illus. 4.30), the Anglo-Saxons show very noticeable divergence, a fact which again suggests that the lower face may exhibit subtle differences in morphology which might assist in the differentiation of roughly contemporary populations more than groups extending through time.

iii. GENERAL CONCLUSIONS FROM THE CANONICAL ANALYSIS

The multivariate assessment of osteometric measurements has provided some significant conclusions as regards the population affinities of certain Winchester groups, both in comparison with one another and in relation to a number of other English samples. In particular, it can be said that the various Anglo-Saxon and medieval samples tend to be distinctive in relation to certain aspects of morphology, which suggests that physical change was indeed occurring in Winchester, and the south generally, from the sixth to roughly the sixteenth century; in other words providing a record of micro-evolutionary change over a thousand years.

Within these major temporal and cultural periods, the Anglo-Saxon and medieval, it is also evident that small regional communities could show variation and distinctiveness. Because this variation does not appear to be haphazard on the canonical plots (Illus. 4.20–4.30), but there is some sensible clustering, it would seem most likely that the intra-cultural variation may truly indicate actual micro-evolutionary differences in these small communities, dependent on such factors as founder effect and environmental conditions.

The most problematical group from Winchester is without doubt the Anglo-Saxon charnel sample. On the evidence of this multivariate analysis, it does not show unequivocal affinities with the Anglo-Saxon groups. Indeed, by the vault measurements the charnel sample is seen to occupy an intermediate position between Anglo-Saxon and medieval forms. Again, one might call in sample bias to explain this, but alternatively it is necessary to question whether social factors or even foreign elements in the community caused a shift in biological affinities.

4

DISCONTINUOUS VARIATION AND CONGENITAL ANOMALIES

In this section we survey the distribution of variable traits of the human skeleton which has been observed in the populations from Winchester. Some, at least, are 'known' to 'run in families' although they may be, in origin, nutritional or occupational as well as inherited. The occurrence of different frequencies of certain traits in different populations supports the contention that they have a genetic basis, although for the most part the mechanism of this inheritance is poorly understood.[1] On further study, some may turn out to have a purely environmental basis. The distribution and frequency of these traits are useful population markers,[2] and can be a means of detecting genetic drift and micro-evolutionary trends in a chronological sequence such as we have at Winchester.

Cranial suture anomalies, torus development, dental anomalies, and variants in the bones of the postcranial skeleton were scored systematically in each skeleton. The existence of a further group of anomalies, mostly vertebral and sternal, was noted whenever it was observed.

It is unlikely that these anomalies would have had any significantly detrimental effect on the life of the individual or on his or her chances of survival. There is, however, a group of anomalies which are, to variable degrees, incapacitating. In particular, the congenital condition of diaphysial aclasia could be included here. The frequency of this condition is extremely low and is more a measure of the mutation rate rather than of affinity within the population or between populations. A single case of diaphysial aclasia in the Cathedral Green samples is described in section vi, below.

i. CRANIAL SUTURE VARIATIONS

The skull bones and the many non-metric variations they present have been the subject of extensive studies for more than a century.[3] The two frontal bones of the newborn child have usually fused and united by the conclusion of the second year of life. A medio-frontal, or metopic, suture persists in a certain proportion of adults and although the exact reason for this is not known there is certainly a genetic component.[4] The trait is apparently linked to the shape of the pteric region as this exhibits greater variability in metopic than in non-metopic series.[5]

The frequency of metopism[6] was higher

[1] For a summary of more recent research into the heritability of non-metric, or epigenetic, traits, see Spector 2012, 33 ff., who defines epigenetics as a heritable effect that is not due to changes in DNA structure, but to methylation, a process through which methyl groups are attached to the bases of DNA, to silence gene expression and so to prevent or modify protein production. The trait is then passed to the next generation, but may fade after a few more generations. The essence of epigenetics is a reversible heritable change which does not alter the DNA sequence, and may give survival advantages. See also Carey 2012; Molleson 2010; VerMilyea et al. 2009; See et al. 2008; Turner 2009.

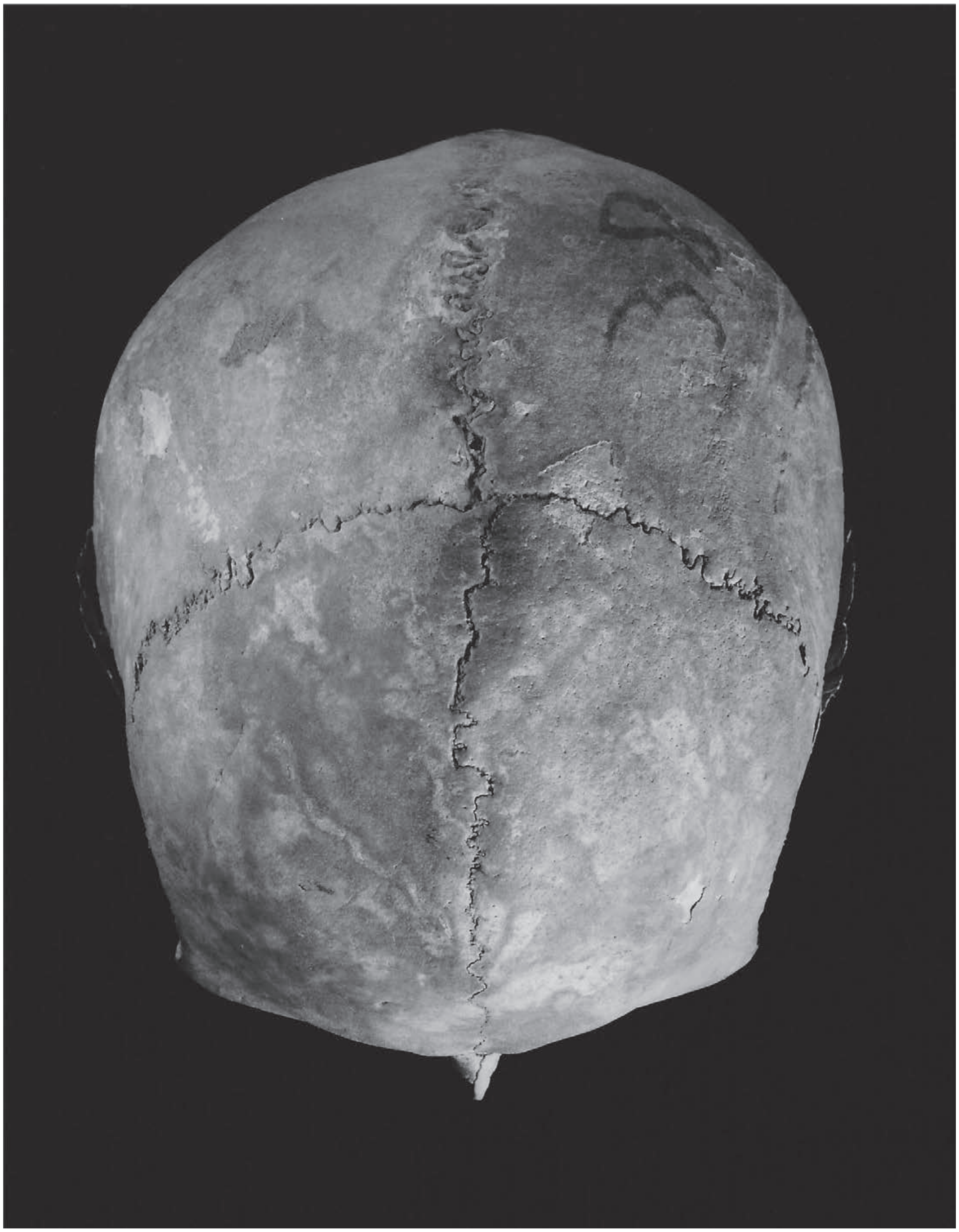
[2] Ossenberg 1976.

[3] Le Double 1903.

[4] Torgerson 1951, 193–201.

[5] Comas 1960.

[6] As used here, metopism is considered to be the presence of a full metopic suture. See above, p. 123, n. 148.



Illus. 4.31. Persistent metopic suture in the frontal bone of an adult. ASC Skull 938.

among females than males in the Anglo-Saxon charnel, but the sexes were almost equally represented in the medieval earth graves. No meaningful trend in frequency levels was detected from Anglo-Saxon to medieval times. Frequency ranged from 6.4% in males from Anglo-Saxon graves to 11.8% in Anglo-Saxon charnel females (Table 4.22, Illus. 4.31).

TABLE 4.22

Percentage frequencies of non-metric traits, Cathedral Green, Winchester

(sample size is shown in brackets)

	Anglo-Saxon graves		Anglo-Saxon charnel		Combined Anglo-Saxon		Combined Medieval	
	M	F	M	F	M	F	M	F
Metopism	6.4 (94)	6.6 (61)	7.0 (115)	11.8 (51)	6.7 (209)	9.2 (112)	9.2 (173)	9.2 (98)
Torus palatinus	25.0 (64)	13.1 (38)	13.3 (30)	ns	19.1 (94)	ns	23.6 (106)	32.3 (65)
Coronal Wormian bones	3.5 (57)	2.2 (46)	3.8 (78)	2.6 (39)	3.6 (135)	2.4 (85)	1.6 (122)	1.3 (75)
Sagittal Wormian bones	7.7 (52)	4.3 (46)	7.3 (68)	10.8 (37)	7.5 (120)	7.5 (83)	1.7 (119)	4.0 (75)
Lambdoid Wormian bones	47.6 (63)	42.2 (45)	38.5 (83)	59.1 (44)	43 (146)	50.6 (89)	42.5 (134)	36.1 (83)
Supraorbital foramen	26.5 (147)	32.3 (102)	26.1 (195)	32.3 (96)	26.3 (342)	32.3 (198)	25.2 (230)	31.7 (145)
Torus maxillaris	38.5 (52)	26.7 (30)	38.7 (31)	ns	38.6 (83)	ns	31.7 (101)	22.9 (61)
Parietal foramen	42.6 (122)	30.8 (78)	46.5 (202)	85.2 (54)	44.5 (324)	58 (132)	58.8 (245)	70.6 (119)
Parietal notch bone	11.1 (99)	11.3 (62)	6.5 (167)	4.6 (65)	8.8 (266)	7.9 (127)	22.2 (203)	22.3 (121)
Torus auditivus	3.7 (80)	0 (56)	1.0 (95)	0 (42)	2.3 (175)	0 (98)	2.2 (136)	3.6 (84)
Torus mandibularis	14.1 (64)	2.0 (50)	ns	ns	ns	ns	5.9 (119)	3.0 (100)
Inca bone	2.7 (74)	1.9 (53)	5.8 (104)	6.8 (44)	4.2 (178)	4.3 (97)	2.8 (143)	2.2 (91)
Sphenoid articulation	0 (48)	0 (39)	1.5 (66)	0 (29)	0.7 (114)	0 (68)	0 (91)	3.2 (63)
Epipteric bones	7.1 (42)	2.7 (37)	1.7 (58)	10.7 (28)	4.4 (100)	6.7 (65)	10.0 (70)	16.7 (60)

ns = Samples smaller than 20 excluded

The sphenoid articulation in the pteric region is normally achieved by spheno-parietal contact isolating the frontal bone from the temporal. In certain cases different contacts are made.[7] The uncommon variations have a very low frequency in European populations and this was the case at Winchester, but the frequency did reach more than 3% in medieval females, while there was only one case, found in the Anglo-Saxon charnel, among the males from all the populations.

Extra-sutural ossicles

Extra-sutural ossicles or Wormian bones were noted on all the main cranial vault sutures. In the coronal suture, bregmatic ossicles (Illus. 4.32)—a rare anomaly occurring in 0.64% of skulls[8]—were observed in both the medieval (two cases from the earth graves) and the Anglo-Saxon populations (eight cases including ASG 255 and ASG 390). Ten observations were thus made and traced; seven male, two female, and one of uncertain sex (Illus. 4.33). The bone was usually approximately rectangular whereas the fontanelle it occupies is kite-shaped in the infant.[9] The similarity and persistence of the bregmatic ossicle suggest the possibility of a familial link between the individuals possessing this extra bone.

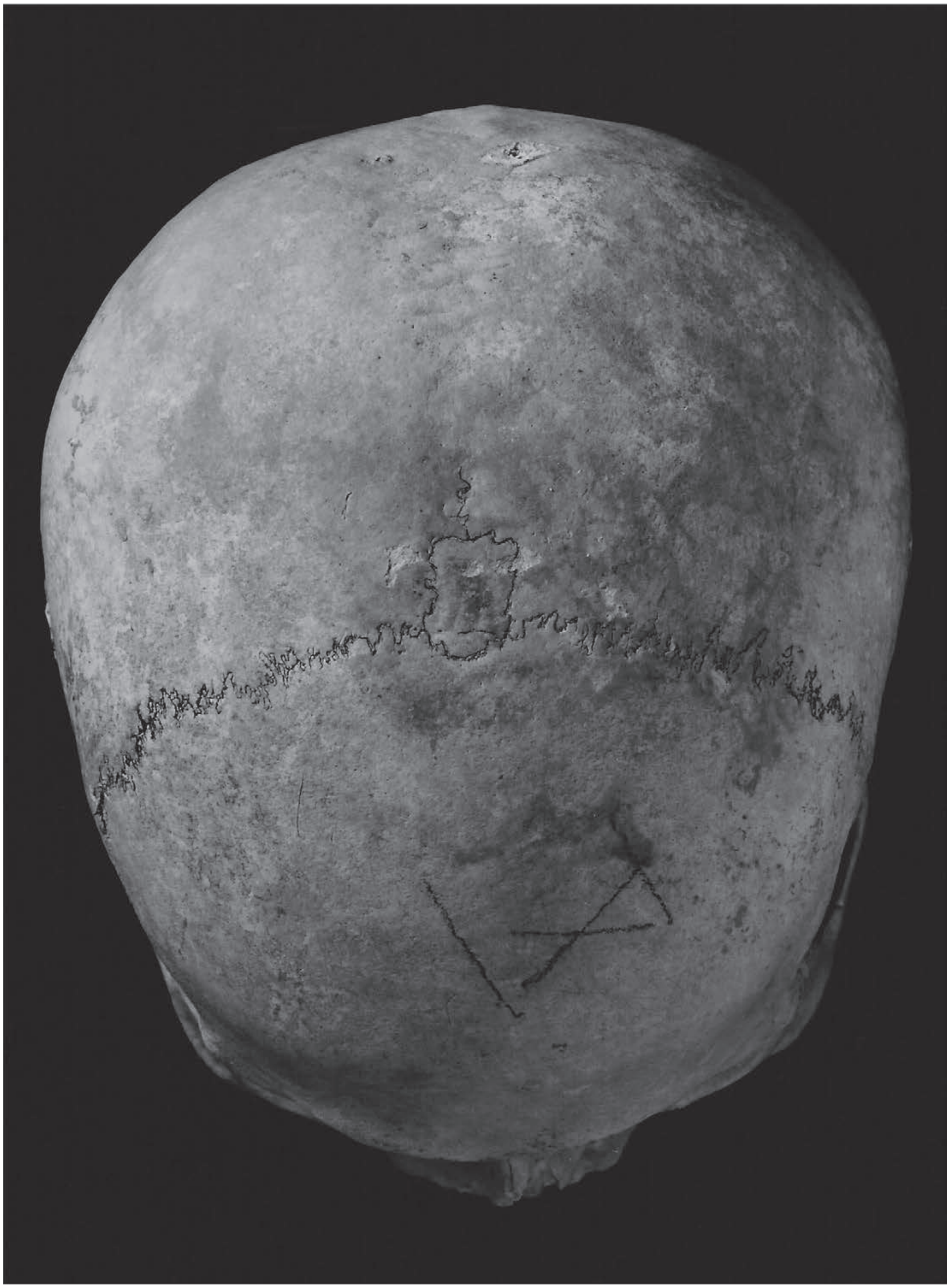
Ossicles on the sagittal suture occurred in 14 crania from the Anglo-Saxon charnel and in 10 from the medieval earth graves. The sexes were about equally represented.

The separate upper part of the occipital bone, called the Inca bone, was noted in 12 crania from the Anglo-Saxon charnel, nine from the medieval earth graves, and one from the medieval cist graves. There was no significant difference between the sexes nor between the different samples.

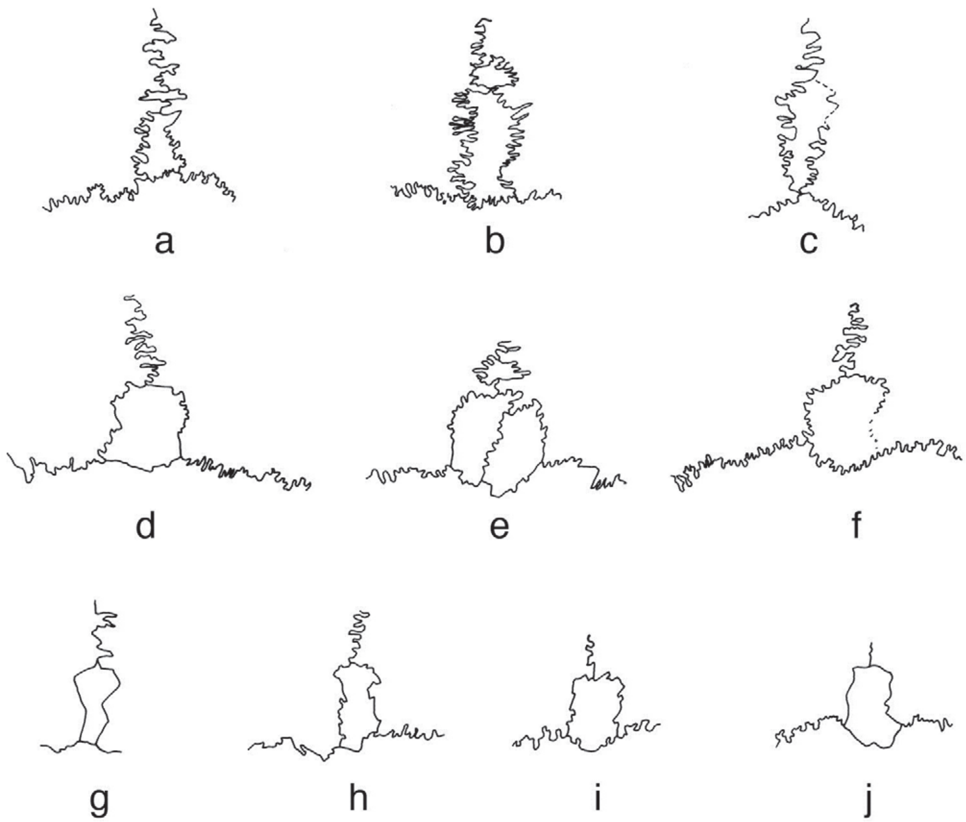
Wormian bones in the lambdoid suture (Illus. 4.34) occurred with the greatest frequency among the Anglo-Saxon charnel females, but for the medieval populations the frequency was greater among males than females. The lowest frequency for females was in the medieval crania, and for males in the Anglo-Saxon charnel.

The normal pterion where the sphenoid meets the frontal bone may be replaced by a

[7] Comas 1960. [8] ibid. [9] Grant 1972, 602.



Illus. 4.32. Bregmatic ossicle between the right and left parietal bones. MG 340, male.



ILLUS. 4.33. Tracings of bregmatic ossicles in the sagittal suture recorded in the adult Winchester Cathedral Green samples; (a) ASC Skull 707, adult; (b) ASC Skull 261, male adult; (c) ASC Skull 20, adult; (d) ASG 390, juvenile age *c.*14–16 years; (e) ASC Skull 497, male adult; (f) ASG 255, male adult; (g) MG 931, female age *c.*28; (h) CG 1964, unstratified medieval adult; (i) MG340, male adult; (j) ASC Skull 317A, male adult.

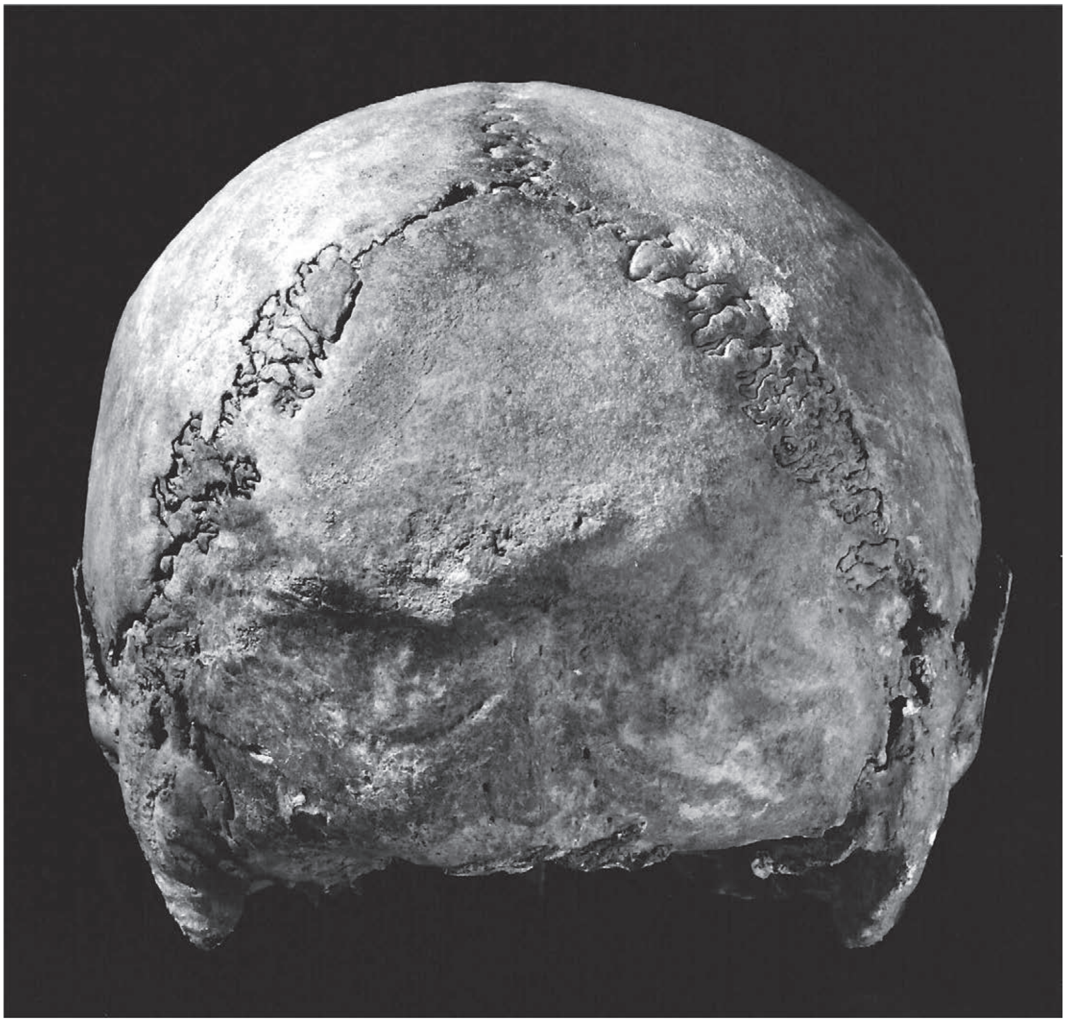
pteric or epipteric bone on one or both sides (Illus. 4.35, 4.36). The frequency recorded for the Winchester populations falls within the range expected for European peoples.[10] The highest values are found amongst the medieval samples (Table 4.22).

The parietal notch bone (Illus. 4.35) was found to have a much higher frequency in the medieval sample than in the Anglo-Saxon (Table 4.22). The highest frequency was found in medieval females. The lowest frequencies were found in the Anglo-Saxon charnel females.

ii. TORUS DEVELOPMENT (TABLE 4.22)

Torus auditivus, a bony obstruction of the external auditory meatus of the ear, is usually very uncommon. Comparable frequencies were found for male Anglo-Saxon and medieval samples combined, while medieval females showed slightly higher frequencies. No case was found among the Anglo-Saxon grave females. The Anglo-Saxon grave male percentage was highest of all, and almost identical to that found in the combined medieval female sample. The frequency overall was higher in Anglo-Saxon males than in females, but higher in medieval females. One case of occlusive bilateral tori was found in a medieval priest,

[10] Comas 1960.



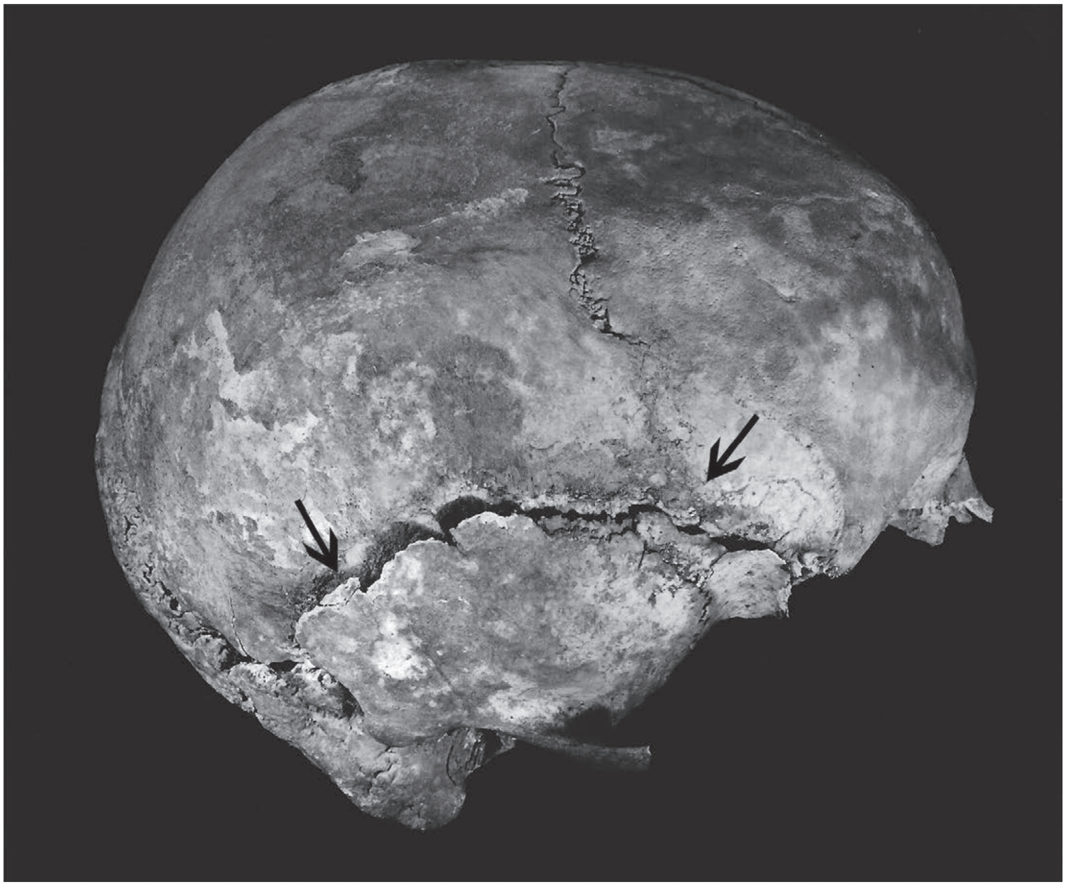
Illus. 4.34. Wormian ossicles in the lambdoid suture between the parietal and occipital bones. ASC Skull 939B, male.

MG 155. He must have been deaf. He also had a healed compression fracture of a lumbar vertebra (L2) and had a fracture of the left clavicle.

Torus palatinus (Illus. 4.37) was again more frequent in the medieval samples than in the Anglo-Saxon samples. The frequency was higher in females than males for the combined medieval sample, but was higher for males in the Anglo-Saxon samples. This bony thickening of the central region of the palate may be partly genetic in origin but appears to occur most frequently in individuals who are older and have lost most of their molar teeth.

Torus maxillaris (Illus. 4.37) was more common in Anglo-Saxons than in medieval people. There was a slightly higher frequency among males than among females.

Torus mandibularis was more marked in medieval males than in females. The greatest frequency overall was found in the Anglo-Saxon male graves. Frequencies are unknown for the Anglo-Saxon charnel, as this trait was not scored in that sample.



Illus. 4.35. Epipteric ossicles around the spheno-parietal suture (pterion), and a parietal notch bone at the posterior end of the temporal bone. ASC Skull 938, adult.

iii. DENTAL ANOMALIES

Studies of the prevalence of dental anomalies vary considerably in their findings. Differences of up to fifty-fold reflect marked contrasts not only in frequency but also in sampling techniques, examination methods, and diagnosis.[11] In view of this, it is difficult to compare the data from Winchester with the data derived from other populations.

Hypodontia (agenesis)

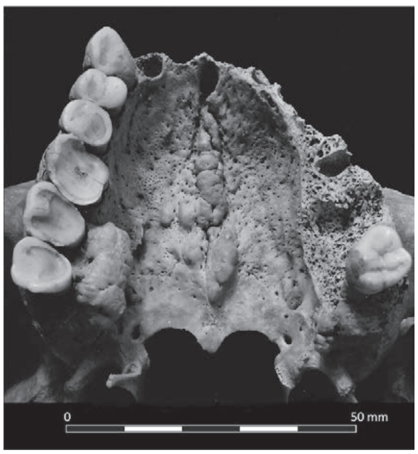
It is necessary when undertaking dental studies to distinguish between congenitally missing and unerupted teeth. Radiographs were made wherever possible for the Winchester material. Table 4.23 shows the frequency of agenesis of lateral incisors, premolars, and third molar teeth in the Winchester samples without regard to sex. The frequency of lower third molar absence was higher for the medieval populations than for the Anglo-Saxons. When tested with chi-squares, this higher frequency was significant at the 5% level and may be part of a trend which has continued to the present day.[12] Studies were also made of the absence of premolars and incisors, but none of the frequencies were significantly different.

[11] Brook 1975, 288–93.

[12] Brothwell (ed.) 1963.

Illus. 4.36. Epipteric ossicle in the spheno-parietal suture. MG 340, male.

Part of the sample was analysed for differences in third molar agenesis between males and females (Table 4.24). Significant differences were found only for the lower right third molar in the medieval earth graves, and here only at the 5% level. The medieval graves showed an increase over the Anglo-Saxon samples in frequency of agenesis for both sexes. With the exception of the upper right molar, the highest frequencies were found in the medieval cist graves.



Illus. 4.37. Torus palatinus and torus maxillaris developed to an extreme degree. MG 297, male adult.

Many of the cases with congenitally missing teeth also had reduced and rotated teeth (Illus. 4.38a, b, f; 4.39a). Some had retained deciduous teeth (Illus. 4.39b), a common association since the shedding of the deciduous teeth is related to the eruption of the replacing permanent teeth. An extreme case of dental agenesis was observed in a male skull from MG 855 (Illus. 4.39c). The premolars and third molars in the upper jaw, and the premolars and second and third molars in the lower jaw had never developed. The lower

TABLE 4.23

Hypodontia (agenesis) in the samples from Cathedral Green, Winchester

Sample	Incisors			Premolars			M3s		
	N absent	N	% absent	N absent	N	% absent	N absent	N	% absent
Upper left									
Anglo-Saxon graves	0	24	0	0	23	0	1	18	5.56
Anglo-Saxon charnel	0	192	0	0	187	0	18	145	12.41
Medieval earth graves	1	108	0.93	1	107	0.93	15	88	17.04
Medieval cist graves	1	66	1.52	1	62	1.61	11	52	21.15
Upper right									
Anglo-Saxon graves	0	24	0	1	24	4.17	3	19	15.79
Anglo-Saxon charnel	3	183	1.64	1	188	0.53	20	140	14.28
Medieval earth graves	3	108	2.78	1	98	1.02	17	84	20.24
Medieval cist graves	1	71	1.41	0	72	0	15	56	26.79
Lower left									
Anglo-Saxon graves	0	33	0	0	27	0	2	25	8.00
Anglo-Saxon charnel	4	709	0.56	3	676	0.44	100	584	17.12
Medieval earth graves	0	120	0	1	116	0.86	20	104	19.23
Medieval cist graves	0	70	0	1	39	1.45	14	67	20.90
Lower right									
Anglo-Saxon graves	0	28	0	1	25	4.00	3	24	12.50
Anglo-Saxon charnel	4	715	0.56	12	652	1.84	78	534	14.61
Medieval earth graves	1	118	0.85	1	116	0.86	22	108	20.37*
Medieval cist graves	0	70	0	1	70	1.43	17	65	26.15*

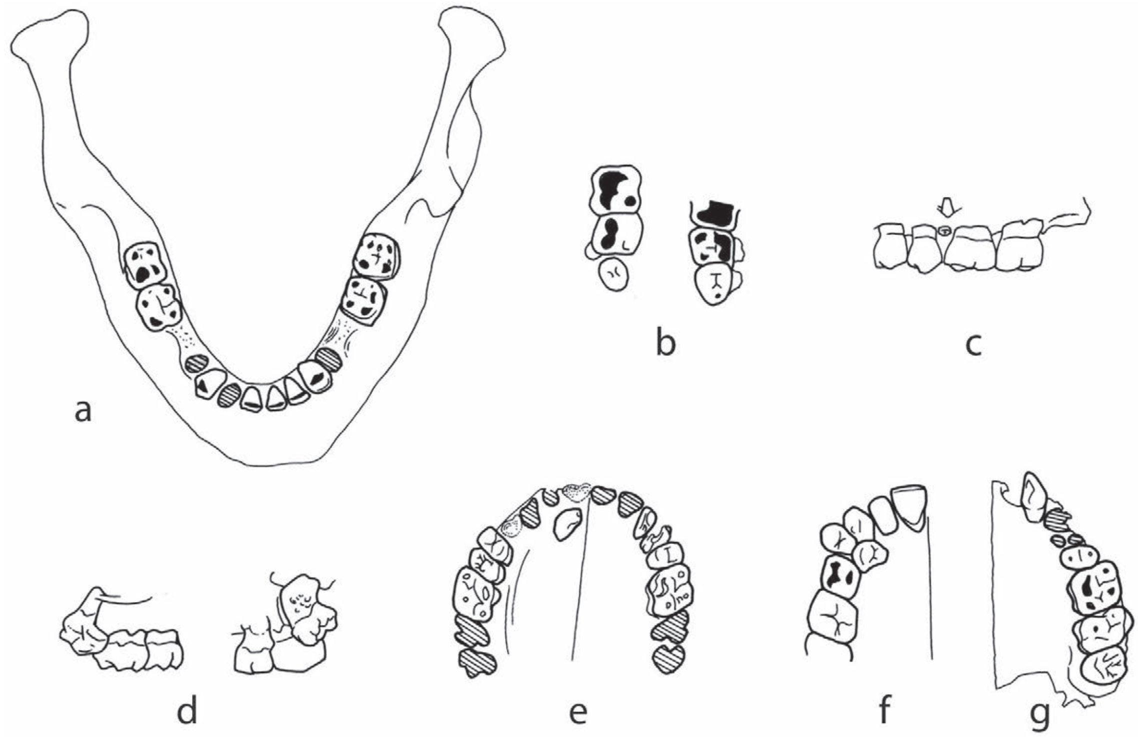
* Significant difference at the 5 per cent level between Anglo-Saxon and medieval samples

TABLE 4.24

Third molar agenesis, males and females, Cathedral Green, Winchester

Sample	MALES			FEMALES		
	N absent	N	% absent	N absent	N	% absent
Upper left						
Anglo-Saxon graves	0	3	0	1	4	25.00
Anglo-Saxon charnel	2	22	9.09	3	11	27.27
Medieval earth graves	17	96	17.71	15	62	24.19
Medieval cist graves	8	31	25.81	7	27	25.93
Upper right						
Anglo-Saxon graves	1	3	33.33	2	4	50.00
Anglo-Saxon charnel	5	29	17.24	4	11	36.36
Medieval earth graves	18	103	17.48	17	59	28.81
Medieval cist graves	8	35	22.86	8	28	28.57
Lower left						
Anglo-Saxon graves	0	1	0	2	3	66.67
Anglo-Saxon charnel	0	3	0	0	1	0
Medieval earth graves	14	110	12.73	17	68	25
Medieval cist graves	5	39	12.82	10	30	33.33
Lower right						
Anglo-Saxon graves	0	1	0	2	3	66.67
Anglo-Saxon charnel	0	2	0	0	1	0
Medieval earth graves	20	109	18.35*	24	71	33.80*
Medieval cist graves	8	36	22.22	14	31	45.16

* Significant at the 5 per cent level



Illus. 4.38. Dental anomalies: (a) agenesis of second premolars and third molars. There is a gap left by the deciduous molar which was probably retained into adulthood. MG 811, male adult; (b) reduced third molars. The right third molar is more reduced than the left. ASC Skull 893, male adult; (c) remnant of a deciduous tooth in the palate. The third molar is absent. ASC Skull 1127, male adult; (d) two views of the roots of an impacted upper third molar. ASC Skull 140, male adult; (e) impacted and misplaced upper right canine. ASG 641A, female adult; (f) displaced premolar in a palate: the second premolar has erupted in front of the first, and the second deciduous molar has not been shed. MG 345, juvenile age 11–14 years; (g) the lateral incisor is rotated and out of line. The second premolar is also slightly rotated. ASC Skull 630, male adult.

second deciduous molars remained functional, and the mandibular angle was notably right-angled. Another male from MG 942 lacked his second premolars in both the upper and lower jaws and had only one much reduced third molar in his upper jaw.

Microdontia

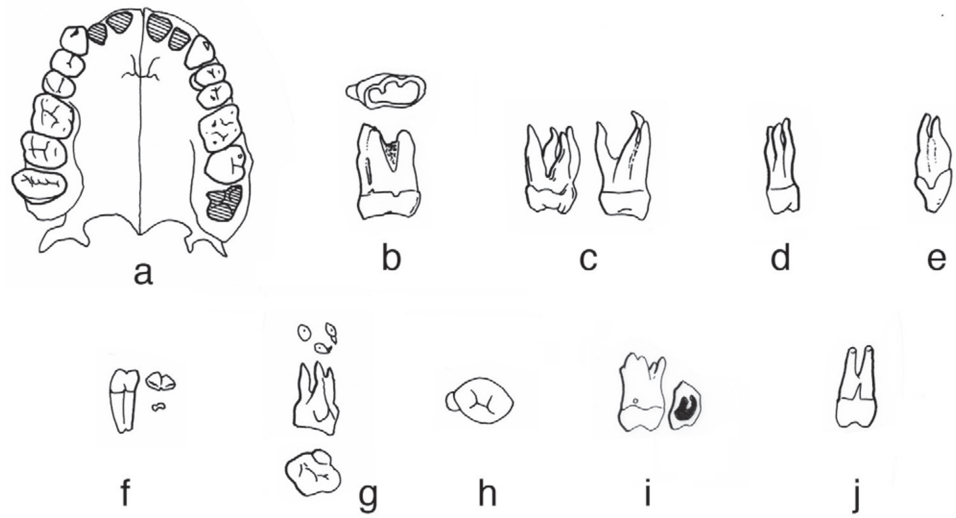
Very few cases with reduced teeth were noted in any of the populations. These were usually associated with agenesis and rotation of other teeth in the jaws, and, in two cases (one medieval and one Anglo-Saxon), with retained deciduous teeth (Illus. 4.38c). The adult male, MG 942, already noted for agenesis of both upper and lower second premolars and three out of four third molars, had a much reduced peg-like upper right third molar. Another male, MG 1100, also had agenesis of all four second premolars, an undeveloped right upper third molar, and a reduced left upper third molar (Illus. 4.39a); both lower wisdom teeth had developed. It may be questioned whether these two males were related. Other tooth displacements, impactions, and rotations were also seen (Illus. 4.38d, f, g; Illus. 4.39d).

The more commonly published condition of dwarfed or absent upper lateral incisors[13] was

[13] Bradlaw 1934, 113–17; Alvesalo and Portin 1969, 563–75; Brook 1974, 37–53.

Illus. 4.39. Dental anomalies: (a) dental agenesis, tooth reduction and rotation. Both upper second premolars and the right wisdom tooth have failed to develop (agenesis) while the left wisdom tooth is reduced to a peg. MG 1100, male adult; (b) agenesis of the lateral incisors. The canines, which have erupted early, have moved close to the central incisor, especially on the left. The retained deciduous molars are functional; the second premolars have not erupted. ASG 409, child age *c.*10; (c) an extreme combination of dental anomalies. The upper left canine and both lower wisdom teeth are impacted. All four second premolars and the upper right wisdom tooth appear to be missing (agenic) and the upper left wisdom tooth is reduced to a peg. The upper molars are rotated. There is extensive calculus build-up on the right, suggesting that the impacted wisdom tooth was causing painful inflammation of the adjacent soft tissues. No caries. MG 855, male adult; (d) tooth crowding. The first premolar and canine are crowded on the right, and the first premolar is displaced on the left. There is also severe anterior attrition with pulp exposure of the central incisor. Isolated medieval mandible, adult.

noted only three times among the Anglo-Saxons, and once among the medieval populations. There were two cases of reduced upper second incisors; one from ASG 383 associated with agenesis of the lower second molars and all four third molars; the other from MG 1100 (noted above), associated



Illus. 4.40. Dental anomalies: (a) the upper right third molar is enlarged and compressed mesiodistally. ASG 846, female adult; (b) isolated upper molar showing extreme compression form. ASC Skull 412, ?female adult; (c) upper left molars showing bifurcation of the buccal root. The first example has four distinct roots. Isolated find, Anglo-Saxon charnel; (d) upper first premolar with three distinct roots. The only case noted. CACP 1961, Tr. IX (29), Pit 5; (e) two-rooted canine. Isolated find, Anglo-Saxon charnel; (f) fused deciduous incisors. The pulp cavities are shared. The rest of the dentition including the permanent incisors appears normal on X-ray. ASG 320, child age *c.*2 years; (g) Carabelli's cusp on the upper second molar. The tooth also has three roots. MG 890, juvenile age 15–16; (h) paramolar cusp on the upper deciduous molar. ASG 883, child age *c.*2 years; (i) upper molar with enamel pearl. ASG 821, ?male adult; (j) molar with enamel extension. ASG 839, juvenile age *c.*14 years.

with agenesis of the second premolars and three of the third molars.

Hyperdontia

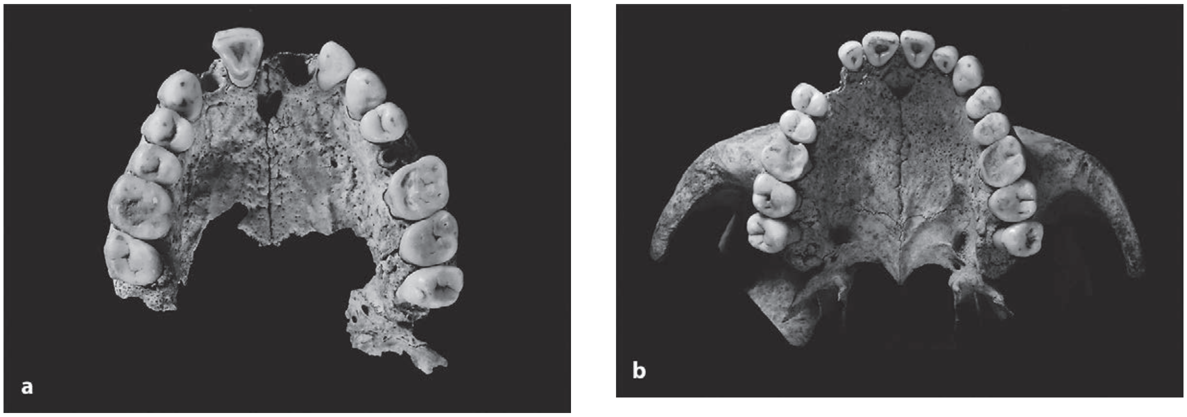
A supernumerary is any tooth or denticle formed from a tooth germ in excess of the usual number for a given region of the dental arch. Supernumeraries occur approximately twice as commonly in males and are also more frequent in the permanent dentition. Since many supernumerary teeth never erupt, reliable figures of frequency in a population will only be achieved by radiographic examination of the entire sample. This could not be done for the Winchester samples.

Very few cases of patent supernumerary teeth were found. Among the Anglo-Saxons (ASG 641A) a supernumerary or possibly a retained deciduous tooth was associated with an impacted canine (Illus. 4.38e). In an Anglo-Saxon from the charnel (ASC Skull 103c), the supernumerary or mesiodens was impacted between the two upper central incisors. In a medieval mandible, an incisor-like supernumerary was associated with a rotated second incisor.

Double teeth

Anterior double teeth, formed of two or more elements, can be diagnosed clinically by incisal notching or labial and palatal grooving, and radiographically by bifurcation of the pulp. Double teeth are most often found in the deciduous dentition.

Only two cases were recognized in the Winchester population: a two-year-old (ASG 320) had fused right lower incisors (Illus. 4.40f) and a child from the Anglo-Saxon charnel had fused lower left incisors. In both cases radiographic examination showed that the permanent teeth would have been normal.



Illus. 4.41. Dental anomalies: (a) shovel-shaped incisors. The central incisor and, to a lesser extent, the lateral incisor are affected. ASG 783, male; (b) shovel-shaped incisors. Both the central and lateral incisors are strongly affected. ASG 874, adult.

Anomalies of the dental crown

A variety of minor variations of the dental crown can be studied and many have been shown to have a higher concordance within families than between families.[14] Inheritance of such variants is probably multifactorial and environmental factors are thought likely to participate. Ethnic variation can be quite marked.

A number of crown anomalies were scored for the Winchester populations. Invaginated or shovel-shaped incisors occur most frequently in males,[15] but because diagnostic criteria have not been standardized there can be considerable variation between observers in the recorded frequency of invaginated teeth. A few cases, mostly slight, of shovel-shaped incisors were found in each of the four Cathedral Green populations. Two Anglo-Saxon cases (ASG 783 and ASG 874), both males, came from the same area (Trench XL) and could possibly be related individuals (Illus. 4.41a, b).

Carabelli's cusps were observed on the upper second molars of individuals of all ages although attrition greatly reduces the observed occurrence in adults (Illus. 4.40g).[16] Other crown anomalies included supernumerary cusps at a low frequency in all populations (Illus. 4.40h); and nine cases of enamel pearls among the Anglo-Saxons (Illus. 4.40i). In one case the tooth had only partially formed and two pearls had formed on opposite sides of the tooth. Enamel pearls are rare in European populations.[17]

Distortion of the third molar during development was noted in all populations. There was extreme compression of the third upper molar in ASG 846 (Illus. 4.40a), as well as in an isolated upper molar from an Anglo-Saxon charnel skull (ASC Skull 412, Illus. 4.40b). Other crown anomalies included MG 389 with a toothlet fused to a lower second molar; and ASG 883, a two-year old with a paramolar cusp on the first deciduous molar (Illus. 4.40h). It could be argued that the generally low frequency of these anomalies is suggestive of a heterogeneous population with a low level of inbreeding.

Root anomalies

A very few cases of root anomalies were identified (Illus. 4.40c–f). Many observations could not be made because the teeth were firmly fixed in the jaw and radiography of all specimens was not possible. The higher numbers noted for the Anglo-Saxon charnel material was a consequence of the high number of loose teeth available in this sample.

[14] Berry 1978. [15] Brook 1975. [16] Berry 1978. [17] Brothwell 1981, 116.

iv. OTHER CONGENITAL ANOMALIES OF THE SKULL

Two cases of partial clefting of the palate were noted, from MG 205 and MG 196. The proximity of these two graves suggests a familial trait. The condition would not really have been noticeable in life. Even less noticeable would have been the peculiar defect of the mandible known as Stafne's defect, which was recorded once only (Illus. 4.42).

v. ANOMALIES OF THE POSTCRANIAL SKELETON

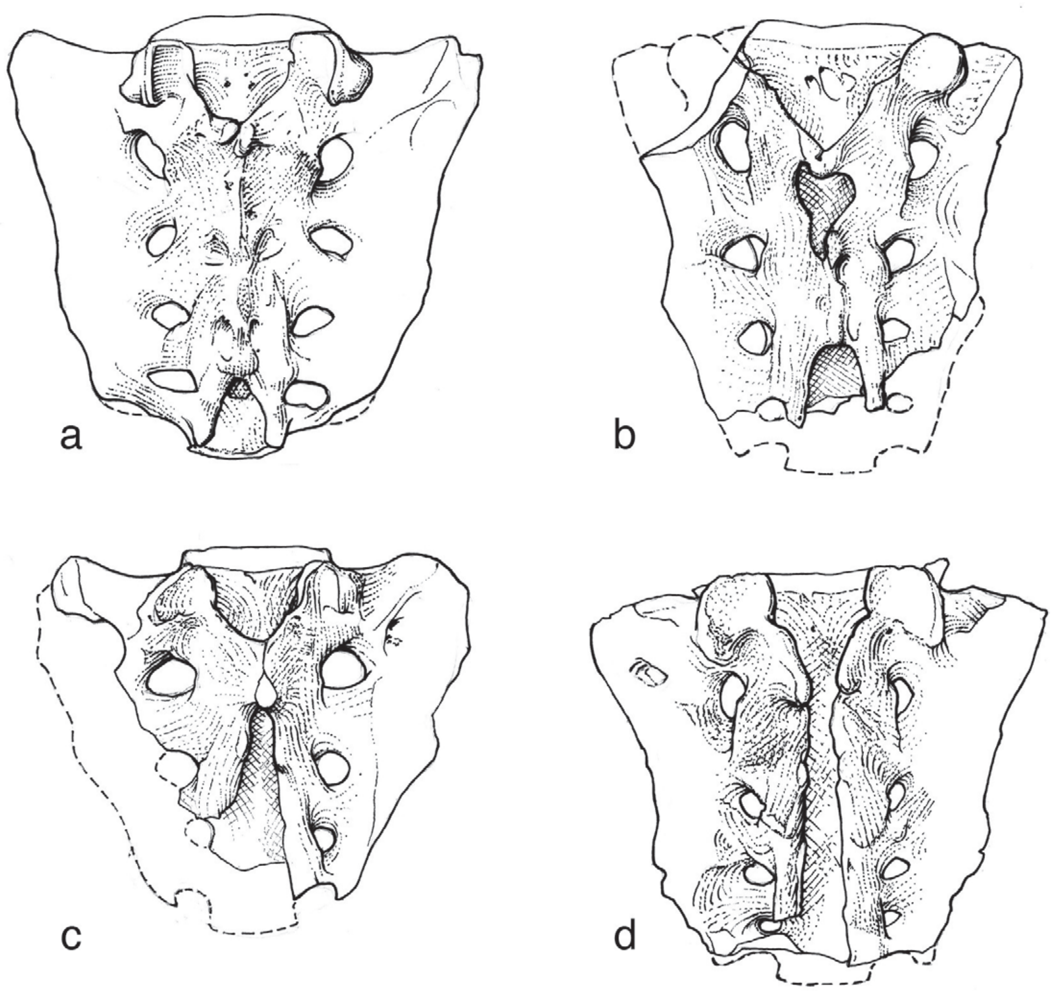
Various vertebral defects were noted in the individual Anglo-Saxon graves and in the medieval samples. The material from the Anglo-Saxon charnel was not well enough preserved for inclusion in this study. These defects mostly consisted of clefts and incomplete union of the neural arch to the centrum of the vertebra, or sacral spina bifida occulta. Analysis of these lesions gave no indication that they were associated in the individual with other conditions or reduced fitness. The most common site for clefting was at the first sacral arch (Illus. 4.43), and this could be considered to fall within the range of normal variation.

Illus. 4.42. Stafne's defect of the mandible, a curious cavity of unknown aetiology, visible in the bone of the mandibular body below the level of M_2 and the socket for M_3. Unnumbered medieval earth grave, DCN 43, male, adult.

Neural arch clefts can occur in all parts of the spine but are especially noted in the atlas, sacral, and lower lumbar vertebrae. The most common form of cleft is a midline cleft of the dorsal arch. Transitional lumbo-sacral vertebrae, intermediate in type between lumbar and sacral, are not so uncommonly cleft in the midline. The whole arch may be detached (spondylolysis) behind the lateral articulations and processes so that the arch forms a separate bone. Lumbar vertebrae are the most commonly affected.

The aetiology of clefting is not clear but there is some evidence that a congenital condition may be exacerbated by nutritional and habitual conditions.[18] At Winchester there was only one Anglo-Saxon cleft atlas in a female, and two cases among the medieval samples. The latter were from cist graves (MG 180 and MG 337). Both were female and there is a possibility that they were related. There were nine cases of cleft L5 among the Anglo-Saxons, and seven cases in the medieval samples. In the medieval earth graves L4 was cleft twice in a lateral position, and in one unusual case L5 was not also involved. The usual sort of bilateral cleft of L5 accounted for most of the other Anglo-Saxon cases; one was unilateral. In one case of this type in a 21-year-old the cleft was through the arch, not the pedicle, and may have been acquired rather than congenital.

[18] There may be an association between neural arch defects and folate deficiency. Vitamin A deficiency in the first trimester of pregnancy also is implicated, as is infection (Molleson 2010).



Illus. 4.43. Degrees of vertebral clefting and spina bifida of the sacrum; (a) S1 cleft, sacral hiatus .S5. MG 173, male adult; (b) S2 and S5 cleft. MG 328, ?male *c.*21; (c) S3–5 cleft. MG 352, female *c.*21; (d) S1–5 cleft. MG 745, male adult.

Lateral clefts of the lumbar vertebrae occurred in 10 of 108 possible cases among the Anglo-Saxons, three involving L4 and eight involving L5 (in one case L4 and L5 were both involved).

Sacral spina bifida occulta was looked for in 89 virtually complete sacra, in a further 19 top segments, and in one lower half from the individual Anglo-Saxon graves. S1 was cleft in 26 cases: in probably five cases all five segments were cleft; four cases were complicated by the presence of a transitional vertebra, which was cleft in three cases. S1 was cleft but not transitional in one case; transitional but not cleft in two cases; and both transitional and cleft in one case. In addition there were probably three cases where all except S1 and S2 were cleft. In all, over 25% of the spines in this Anglo-Saxon series had some degree of sacral spina bifida.

Transitional lumbar vertebrae and six-part sacra were noted in 12 out of 80 possible cases among the Anglo-Saxons. Six of these had no defect of the arch; of the remaining six, two apparently had sacralized coccygeal vertebrae rather than lumbosacral transitional vertebrae.

TABLE 4.25

Vertebral clefts in selected British populations

	Atlas	Lumbar 4	Lumbar 5	Transitional	Sacral 1	Sacral other	Sacral 1–5
Cannington (Somerset)	5F 1M (148)	0 –	4F 2M (164)	11 (5 cleft) (127)	21 (127)	0 –	0 –
Winnall, Anglo-Saxon	0 (22)	2 (25)	5 – – (25)	2 (0 cleft) (19)	5 (19)	0 –	0 –
Winchester, Cathedral Car Park	0 (11)	0 –	1 – – (15)	0 – –	3 (11)	0 –	0 –

M = male, F = female. Sample size in brackets.

TABLE 4.26

Sternal anomalies, Cathedral Green, Winchester

	Anglo-Saxon graves		Medieval earth graves		Medieval cist graves	
Perforated	2	(44)	3	(39)	1	(60)
Segmented	4	(49)	3	(37)	8	(53)
Manubrium/body fused	4	(58)	6	(40)	0	(60)

Sample size in brackets.

In some cases where the skeleton was well preserved, it could be seen that the transitional vertebra was an extra vertebra; in other cases it was a sacralized L5.

Of 201 sacra examined from the medieval samples, 21% had clefting of S1, and 5% had complete or near-complete clefts. There was no marked difference between the sexes. In the medieval earth graves eight out of 32 had cleft sacra, and two out of 22 had spondylolysis of L5. In the medieval cist graves seven out of 32 had cleft sacra. None had spondylolysis of L5, but there were two cases of cleft atlas. The males from the medieval earth graves showed a frequency of 11 clefts in 33 sacra (one completely cleft, two with three units cleft) and two clefts in 31 examples of L4 and L5. From the medieval cist graves there were 14 clefts in 33 sacra (one completely cleft, three with three units cleft); four clefts in L5; and no clefts in L4 atlas vertebrae.

A comparison of vertebral and sacral anomalies was made between the Winchester Cathedral Green samples and those found at the Winchester Cathedral Car Park, the Winnall II Anglo-Saxon cemetery, and Cannington in Somerset. Data for Cannington, Winnall II, and Winchester Cathedral Car Park will be found in Table 4.25. Although the frequencies for all vertebral anomalies were higher for the Winchester samples described above, as well as the Winnall II Anglo-Saxons, than for the population from Cannington, there does not appear to be any significant difference between the different Anglo-Saxon and medieval populations in Winchester itself. Sacral spina bifida occulta was found in approximately 25% of the Anglo-Saxons at Winnall II and also in Winchester. At Cannington there was a higher frequency of clefting of the atlas among women (5:1) and of the detached arch of L5 (4:2), but the sacral arch clefts were only found among males.[19] A number of sternal anomalies were noted in the Cathedral Green samples and are shown in Table 4.26.

[19] Brothwell et al. 2000, 197.

Isolated cases of other congenital anomalies were noted. A priest buried in a cist with chalice, paten, and trowel (MG 203) had fusion of the first and second ribs on his right side. Four individuals from Anglo-Saxon graves[20] and six individuals from medieval graves[21] had a supracondylar process on the humerus. This supracondylar process was specially looked for in the Anglo-Saxon graves for possible association with a case of diaphysial aclasia described below.

There was a case of bilateral shortening of the first metatarsal in the left foot of one Anglo-Saxon male (ASG 940, Illus. 4.44). Microdactyly of the right thumb was noted in a gracile medieval male buried with a chalice (MG 898). The thumb was somewhat undersized and completely stiff, probably owing to a defect of the basal epiphysis of the terminal phalanx during growth. It might have been an injury or congenital microdactyly. Myositis ossificans progressiva was considered as an alternative diagnosis because microdactyly of Digit 1 sometimes occurs as a marker trait for this condition, but x-rays showed no suggestion of it.

A case of hydrocephalus was recorded in an Anglo-Saxon child (ASG 903, Illus. 4.45) who survived to about six and a half years old.

Illus. 4.44. Reconstructed foot of an Anglo-Saxon with microdactyly of the first metatarsal. Both feet were affected. ASG 940, middle-aged male (see also MG 702, Illus. 4.73).

vi. OTHER CONGENITAL ABNORMALITIES

In a case of diaphysial aclasia in an Anglo-Saxon child who survived to about three years old (ASG 932, Illus. 4.46), exostoses were found on the scapula, right clavicle, both ilia, the right humerus (the left was missing), and both femora. Both femora had broad-based exostoses at the lower metaphysial/diaphysial junction, with a cortex of compact bone and widening of the lower femur. These changes are compatible with diaphysial aclasia. The disorder leads to a stunting of growth but is not particularly incapacitating. This condition has been previously discussed in relation to hereditary multiple exostoses in general.[22] The child probably also suffered from anaemia leading to osteoporosis of the orbits (cribra orbitalia) and parietals.

[20] ASG 747, ASG 932, ASG 296, and ASG 533.

[21] MG 202, MG 228, MG 240, MG 337, MG 355 and an unnumbered specimen from a medieval context.

[22] Ortner and Putschar 1981, 381–2.

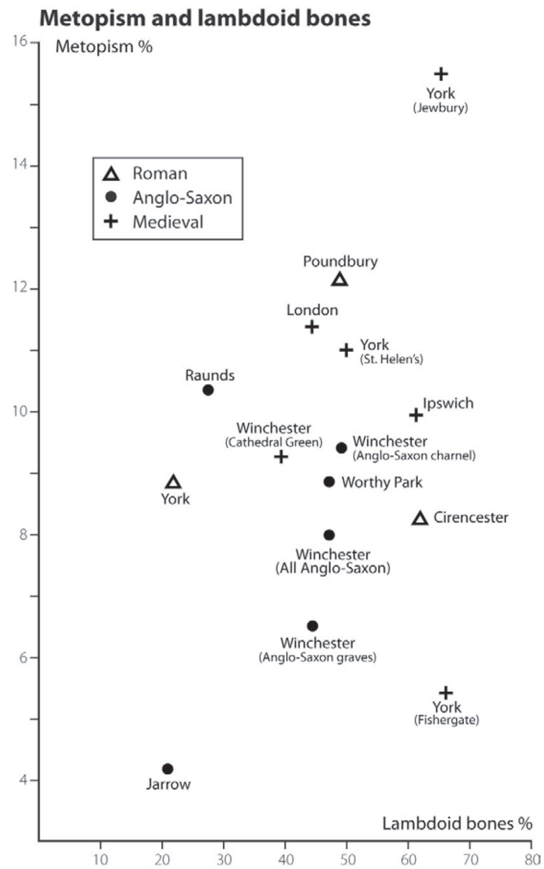
Illus. 4.45. Superior view, skull of an Anglo-Saxon child with hydrocephalus. The parietal bones in particular are enlarged. Isolated skull, DCN 903, child *c.*6½.

Illus. 4.46. Bones of a child with diaphysial aclasia, showing exostoses on the scapula, ilium, femur, and humerus. ASG 932, child *c.*3.

vii. NON-METRIC VARIATION BETWEEN GROUPS

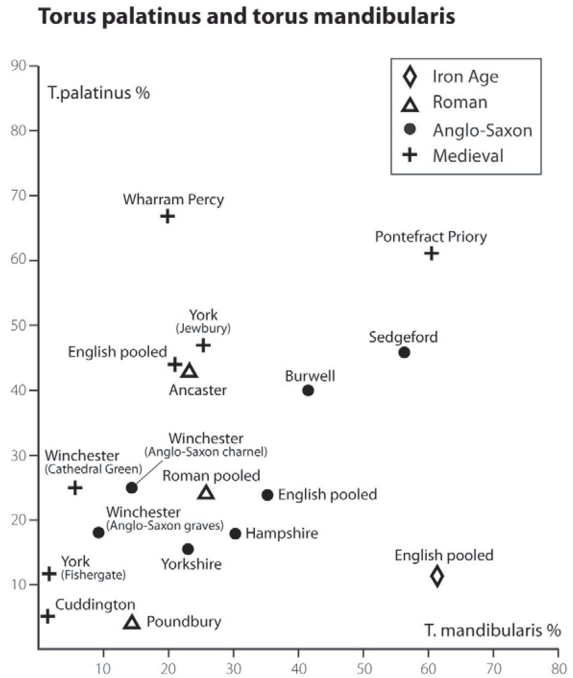
Although a relatively large number of variants have been identified in early British and other populations, the number selected for study and analysis varies considerably between researchers. Those selected for investigation in the Winchester groups seemed potentially to be ones which might show variation between groups. However, in the case of sphenoid articulation and torus auditivus, the slight variations in the low percentages are not significant. In the other Winchester traits, percentages vary between under 5% and over 50%. Fluctuations through time could be seen as secular trends in a few instances, but this is simply not the case when the differing aetiologies of the anomalies are taken into consideration.

Again, in some instances the difference between the sexes is not significant, while in traits such as the occurrence of lambdoid Wormian bones and parietal foramina, it is more than expected. Indeed, we are left with the problem of interpreting the differences between sexes. Is a sample of 100 or 200 still too small to evaluate accurately the differences between men and women or is this a true biological difference? This has been debated by other researchers, but still remains a question for further consideration. And if there are significant differences, but they are not to be expected in homogeneous male/female samples, could they be used to evaluate mating or work patterns within communities? Could they be a reflection of rural males seeking work in urban centres, or urban/rural females tending to marry out of their own group? Such questions must remain for the future. Our concern here must be limited to a consideration of non-metric traits in the Winchester samples in general, and of comparative data available at the time of writing.

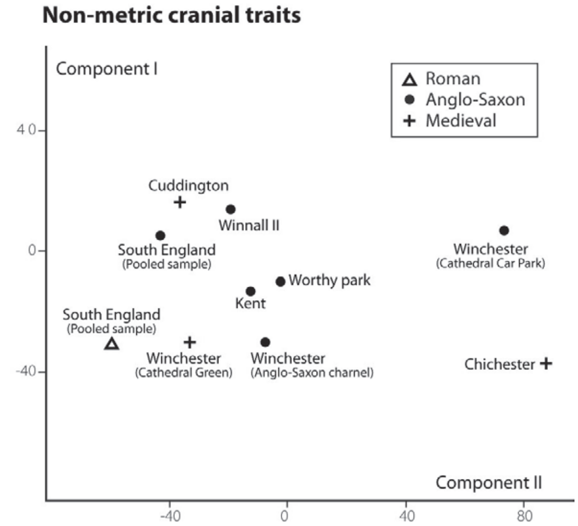


ILLUS. 4.47. Frequency of metopism and ossicles in lambdoid suture.

In order to consider the maximum degree of variation in all the comparative groups, four non-metric traits were selected for contrasts in percentage variation. In Illus. 4.47, metopism, which displays relatively low variation, is plotted with the occurrence of lambdoid Wormian bones (showing much greater variation). Only samples of over 50 have been used. The most distinctive samples are from Jarrow (Northumberland), with surprisingly low values, and the Jewbury (York) group, which can be viewed as a religious isolate. The Winchester samples are relatively close in position.



Illus. 4.48. Frequency of torus palatinus and torus mandibularis.



Illus. 4.49. Spatial separation of early southern English groups, based on the principal components analysis of non-metric cranial traits.

In the case of torus mandibularis and torus palatinus (Illus. 4.48), there is considerable variation displayed in the comparative groups, with maximum contrasts in the medieval samples. Again, however, the Winchester samples are quite close, as are the pooled Hampshire Saxons (excluding Winchester). If, as is currently considered, these traits are to some extent controlled genetically, then it would argue against significant genetic change occurring through time in Winchester samples.

When a whole series of non-metric traits are considered by means of multivariate analysis, overall biological 'distances' from these variants are obtained. Illus. 4.49 is the result of a principal component analysis of the non-metric data for a series of Romano-British, Anglo-Saxon, and later medieval samples.[23] Only males are given here. The samples are mainly Anglo-Saxon and later medieval groups, together with a pooled southern Romano-British group. It is clear that the three periods do not separate clearly, although the general southern Romano-British sample is somewhat marginal to the other distributions. Anglo-Saxon and later medieval groups spatially overlap, and clearly the value of the differences is within specific periods. Of particular note is the fact that the Winchester Anglo-Saxons, as exemplified by the Cathedral Green Anglo-Saxon charnel, Winnall II, and Winchester Cathedral Car Park, are well separated by the analysis.

Similarly, the Winchester later medieval people are well separated from the southern English Cuddington (Surrey) and Chichester (Sussex) groups. This suggests that some degree of mating isolation occurred in these small communities, even though distances between them were not great.

[23] Principal components analysis conducted by Professor Don Brothwell: for the sites used (which do not include Winchester Lankhills), see Table 4.21.

5

DENTAL HEALTH

The oral and dental health of past populations can be ascertained to some extent from an examination of the teeth and alveolar margins of the jaws. The study of the oral health of the people of Winchester was carried out by examining the teeth for caries, pulp exposure, calculus development, and evidence for healed abscesses and ante mortem tooth loss. The alveolar margins of the jaws were examined for evidence of periodontal disease, bearing in mind that the bone is only affected in the later stages of the disease. The degree of attrition manifested by the teeth was scored according to a modified version of the grades in Brothwell.[1] Attrition is discussed in this chapter since it has a bearing on the development of pathological conditions and together with them is important in assessing the role diet played in influencing the dental health of the people. Since attrition of the teeth is essentially progressive in nature, it can be viewed ultimately as a degenerative condition culminating in the loss of the teeth. When the rate can be evaluated, the degree of attrition becomes a most important tool for assessing the age of the individual at death, and this aspect of dental attrition in the Winchester populations has been discussed elsewhere.[2]

i. ATTRITION (TABLE 4.27)

Attrition of the occlusal surface of the teeth, the result of dietary wear, was graded from none (0) to very heavy (9), and scored for each of the molar teeth in the four population samples. The results are presented in Table 4.27 and graphically in Illus. 4.7 for the upper jaw and Illus. 4.8 for the lower jaw. In Illus. 4.7 and 4.8 each graph records (0–9 on the horizontal axis) those teeth having or having had a particular attrition grade. The pattern of attrition was generally similar for each of the samples, and in each case produced a sigmoidal curve, although the very small sample for the mandibles from the Anglo-Saxon charnel somewhat distorts the picture. Table 4.27 and the graphs both show that fewer of the medieval teeth attained grades of attrition greater than 6. This is particularly marked for the lower jaw. Nearly 60% of the Anglo-Saxon grave sample attained grade 5 attrition on M1, whereas only 50% of either medieval population attained this grade. The difference is even more marked for the second molar. Here again the results for the medieval earth and cist graves are very similar, but in the upper jaw, the jaws from the medieval cist graves are often more like those from the Anglo-Saxon graves than the jaws from the medieval earth graves.

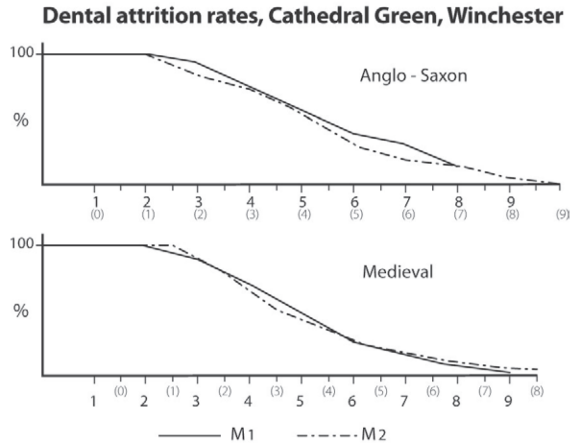
The pattern of attrition in the medieval teeth could result from a less abrasive diet or from a generally younger age at death for the population as a whole. If the liability of the two molar teeth to wear is taken to be similar, then the difference in attrition grade on M1 and M2 must represent the amount of wear sustained by M1 in the six years it was in use before M2 erupted. Thereafter both teeth probably wore at roughly similar rates. The gradients of wear for M_1 and M_2 Anglo-Saxon teeth are very similar and have one grade of attrition difference. The curves for M_1 and M_2 attrition can thus be

[1] Brothwell 1965, 79–85 (cf. Illus. 4.5).

[2] See above, pp. 274–5.

TABLE 4.27
Molar attrition grades, Cathedral Green, Winchester

Degree of attrition		Molar 1								Molar 2								Molar 3							
		Anglo-Saxon graves		Anglo-Saxon charnel		Medieval earth graves		Medieval cist graves		Anglo-Saxon graves		Anglo-Saxon charnel		Medieval earth graves		Medieval cist graves		Anglo-Saxon graves		Anglo-Saxon charnel		Medieval earth graves		Medieval cist graves	
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Upper jaw	0	0	–	0	–	0	–	0	–	0	–	0	–	0	–	0	–	13	100	1	100	19	100	11	100
	1	3	100	7	100	2	100	1	100	28	100	26	100	24	100	10	100	44	78.1	34	98.3	42	77.6	30	82
	2	12	97.1	17	93.8	13	98	11	98.6	24	77.4	42	79.6	21	73	16	85.5	13	36.2	9	38.6	9	28.2	9	32.8
	3	20	89.1	17	82.8	19	85	11	83.6	20	58.1	12	46.5	14	49.4	13	62.3	3	23.8	1	22.8	2	17.7	2	18
	4	34	74.5	43	71	22	66	19	68.5	27	41.9	30	39	14	34.8	12	43.5	12	20.9	9	21.1	5	15.3	2	14.8
	5	13	49.6	15	41.4	16	44	4	42.5	8	20.2	4	13.4	7	19.1	3	26.1	2	9.5	3	5.3	3	9.4	3	11.5
	6	11	40.1	6	30.3	8	28	10	37	8	13.7	5	10.2	3	11.2	7	21.7	1	7.6	–	–	1	5.8	3	6.6
	7	17	32.1	18	27.6	10	20	3	23.3	4	7.3	3	6.3	3	7.9	4	11.6	4	6.7	–	–	2	4.7	–	–
	8	17	12.4	15	15.2	5	10	13	19.2	4	4	4	3.9	1	4.5	3	5.9	2	2.9	–	–	–	–	–	–
	9	10	7.3	7	4.8	3	5	1	1.4	1	0.8	1	0.8	3	3.3	1	1.4	1	0.9	–	–	2	2.3	1	1.6
Total		**137**		**145**		**100**		**73**		**124**		**127**		**89**		**69**		**105**		**57**		**85**		**61**	
not scored		7				29		10		7				30		10		7				21		10	
Total		**144**		**145**		**129**		**83**		**131**		**127**		**119**		**79**		**112**		**57**		**106**		**71**	
Lower jaw	0	0	–	0	–	0	–	0	–	0	–	0	–	0	–	0	–	25	100	0	100	25	100	11	100
	1	1	100	–	100	–	100	2	100	22	100	2	100	21	100	12	100	38	81.2	2	100	38	79	29	83.6
	2	6	99.3	1	100	10	100	6	97.2	16	85.1	3	88.9	34	82.5	18	82.1	21	52.6	3	84.6	20	46.9	6	40.3
	3	27	95.1	2	94.7	22	91	16	88.7	27	74.3	1	72.2	19	54.2	12	55.2	15	36.8	1	61.5	9	30.3	4	31.2
	4	26	76.1	7	84.2	26	71.2	14	66.2	37	56.1	4	66.7	18	38.3	6	37.3	14	25.6	1	53.8	9	22.7	5	25.8
	5	25	51.7	2	47.4	22	47.7	12	46.5	17	31.1	1	44.4	10	23.3	4	26.9	7	15	2	46.2	8	15.1	3	17.9
	6	12	40.1	–	–	12	27.9	9	29.6	7	19.6	2	38.9	8	15	6	21.4	2	9.8	1	30.8	4	8.4	4	13.4
	7	7	31.7	2	36.8	9	17.1	9	16.9	13	14.9	2	27.8	5	8.4	5	11.9	6	8.3	–	–	4	5	4	7.5
	8	13	13.4	3	26.3	6	9.0	1	4.2	7	6.1	3	16.7	4	4.2	4	6	4	3.8	2	23.1	1	1.7	1	1.5
	9	6	4.2	2	10.5	4	3.6	2	2.8	2	1.3	–	–	1	0.8	–	–	1	0.8	1	7.7	1	0.8	–	–
Total		**142**		**19**		**111**		**71**		**148**		**18**		**120**		**67**		**133**		**13**		**119**		**67**	
not scored		18				36		5		11				21		5		10				20		8	
Total		**160**		**19**		**147**		**76**		**159**		**18**		**141**		**72**		**143**		**13**		**139**		**75**	



Illus. 4.50. Comparison of molar attrition rates for Anglo-Saxon and medieval samples by superimposition of the curves for M_2 on the curves for M_1 (from Illus. 4.8). There was a higher rate of attrition among the Anglo-Saxons with one grade of wear between M_1 and M_2. The rate of attrition was less in the medieval samples, with only one-half grade on M_1 when M_2 erupted.

superimposed if the axis for M_2 is shifted down one grade (Illus. 4.50). Examination of the curves for medieval attrition grades reveals that here the difference in attrition grade between M_1 and M_2 is half a grade. The fit of the two curves is excellent, and the inference to be drawn must be that half a grade of attrition had taken place on the first molar before the second came into use.

Illus. 4.51. Occlusal caries on the right M^1 which has infected the pulp and led to an apical abscess, the drainage hole for which can be seen in the palate. There is also a moderate development of torus palatinus. MG 340, male adult.

It follows that the rate of attrition was lower on the medieval teeth. By medieval times the diet must have been softer with less fibrous food such as fresh vegetables and meat but a higher component of milled flour. This sort of diet would have been more conducive to the development of caries.

ii. CARIES (TABLES 4.28A AND 4.29B)

Caries will eventually develop in teeth wherever there is plaque, with certain carbohydrate foods adhering to the enamel, around the teeth and gum margins, and in fissures on the occlusal surfaces (Illus. 4.51). In populations with a hard fibrous diet, attrition of the occlusal surface is usually faster than the growth of any carious cavity on the occlusal surface; occlusal caries are thus less common in populations living before the introduction of soft foods and low attrition rates.

The frequency of caries at other sites on the tooth tends to be strongly correlated with a number of other factors. The position of the tooth in the mouth is important; anterior teeth, being more easily freed of food particles by biting action and by movements of the lips and tongue, have a low frequency of caries. The susceptibility of the tooth to hold food particles means that the chewing teeth at the back of the mouth are particularly at risk, as food is trapped both between the cusps and between the individual teeth and the gum (Illus. 4.52). Frequency of caries is highest in the first molar, being the first of the permanent dentition to erupt, and the frequency of caries in any given tooth increases with the age of the individual.

TABLE 4.28a

Dental pathologies: caries and pulp exposure, total percentage of occurrences for tooth positions 1–8, Cathedral Green, Winchester

Sample		Caries (inc. occlusal)				Occlusal caries				Pulp exposure			
		Anglo-Saxon graves	Anglo-Saxon Charnel	Medieval earth graves	Medieval cist graves	Anglo-Saxon graves	Anglo-Saxon Charnel	Medieval earth graves	Medieval cist graves	Anglo-Saxon graves	Anglo-Saxon Charnel	Medieval earth graves	Medieval cist graves
Tooth 1	Upper	R 0.76	0	L 0.91	0	0	0	0	0	0	0	L 0.91	L 1.44
	Lower	L 0.64	0	0	0	0	0	0	0	0	0	0	0
Total		**0.69**	**0**	**0.36**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0.36**	**0.61**
Tooth 2	Upper	1.17	L 3.03	R 0.59	0	0	0	0	0	R 0.58	0	0	L 1.19
	Lower	0	L 2.08	R 0.48	1.89	0	0	0	L 0.94	0	0	0	L 0.94
Total		**0.55**	**2.47**	**0.53**	**1.05**	**0**	**0**	**0**	**0.53**	**0.27**	**0**	**0**	**1.05**
Tooth 3	Upper	L 0.42	R 1.03	3.62	3.92	0	0	0	0	0.84	0	R 0.45	R 0.98
	Lower	0	0	R 0.39	R 0.88	0	0	0	0	0	0	0	0
Total		**0.21**	**0.54**	**1.88**	**2.33**	**0**	**0**	**0**	**0**	**0.41**	**0**	**0.21**	**0.46**
Tooth 4	Upper	L 4.38	L 2.43	L 11.88	L* 7.41	R 0.4	0	0	0	L 0.8	0	R 0.41	0
	Lower	R 1.13	R 0.51	R 0.38	0	0	0	0	0	R 0.38	0	0	0
Total		**2.71**	**1.49**	**5.95**	**3.08**	**0.19**	**0**	**0**	**0**	**0.58**	**0**	**0.2**	**0**
Tooth 5	Upper	L 4.72	L 1.7	R 5.69	L 10.68	0	0	R 0.81	R 0.97	R 0.39	0	0	0
	Lower	R 1.94	R 0.4	R 4.82	R 3.57	0	0	0	R 0.89	L 0.39	0	R 0.4	R 0.89
Total		**3.23**	**1.03**	**5.25**	**6.51**	**0**	**0**	**0.4**	**0.93**	**0.39**	**0**	**0.2**	**0.46**
Tooth 6	Upper	R 8.71	R* 6.35	R 12	L 14	R 0.38	0.67	2.67	R 5	2.27	L 1.67	R 2.27	0
	Lower	L* 6.55	R* 5.25	12.17	11.43	L 3.1	0.31	L 2.17	R 5.71	R 1.38	L 2.01	L 1.3	R 2.86
Total		**7.58**	**5.6**	**12.09**	**12.68**	**1.8**	**0.42**	**1.42**	**5.37**	**1.8**	**1.9**	**1.76**	**1.46**
Tooth 7	Upper	L 8.55	R 3.07	13.26	L 13.33	R 2.13	R 1.75	L 4.59	2.22	0	L 0.44	0	0
	Lower	L 8.33	L 3.9	R 9.88	R 8.11	L 3.12	L* 2.97	R 2.77	R 4.5	0	L 0.74	0	0
Total		**8.43**	**3.65**	**11.36**	**10.45**	**2.68**	**2.61**	**3.56**	**3.48**	**0**	**0.65**	**0**	**0**
Tooth 8	Upper	4.51	2.1	7.41	L 14	R 1.5	R 1.05	R 1.85	L 10	0	0	0	0
	Lower	R 12.64	L* 4.4	R 8.57	R 14.67	7.69	R 5.86	R 4	R 4	R 0.55	L 0.29	0	0
Total		**9.2**	**3.9**	**8.13**	**14.4**	**4.44**	**4.82**	**3.18**	**6.4**	**0.32**	**0.23**	**0**	**0**

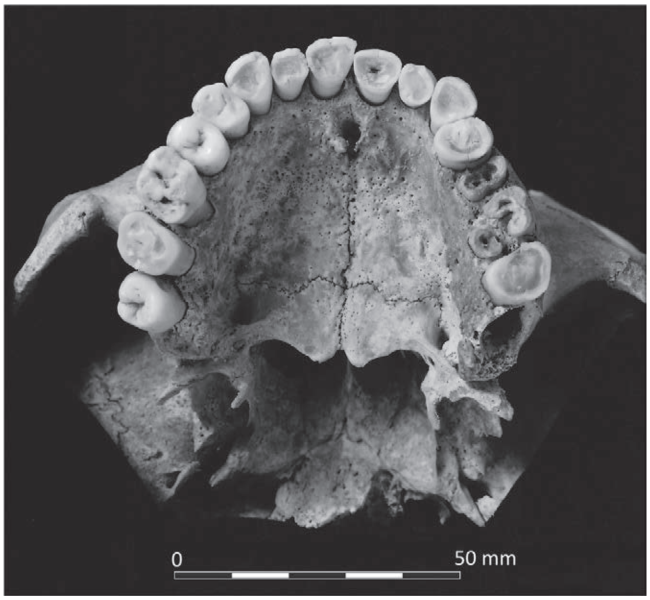
L or R denotes whether the frequency was greater on the left or right. Where there is no letter the sides were equal in frequency.
* denotes an excess frequency of 5 or more.

TABLE 4.28b

Dental pathologies: ante mortem loss and abscesses, total percentage of occurrences for tooth positions 1–8, Cathedral Green, Winchester

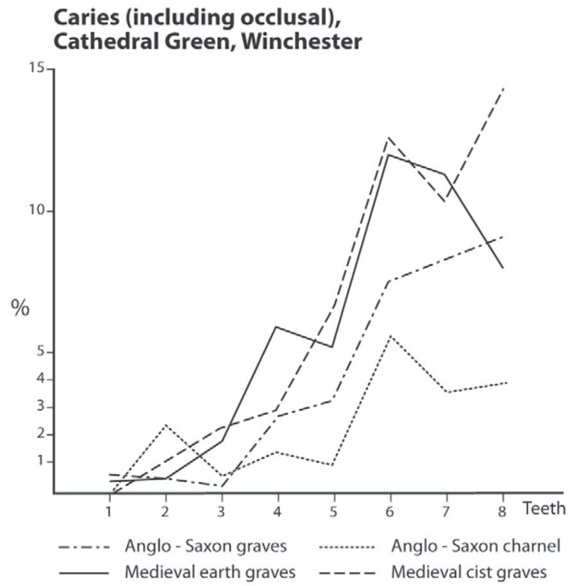
Sample		Ante mortem loss				Abscesses			
		Anglo-Saxon graves	Anglo-Saxon Charnel	Medieval earth graves	Medieval cist graves	Anglo-Saxon graves	Anglo-Saxon Charnel	Medieval earth graves	Medieval cist graves
Tooth 1	Upper	L 5.98	L 1.24	L 5.25	R 0.61	L 0.92	0.72	L 1.06	1.31
	Lower	L 2.83	L 1.96	L 7.08	L 1.85	0	0.35	L 0.35	R 0.62
Total		**4.43**	**1.8**	**6.18**	**1.23**	**0.52**	**0.44**	**0.7**	**0.96**
Tooth 2	Upper	3.56	0.84	L 6.54	L 0.63	0.61	L 0.72	L 0.36	R 1.92
	Lower	L 1.84	R* 0.73	3.51	1.23	0	0.22	L 0.33	R 0.62
Total		**2.72**	**0.75**	**4.98**	**0.93**	**0.29**	**0.34**	**0.35**	**1.26**
Tooth 3	Upper	2.04	L 0.2	2.15	R 0.61	R 1.2	L 0.52	R 1.76	L 0.64
	Lower	R 0.77	R 0.06	2.27	0	R 0.55	R 0.32	0	0
Total		**1.4**	**0.09**	**2.69**	**0.31**	**0.86**	**0.37**	**0.85**	**0.31**
Tooth 4	Upper	L 4.08	1.23	L 8.18	1.24	R 1.22	R 0.53	R 3.69	L 1.29
	Lower	L* 1.81	L 0.51	R 3.55	0.62	0.56	L* 0.36	L 0.68	0
Total		**2.95**	**0.68**	**5.79**	**0.93**	**0.87**	**0.4**	**2.13**	**0.63**
Tooth 5	Upper	R 4.21	R 0.83	L 8.63	R 5.66	R 0.31	L 1.06	R 2.63	L 3.92
	Lower	R 6.5	L* 2.28	R 8.63	3.75	L 0.9	1.23	0	L 0.65
Total		**5.63**	**1.93**	**8.63**	**4.7**	**0.61**	**1.19**	**1.31**	**2.27**
Tooth 6	Upper	L* 10.5	L 5.15	R 27.15	R 16.1	L 5.46	7.11	R* 5.09	L 5.26
	Lower	13.65	R* 6.52	L* 27.22	R 17.4	L 4.67	L* 6.87	6.02	4.48
Total		**12.07**	**6.2**	**27.19**	**16.8**	**5.05**	**6.93**	**5.56**	**4.87**
Tooth 7	Upper	L 10.29	L* 5.52	L* 23.31	L 15.3	L 2.98	L 4.37	2.86	L 7.52
	Lower	L 11.04	L 3.29	L* 16.31	R 10.6	L 2.15	R* 3.38	L 2.8	2.74
Total		**10.73**	**3.8**	**19.65**	**12.9**	**2.53**	**3.62**	**2.83**	**4.87**
Tooth 8	Upper	L 9.09	L 4.05	R 24.54	R 16.9	L 2.59	1.05	L 6.67	R 6.06
	Lower	L* 11.24	R* 2.24	L 17.34	10.3	L 3.77	R* 2.96	L 2.62	L 3.88
Total		**10.19**	**2.64**	**20.69**	**13.7**	**3.24**	**2.49**	**4.49**	**4.95**

L or R denotes whether the frequency was greater on the left or right. Where there is no letter the sides were equal in frequency.
* denotes an excess frequency of 5 or more.



Illus. 4.52. Caries in the left PM^2 and M^1 has destroyed both crowns and exposed the root pulps. The pattern of attrition suggests that for a time the individual chewed preferentially on the left side, then when this became too painful, chewed with the anterior teeth. The rapid attrition here has exposed the pulp of the central incisor. Normally secondary dentine would form. MG 205, male.

These patterns obtain whatever the age of the population, but there has been an overall increase in the frequency of caries in British populations from the Iron Age, through Romano-British and Anglo-Saxon times to the medieval and modern periods, although this increase has not necessarily been linear or consistent in all time periods. Only the very low frequency of caries in deciduous teeth has proved the exception to this trend until modern times. Changing diet and eating habits have presumably played a large part in this secular trend.



Illus. 4.53. Relative frequencies of caries in the Winchester Cathedral Green samples. Caries frequency increases with exposure and is usually greatest in the first molar, the first of the permanent teeth to erupt.

Dental caries was one of the commonest types of pathology encountered among the Winchester skeletons. The frequency of caries among males was lower in those from the Anglo-Saxon charnel than in the males from either medieval population. On the other hand, the frequency was higher in females from the Anglo-Saxon charnel than in medieval females; there are possibly cultural reasons for this unexpected difference, if it is not the result of sampling.

In medieval times, the frequency of caries was similar for both males and females whether they

TABLE 4.29a

Frequency (TPR) of ante mortem loss and apical abscesses, Cathedral Green, Winchester

Sample	Ante mortem loss				Apical abscesses			
	Anglo-Saxon graves	Anglo-Saxon Charnel	Medieval earth graves	Medieval cist graves	Anglo-Saxon graves	Anglo-Saxon Charnel	Medieval earth graves	Medieval cist graves
MALES, FEMALES, AND JUVENILES								
Pathological sites	230	67	244	194	57	36	41	66
Teeth/sockets	5,776	1,634	2,258	2,673	7,010	1,579	2,301	2,563
% affected	3.98	4.10	10.80	7.54	0.01	2.27	1.78	2.57
Affected individuals	59	24	56	49	38	22	26	34
Individuals studied	370	151	112	103	372	141	113	104
Mean pathology per individual	3.89	2.79	4.35	3.95	1.50	1.63	1.57	1.94
MALES								
Pathological sites	101	63	137	123	40	24	27	32
Teeth/sockets	2,052	1,216	1,342	1,489	2,075	1,128	1,375	1376
% affected	4.92	5.18	10.20	8.26	1.92	2.12	1.96	2.32
Affected individuals	26	20	32	29	27	14	18	17
Individuals studied	101	104	69	59	101	94	69	59
Mean pathology per individual	3.88	3.15	4.28	4.24	1.48	1.71	1.50	1.88
Maximum pathology per individual	15	8	15	16	3	3	3	6
FEMALES								
Pathological sites	127	4	107	71	16	12	14	34
Teeth/sockets	1,278	336	847	1,134	1,256	326	846	1,187
% affected	9.93	1.19	12.63	6.26	1.27	3.57	1.65	2.86
Affected individuals	31	4	24	20	10	8	8	17
Individuals studied	60	33	39	44	60	33	40	45
Mean pathology per individual	4.09	1.00	4.45	3.55	1.60	1.50	1.75	2.00
Maximum pathology per individual	16	1	11	11	4	3	6	6

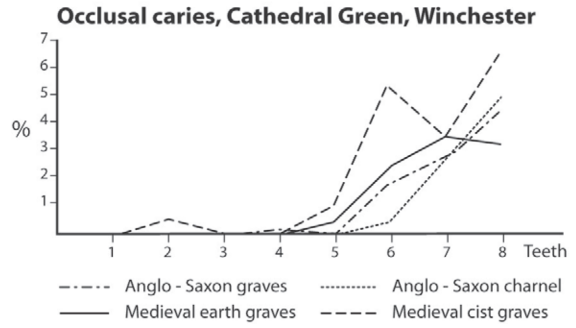
TABLE 4.29b

Frequency (TPR) of caries and pulp exposure, Cathedral Green, Winchester

Sample	Caries				Pulp exposure			
	Anglo-Saxon graves	Anglo-Saxon Charnel	Medieval earth graves	Medieval cist graves	Anglo-Saxon graves	Anglo-Saxon Charnel	Medieval earth graves	Medieval cist graves
MALES, FEMALES, AND JUVENILES								
Pathological sites	107	16	88	109	18	4	12	28
Teeth/sockets	4,878	734	1,517	1,936	3,543	736	1,467	1,850
% affected	0.02	2.17	5.80	5.63	1.50	0.54	0.81	1.51
Affected individuals	54	10	45	45	13	3	8	11
Individuals studied	366	131	107	104	367	131	107	104
Mean pathology per individual	1.98	1.60	1.95	2.42	1.38	1.33	1.50	2.54
MALES								
Pathological sites	61	8	60	58	9	4	5	17
Teeth/sockets	1,457	531	873	1,083	1,460	541	882	975
% affected	4.18	1.5	6.87	5.35	0.61	0.73	0.56	1.74
Affected individuals	31	6	29	26	7	3	4	7
Individuals studied	100	85	65	59	100	85	65	59
Mean pathology per individual	1.96	1.33	2.06	2.23	1.28	1.33	1.25	2.42
Maximum pathology per individual	11	2	5	7	2	2	2	6
FEMALES								
Pathological sites	39	8	24	51	9	0	3	11
Teeth/sockets	824	148	584	853	814	146	525	875
% affected	4.73	5.4	4.1	5.97	1.1	0.00	0.57	1.25
Affected individuals	20	4	15	19	6	0	3	4
Individuals studied	58	32	38	45	58	32	38	45
Mean pathology per individual	1.95	2.00	1.60	2.68	1.50	0.00	1.00	2.75
Maximum pathology per individual	4	3	4	6	4	0	1	5

were buried in the earth graves or in the cists. Although the mean number of caries per case was broadly similar across populations and between sexes (excepting the males in the Anglo-Saxon charnel) there was an overall increase in frequency of caries by medieval times, together with an exceptionally high frequency in the third molars of the medieval cist grave population (Illus. 4.53). There were seven cases of caries in deciduous dentitions of the medieval period (four from earth graves, three from cist graves), and two cases from the Anglo-Saxon graves.

The overall increase in caries frequency among the medieval people at Winchester may be a reflection of the increasing use of refined flours by an urban people. The evidence for this derives from the observation that many of the increased number of caries cases in the teeth of the medieval people are sited on the occlusal surfaces of the teeth, especially the first and third molars (Illus. 4.54). In populations with a hard fibrous diet this surface is usually worn away before caries can be established.

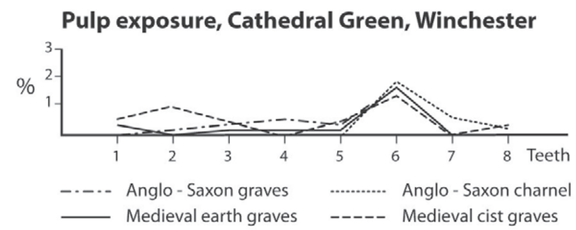


Illus. 4.54. Occlusal caries distribution and frequency in the Winchester Cathedral Green samples. The high frequency of occlusal caries on the molars, especially the first (6) and third (8) molars of the medieval cist grave sample, may reflect greater infection since the attrition rate on the teeth of this group is not significantly different from that of the medieval earth grave sample.

iii. pulp exposure (tables 4.28a and 4.29b)

Extreme attrition, if proceeding at a greater rate than secondary dentine can form, will lead to exposure of the pulp of the tooth. A more common cause of pulp exposure today is the excessive growth of caries, sometimes assisted by the collapse of the tooth crown. Occasionally trauma—the breaking of a tooth—will result in pulp exposure. The exposure of the pulp of a tooth is painful and usually of comparatively short duration. The way is open for infection of the root, the development of an apical abscess, and eventually the loss of the tooth.

The pattern of pulp exposure did not differ significantly in either of the Anglo-Saxon or medieval populations examined; the first molar showed the highest prevalence in each of the samples (Illus. 4.55). The overall frequency was lower for the Anglo-Saxon samples (none at all being recorded for females from the charnel) than for the medieval samples. For both sexes combined it was highest in the medieval cist graves. Amongst the medieval samples, the frequency of pulp exposure for the males from the earth graves was higher than for the males from the cist graves. This pattern was reversed for the females, but generally in both the Anglo-Saxon and medieval samples the males had a higher frequency of pulp exposure. These differences may simply reflect sampling variation, rather than the influence of gender or social differences.



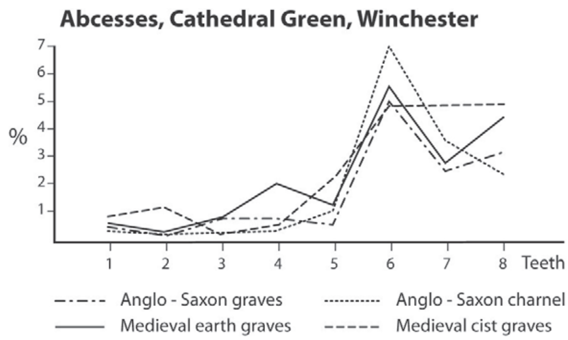
Illus. 4.55. Relative frequencies of pulp exposure in the Winchester Cathedral Green samples by tooth position (1–8). In all samples the first molar (6) is the most vulnerable tooth.

Illus. 4.56. Apical abcesses: (a) on a maxillary molar. MG 271, male age *c*.50; (b) on a right PM^2. The crown of the tooth has broken off, leaving only a root in the jaw. The drainage cavity of the abscess can be seen near the tip of the root. The extreme build-up of calculus on the teeth suggests that the individual had not been chewing on the right side for some time before death. MG 269, male age 30–40.

iv. ABSCESSES (TABLES 4.28B AND 4.29A)

An abscess will develop at the apex of the root of a tooth, in modern populations usually when infection enters the tooth through exposure of the pulp cavity. Some apical abscesses may be caused directly by trauma to the root, giving rise to a local inflammation. Pus accumulates around the root of the tooth, causing pressure and erosion of the alveolus. Eventually a pus cavity perforates the alveolar wall and the abscess drains away. Usually the nerve to the tooth dies. The tooth becomes non-vital and is eventually shed. Healing of the abscess cavity, usually after tooth loss, can be recognized by the changed texture of the bone around the tooth socket (MG 271, MG 269, Illus. 4.56a, b). Sometimes an abscess perforates the antrum of the maxillary sinus, forming a fistula draining into the sinus, e.g. MG 163, or to the buccal cavity below the malar bone, as found in ASG 473.

Not surprisingly the pattern of abscess occurrence in the different teeth was much the same as the pattern already noted for caries development, the highest frequency being observed in the molar teeth, especially the first molar (Illus. 4.57). Although the frequency of abscesses was highest among the Anglo-Saxon charnel females, the overall trend was for an increased frequency of abscesses in the medieval samples. The mean number of abscesses per case was highest for the males from the medieval earth burials.



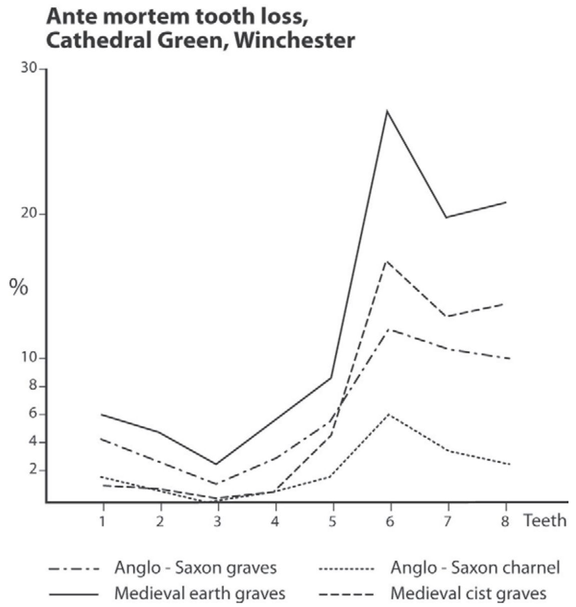
Illus. 4.57. Abscess distribution and frequency in the Winchester Cathedral Green samples. In all samples the first molar (6) is the most vulnerable tooth.

Illus. 4.58. Ante mortem tooth loss: (a) of left M_1. The tooth has been shed for some time and the alveolus is beginning to fill up. MG 357=333, female adult; (b) of M_1 and gingival caries of M_3. MG 118, adult; (c) an edentulous mandible after loss of all the teeth and consequent alveolar bone loss. The alveolar margin has remodelled into a smooth bony line. MG 196, male age *c.*55.

v. ANTE MORTEM TOOTH LOSS (TABLES 4.28B AND 4.29A)

Once again the frequency of ante mortem tooth loss increased in medieval times and was similar for both sexes. The frequencies for both sexes were greater in the medieval earth graves than in the medieval cist graves, instead of being similar, as they were for caries. This is an indication, perhaps, of a greater mean age at death. Varying degrees of ante mortem tooth loss are shown in Illus. 4.58a–c. The mean number of teeth lost seems to be slightly less in the males from the Anglo-Saxon charnel and medieval cist graves than for any other sexed group (Illus. 4.59).

As in the findings for caries, abscesses, and pulp exposure, the first molar is the tooth with the highest frequency of ante mortem loss. This pattern is maintained to present times. Significance tests carried out on dental pathology percentages of upper and lower teeth combined,



Illus. 4.59. Ante mortem loss of teeth in the Winchester Cathedral Green samples. The distribution of ante mortem shedding is very similar to the distribution of caries and is age related.

Illus. 4.60. A medieval dentist extracting a tooth: an English manuscript illumination in the *Omne Bonum* written 1360–75 (London, British Library, Royal MS 6 E.VI, f. 503v). By permission of the British Library Board.

and male and female combined, showed ante mortem tooth loss to be significantly greater ($p = 0.001$) in the Anglo-Saxon graves than in the Anglo-Saxon charnel. The medieval earth graves also had a significantly higher frequency of ante mortem tooth loss than did the medieval cist graves. Medieval populations were also significantly ($p = 0.001$) more likely to have ante mortem tooth loss than the Anglo-Saxon (Table 4.30). These population differences may reflect both differences in eating habits and differences in calcium status; a poor calcium status predisposes the individual to caries. The age structure of the population will also affect the frequency of ante mortem tooth loss since the rate of loss increases with individual age.

No direct evidence for deliberate extraction of teeth was observed and would in fact be very difficult to ascertain on skeletal material (Illus. 4.60).

vi. PERIODONTAL DISEASE (TABLE 4.31)

Together with caries, periodontal disease is one of the major causes of tooth loss. It begins as an infection of the soft tissues of the mouth (gingivitis). Later it spreads to the underlying alveolar margins of the mandible and maxilla (Illus. 4.61), where it causes recession, resulting eventually in the loosening and loss of teeth. As in caries, various factors are involved in the production of this condition, including poor oral hygiene, irritation by calculus deposits, attrition, and lowered tissue resistance through a faulty diet.[3]

Cases of periodontal disease tended to be

[3] Brothwell (ed.) 1963.

TABLE 4.30

Significance tests of dental pathology percentages: upper and lower combined, male and female combined, Cathedral Green, Winchester

Tooth	Anglo-Saxon (graves v. charnel)			Medieval (earth graves v. cist graves)			All populations: medieval v. Anglo-Saxon		
	AM loss	Abscess	Caries	AM loss	Abscess	Caries	AM loss	Abscess	Caries
1	+++			++			+++		
2	+++			++			+++	+	
3	+++			+			+++	+	++
4	+++			+++			+++	+++	+++
5	+++		+	+			+++	+	+++
6	+++			+++			+++	+	+++
7	+++		+++	+			+++		+++
8	+++		++	+			+++	+	+++

+ Significant at 0.05 level
++ Significant at 0.01 level
+++ Significant at 0.001 level

TABLE 4.31

Frequency (CPR) of periodontal disease, Cathedral Green, Winchester

Sample	Anglo-Saxon graves	Anglo-Saxon charnel	Medieval earth graves	Medieval cist graves
MALES, FEMALES, AND JUVENILES				
Total affected	98	33	174	58
Slight	38	16	64	22
Medium	35	12	65	20
Considerable	25	5	45	16
Total examined	191	51	272	80
% affected	51.31	64.70	63.98	72.50
MALES				
Total affected	63	23	109	33
Slight	23	10	35	9
Medium	27	9	48	15
Considerable	13	4	26	9
Total examined	77	37	143	42
% affected	81.81	62.16	74.22	78.57
FEMALES				
Total affected	32	10	59	23
Slight	12	6	27	13
Medium	8	3	15	4
Considerable	12	1	17	6
Total examined	38	14	89	35
% affected	84.21	71.43	66.29	65.71

more serious among the medieval people than among the Anglo-Saxons, but there was a higher frequency among the Anglo-Saxon females than among the medieval females or males. In medieval times the males showed a higher frequency of periodontal disease than did the females, whether they were buried in earth graves or cist graves.

vii. INJURIES TO THE TEETH

A few cases of ante mortem fractured and chipped teeth occurred in all four samples. The burial in MG 846 had an old fracture of an incisor (Illus. 4.61) as well as a sword cut on the head; three Anglo-Saxons from the charnel had evidently chipped various teeth (an incisor, upper first molar, and upper third molar) during life; five others from this sample had fractured molars or in one case an upper premolar. One person from a medieval earth grave had chipped an upper incisor, and another had fractured both lower central incisors.

viii. HYPOPLASTIC ENAMEL DEFECTS

The frequency of enamel defects in any of the samples was surprisingly low. Enamel defects develop during the growth of the tooth, usually when the child suffers a fairly acute illness that causes tooth formation to slow temporarily. However, periods of acute nutritional or emotional stress can also be a factor. Calcification of the tooth germ is renewed on recovery from the illness and a hypoplastic line marks the tooth. The position of the line on the developing crown can be equated with the age of the child at the time of its illness. Unlike lines of arrested growth in the bones, hypoplastic lines are not remodelled and are therefore good indicators of childhood health or nutritional problems. Six severe cases with hypoplastic defects were observed on the teeth of juveniles from the Anglo-Saxon graves and 14 cases were noted from the Anglo-Saxon charnel, mostly in unassociated jaws. Only two cases were recorded from the medieval graves, one from an earth grave, and one from a cist grave. This appears to be a remarkably low frequency, although minor hypoplastic defects were more common. It is important to note that the evidence of hypoplasia may be obscured by non-occlusal dental attrition, the polishing which occurs generally over the crown as a result of mastication of food.

ix. CONCLUSIONS ON THE ANALYSIS OF DENTAL HEALTH IN THE WINCHESTER ANGLO-SAXON AND MEDIEVAL SAMPLES

The overall impression from the analysis of the frequencies of caries, abscesses, pulp exposure, ante mortem loss, and periodontal disease in the Winchester samples is one of a general and considerable deterioration in the dental health of the people from Anglo-Saxon to medieval times. If the interpretation of a diminished rate of dental attrition for the medieval populations is correct, and if therefore the age at death of the medieval people was on average less than that of the Anglo-Saxons, then the poor dental health of these medieval people may have be reflected in their shorter life span.

With the exception of the women, the dental health of the people in the Anglo-Saxon charnel was better than that of those in the individual Anglo-Saxon graves, and we appear to be witnessing a deterioration in oral health of the people of Winchester from the later seventh century onwards which may reflect changes in living standards and perhaps in the quality of available food. It is surprising therefore that so few cases of hypoplastic defects of the enamel were recorded. Children either continued to have a satisfactory diet or did not survive illness of the duration and severity to be recorded on the developing tooth.

Generally the dental health of the medieval people was very similar whether they were buried in earth graves or in cist graves. The significantly higher ante mortem tooth loss among the medieval people in the earth graves may imply a greater average age at death for this group.

Illus. 4.61. Periodontal disease and activity-related wear of front teeth. The notch in the upper left central incisor and abrasion of the roots of both lower right incisors with uneven occlusal wear of the central incisor suggests that the front teeth were used to process thread; as a consequence calculus built up along the gum line. MG 846, male age 50+.

6

GENERAL HEALTH

The assessment of disease in the samples from early Winchester was made mainly by visual inspection of the skeletal remains. In an attempt to improve diagnostic accuracy, radiography of many of the human bones, essentially those with external evidence of disease, was also undertaken and was an integral part of the study of the two samples, Anglo-Saxon and medieval. Unfortunately only those diseases which manifest themselves in bone can be studied in this way, and it should be remembered that the major killers of the past included epidemic diseases which left no osteological traces.

The Anglo-Saxons for the most part were a robust country folk, whose general good health may well be reflected in the skeletal evidence. The later skeletons indicate that the medieval population was possibly less robust than the Anglo-Saxon. Since, however, the Winchester skeletons represent a monastic and urban population, there is the possibility that the health of the medieval rural peasant may have resembled that of his Anglo-Saxon ancestors.

i. NUTRITIONAL DISEASES

There was no evidence for widespread scurvy or rickets in either the Anglo-Saxon or the medieval populations from Cathedral Green, although a few possible cases were found.

Mild bowing of the weight-bearing long bones, the femur and tibia, but with no radiographic evidence of active bone disease, was taken to be indicative of healed childhood rickets, caused by a vitamin D (normally due to insufficient sunshine or D-rich food in the diet) and calcium deficiency. The bowed bones indicative of rickets were found in six Anglo-Saxon adults and 10 medieval skeletons (Illus. 4.62). Generally the skeletons were too incomplete to evaluate the ribs for 'rickety rosary', or were older individuals where the rosary tends not to be evident.

One Anglo-Saxon infant (ASG 574) was found to have a laminar periosteal elevation in the long bones. Apart from trauma and infection, for which there was no supporting radiological evidence, the most likely cause was vitamin C deficiency or scurvy, which leads to bleeding under the periosteum.[1] Some support for this diagnosis comes from the fraying of the ends of the long bones, but unfortunately the natural process of decay had made the ends of the bones friable and some diagnostic uncertainty thus remains.

Cribra orbitalia (a perforation of the upper surface of the orbits) were detected in a number of skulls from all four samples. Found in 23.6% of the Anglo-Saxons and 17.0% of the medieval sample, it was probably caused mainly by anaemia in early British groups and most often occurred in childhood.[2] Other stress conditions have been discussed in relation to this pathology, but anaemia remains the most likely cause at Winchester. The frequency of the disease was usually higher for females than for males in the

[1] See Roberts and Manchester 2005, 234–7.

[2] Angel 1967, 378–89; Stuart-Macadam 1992.

Illus. 4.62. Lateral views of rickets in the leg bones of a medieval child. Left, the femoral shaft shows slight forward bowing. Right, the tibial shaft is quite strongly bowed medio-laterally. CG 1966 (4) unnumbered, child age 6.

skeletons studied, although the differences were not likely to be statistically significant. The degree of porosis was rarely extreme and this would seem to indicate that the anaemia was usually not severe.

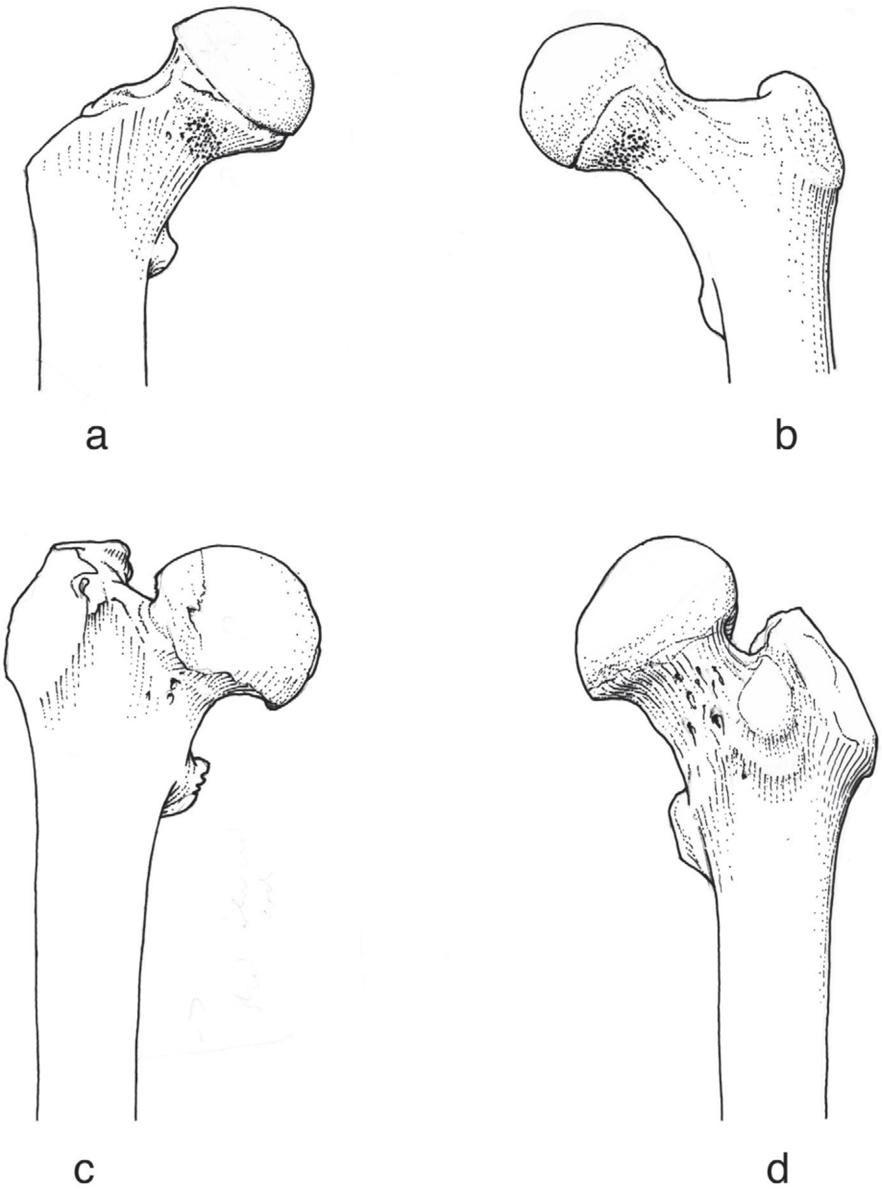
Cribra femoris, a perforation of the neck of the femur (Illus. 4.63) of unknown cause but quite possibly nutritional or related to mechanical stress, was found predominantly in juveniles. The much higher frequency among the Anglo-Saxon than among the medieval skeletons (38:16) may reflect sampling.

ii. PARASITE INFECTION

Long-term infection by helminths and other intestinal parasites must have been quite common in rural Britain until relatively recently.[3] The infection would have been chronic rather than fatal, and thus we might question whether it predisposed the skeleton at times to much the same defects as do nutritional deficiencies.

The eggs of intestinal worms, both roundworms and tapeworms, have been found in

[3] Biddle and Pike 1966, and references. See also Mitchell et al. 2013.

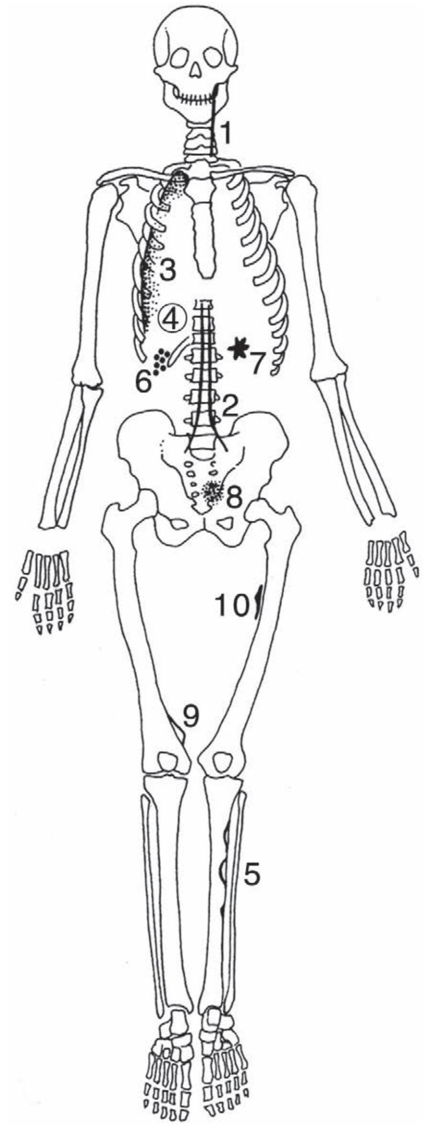


Illus. 4.63. Four examples of different degrees of cribra femoris, pitting of the anterior surface of the neck of the femur. It was found predominantly in juveniles, becoming less distinct in adults. Unstratified: (a and b) sub adult. (c and d) adult.

Anglo-Saxon and medieval deposits in Winchester and elsewhere.[4] Infestation by these worms can contribute to poor health and could have been associated with orbital and cranial vault osteoporosis. Cribra parietalis (a perforation of the parietal bones) in one nine-year-old Anglo-Saxon (ASG 237) occurred as two distinct patches and two less distinct zones suggesting perhaps two periods of stress.

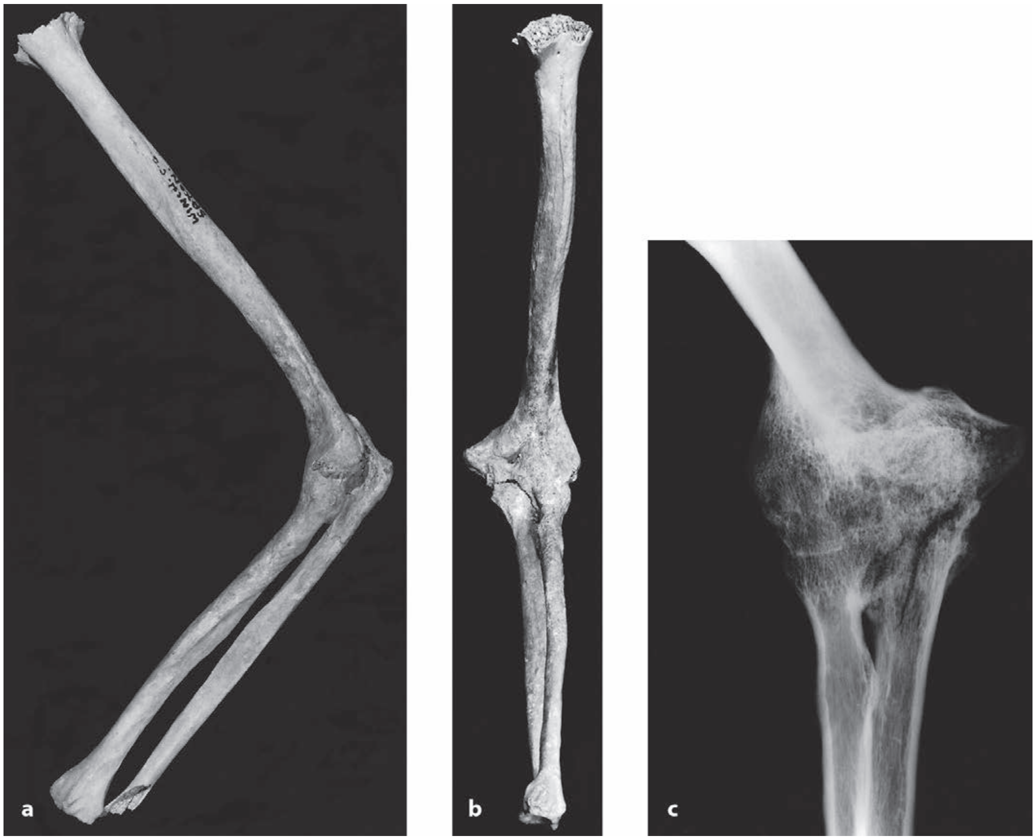
Hydatid disease (echinococcosis) is caused by an intestinal tapeworm of dogs, the eggs being transmitted from dog to man by handling and

[4] Biddle and Pike 1966, and references. See also Mitchell et al. 2013.



Illus. 4.64. Common sites for soft tissue calcifications. Following infections by parasites, calcification is sometimes seen as the end process of prolonged inflammation. The majority of calcification in soft tissue is amorphous and disappears in the process of decay. Only calcifications attached to bone, stones, and the tubular calcifications associated with vascular disease are likely to be preserved and recognized in excavated material. Arterial; 1 carotid, 2 aorta; Infective: 3 pleural, 4 hydatid cyst, 5 parasitic worms; Calculi: 6 gall stones, 7 kidney stones, 8 bladder stones; Other calcifications: 9 pulled muscle, 10 bone growth.

contact. In man the eggs develop and migrate to soft tissues, normally lung or liver, where they form cysts (Illus. 4.64). These evoke an intense inflammatory response, and fibrous scar tissue is laid down around the cysts to contain them; eventually calcium salts (hydroxyapatite) are deposited in this fibrous tissue. Such a calcified cyst about the size of a walnut was found at Winchester in the position of the abdominal cavity of a woman in a medieval cist grave (MG 253). X-ray diffraction analysis of the hollow, egg-shaped cyst showed that it was almost pure



Illus. 4.65. The bones of the left elbow are fused solid and fixed at just over a right angle. There is no evidence of active disease and the ankylosis is presumably the result of a previous infective arthritis which may have been tuberculosis: (a) lateral; (b) anterior; (c) radiograph. ASG 324, female adult.

hydroxyapatite, and radiography revealed the woven texture of the inner lining which, with the smooth texture of the outer wall, is typical of a calcified hydatid cyst.[5]

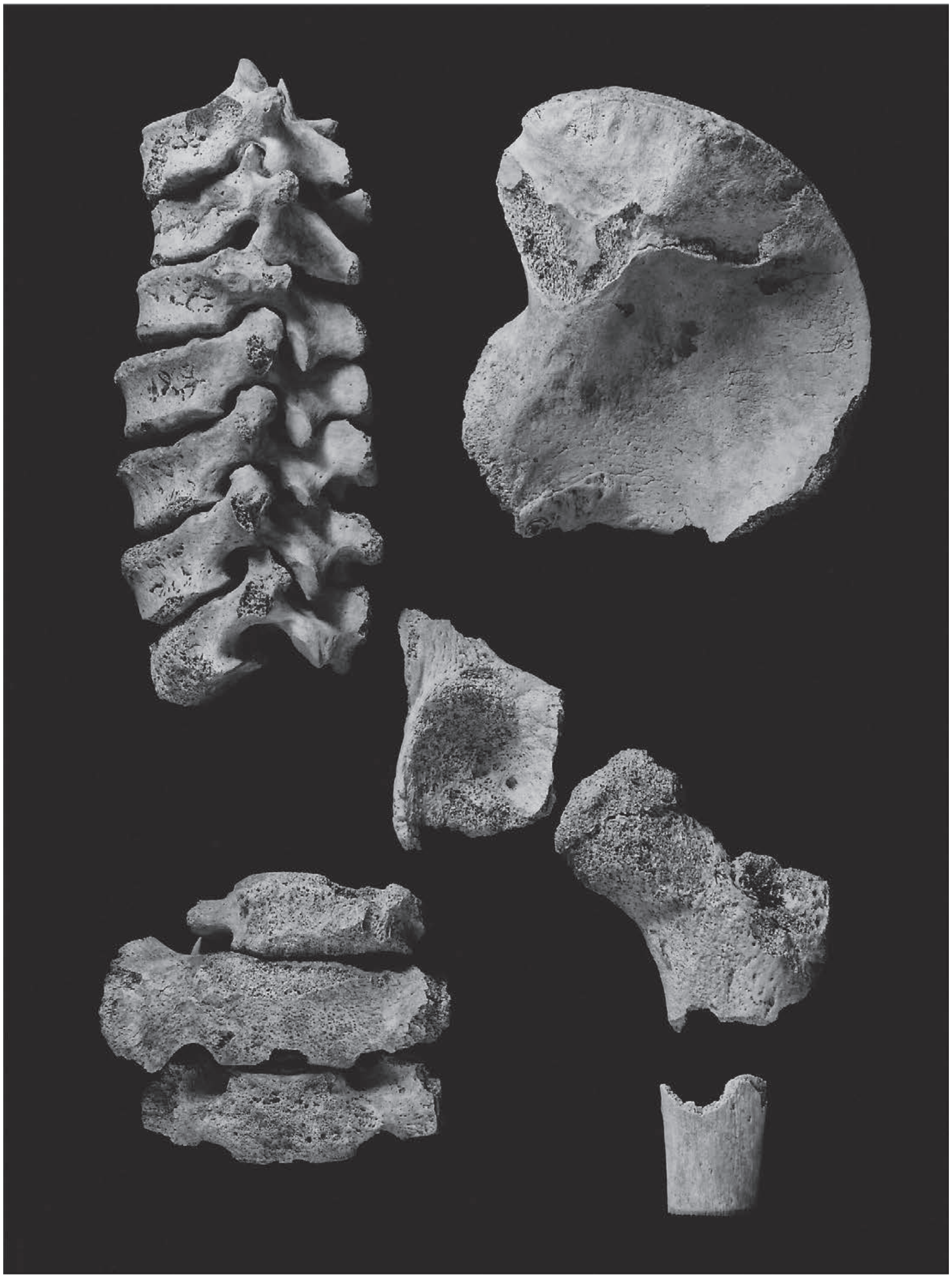
iii. INFECTIOUS DISEASES

Inflammatory bone and joint changes were not very common, but were represented in several specimens, both Anglo-Saxon and medieval.

Tuberculosis

The existence of tuberculosis (infection with *Mycobacterium tuberculosis hominis* or *M. tuberculosis bovis*) was strongly indicated in at least six individuals, three from Anglo-Saxon graves, and three from medieval burials. The disease may be contracted by contact with infected cattle or by consuming contaminated milk, cheese, or butter, or by human contact. In about 1% of modern cases bones (usually a long bone joint or vertebral body) are infected. Large areas of bone may be affected and resorbed, and disintegration of affected joints may take place. Other than in the vertebral column, diagnosis

[5] Other protozoal parasites such as *Giardia lamblia* and various amoebae, which can also lead to absorption problems, may have occurred in the Winchester population as well, but could not be detected.



Illus. 4.66. The left hip and part of the spine exhibit periostitis and osteitis affecting the whole pelvis and the head of the femur. The ischium is very badly affected and the hip socket is malformed. These changes may be the result of active tuberculosis. MG 389, adolescent *c.*16.

must usually remain highly tentative. From even the number of suspected cases of bone tuberculosis it is evident that the disease must have been a major scourge during both the Anglo-Saxon and medieval periods. Many more cases by far would not have affected the bones and subclinical infections may have been common.[6]

An Anglo-Saxon elbow joint (ASG 324, Illus. 4.65) shows a well-consolidated union (ankylosis) and was fixed in flexion. There was no evidence of active disease, but the radiograph shows destruction of the articular surfaces which was almost certainly the result of an infective arthritis, possibly tuberculosis.

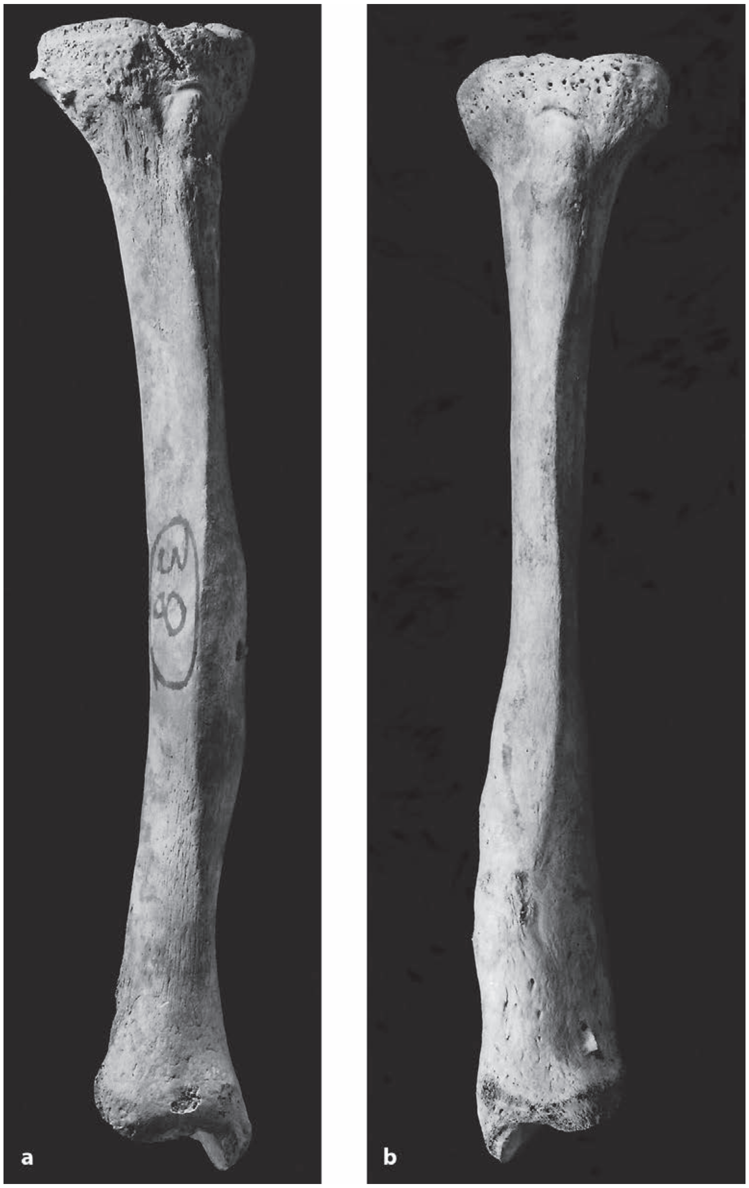
Tuberculosis may have been present in a medieval adolescent (MG 389) who exhibited a diffuse periostitis and osteitis, especially affecting the spine, pelvis, and femoral heads (Illus. 4.66). Tuberculosis was also suspected in a medieval adolescent (MG 890) who had a collapsed vertebral body (Illus. 4.67). Radiographs showed old destructive changes adjacent to the disc space, with reparative new bone formation indicating a healed persistant inflammatory process. Marked curvature of the spine was present, giving a hunchback appearance. Bony spurs projected from the margins of the vertebral bodies and would have given increased rigidity and helped to stabilize the spine.

Illus. 4.67. Radiograph of the spine, with well-healed infection. Spinal tuberculosis (Pott's disease) is a probable diagnosis. The body of L1 has collapsed completely and is solidly fused to the vertebrae above and below, with angular kyphosis. However, only one disc is involved and sclerosis is not marked, so brucella or even staphylococcus are possible causes of infection. MG 890, adolescent *c.*15–16.

Chronic osteomyelitis

A long-standing infection of the inner tissue of bone, chronic osteomyelitis was diagnosed in the tibia from a medieval earth grave (Illus. 4.68a). In another case (MG 703), the lower third of the tibia had an irregular thickened surface with deformity of the bone. Radiographs showed a coarse texture with thickened trabeculae and dense new bone that had been laid down under the periosteum.

[6] Tuberculosis is usually of a chronic granulomatous type but is rarely non-granulomatous, and it can mimic other inflammatory conditions.

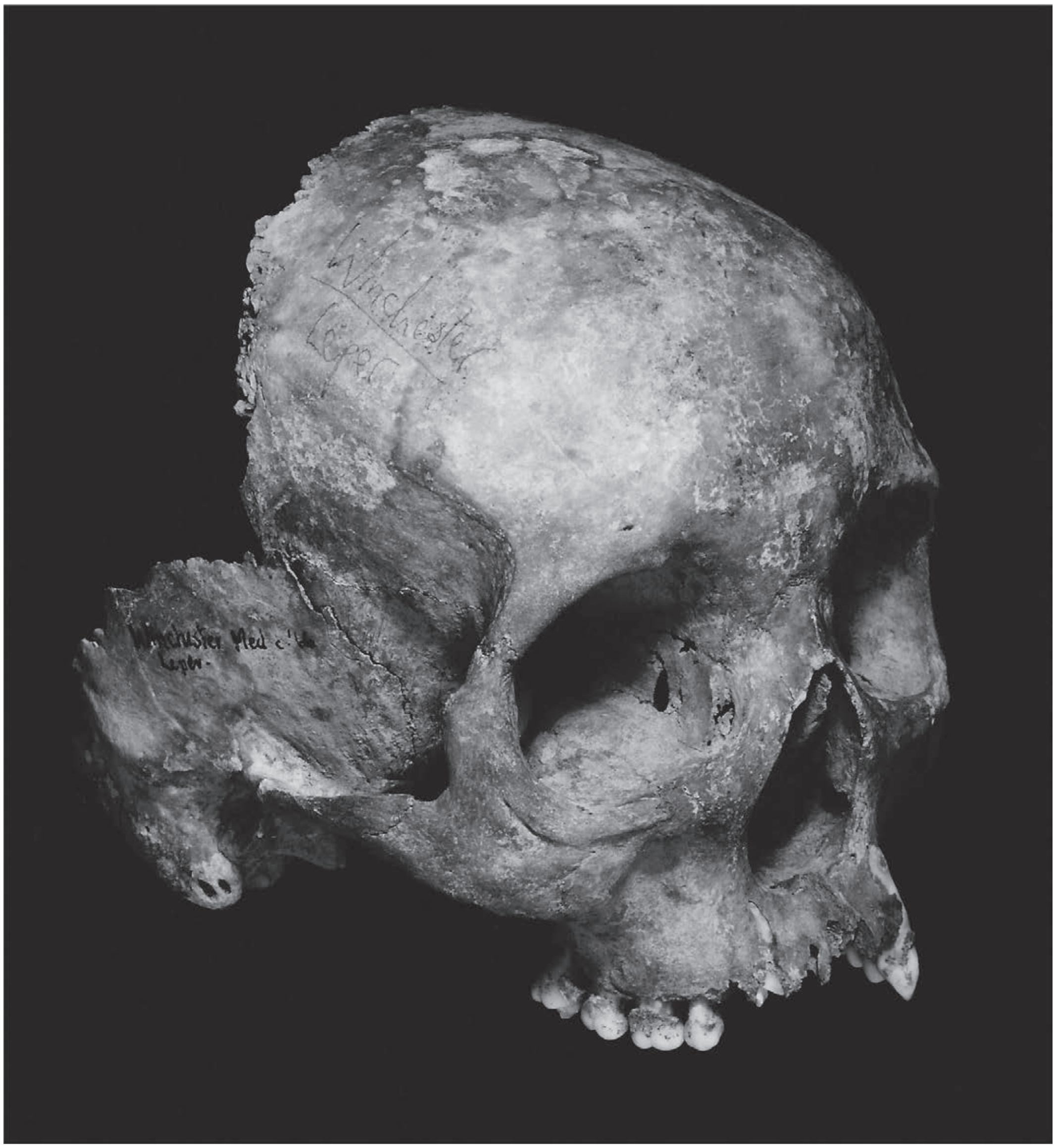


Illus. 4.68. Chronic osteomyelitis of the tibia: (a) right tibia. CG 1969, Tr. XXXVIII (12) unnumbered, medieval male adult; (b) left tibia. MG 703, male adult.

These appearances are diagnostic of a chronic suppurative bone infection, for example due to a staphylococcus (Illus. 4.68b). Radiographic examination of the lower femoral shaft of an Anglo-Saxon of unknown sex suggested a differential diagnosis between a chronic non-specific osteomyelitis and a tuberculous osteomyelitis.

Leprosy

Four possible cases of leprosy (an infection with *Mycobacterium leprae*) were found, two in skulls from the Anglo-Saxon charnel and two from medieval graves. The evidence for leprosy amongst the Cathedral Green samples consisted primarily of atrophy of the alveolar bone of the



ILLUS. 4.69. Cranium showing resorption of the nasal spine in leprosy. Alveolar resorption is not far advanced but is quite clearly most marked about the upper central incisors. All the teeth were present at death. MG 854, male age *c.*34.

face in the region of the upper incisors and of resorption of the inferior nasal spine (Illus. 4.69). No case of leprous resorption of the toes or fingers was seen. The foundation of the hospital of St Mary Magdalene before 1148 for the care of lepers and other sick persons on the downs nearly one and a half miles east of the city indicates that what was considered to be leprosy was known in Winchester.[7] At that time the term 'leprosy' was, however, taken to include other skin conditions which caused the victim to be 'full of sores' or 'leprous' in appearance.

[7] WS 1, 90 (Entry II, 276, n. 2), 328. See also Roffey and Tucker 2012; Taylor et al. 2013.

TABLE 4.32
Observed occurrences of periostitis, Cathedral Green, Winchester

Site	Anglo–Saxon graves	Anglo–Saxon charnel	Medieval earth graves	Medieval cist graves
Skull*	9	30	5	6
Vertebrae and ribs	5	–	–	2
Pelvis	–	–	1	1
Arms	3	–	2	4
Hands	1	–	–	–
Femur	2	Several (fragmentary)	–	2
Knee	1	–	2	–
Tibiae	20	Several (fragmentary)	27	20
Fibulae	11	–	9	13
Heel	1	–	–	5
Feet	3	–	4	6
Legs	1	–	2	4

* Periostitis in the skull is predominantly associated with infections of the teeth and/or sinuses. There is the possibility that endocranial infection is more likely to be linked to tubercular meningitis, but the evidence so far is poor.

Poliomyelitis

Poliomyelitis was a possible cause of disuse atrophy in an unnumbered adult femur from a medieval earth grave. The femoral shaft was thinner but not shorter than normal, the cortex narrow, and there had been loss of trabecular pattern. These effects are consistent with disuse atrophy, the paralysis apparently occurring after early adulthood when the epiphyses had fused, since the bone had not shortened. This is one of a number of alternative diagnoses, not all of them being as likely.

Non-specific periostitis

The periosteum is a thin, tough, connective tissue membrane which forms a layer over the bone and plays a part in the adjustment of bone growth. It is thus sensitive to inflammatory processes arising from within or on the surface of the bone or in the adjacent tissues.

When the long bones from a number of the graves were being cleaned, it was noticed that a high proportion of the lower leg bones (tibiae and fibulae) displayed a subperiosteal reaction, which varied from striations and pitting with a thin superficial film which easily brushed off, to a coral-like mass adhering to the bone. Radiographs did not suggest post mortem change caused by an alkaline environment. The frequency was somewhat higher among medieval bones (Table 4.32). It was slightly less common in the Anglo-Saxon group. Tibiae were especially affected, but fibulae and feet were also often involved. The upper leg, spine, and arms were less often affected.

The illustrations show several degrees of the condition varying from a lamellar type of periostial reaction (Illus. 4.70a–c) to a gross irregular proliferative periostitis (Illus. 4.70d–f, Illus. 4.71). The changes seen on radiographs were very similar to those described in present-day tropical ulcers, and also occur with varicose and non-specific ulcerations.[8]

Garter-hooks were found associated with some burials, and in others post mortem green stains showed the original position of copper alloy objects, usually on the upper third of the inner side of the tibia.[9] If the garters were worn with 'puttees' which were seldom changed, in soggy

[8] Ennis et al. 1972.
[9] WS 7.ii, 548–52, Figs. 148–9.

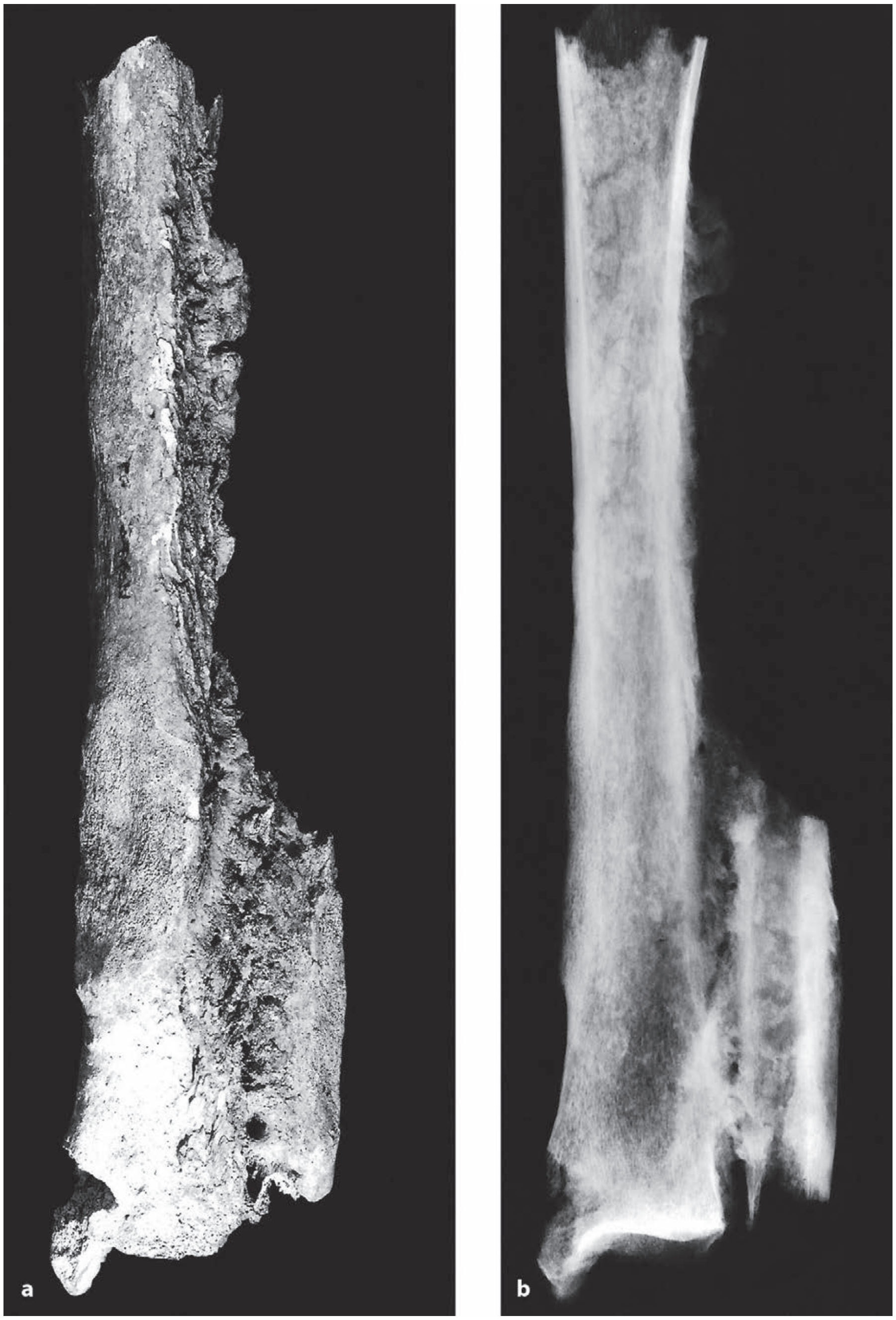
Illus. 4.70. Non-specific periostitis, unprovenanced adult tibiae, Cathedral Green: (a–e) increasing degrees of severity of non-specific periostitis.

humid conditions this could be a predisposing factor in producing leg ulcers and varices. Vitamin deficiencies are also implicated. Møller-Christensen appreciated the nature of changes to the tibia and fibula in victims of leprosy.[10] The changes to the tibia often appear in the form of

[10] Møller-Christensen 1953.

longitudinal striations on the lateral surface and always appear to be accompanied by pathological changes in the feet. The fibulae are not usually attacked to the same degree. This description makes a diagnosis of leprosy for these Winchester cases unlikely.

A few examples of a curious undulating cortical thickening of the tibia were found in both the Anglo-Saxon and medieval populations. This was due to subperiosteal new bone formation and was localized to the subcutaneous aspect of the bone. These thickenings could be regarded



Illus. 4.71. Periostitis: (a) extreme proliferative periostitis leading to fusion of the left tibia and fibula. Probably associated with a 'tropical ulcer', a type of sloughing ulceration of the skin. Cathedral Green, unprovenanced medieval; (b) radiograph of the same individual.

as osteomata (benign proliferations of new bone), but they might equally have been caused by superficial ulceration. Repetitive trauma also needs to be considered in a differential diagnosis.

TABLE 4.33

Osteoarthritis by joints, Cathedral Green, Winchester

A. One site, vertebrae

	Sex	Cervical	Thoracic + torso	Lumbar	Sacrum + Sacro-iliac	'Vertebrae'
Anglo-Saxon graves	M	1	3	3	2	20
Medieval earth graves	M	6	n/a	2	1	20
Medieval cist graves	M	2	1	8	n/a	10
Anglo-Saxon graves	F	1	3	1	n/a	12
Medieval earth graves	F	4	4	1	1	10
Medieval cist graves	F	n/a	2	1	n/a	8
Anglo-Saxon graves	?	7	13	10	2	14
Medieval earth graves	?	5	4	9	2	10
Medieval cist graves	?	n/a	n/a	1	n/a	20

B. Arthropathies: shoulder and arm, hip and leg. One site involved only.

	Sex	Shoulder	Elbow	Wrist	Hand	Fingers	Hip	Knee	Ankle	Foot	Great loe	Other toes
Anglo-Saxon graves	M	1	1	2	1	n/a	4	2	1	n/a	1	1
Medieval earth graves	M	1	1	2	1	n/a	5	1	n/a	1	n/a	n/a
Medieval cist graves	M	2	n/a	n/a	n/a	n/a	1	n/a	1	n/a	n/a	n/a
Anglo-Saxon graves	F	n/a	n/a	n/a	1	n/a	n/a	n/a	n/a	1	n/a	n/a
Medieval earth graves	F	n/a	n/a	n/a	n/a	n/a	n/a	4	n/a	1	1	n/a
Medieval cist graves	F	1	n/a	2	n/a	n/a	n/a	n/a	n/a	n/a	2	n/a
Anglo-Saxon graves	?	2	1	2	n/a	1	2	1	2	n/a	1	1
Medieval earth graves	?	n/a	1	1	n/a	n/a	2	1	1	1	1	1
Medieval cist graves	?	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

C. Vertebrae and one joint site

	Sex	Vertebrae + shoulder	Vertebrae + elbow	Vertebrae + wrist	Vertebrae + hand	Vertebrae + hip	Vertebrae + knee	Vertebrae + great toe
Anglo-Saxon graves	M	1	1	1	n/a	2	n/a	n/a
Medieval earth graves	M	n/a	1	1	n/a	3	n/a	n/a
Medieval cist graves	M	n/a	n/a	n/a	n/a	3	1	n/a
Anglo-Saxon graves	F	n/a	1	1	n/a	n/a	n/a	n/a
Medieval earth graves	F	3	1	1	1	n/a	n/a	1
Medieval cist graves	F	1	1	1	1	n/a	n/a	1
Anglo-Saxon graves	?	1	n/a	1	n/a	n/a	n/a	n/a
Medieval earth graves	?	1	n/a	1	n/a	1	1	2
Medieval cist graves	?	n/a	n/a	n/a	n/a	n/a	n/a	1

D. Two sites, same joint

	Sex	Shoulders	Hips	Knees	Ankles	Feet	Great toes
Anglo-Saxon graves	M	n/a	n/a	1	1	2	n/a
Medieval earth graves	M	n/a	n/a	n/a	n/a	1	1
Medieval cist graves	M	n/a	n/a	n/a	n/a	2	n/a
Anglo-Saxon graves	F	2	1	n/a	n/a	n/a	n/a
Medieval earth graves	F	n/a	n/a	1	n/a	1	n/a
Medieval cist graves	F	n/a	n/a	1	n/a	n/a	n/a
Anglo-Saxon graves	?	n/a	n/a	1	n/a	n/a	n/a
Medieval earth graves	?	n/a	n/a	n/a	n/a	1	2
Medieval cist graves	?	n/a	n/a	n/a	n/a	n/a	n/a

TABLE 4.33 (*cont.*)

E. Two sites, different joints

	Sex	Hip + shoulder	Hip + elbow	Hip + wrist	Foot + shoulder
Anglo-Saxon graves	M	n/a	n/a	n/a	n/a
Medieval earth graves	M	n/a	n/a	n/a	1
Medieval cist graves	M	n/a	1	n/a	n/a
Anglo-Saxon graves	F	n/a	n/a	n/a	n/a
Medieval earth graves	F	n/a	n/a	1	n/a
Medieval cist graves	F	2	n/a	n/a	n/a
Anglo-Saxon graves	?	n/a	n/a	n/a	n/a
Medieval earth graves	?	n/a	n/a	n/a	n/a
Medieval cist graves	?	n/a	n/a	n/a	n/a

F. Vertebrae and two sites in the same joint

	Sex	Vertebrae + shoulders	Vertebrae + elbows	Vertebrae + hands	Vertebrae + hips	Vertebrae + knees	Vertebrae + feet	Vertebrae + great toes
Anglo-Saxon graves	M	n/a	n/a	n/a	2	n/a	1	n/a
Medieval earth graves	M	2	n/a	1	1	n/a	1	n/a
Medieval cist graves	M	1	1	n/a	n/a	n/a	n/a	n/a
Anglo-Saxon graves	F	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Medieval earth graves	F	n/a	n/a	n/a	2	n/a	n/a	n/a
Medieval cist graves	F	n/a	n/a	n/a	n/a	1	n/a	1
Anglo-Saxon graves	?	n/a	n/a	n/a	n/a	1	n/a	n/a
Medieval earth graves	?	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Medieval cist graves	?	n/a	n/a	n/a	n/a	n/a	n/a	n/a

G. Vertebrae and two sites in different joints

	Sex	Vertebrae, hip, shoulder	Vertebrae, hip, wrist	Vertebrae, hip, knee	Vertebrae, hip, toe	Vertebrae, finger, toe
Anglo-Saxon graves	M	n/a	n/a	n/a	n/a	1
Medieval earth graves	M	n/a	n/a	n/a	1	n/a
Medieval cist graves	M	n/a	n/a	n/a	n/a	n/a
Anglo-Saxon graves	F	n/a	n/a	n/a	n/a	n/a
Medieval earth graves	F	n/a	n/a	1	n/a	1
Medieval cist graves	F	n/a	n/a	n/a	n/a	n/a
Anglo-Saxon graves	?	n/a	1	n/a	n/a	n/a
Medieval earth graves	?	n/a	n/a	n/a	n/a	n/a
Medieval cist graves	?	1	n/a	n/a	n/a	n/a

H. Three sites, with or without vertebrae

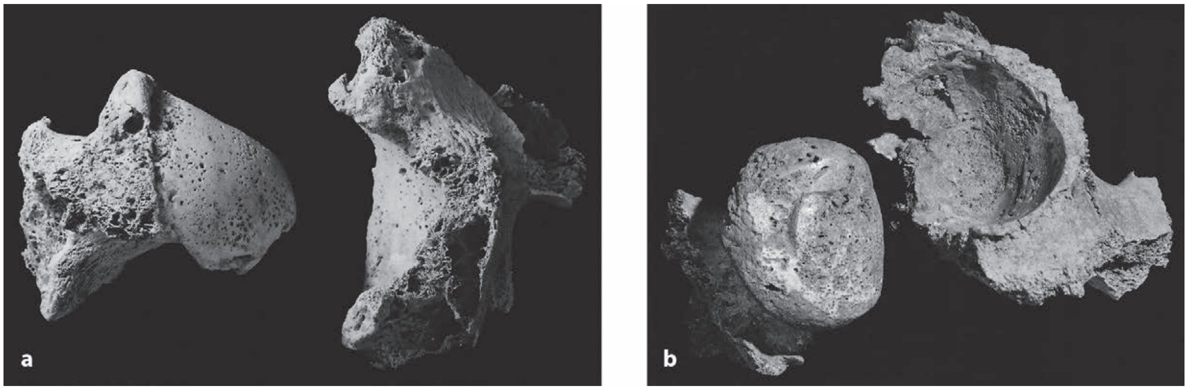
		Three sites			Three sites + vertebrae	
	Sex	Elbow, wrist, hip	Ankle, toes	Elbow, wrist, hand	Vertebrae, elbows, knee	Vertebrae, wrist, knee
Anglo-Saxon graves	M	1	n/a	n/a	n/a	n/a
Medieval earth graves	M	n/a	n/a	n/a	n/a	n/a
Medieval cist graves	M	n/a	n/a	n/a	n/a	1
Anglo-Saxon graves	F	n/a	n/a	n/a	n/a	n/a
Medieval earth graves	F	n/a	n/a	n/a	n/a	n/a
Medieval cist graves	F	n/a	n/a	1	1	n/a
Anglo-Saxon graves	?	n/a	n/a	n/a	n/a	n/a
Medieval earth graves	?	n/a	1	n/a	n/a	n/a
Medieval cist graves	?	n/a	n/a	n/a	n/a	n/a

TABLE 4.33 (*cont.*)

I. More than three sites

	Sex	Vertebrae, hips, shoulders	Elbow, hips, knees, toes	Vertebrae, hips, wrist, knee	Elbow, wrist, hands, sternum
Anglo-Saxon graves	M	1	n/a	n/a	n/a
Medieval earth graves	M	n/a	n/a	1	n/a
Medieval cist graves	M	n/a	1	n/a	n/a
Anglo-Saxon graves	F	n/a	n/a	n/a	1
Medieval earth graves	F	n/a	n/a	n/a	n/a
Medieval cist graves	F	n/a	n/a	n/a	n/a
Anglo-Saxon graves	?	n/a	n/a	n/a	n/a
Medieval earth graves	?	n/a	n/a	n/a	n/a
Medieval cist graves	?	n/a	n/a	n/a	n/a

n/a = not applicable



Illus. 4.72. Osteoarthrosis of the joints. Deformity of the hip as a result of degenerative osteoarthritis superimposed on rheumatoid disease or possibly old Perthe's disease. There is loss of cartilage, pitting, and remodelling of the femoral head and acetabulum: (a) Anglo-Saxon charnel, adult; (b) CG 1964, medieval, unprovenanced adult.

iv. DEGENERATIVE DISEASES

Osteoarthritis and other arthropathies

In modern populations, osteoarthritis is a common cause of disability and suffering. The disease is rarely manifest in any degree of severity below the age of forty and, while more common in the elderly, it is by no means certain that it arises as a natural consequence of ageing.[11]

Both the Anglo-Saxon and medieval samples had a high frequency of osteophytic lipping of the margins of the vertebral bodies with osteoarthritic changes in the posterior vertebral joints (Table 4.33). Osteoarthritis was found in 152 subjects in the hips, knees, elbows, shoulders, and wrists, in that order of frequency, whereas in modern populations, hip changes are less common than those in the knees and elbows. In 62 of these 152 subjects osteoarthritic changes were also present in the spine. One

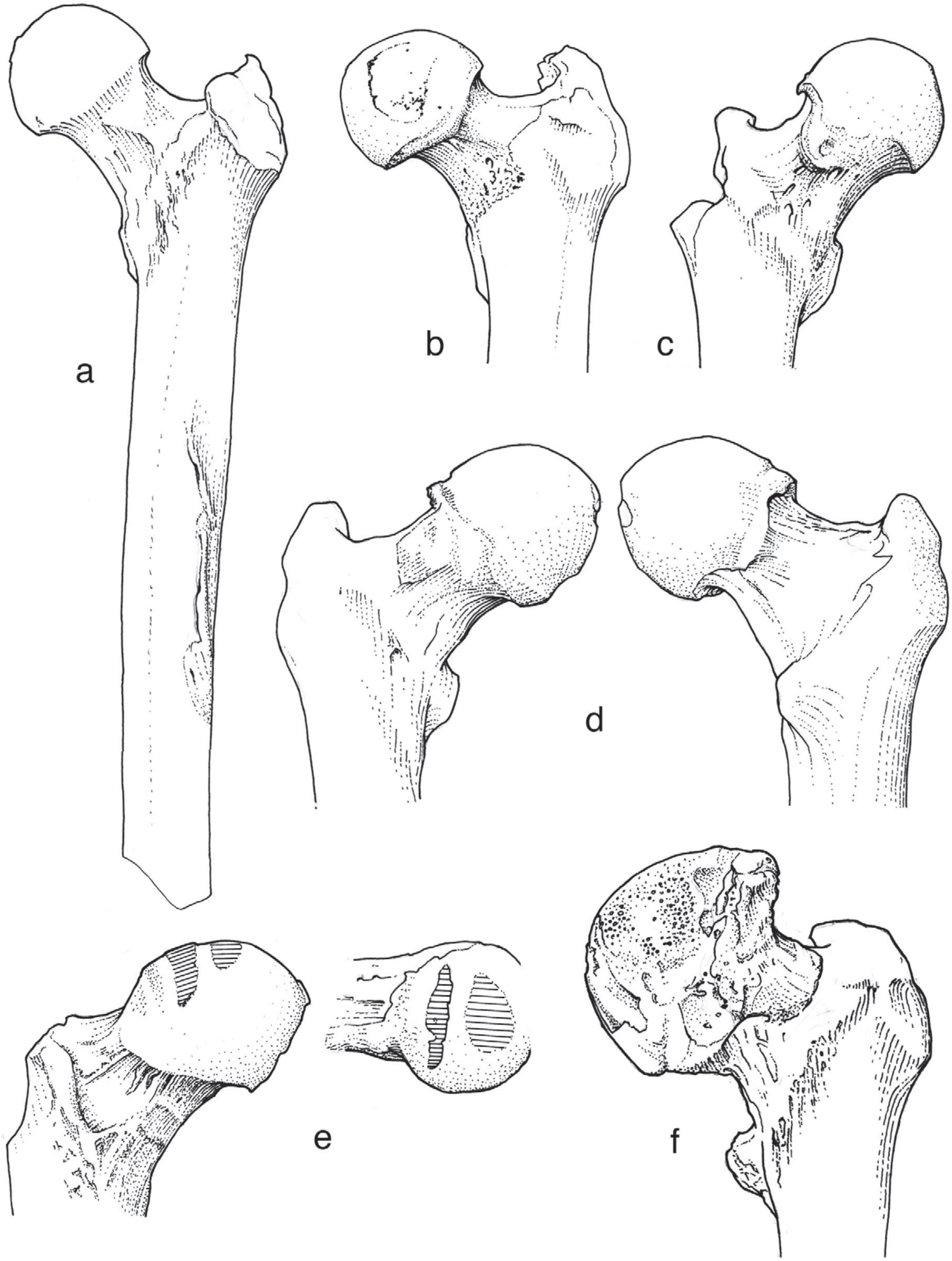
[11] Weiss and Jurmain, 2007.

Illus. 4.73. Rheumatoid disease of the foot: (a) possible rheumatoid disease in a medieval foot. MG 702, female adult; (b) fusion of the metatarsal and proximal phalange of the big toe. MG 312, male age *c*.45.

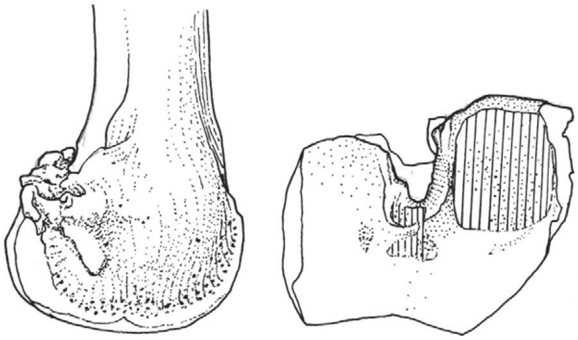
medieval lumbar spine with degenerative changes had osteophytic spurs on the concavity of a lateral curvature of scoliosis, from which the spurs probably resulted. Other joints were occasionally involved and cases of osteoarthritis in the great toe were also found (Illus. 4.73a, b), although the small bones of the hands and feet were sometimes poorly preserved. Hip osteoarthritis (Illus. 4.71a, b) was more common among males, while osteoarthritis of the knee was more common in females. It is important to remember that sample sizes were relatively small. In those individuals where, apart from vertebral changes, osteoarthritis was discovered in more than one joint, three-quarters had hip involvement. Seventy-one subjects had osteoarthritic changes in the spine alone.

A knee joint with osteoarthritis involving the lateral compartment may well have been due to a meniscus cartilage injury (Illus. 4.75). A right hip joint showed marked irregularity and flattening due to increased wear on the joint surface of the femoral head. Osteophytes protruded from the margins of the joint, and some new bone formed to remodel and buttress the femoral neck in response to the stresses imposed by the deformity of the joint. These changes were undoubtedly long-standing and radiographic appearances suggest that the osteoarthritis may have been initiated by impairment of the vascular supply to the femoral head.

In another example, radiological appearances suggest that an old infective arthritis was probably responsible for the osteoarthritic changes in



ILLUS. 4.74. Degenerative changes in the femur: (a) anterior view of the left femur with a pronounced intertrochanteric line and thickening of subperiosteal bone. The head of the femur is normal. Unprovenanced, adult; (b-e) progressive degenerative changes to the femoral head. The articular surface is extended by the development of marginal osteophytes. The articular cartilage is destroyed and there is pitting and sclerosis of the articular surface. Unprovenanced, adults; (f) in severe osteoarthritis of the hip the femoral head becomes grossly enlarged. Unprovenanced, adult.



Illus. 4.75. Osteoarthritis of the knee. Distal femur and distal articular surface. Degenerative osteoarthritis of the joint surface of the femur and tibia can follow prolonged or excessive stress on the joint. New bone forms in areas underlying destroyed articular cartilage. The surface of the bone is denser, pitted, and often striated where bone has rubbed on bone. In the case of the knee, the medial condyle is usually more severely affected than the lateral condyle. Unprovenanced, adult.

a humerus and scapula from Anglo-Saxon grave ASG 295 (Illus. 4.76a). Here the joint surfaces were irregular and eroded, and osteophytes have appeared on the margins of the joint. The cortex and trabeculae of the shaft of the humerus were thin, indicating disuse atrophy. The radiographs of another medieval specimen showed narrowing of the shoulder joint, with a flat and irregular humeral head. Very dense bone had been laid down under the joint surfaces. Such changes can occur when the nerve supply to the joint is impaired, but can also be caused by repeated minor trauma. The use of crutches has been known to produce this appearance.

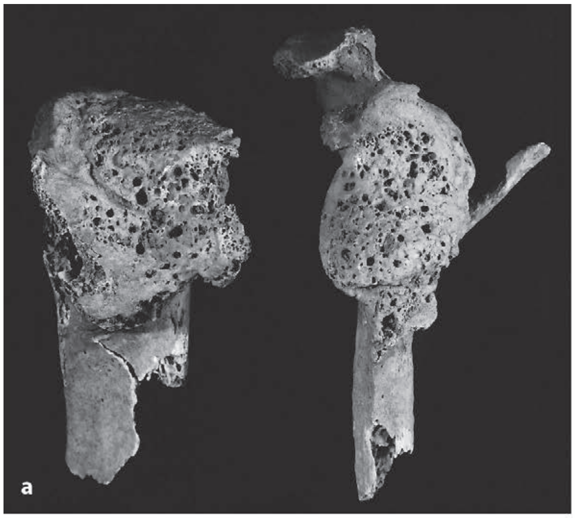
Five cases of hallux valgus or bunions were recognized among the Anglo-Saxon skeletons and one case among the medieval skeletons (Illus. 4.77). This is a common arthritic deformity in groups where shoes or hose too short for the foot are worn. It may also have a genetic component. The first metatarsal deviates outwards and this is often associated with a varus deformity (inward deviation) of the first phalanx of the big toe. The head of the metatarsal shows an overgrowth on the medial side. In extreme cases the ligaments binding the metatarsals become so stretched that they break down.

Spondylosis is defined as osteoarthritis occurring in the spine as a result of degenerative disc disease. The disc instability causes abnormal movements of the vertebral bodies. Small bony traction spurs and osteophytes appear at the margins of the vertebral bodies as a response to this movement (Illus. 4.78). True osteoarthritic changes initiated by the mechanical stresses are found in the small posterior vertebral articular processes interlocking the vertebrae (Illus. 4.76b). It is thought that minor congenital anomalies may predispose to spondylosis and a strong familial occurrence has been demonstrated in spondylosis of the cervical spine.[12] At Winchester 50% of subjects with congenital spine anomalies had evidence of vertebral osteoarthritis, as compared with 20% in the rest of the population.

The presence of such osteoarthritic changes, particularly those in the spine, which tend to manifest themselves in middle age in modern populations, suggests that a substantial number of the Anglo-Saxon and medieval inhabitants of Winchester had similarly reached middle age. As is the case with the frequency of Paget's disease of bone, this finding is at variance with other techniques for assessing age, unless it is assumed that the ageing process was accelerated by other factors not present in the population today.

No convincing evidence of rheumatoid arthritis came to light in the Winchester investigation. Rheumatoid disease is a generalized disease of connective tissue which causes destructive erosive changes in the joints and when the inflammatory process subsides osteoarthritic changes can supervene. A medieval hip joint with osteoarthritis had consider-

[12] MacGregor and Spector 1999, 584.

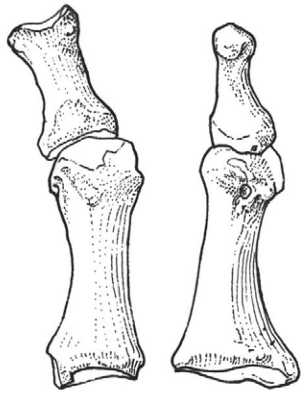


Illus. 4.76. Osteoarthritis: (a) deformity of the shoulder as a result of degenerative osteoarthritis. ASG 295, female age 45+; (b) degenerative osteoarthritis of the spine (L2-L5) with L5 ankylosis to the sacrum on the right side. Isolated find.

able lateral drift of the femoral head which might indicate rheumatoid disease as an underlying cause (Illus. 4.71b). Similarly, a rheumatoid-type disease was considered a possible diagnosis in one set of medieval foot bones tentatively classified as showing osteoarthritic changes (Illus. 4.73a).

In one medieval skeleton there was calcification of the ligaments in the dorsal spine with obliteration and bony fusion of the posterior joints (Illus. 4.79b). Heavy ossification in the anterior and lateral ligaments of the spine was also found. This had a smooth undulating surface. This is characteristic of diffuse ideopathic skeletal hyperostotis (Forestier's disease or DISH), a variant of osteoarthritis, and is not to be confused with ankylosing spondylitis. A similar condition was found in the remnants of a spine from the Anglo-Saxon charnel (Illus. 4.79a and Illus. 4.80).

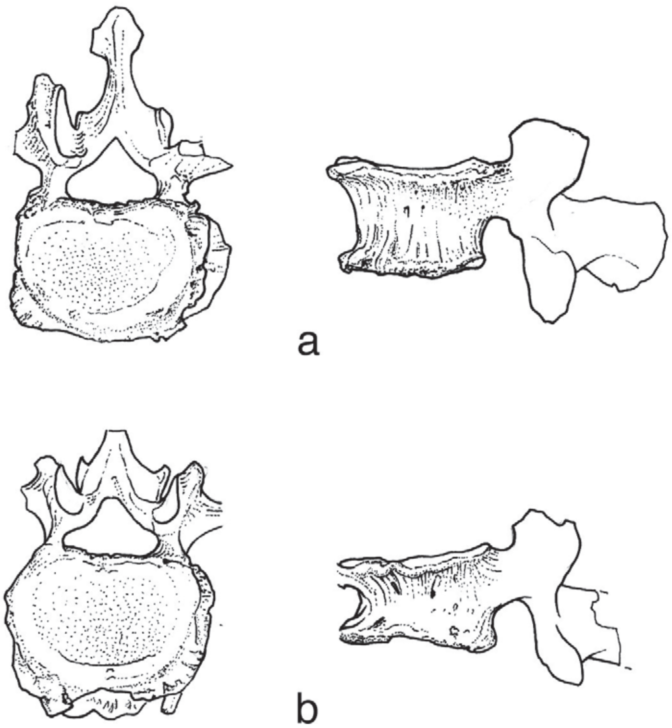
The foot from Anglo-Saxon grave ASG 124 showed cystic changes at the base of the first phalanx, with fringe osteophytes and some irregularity of the articular surface. This was



Illus. 4.77. Hallux valgus, commonly called 'bunions'. Superior and lateral views. Osteoarthritis develops around the joints of the big toe, displacing the phalanges laterally. Unstratified medieval, adult.

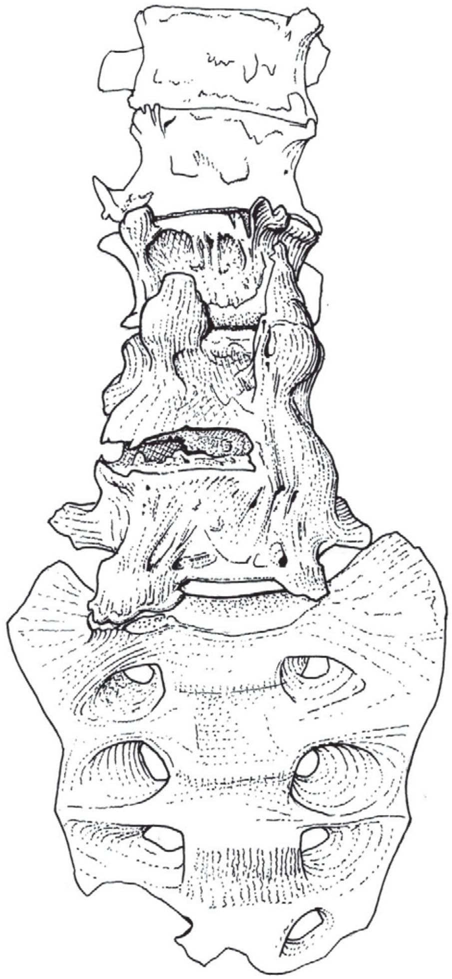
probably a case of osteoarthritis but it could have been due to gout or other crystal arthropathy (Illus. 4.73b). The stiff, atrophied thumb found in a priest from a medieval earth grave (Illus. 4.81) may have been the result of traumatic arthritis, or more likely, may have been the result of congenital fusion of the phalanges.

A calcified carotid siphon (artery) was found in the filling of a skull from the medieval layers. Calcification of the carotid occurs occasionally in older individuals, but unfortunately it was not possible to associate the vessel with any individual to provide a correlation of age and possible degenerative disease.



Illus. 4.78. Defects of the vertebrae. Spondylosis of the vertebrae is usually the result of degenerative changes. Osteophytes develop around the periphery of the vertebral body: (a–b) Unprovenanced, adult.

Illus. 4.79. Diffuse idiopathic skeletal hyperostosis (DISH) in the spine. Ossification of the anterior ligaments of the vertebrae results in fusion of several vertebrae. The disease is more common in men than in women: (a) thoracic vertebrae, probably T2–T6. Anglo-Saxon charnel, adult; (b) thoracic vertebrae, probably T3–T12. CG 1964, unstratified medieval, adult.



Illus. 4.80. Diffuse idiopathic skeletal hyperostosis (DISH), showing a relatively massive ossification of the anterior spinal ligaments. The vertebral discs are not usually involved. Anglo-Saxon charnel, adult.

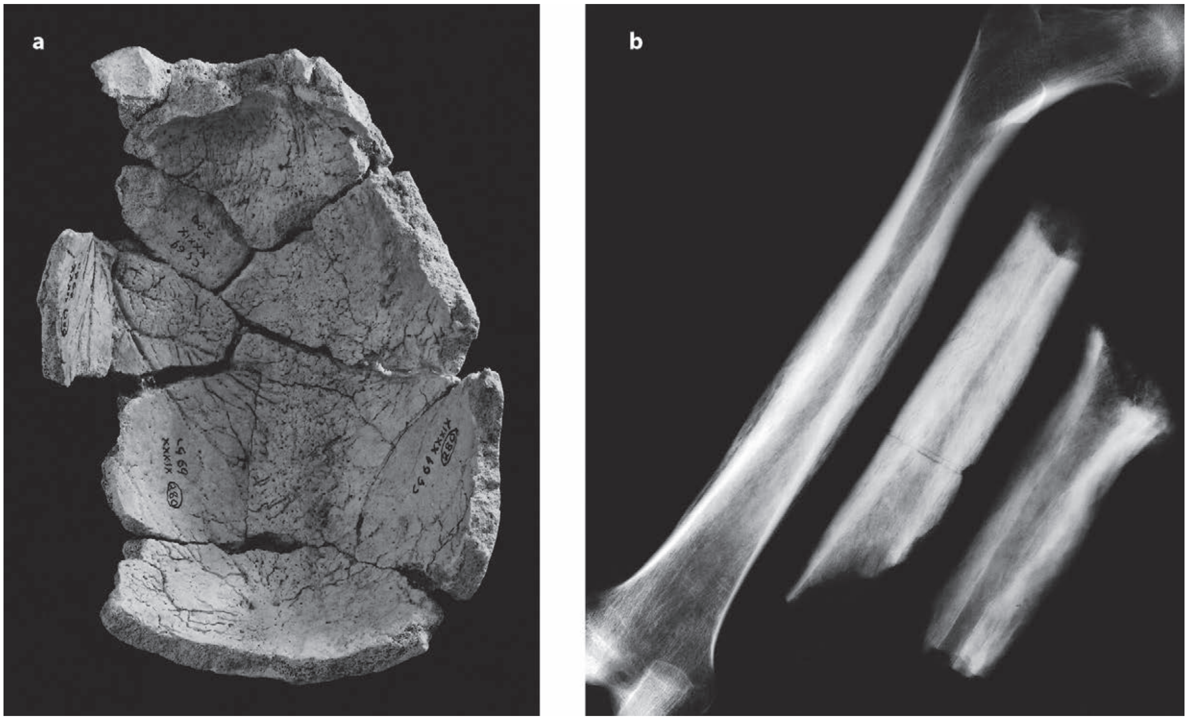
Illus. 4.81. Stiff atrophied thumb, possibly the result of congenital fusion of the phalanges. Medieval priest. MG 898, male age *c*.60.

v. OSTEITIS DEFORMANS OR PAGET'S DISEASE OF BONE

Sir James Paget first described five cases of the disease which for many years bore his name.[13] Normally in life bone is a dynamic structure and there is a continuous process of resorption and rebuilding at a microscopic level. In osteitis deformans these processes become disordered and asynchronous and this results in a disorganized architectural pattern. The bone becomes softened and widened and has a spongy texture. In most cases the disease process remains localized in a particular bone and may remain asymptomatic. The diseased area often shows demarcation, with the disease process being most active at the advancing edges. Eventual sarcomatous change can occur.

Anglo-Saxon grave ASG 867, as well as eight

[13] Paget 1877.



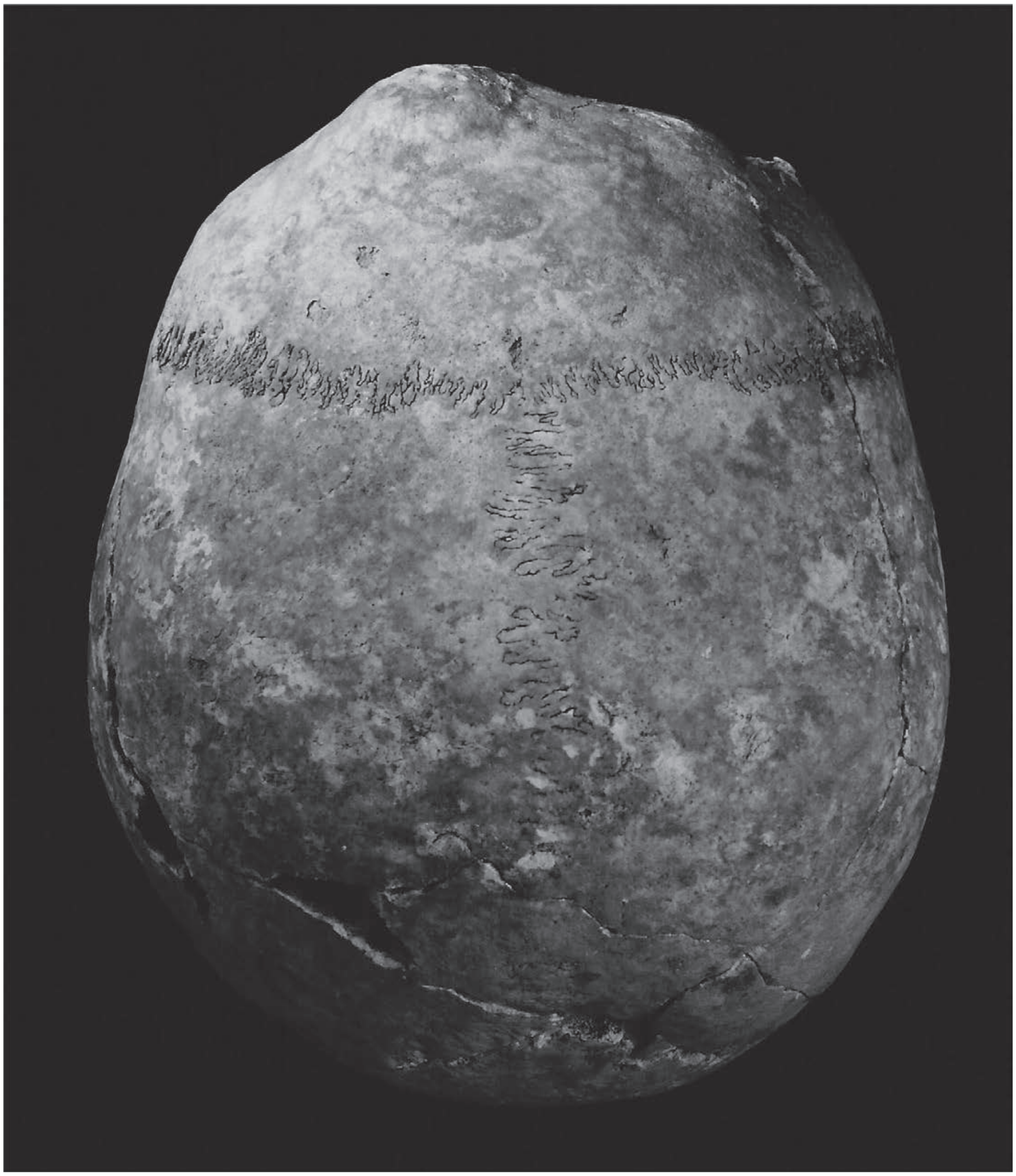
Illus. 4.82. Osteitis deformans (Paget's disease of bone). The bones of the cranium are thickened but have a light chalky texture, (a) reassembled fragments of a cranium from the Anglo-Saxon charnel. ASC Skull 734, adult: (b) osteitis deformans of the femora reflected in the radiographic appearance of the grossly thickened femoral shafts. The joints remained normal. Unstratified medieval adult.

long bones and three skulls from the Anglo-Saxon charnel, and one skull, a femur, and a radius from medieval contexts showed evidence of Paget's disease of bone (Illus. 4.82). The radiological diagnosis was confirmed microscopically on histological sections.

The commonest site for Paget's disease of bone, as shown by radiological surveys, is the pelvis (75% of cases), followed by the lumbar spine, sacrum, femora, and skull. Since few pelves were found in the Anglo-Saxon charnel, a number of cases could have been overlooked and the frequency of Paget's disease in the population could have been higher.

Today, Paget's disease of bone is rare under the age of 40 and the age frequency as determined at autopsy varies from 1% to 1.8% in the 40–49 age group to 4% at age 60–69 and 7.81% in the decade 80–89.[14] It has been suggested that the average life expectancy in early Britain was as low as 30 to 35 years, with few adults living beyond 50 years. The frequency of Paget's disease at Winchester suggests that many of the population lived beyond 50 years. This conjecture is supported by the finding of a hardened carotid artery in the medieval levels and by the fact that osteoarthritis, again a disease of the older age groups, was prevalent in both the Anglo-Saxon and medieval populations.

[14] Schmorl 1932.



Illus. 4.83. Osteoma, a benign neoplasm, on the frontal bone. MG 216, male age 40–45.

vi. NEOPLASTIC TUMOURS

A few minor tumours were recognized. Button osteomata, which are benign, of unknown cause, and would not have inconvenienced the individual, were found on the skulls of both Anglo-Saxon and medieval individuals, mostly on the frontal bones (Illus. 4.83).

The presence of an osteochondroma (a benign tumour) was suspected on examining a cystic rib, but as there was no bone enlargement a primary bone tumour was ruled out, the lesion being more likely to be traumatic in origin.

Brothwell has already suggested elsewhere

ILLUS. 4.84. Skeleton of an Anglo-Saxon juvenile with possible metastases, which are secondary malignant neoplasms probably developing here from a primary carcinoma of soft tissue. CACP 1961, G. 30: (a) right parietal, temporal, and sphenoid bones; (b) left mandibular ramus and ilium of the pelvis.

that the Anglo-Saxon skeleton of a juvenile (CACP 1961, G30) showed changes to the cranium, jaw, and pelvis that can best be explained as metastases, that is, secondary tumours invading bone, spreading from a primary soft tissue neoplasm elsewhere (Illus. 4.84).[15] In the skull the lesions varied from irregular osteolytic destruction of bone, with or without marginal reactions, to rounded punched-out lesions. In the pelvis there was extensive involvement of the innominate which was partly destructive but also with new bone formation. In the same bone there was a rounded punched-out area. In the vertebral column, there was clear evidence that osteolytic destruction of some vertebral bodies had commenced but was not advanced.

[15] Brothwell and Sandison 1967, 340–1.

7
INJURIES

i. INTRODUCTION

Injury to the bones of the skeleton can come about as a result of a fall or a blow or other undue impact to a bone or joint. Fractures and dislocations are the result of severe trauma. Osteoarthritis may develop as a consequence of injury or prolonged joint stress. Occasionally where muscles or other soft tissues are damaged and there is internal bleeding (haematoma), or the periosteum covering a bone is torn, there may be some ossification within the damaged tissue. This may produce an ossified haematoma or restricted myositis ossificans and can be recognized by its irregular though bony nature and the fact that it is adhering to the original bone surface. It develops superficially and not from within the cortex. This feature is best seen on a radiograph.

Many injuries are associated with occupation or activity, and as such can provide information about the culture and environment of a people.

Signs of healing are seen in the welding together of parts of a fracture by callus. This callus gradually becomes denser and reduces in size so that after about two years the broken bone is again whole, although the site of the fracture may be evident as a thickening, often fusiform, in a long bone. Most fractures encountered in the Winchester groups were well-healed and had occurred some years before death.

Healing of cut wounds is apparent by the development of a smooth, sclerotic margin to the injury. Healing starts within hours of injury, but the death of the victim may still follow. An immediately fatal injury, on the other hand, is difficult to distinguish from post mortem damage. Breaks to bone sustained long after death and burial can display a different fracture pattern and may appear relatively clean if new.

Occasionally there may be signs of an inflammatory reaction at the site of injury. New bone, light and pitted, is laid down superficially over the old bone. Only occasionally does an injury become infected by micro-organisms entering the open wound. The infection can affect the entire bone so that the dense cortex and spongy inner bone are much altered. Healed examples of bone infections (periostitis or osteomyelitis) are found, although signs of the infection usually remain, sometimes with gross deformity.

ii. CRANIAL INJURIES (TABLES 4.34 AND 4.35)

Sword cuts

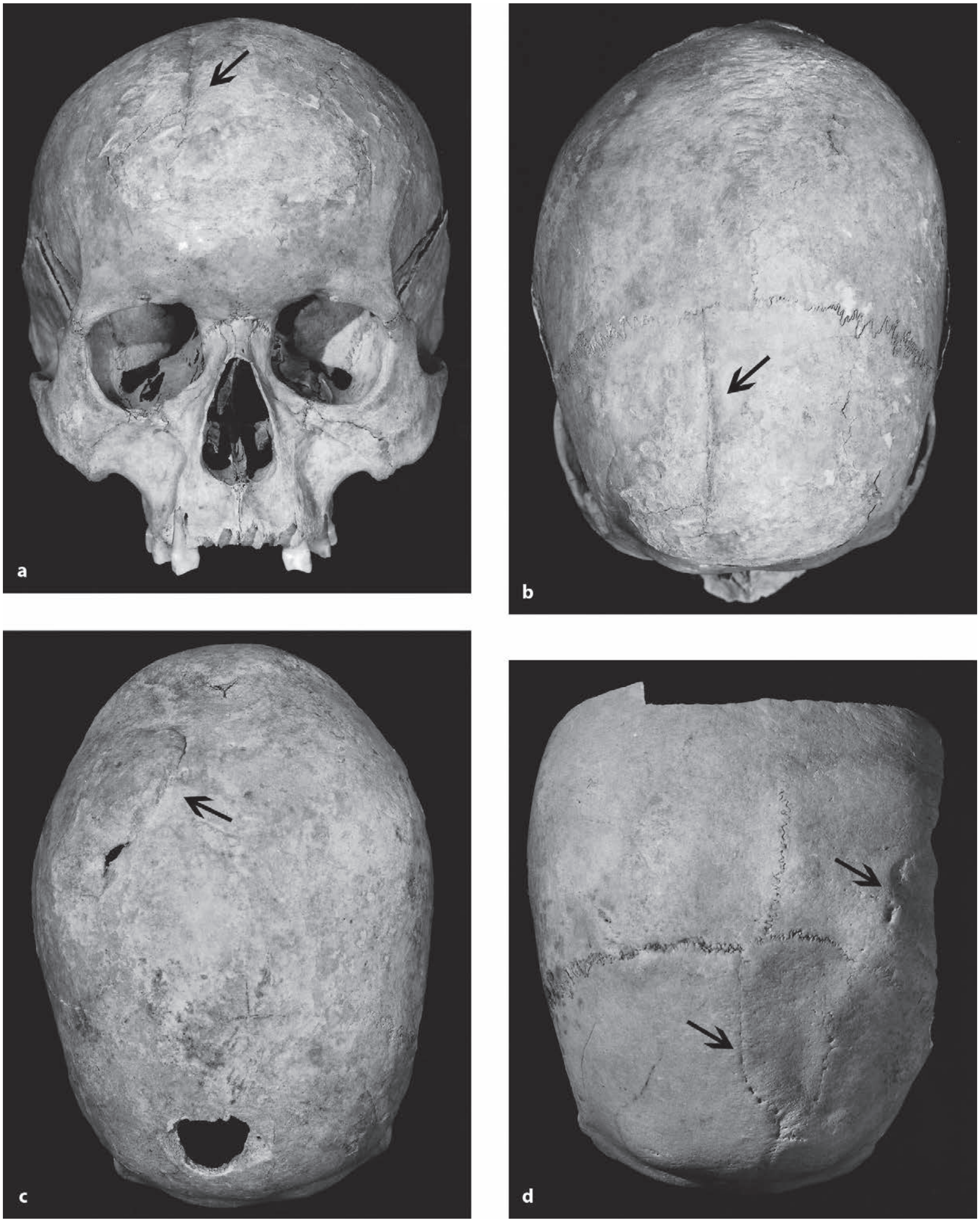
Skull injuries, both healed and unhealed, were more common among the Anglo-Saxon than the medieval skeletons, and were much more prevalent among males than among females. There were possibly 10 healed injuries (eight Anglo-Saxon, two medieval) to the frontal and parietal regions (e.g. ASG 44, ASG 449, ASC Skull 117, ASC Skull 120A, and an unstratified medieval

TABLE 4.34
Cut marks and fractures of the skull, Cathedral Green, Winchester

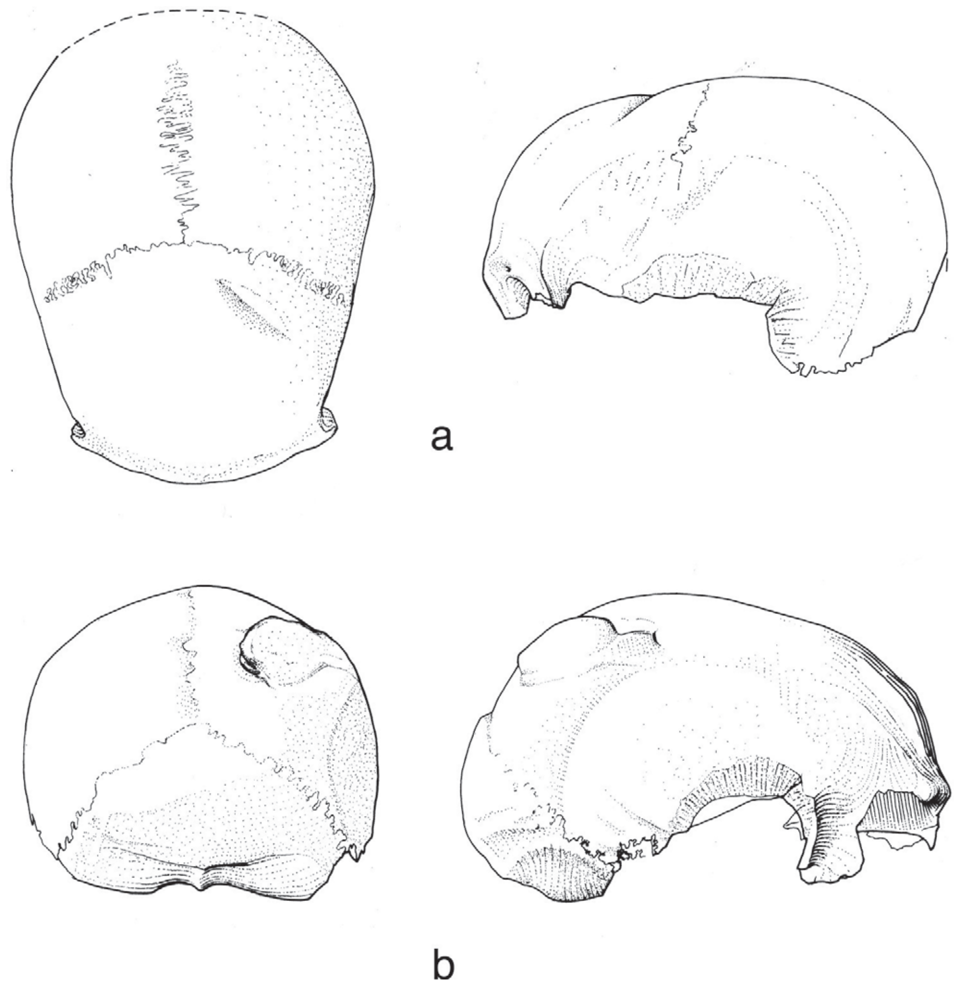
Grave number	Sex	Pathology	Illustration number
A. Anglo-Saxon Graves			
ASG 44	M	Healed cut mark, r. frontal	Illus. 4.85a–b
ASG 122c	M	Healed depressed fracture over r. eye	–
ASG 417	M	Unhealed cut, inferior occipital & part of r. parietal	Illus. 4.87a
ASG 441	M	Two depressions, poss. healed fractures, on frontal	–
ASG 449	M	Healed cut with elevated bone, posterior r. parietal	Illus. 4.86b
ASG 646	M	Healed cut on l. frontal	–
CG1966 XXVII/19	M	Healed cuts on parietal, r. frontal, neck	Illus. 4.87b
CG XXVII/264	–	Healed injury on brow	–
B. Anglo-Saxon Charnel			
ASC Skull 6	F	Small healed depressed fracture, r. parietal	–
ASC Skull 16	F	Healed depressed fracture on vertex	–
ASC Skull 35	–	Healed fracture	–
ASC Skull 117	M	R. posterior parietal, almost healed blade cut	Illus. 4.85c
ASC Skull 120A	M	Healed cut on left frontal	Illus. 4.86a
ASC Skull 169	F	Unhealed wound on frontal	–
ASC Skull 275	–	Healed frontal wound	–
ASC Skull 433	–	Healed circular depressed fracture	–
ASC Skull 631	M	Healed shallow wound in upper l. frontal	–
ASC Skull 670	M	Healed wound leaving open area	–
ASC Skull 702A	M	Unhealed drill hole at bregma, possibly modern bone sample taken	–
ASC Skull 703	M	Healed cut wound on frontal	–
ASC Skull 775	M	Unhealed blade cuts, l. parietal	Illus. 4.88
ASC Skull 795A	M	Healed open puncture wound on frontal	–
ASC Skull 806	–	Perforation in frontal, adjacent to temporal	–
ASC Skull 808	–	Blade cuts in parietal	–
ASC Skull 824/833	M	Healed cuts on l. parietal	–
ASC Skull 1132	F	Healed cranial fracture with raised edges	–
unnumbered	C	possible trephination, frontal, r. of midline	–
C. Medieval Cist Graves			
MG 225	?M	Healed wound	–
MG 367	M	Blade cut on l. orbital margin of frontal	–
D. Medieval Earth Graves			
MG 1009	M	Small healed injury on frontal, caused by blow or cut	–
DCN 128	–	Partially healed depressed fracture of parietal fragment	–
DCN 240	M	Healed wound above lambda	–
DCN 246	?F	Healed depressed fracture of l. parietal	–
DCN 256	M	Depressed fracture of vault	–
DCN 257	?M	Multiple healed fissure fractures	–
Tr. XXIV	–	Posterior occipital, part r. parietal cut off—possibly post mortem?	–
unstratified	–	Healed bifurcated cut on frontal and parietal	Illus. 4.85d
unstratified	–	Healed depressed fracture along mid-sagittal suture	–

TABLE 4.35
'Crater' lesions on the skull, Cathedral Green, Winchester

Grave number	Sex	Pathology	Illustration number
A. Anglo-Saxon graves			
No examples found			
B. Anglo-Saxon charnel			
ASC Skull 230	M	Shallow healed crater, l. frontal near coronal suture	–
ASC Skull 573	M	Two craters at bregma	Illus. 4.90
ASC Skull 697	M	Deep healed crater in vertex	–
ASC Skull 895	M	Crater at bregma	–
ASC Skull 950	M	Possible crater at mid-sagittal suture	Illus. 4.91
ASC Skull 1000	M	Healed crater injury at bregma	–
ASC Skull 1033	M	Healed crater wound and post mortem hole	–
C. Medieval cist graves			
MG 169	M	Crater at bregma, inflamed	–
D. Medieval earth graves			
MG 907	?M	Possible crater near bregma	–



Illus. 4.85. Healed cranial injuries (arrowed): (a–b) frontal and superior views of a healed blade cut on the right frontal bone. ASG 44, male adult: (c) almost fully healed blade cut to the posterior right parietal. The hole in the frontal is post mortem damage. ASC Skull 117, male adult; (d) healed cuts on the frontal and left parietal. Unnumbered skull from a medieval earth grave.



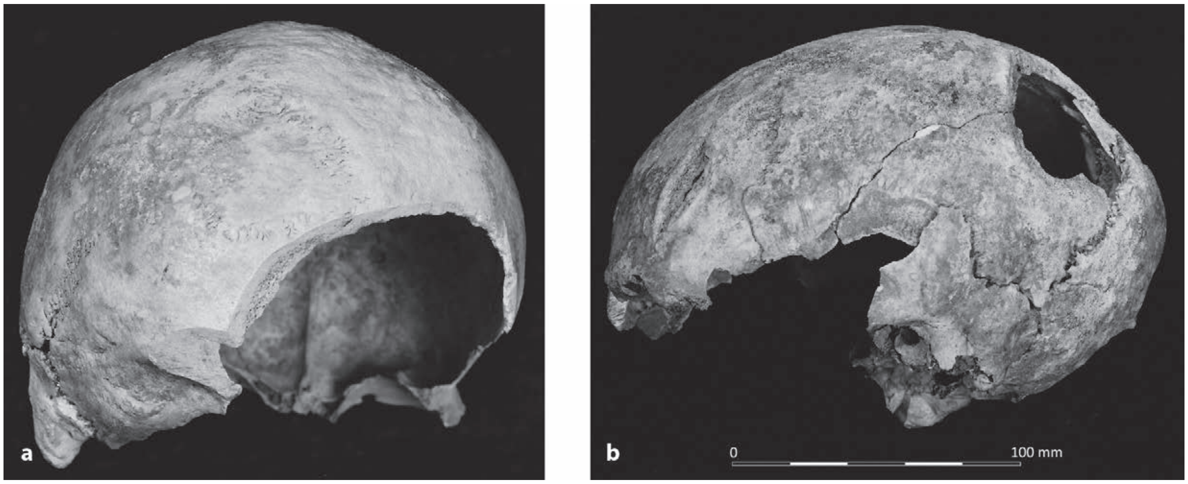
ILLUS. 4.86. Healed cranial injuries: (a) healed blade cut on the left frontal. Superior and lateral views. ASC Skull 120A, male adult; (b) healed blade cut to the posterior portion of the right parietal. A rondel of bone has been partially lifted off and healed out of position. ASG 449, male adult.

earth grave) which may have resulted from sword or axe cuts (Illus. 4.85 and 4.86). Many of these left crater-like depressions in the skull upon healing. In addition there were several injuries which showed no signs of healing (Illus. 4.87). These latter cases could be taken as fatal injuries and indeed were usually more extensive than the healed injuries. In two cases the skull had received several cuts (Illus. 4.88), and in another, two or three roundels of bone had been removed by slashing blows (cf. Illus. 4.89).[1]

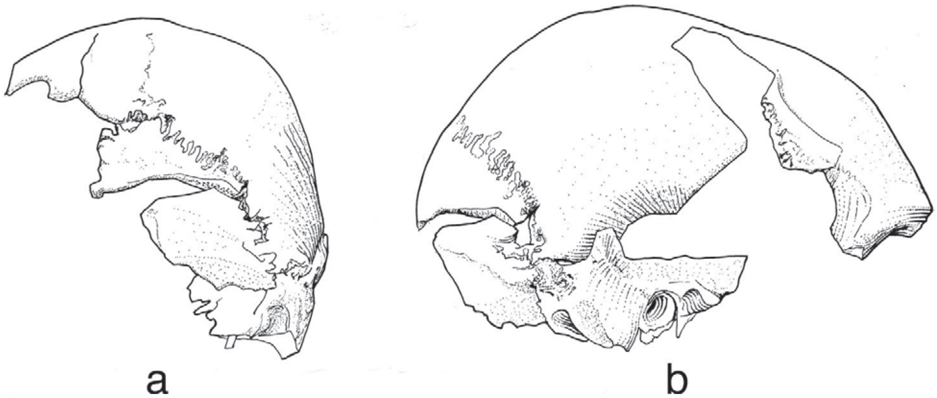
Skull fractures

Skull fractures may appear as linear fissures and may extend from the vault into the base, possibly causing damage to underlying blood vessels or nerves. One fragment of skull from the Anglo-Saxon charnel showed a circular depressed fracture the shape and size of a golf ball, and was well healed (ASC Skull 433). The fracture, probably resulting from a blow near the vertex, was star-shaped, and the edges were still discernable

[1] See Appendix D, Glossary, pp. 447 and 456 for more detailed descriptions of types of fractures and wounds.



Illus. 4.87. Unhealed (and probably fatal) cranial injuries: (a) the posterior right parietal and occipital have been sliced off at a single blow. ASG 417, male adult; (b) partially healed blade cut on the left frontal. On the left posterior parietal a rondel of bone has been removed by a slicing blow. CG 1966, Tr. XXVI (19), unnumbered Anglo-Saxon skull, male adult.

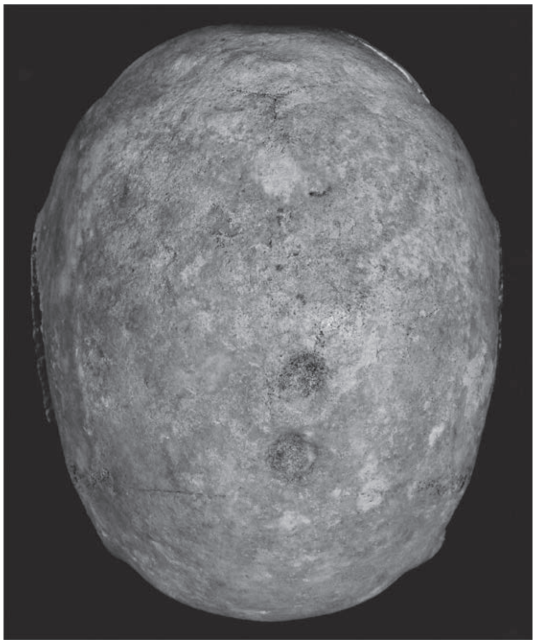


Illus. 4.88. Cranial injuries showing no signs of healing. At least one blade cut, and possibly more, have removed part of the left parietal and occipital. There appears to be a second cut across the right occipital, and a possible cut to the right parietal. ASC Skull 775, male adult: (a) posterior view; (b) lateral view.

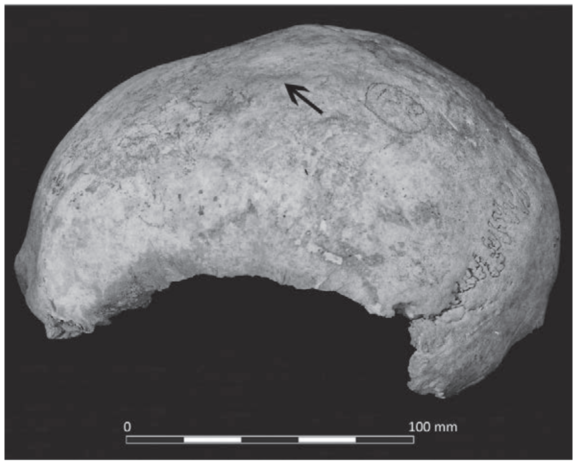
projecting into the interior of the skull. In another case from an Anglo-Saxon grave in which the injury must have damaged the eye, a healed depressed fracture remained over the right eye, part of the orbital rim being displaced inwards by nearly 10 mm (ASG 165 = 122).

From the medieval earth graves, four cases of healed depressed fracture were noted, as was one case from a medieval cist grave. One incomplete calvarium showed multiple depressed fractures from a blow on the left upper frontal area (medieval earth grave DCN 128). There was massive pitting on the endocranial surface, and smaller pits were seen on the outer surface along the fracture lines, suggesting an early stage of healing or possibly infection. Of the other cases, one injury was to the area above the right eye, and projected endocranially to a degree which may have caused pressure on the brain (MG 367). Two other cases concerned lesions further back on the

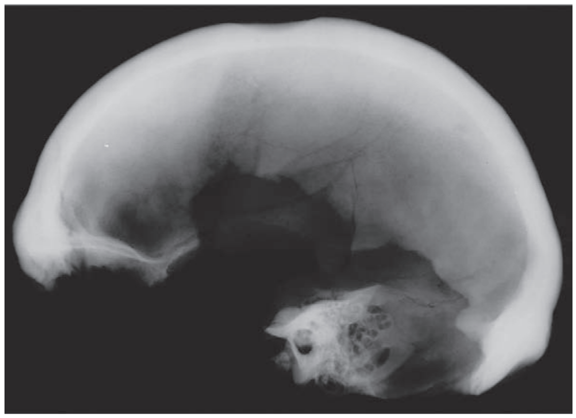
Illus. 4.89. Death in a mêlée: the murder of Archbishop Thomas Becket in Canterbury Cathedral, 29 December 1170, as shown in a manuscript illumination in an English psalter of about 1250 (Baltimore, Walters Art Gallery, Acc. No. W.34.15V). Courtesy of the Walters Art Gallery.



Illus. 4.90. Two 'crater' lesions on the sagittal suture immediately posterior to bregma. ASC Skull 573, male adult.



Illus. 4.91. 'Crater' lesion, lateral view. ASC Skull 950, male adult.



Illus. 4.92. Radiograph of the 'crater' lesion from the same individual, taken at a slightly different angle.

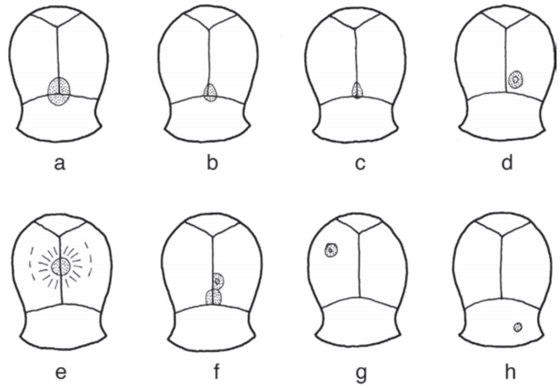
head, and the bone projected only slightly into the brain cavity (medieval earth grave DCN 246; medieval earth grave DCN 256).

'Crater' lesions

Apart from fractures and 'sword cuts', most of the other healed injuries and miscellaneous lesions on the skull were very minor, leading to small pits, lumps, or areas of roughness on the bone. One group of lesions, however, was of special interest (Illus. 4.90 and 4.91). Six or possibly seven skulls from the Anglo-Saxon charnel, one from a medieval earth grave (MG 907) and one from a medieval cist grave (MG 169), were noted to have 'crater' lesions at the top of the skull (Table 4.35). All were adult males. The radiographs, one of which is shown in Illus. 4.92, showed the saucer depressions extending through the outer table of the skull bone. The edges of the lesions were slightly raised and a faint sclerotic rim was present, indicating a healing process. Two of the 'craters' showed widespread inflammatory change around the lesion.

The site of the 'craters' (Illus. 4.93) implied that they were induced, and the features are consistent with a response to a haematoma resulting from moderate trauma. Cephalohaematomata and subgaleal haematomata are seen today most often in infants as a result of difficult deliveries and usually soon disappear.[2] The particular haematomata that possibly caused the Winchester 'craters' were more likely to be the result of injury

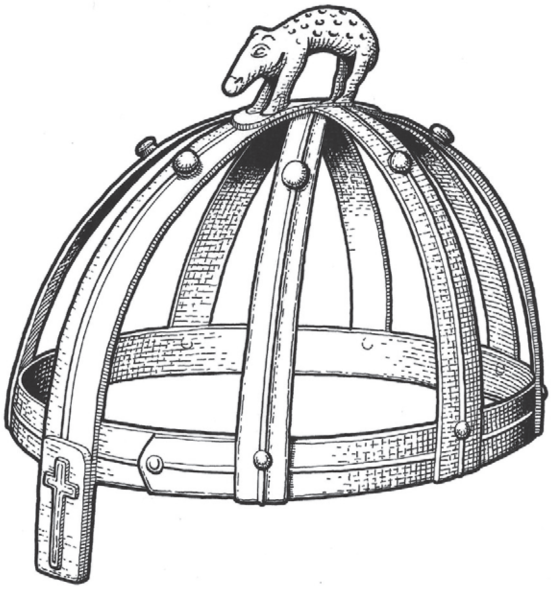
[2] Gibbs et al. 2008.



Illus. 4.93. Variations in position of 'crater' lesions in the top of the skull seen in the Cathedral Green samples.

in late childhood or early adult life, after the skull had completed most of its growing.[3]

It is also possible to develop a haematoma from a blow on the head, such as might be sustained during battle. The design of the Anglo-Saxon helmet, with iron bands meeting at the vertex (Illus. 4.94), may have meant that an ill-fitting helmet, while protecting the wearer from sword cuts, rested, either directly or over a cap, on the crown of the head and led to bruising of the crown if struck from above. The radiographic appearance of the 'craters' is also similar to that described in cases of trepanation.[4] A type of partial symbolic trepanation performed with a scraping instrument was known in the Middle Ages.[5] Two cases comparable to the Winchester skulls, from a similar period in ninth- to tenth-century Bohemia, have been described as symbolic trepanation *intra*



Illus. 4.94. Boar-crested mid-7th century Anglo-Saxon helmet of the *Spangenhelm* type found in a burial mound at Benty Grange, Monyash, Derbyshire, in 1848 (Sheffield City Museums, J.93.1189). Redrawn by Simon Hayfield from the conserved and remounted remains.

vitam; whilst medieval cases found in Norway are attributed to cauterization, and the skull said to be that of Earl Rognvald bears a healed crater lesion on the vertex behind the bregma.[6]

Among the unhealed injuries mentioned earlier was one skull which showed a neat hole, about 10 mm in diameter, in the same position as most of the 'craters' just described (ASC Skull 702A). This could have been the result of an extreme form of this operation, but might also have been the result of post mortem damage.

iii. INJURIES TO POSTCRANIAL BONES (TABLE 4.36)

Fractures

Fractures were the commonest type of post-cranial injury observed (Illus. 4.96). Abrupt mechanical stress to a bone can produce a fracture, the type of fracture largely depending on the type of stress and also on the site to which the stress is applied. Transverse fractures of long bones, usually occurring in the forearms or legs, are caused by a shearing force applied to the opposite sides of a bone, and can be produced by direct impact of a blunt object or by a fall. Spiral

[3] De Boulay, pers. comm.
[4] Vyhnánek 1967, 35–8.
[5] Brongers 1969, 41–6.
[6] Chochol 1967; Holcke 2002; Jesch and Molleson 2005, 138.

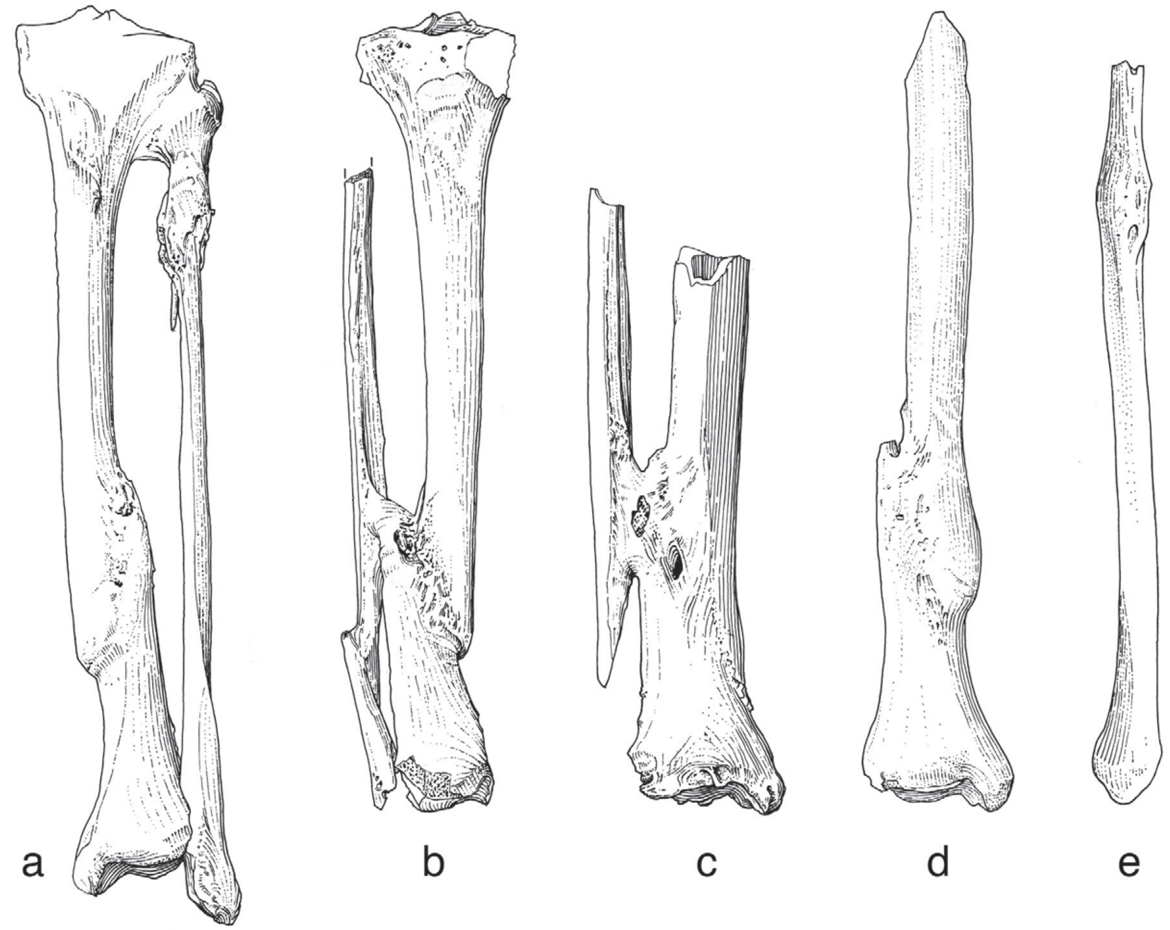
TABLE 4.36

Injuries to postcranial bones, Cathedral Green, Winchester

Grave number	Sex	Pathology	Illustration number
A. Anglo-Saxon graves			
Humerus, radius, ulna			
ASG 81	F	Healed? fracture, r. ulna	–
ASG 88	M	Healed ununited fracture, r. ulna	Illus. 4.100c
ASG 295	F	Traumatic OA, left shoulder joint	Illus. 4.107a
ASG 324	F	Fused l. elbow	Illus. 4.65
ASG 366	Inf.	Unhealed? fracture, ulna	
ASG 460	F	Traumatic OA distal r. ulna	Illus. 4.107b
ASG 600	M	Healed fracture, r. humerus, associated with elbow dislocation	Illus. 4.102b
ASG 620	F	Healed l. radius, mid-shaft parry fracture	–
Tr. XL (900)	–	Healed mid-shaft parry fracture, l. ulna	Illus. 4.100b
No no.	–	Unhealed fracture, ulna	–
Femur, tibia, fibula			
ASG 26	F	Exostosis, fibula	–
ASG 97=83	?F	Healed fracture, fibula	–
ASG 408	–	Healed fracture, ?l. fibula, very long-standing	–
ASG 440	M	Healed fracture, fibula with periostitis	–
ASG 460	F	Healed fracture, r. tibia	–
ASG 476	Juv.	Exostosis, femur	–
ASG 483	M	Healed fracture, r. tibia; secondary deposit	–
ASG 558	M	Healed, well-aligned fracture, l. tibia	–
ASG 579	M	Healed fracture, fibula (fill bone)	–
ASG 587	M	Healed fracture, l. tibia/fibula	–
ASG 652	F	Healed fracture, l. tibia	Illus. 4.95d
ASG 695	M	Healed fracture, r. tibia	–
ASG 763	M	Healed fracture, l. tibia/fibula	–
Tr. XL/147	F	Healed fracture, r. fibula	–
Scapula, clavicle			
ASG 253	Inf.	Healed fracture, r. clavicle	–
ASG 387	M	Healed fracture, l. clavicle; secondary deposit	–
Vertebrae, ribs			
ASG 124	M	Healed fracture, rib	–
ASG 284	M	Cystic rib (dermatoma)	–
ASG 547	–	Compression fracture, lower thoracic vertebra	–
ASG 757	M	Healed fracture, ribs	–
ASG 943	M	Healed fractures, rib	–
Hands, feet			–
ASG 274	M	Healed fracture, l. metacarpal 4	–
ASG 382	?F	Fused r. ?fourth finger. Possible dislocation	–
ASG 441	M	Healed fracture, metacarpal; secondary deposit	–
B. Anglo-Saxon charnel			
Humerus, radius, ulna			
No no.	–	Healed Colles fracture, radius	–
Femur, tibia, fibula			
No no.	–	Healed fracture, l. tibia	–
No no.	–	Healed fracture, r. tibia	–
No no.	–	Healed fracture, l. tibia	–

TABLE 4.36 (*cont.*)

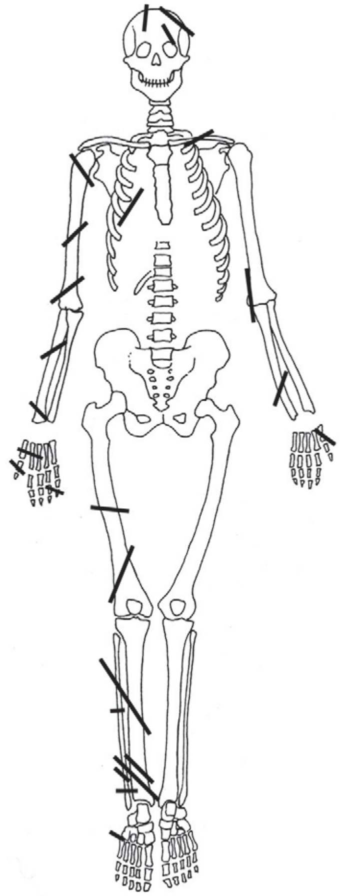
Grave number	Sex	Pathology	Illustration number
C. Medieval cist graves			
Humerus, radius, ulna			
MG 159	M	Healed fracture, r. humerus shaft	Illus. 4.102a
MG 184	?F	Amputation, distal r. radius and ulna	Illus. 4.109
MG 198	F	Dislocation of l. elbow	Illus. 4.108a
MG 263	M	Healed fracture, r. ulna	–
MG 321	F	Healed fracture, r. radius	–
MG 359	M	Healed fracture, r. ulna	Illus. 4.100d
MG 367	M	Healed fracture l. radius	Illus. 4.101a
Femur, tibia, fibula			
MG 164	M	Healed fracture r. fibula	–
MG 190	M	Healed fracture, r. tibia	–
MG 238	F	Healed fracture, r. fibula with periostitis	–
MG 371	?F	Healed fractures, r. tibia and fibula, l. fibula	–
Scapula, clavicle			
MG 155	M	Healed fracture, l. clavicle	–
MG 165	M	Healed fracture, r. clavicle	–
Vertebrae, ribs			
MG 155	M	compression fracture, L2 vertebra	–
MG 171	M	Healed fracture, four ribs; penetrating injury	Illus. 4.97a
Hands, feet			
MG 198	F	Fused l. carpals and metacarpals	Illus. 4.108b
MG 263	M	Healed fracture, l. 5th metatarsal	–
D. Medieval earth graves			
Humerus, radius, ulna			
MG 803=364A	M	Healed fracture, ulna	Illus. 4.100e
MG 876	F	Healed r. humerus head; arm wrenched up and dislocated	Illus. 4.106a–b
Tr XXX	–	Left shoulder dislocated	–
MG 877	F	Exostosis on l. humerus; dislocated?	–
MG 899	?F	Healed parry fracture, l. radius	Illus. 4.100a
unnumbered	–	Healed fracture, l. radius head	–
1964	A	Healed fracture, l. radius	Illus. 4.101b
1964	–	Healed? fracture, ulna	–
CGW Tip	A	Healed fracture, distal r. ulna	Illus. 4.100f
BK XXII/XXV	?F	Healed fracture, ulna	–
65 Tr XXIV	A	Healed fracture, distal r. ulna	Illus. 4.100g
Tr XXV	–	Healed Colles fracture, l. ulna	–
unnumbered	–	Healed fracture, distal r. humerus	–
Femur, tibia, fibula			
MG 905	F	Healed fracture, l. fibula with exostosis and false joint	Illus. 4.97b
MG 1146	F	Healed fracture, r. femur	Illus. 4.98a–b
1965	–	Healed fracture, tibia with ankle joint dislocation	Illus. 4.105a–b
66 Tr XXV	M	Healed spiral fracture r. tibia, ankylosed to fibula	Illus. 4.95c
XXXII/XXXIII (4)	M	Healed fracture, r. tibia	Illus. 4.99
66 Tr XXVI	–	Healed fracture, r. tibia-fibula	Illus. 4.95b
unnumbered	–	Healed fracture, r. tibia-fibula; knee-crutch used?	Illus. 4.103a–b
66 XXIX (7)	–	Healed fracture, l. tibia-fibula	Illus. 4.95a
66 Tr XXVI (4)	–	Healed fracture, fibula	Illus. 4.95e
Vertebrae, ribs			
MG 876	F	Fused C2 and C3	Illus. 4.106c
MG 1120	–	Compression fracture, thoracic vertebra	–
Hands, feet			
MG 892	F	Healed fracture, metacarpal	–
65 Tr XXIV	M	?Healed fracture, metacarpal	–



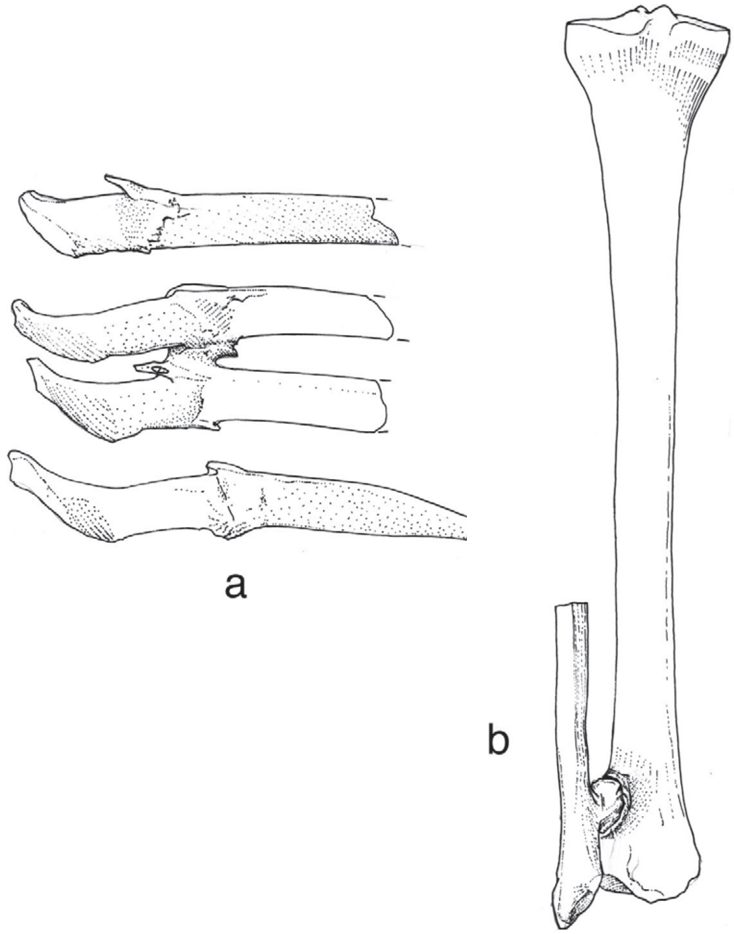
Illus. 4.95. Healed fractures of the lower leg: (a) spiral fractures of the left tibia and fibula, anterior view. CG 1966, Tr. XXIX (7), unnumbered medieval earth grave, adult; (b) spiral fractures of the right tibia and fibula, anterior view. CG 1966, Tr. XXVI, unnumbered medieval earth grave, adult; (c) spiral fracture of the right tibia with evidence of infection and fusion to the fibula, anterior view. CG 1966, Tr. XXV, unnumbered medieval earth grave, male adult; (d) well healed spiral fracture of the left tibia, with callus formation. Anterior view. ASG 652, female adult; (e) well healed and aligned fracture of a fibula. Side uncertain. CG 1966, Tr. XXVI (4), unnumbered medieval earth grave, adult.

or oblique fractures, which were common in the tibiae and humeri in this series, are caused by a rotary or twisting type of injury, and can again result from a clumsy fall (Illus. 4.95b). Ambion or chip-type fractures are of importance, as they are associated with forcible tearing of ligaments, tendons, or muscle attachments. They usually occur near a joint and may involve its articular surface, thus predisposing the joint to osteo-arthritic changes later in life (cf. Illus. 4.102b). Severe crushing or impact injuries, known as comminuted fractures, may lead to the collapse of the bone into fragments. They may be caused by missile injuries, heavy blows or, for example, by the dropping of heavy objects on the small bones of the foot. Various diseases may weaken the bone structure, making it more subject to pathological fractures which may occur with only a minimal amount of stress or force. Bone tumours, chronic infection, lack of mineralization, and cysts may all produce this effect.

The site of fractures is related to age, sex, and occupation or activity: in the young, the most common fractures are to the bones of the forearm,



Illus. 4.96. Distribution of sites of fractures including possible blade injuries.



Illus. 4.97. Complications of fractures: (a) ossification of soft tissue following rib fractures. MG 171, male adult; (b) a false joint between the left tibia and fibula at the site of a healed fracture in the distal fibula. MG 905, female adult.

followed by the lower legs and elbows. In the old, fractures occur most commonly in the ribs, followed by wrists and ankles. Fractures in the old tend to occur at the ends of long bones and to involve the neck of the femur, the humerus, and the wrist and ankle joints.[7] These differences are probably related to more vigorous activity in the young and the gradual weakening and demineralization of the bone in the old who, being less agile, are more prone to succumb to unusual stresses at the ends of long bones as they stumble and fall. In the healing of bone fractures, a blood clot forms around the ends of the broken bone, and scar tissue develops in the clot. After about four weeks ossification occurs in this tissue, forming bony callus which can be seen on a radiograph. After about seven weeks denser bone callus forms, and gradual remodelling and re-formation of the bone contours then occurs during a period of eighteen months to two years, an estimate of the age of a fracture up to two years can be given.[8]

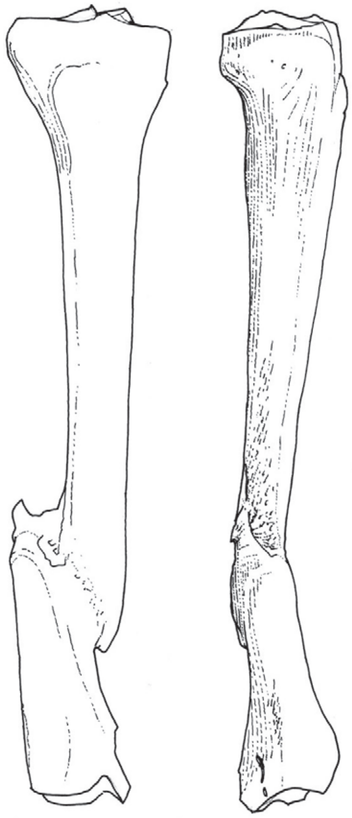
[7] Donaldson et al. 1990.

[8] See Roberts and Manchester 2005, 92–4 for a discussion of the complications of fracture.

Illus. 4.98. MG 1146, young adult female: (a) healed compound fracture of the right femur; (b) radiograph of the same individual showing no evidence of bone infection despite gross angulation and overlap of the bone fragments.

Complications of fractures include a failure to unite, the formation of false joints, superimposed infection (periostitis or osteomyelitis), and disturbance of the blood supply to the bone resulting in death of the tissue or necrosis (Illus. 4.97). If there is a considerable blood clot in the muscles adjacent to the fracture, ectopic (abnormally placed) bone may form, or calcium salts may be deposited in the soft tissue, resulting in localized myositis ossificans.

The compression fracture is the most common type of injury involving the vertebral body and is caused by a sudden forward bending of the spine. Underlying disease processes or osteoporosis may also be involved, weakening the structure of the bone and making it more



Illus. 4.99. Unset or poorly set healed fracture of the right tibia showing angulation and overlap. Anterior and lateral views. Baulk XXXII/XXXIII (4), unnumbered medieval earth burial, male.

susceptible to fracture. Mechanically, a vertebral body may be regarded as two circular plates supported by vertical struts, with varying cross-ties between the struts. In a flexion injury the front portion of the vertebral body collapses, leaving a wedge shape. Minor degrees of injury may result only in the displacement of chips from the end plates

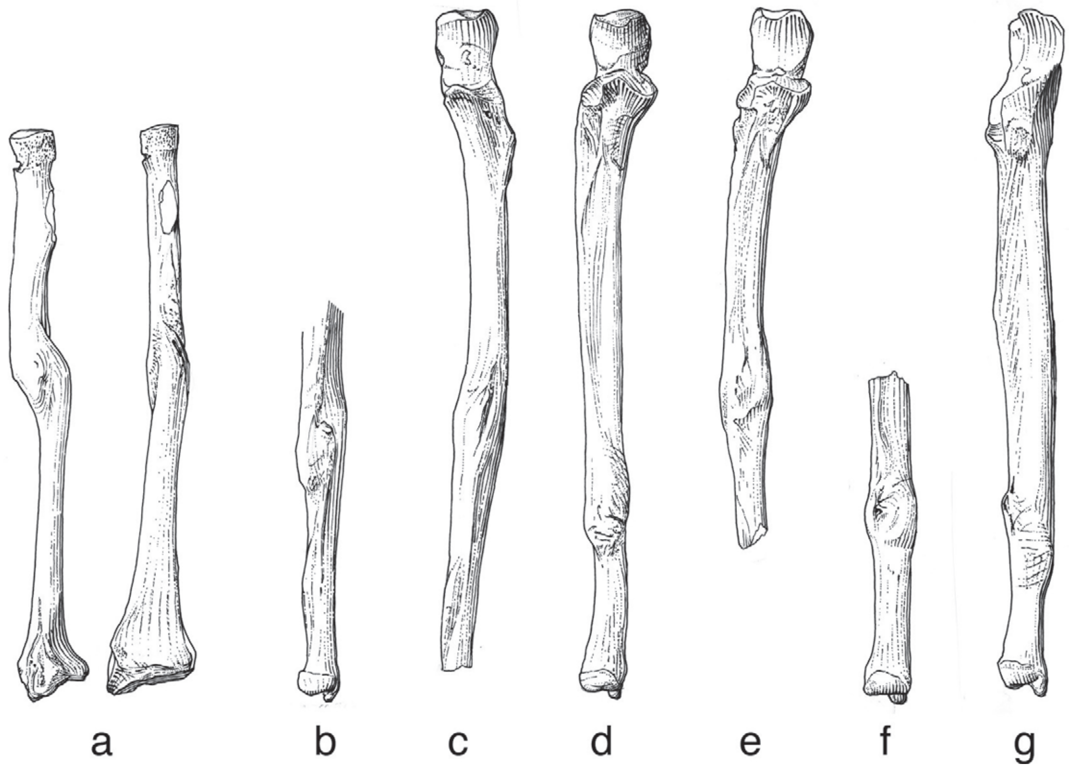
Amongst the healed fractures to the long bones seen in the Cathedral Green skeletons, remarkably good alignment was often achieved, suggesting that splints were used. Traction of broken limbs using weights and pulleys first made its appearance during medieval times but we can offer no evidence for the use of mechanical traction at Winchester.

Most fractures in the Cathedral Green Anglo-Saxon and medieval long bones were well aligned, especially the arm bones. An exceptional case where alignment did not occur was the femur of a young female, MG 1146, which showed a healed fracture of the lower third of the shaft with gross angulation and overlap of the bone fragments (Illus. 4.98). It is difficult to see how the bone of MG 1146 did not penetrate the skin, but no evidence of bone infection was detected on the radiograph. The extent and orientation of the callus joining the two parts of the femur indicate that the fracture had healed and that the limb was weight-bearing at the time of death.

In the Anglo-Saxon graves the most frequent site of fracture was the lower leg, with only slightly lower frequencies in medieval bones (Table 4.36; Illus. 4.99). In one-third to one-half of the cases bone callus had formed between the tibia and fibula during healing, so that the two bones were fused together. Seven cases (two Anglo-Saxon and five medieval) involved fracture of both tibia and fibula.

The lower arm was the next most common site of fracture (Illus. 4.100), and there were more fractures here among the medieval population (14) than among the Anglo-Saxon (5). Most of the lower arm fractures had occurred some years before death and healing had taken place. An exception to this was an ulna from ASG 88 where the fracture of the shaft was not united, although some bone callus formation had occurred. In no case of lower arm fracture were both the radius and ulna involved.

Lower arm fractures in the mid-shaft, known as parry fractures, were possibly incurred in fending off a blow, usually to the left arm (cf. ASG 620 and an unnumbered Anglo-Saxon grave from Trench XL (900)). Most of the other lower arm fractures were to the distal end of the radius (Colles' fracture, Illus. 4.101) or ulna, and would have resulted from falls.



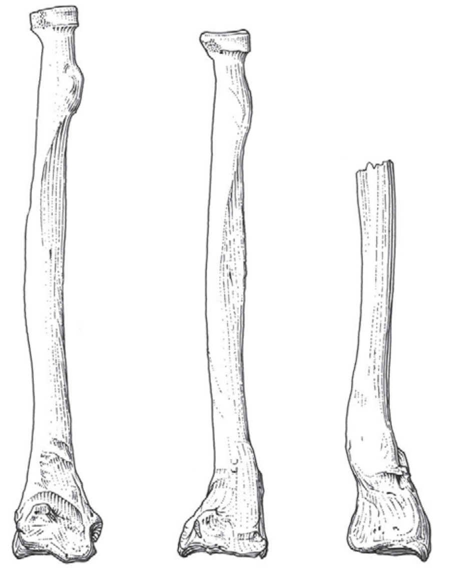
Illus. 4.100. Healed fractures of the forearm: (a) parry fracture, right radius. MG 899, ?female adult; (b) right, midshaft. Tr. XL (900), unnumbered Anglo-Saxon adult; (c) left ulna, midshaft. ASG 88, male age 21–25; (d) distal third of the right ulna shaft. MG 359, male adult; (e) midshaft of a right ulna. MG 803=364A, male adult; (f) distal third of a right ulna shaft. CG W Tip. Unnumbered medieval earth grave, adult; (g) distal third of a right ulna shaft. CG 1965, Tr. XXIV, unnumbered medieval earth grave, adult.

An example of multiple fractures which may have been caused by a fall is provided by the cist burial MG 155, the associated chalice and paten indicating a priest. The skeleton had a fractured left clavicle and a compression fracture of the second lumbar vertebra. Another cist burial, MG 263, showed fractures of the right ulna and left fifth metatarsal, which may have been caused by extending the arm to break the fall after stumbling. In a third cist, MG 367, a healed fracture of the radius was associated with a healed 'sword cut' which left a hole above the left eye (cf. Table 4.34). Were these injuries possibly sustained at the same time, perhaps during a fight?

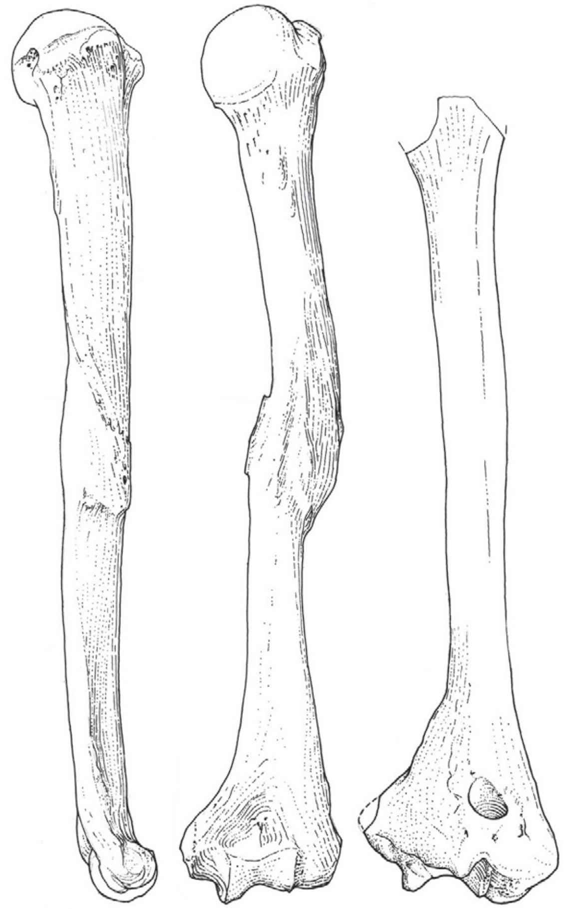
Only five fractures of the humerus were observed, one from an Anglo-Saxon grave (ASG 600), one with unspecified provenance, and three from medieval contexts (Illus. 4.102). Of these five, two were associated with dislocated shoulders, and are described elsewhere.[9]

Among the medieval earth burials an unnumbered isolated right leg was found with the knee fixed at a right angle (Illus. 4.103a, b). The knee joint was destroyed, the tibia was bent backwards, and a pseudoarthrosis or false joint had formed, its upper margin consisting of a bony spur from the femur. The remains of the kneecap were fused to the lateral condyle of the femur. A badly healed diagonal fracture of the ankle, involving

[9] See below, pp. 379–81, Illus. 4.106–108.



Illus. 4.101. Colles' fractures in the radius, possibly as the result of a fall: (a) left radius. MG 367, male, young adult; (b) left radius. CG 1964, unstratified medieval, adult; (c) Anglo-Saxon charnel, adult.



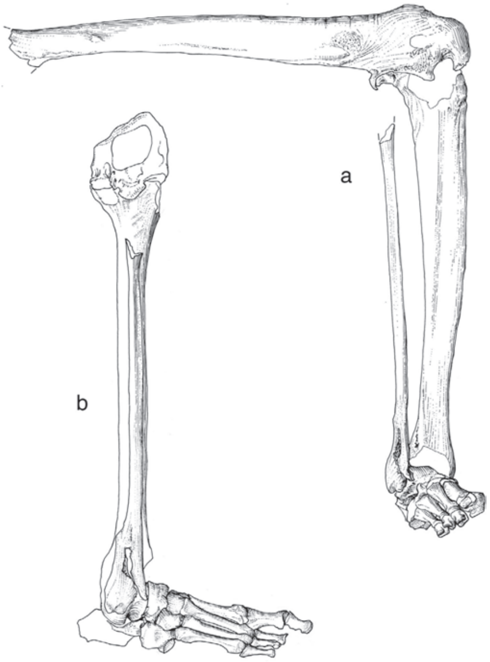
Illus. 4.102. Healed fractures of the humerus: (a) right humerus showing anterior and lateral views of a well healed, slightly misaligned midshaft fracture. MG 159, elderly male; (b) healed fracture of the distal right humerus, associated with dislocation of the elbow. ASG 600, male adult.

both tibia and fibula, was also present, and the normally blade-like front edge of the tibia was rounded and broadened and, on radiography, demonstrated to be thickened. This thickening could have been the result of wearing a knee-crutch to support the leg after fracturing the ankle (Illus. 4.104). In this case, the deformity caused by the crutch was worse than that due to the original fracture.

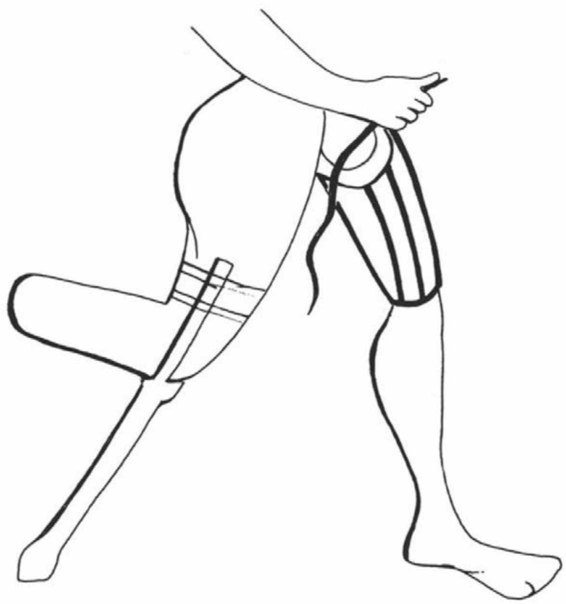
Another incomplete male skeleton from an unnumbered medieval earth grave excavated in 1965 displayed a severe disability of the right leg, resulting from the fracture and dislocation of the ankle joint. The articular surfaces of the ankle bones were eburnated, arthritic osteophytosis had developed at the articulation with the tibia, and the foot was tilted up (Illus. 4.105a, b).

Injuries other than fractures

Injuries other than fractures to postcranial bones are also summarized in Table 4.36. A number require specific comment. Damage to the head of the humerus was noted in several



Illus. 4.103. Healed diagonal fracture of the right tibia and fibula. Destruction of the knee joint was possibly a result of using a knee crutch: (a) anterior view; (b) lateral view. Unnumbered medieval earth grave, adult (nts).



Illus. 4.104. Representation of a knee crutch redrawn after a figure by Hieronymous Bosch (1450–1516), from *The Haywain*, painted 1516.

skeletons. Two cases, one Anglo-Saxon and one from a medieval cist grave, where arthritic changes seen in the shoulder joint have already been described.[10]

In two further cases, both from medieval earth graves, the humerus was fixed in an elevated, internally-rotated position (Illus. 4.106a, b). The surgical neck of the humerus was fractured in the former and in the latter the head of the humerus showed a rounded cavity with a flange of distorted bone below it. Only half of the head was in the socket and a false joint with additional bone growth had developed. Both skeletons showed long-standing degenerative changes indicating that the individuals had survived long after their injuries. There was osteoarthritic lipping at the vertebral body margins of both, and in the latter the second and third vertebrae in the neck were fused together on the side away from the injury (Illus. 4.106c). The mechanism accounting for this type of deformity would be a violent wrench or half-Nelson type of wrestling hold applied with great force and beyond the normal range, pulling the arm out of its socket and screwing it round. This might occur in some forms of torture or punishment, but such treatment might be expected to produce bilateral dislocation, and no such cases were found, although the upper ends of humeri were not always very well preserved. Another medieval humerus was found with a peculiar swelling just below the head which might have been due to a milder version of this type of injury (MG 877). Where sex could be assigned, all these cases of damaged humeral heads occurred in female skeletons. Could this be an indicator of domestic violence? Traumatic

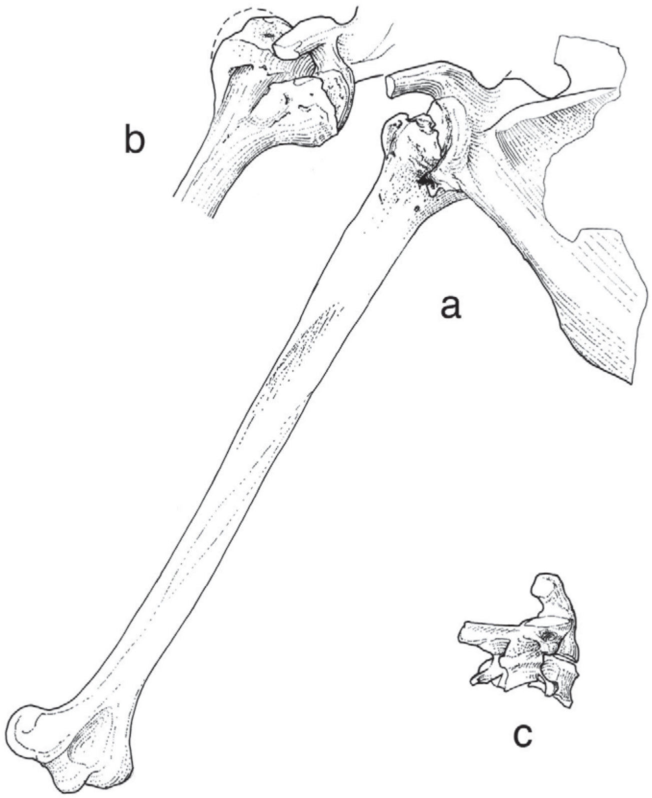
[10] See above, p. 356.

Illus. 4.105. Fracture and dislocation of the right ankle joint: (a) tibia, talus, and calcaneus; (b) superior articular surfaces of talus and calcaneus showing pitting, burnishing, and osteoarthritic changes related to the trauma. Unprovenanced medieval, adult.

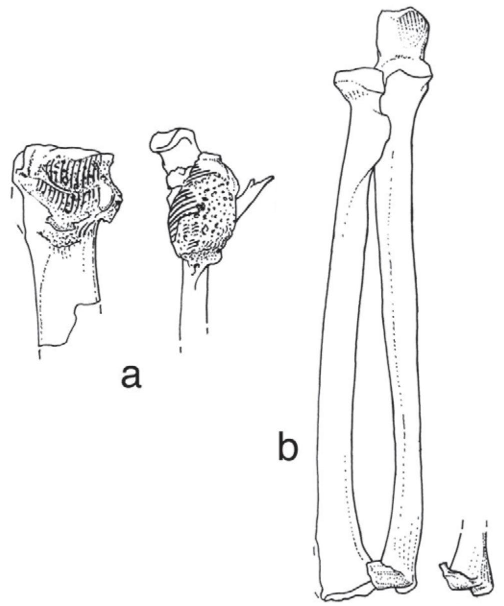
osteoarthritis and deformity of the shoulder joint was also seen in another female, ASG 295 (Illus. 4.107a).

The elbow was another area which was frequently injured. There were three cases of fracture, two Anglo-Saxon graves (ASG 324 and ASG 600)[11] and one medieval cist grave (MG 198). In ASG 600, a male, the articulation was twisted, but movement was still possible. In the medieval case, a female, the joint may have been fixed at right angles as a result of the development of severe arthritis (Illus. 4.108a). Three other cases of elbows fused or restricted in movement because of traumatic osteoarthritis, one each from Anglo-Saxon, medieval earth, and medieval cist graves, were found. The case from the cist, MG 198, also showed severe osteoarthritis of the hand bones, which had fused (Illus. 4.108b). The skeleton was that of a young adult female, and it is probable that the arthritis was the result of a severe trauma, such as a crushing injury or a bad fall. A few other cases where bones were fused or slightly deformed due to similar types of injury were noted; these were

[11] See above Part 4, Chapter 6, p. 344, Illus. 4.65.



Illus. 4.106. Dislocation of a major joint: (a) dislocated shoulder, right humerus; (b) detail of humeral head deformation; (c) fused second and third cervical vertebrae from the same individual. MG 876, female adult.



Illus. 4.107. Evidence of stress and injury to postcranial bones. (a) Osteoarthritis with eburnation in the left shoulder joint. ASG 295, female age 45+. (b) Osteoarthritis on the distal right ulna, probably the result of injury. ASG 460, female adult.

mainly in the small delicate bones of the hand or foot, or the wrist or elbow (Illus. 4.107b).

Amputation

Surgical intervention, whether required by an exceptionally severe hand injury or by gross infection, or judicial mutilation, is suggested as an explanation for the amputation of the right hand of a female skeleton in a cist, MG 184. There were marked degenerative changes in the vertebrae indicating that the woman was of mature years. The right hand had been cut off just above the wrist with a sharp implement apparently passing from the ulnar to the radial side, with the hand laid palm down, and the cut was so neat as to appear deliberate (Illus. 4.109). The bone ends were well healed and had not fused. The stumps were wasted, indicating that the amputation had occurred many years before death. The surgical interpretation is perhaps to be preferred, given the relative status implied by burial in the Paradise cemetery and possibly implicit in the provision of a cist.

Illus. 4.108. Dislocation of the left elbow and injury to the hand: (a) left humerus, radius, and ulna; (b) fusion of the left carpals and two metacarpals as a result of injury. MG 198, female age *c.*21.

Illus. 4.109. Amputation of the hand at the level of the distal right radius and ulna. The well healed ends of the bones and the wasted stumps indicate that the event occurred many years before this individual's death. MG 184, ?female age *c.*39.

iv. CONCLUSION

As expected, a high frequency of bone trauma was found during the study. Many healed lower tibial fractures were noted in the medieval series. This type of fracture is the result of a rotational shearing strain sustained in a fall when the shod foot is trapped. The fractures found in the Anglo-Saxons were less predictable but mainly involved the long bones and ribs. This may reflect the possibility that the Anglo-Saxon inhabitants experienced lifestyles and work which contrasted with the medieval sample. Crush fractures of the vertebral bodies and impact fractures were rare but were found in medieval skeletons.

8

CONCLUSIONS[1]

i. ANGLO-SAXON AND MEDIEVAL PALAEODEMOGRAPHIC COMPARISONS

It was pointed out early in the study of the Winchester populations that skeletal samples are no substitute for substantial surveys of large historical populations. However, the fact remains that skeletal samples may be all that remains as evidence of earlier historic groups, and in these circumstances, the demographic information is worthy of attention, provided that potential bias and the smallness of sample sizes are fully taken into account. Boddington has discussed in detail the potential sources of error in palaeodemographic statistics, including the differential survival of infant remains, the length of time a cemetery is in use, problems of ageing, migrations, and population change, and possible changes in the sex ratio.[2] While much information has been discussed already in relation to period samples for Winchester, a number of general questions need to be considered further.

The representation of children in Anglo-Saxon and medieval contexts[3]

This is a constant problem, both from the point of view of diagenetic factors, which might cause the differential decay of thin infant bones, but also in terms of social factors, which could influence the burial of young children separately. It could reasonably be argued that death from warfare away from the home community could affect at least older teenage males. However, it is just as likely to increase the mortality of younger adult males. Although Russell and others have discussed child mortality at length, there is still a need for further analysis, particularly in relation to new data.[4]

In Christian communities, it is reasonably assumed that the majority of children will be placed with parents and other family in the same cemetery (or one local to them at death). Viewing, then, the number of children (under approximately 19–20 years of age), especially from the larger cemetery samples (Table 4.37), do these appear to be of 'normal' proportions? In John Graunt's classic study of mortality from London parish registers, he records that 60% of children had died before the age of 16 years.[5] In view of the fact that this represented a dense, environmentally stressed urban population, it may probably be used as a model of extreme child mortality. Because it is difficult to evaluate the impact of disease and other environmental factors at any period or in any locality, only broad trends or contrasts are likely to be meaningful.

Regarding the later Winchester samples and other English groups, the Winchester Anglo-Saxon graves compare well with Cannington (Soms.)[6] and Raunds (Northants),[7] all three suggesting

[1] The data analyses and statistical graphs in this chapter have kindly been provided by Professor Don Brothwell.

[2] Boddington 1982.

[3] For discussion of this topic for the Roman period and of the question of sex ratios in the same period, see above, p. 44. The demography of the Early Anglo-Saxon samples will be found on pp. 212–17.

[4] Russell 1985.

[5] Graunt 1662.

[6] Brothwell et al. 2000.

[7] Powell 1996.

TABLE 4.37

Major age contrasts in excavated Anglo-Saxon and medieval samples

Site	Author	% Immature	Age 0–19	Age 20+	Total Aged
CATHEDRAL GREEN GROUPS					
Anglo-Saxon graves	This study	58.8	174	122	296
Anglo-Saxon charnel	This study	13.9	98	607	705
Medieval earth graves	This study	6.6	10	142	152
Medieval cist graves	This study	12.3	13	93	106
Total Anglo-Saxon sample	This study	27.2	272	729	1001
Total medieval sample	This study	8.9	23	235	258
OTHER ENGLISH GROUPS					
Cannington, Somerset	Brothwell *et al.* 2000	45.0	177	216	393
Bidford on Avon, Warwickshire	Brash and Young 1935	26.1	58	164	222
St Helen-on-the-walls, York	Dawes & Magilton 1980	27.2	291	777	1068
Raunds, Northamptonshire	Powell 1996	63.4	208*	120	328

* 0–17 years

TABLE 4.38

Sex ratios in excavated Anglo-Saxon and medieval samples

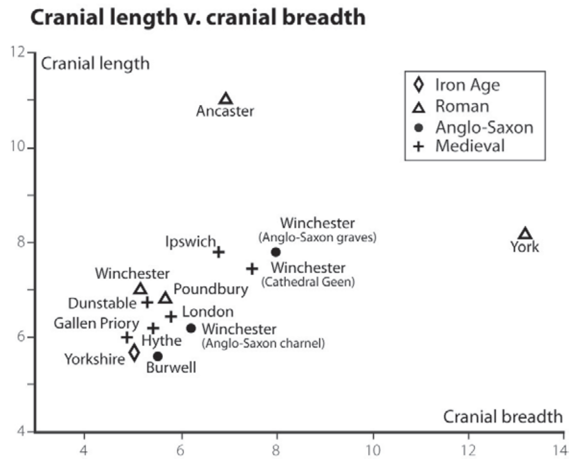
Site	Males	Females	Ratio
ANGLO-SAXON			
Cathedral Green, Anglo-Saxon graves	69	48	1.4:1
Cathedral Green, Anglo-Saxon charnel	63	27	2.3:1
Cathedral Green, total Anglo-Saxon	132	75	1.8:1
Raunds, Northamptonshire	98	77	1.2:1
Cannington, Somerset (Dark Age)	119	186	0.6:1
MEDIEVAL			
Cathedral Green, total medieval	135	96	1.4:1
Fishersgate, York	128	52	2.5:1
Jewbury, York	163	151	1.1:1
St Helen-on-the-walls, York	338	294	1.2:1
Black Friars, Ipswich	148	64	2.3:1

relatively stressed populations, with many not reaching adulthood. The Winchester Anglo-Saxon charnel has clearly been affected by taphonomic factors, as few infant bones were likely to be picked up and redeposited. The later medieval graves appear also to be affected by burial factors, with better survival in the medieval cist graves (although the enclosed dampness of these graves produced discolouration and evidence of fungal damage).

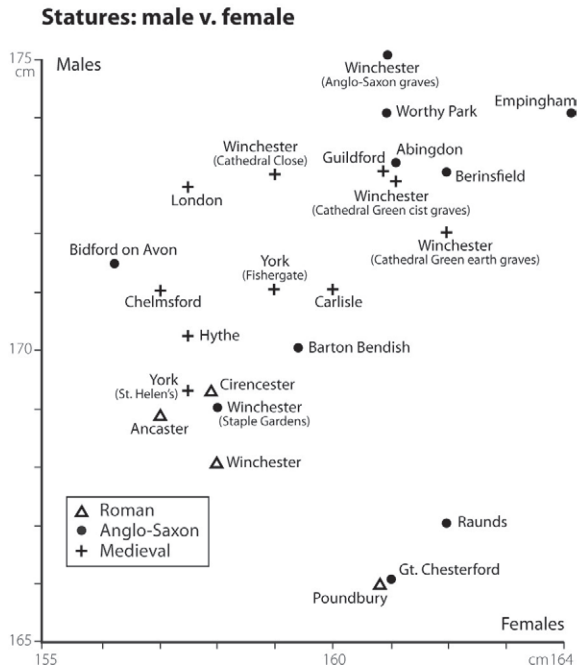
The sex ratio in comparative Anglo-Saxon and medieval samples

Variation in the sex ratio of earlier populations has been discussed previously in relation to samples from earlier human populations.[8] The majority of groups cluster around the 1:1 ratio, but the interesting groups are those which diverge, as there appear to be social influences in most of the anomalous ratios. Medieval Gallen Priory (Offaly, Ireland) has a male bias,[9] as also does the Dominican friary in Ipswich (Table 4.38).[10] Later Winchester samples, and comparative groups, display more variation than expected. Generally, for the Anglo-Saxon and later medieval series,

[8] Brothwell 1971. [9] Howells 1941. [10] Mays 1991.



Illus. 4.110. Standard deviations of cranial length plotted against standard deviations of cranial breadth for Winchester Cathedral Green samples and comparative English samples.



Illus. 4.111. Mean male statures plotted against mean female statures for Winchester Cathedral Green samples and comparative English samples.

females are less well represented. It seems unlikely that differential preservation can be called on to explain this for the different groups (and localities), and it is likely that other factors are at work.

One possible factor which deserves consideration is that deaths in childbirth may have particularly occurred in subadult females or very young adults, and these are not being sexed because they appear skeletally immature. Another problem, but this should not cause significant bias, is that a few more robust females are classed as male. Could a further possible bias be that towns and industry especially attracted the younger male, as in developing countries today?

ii. HOMOGENEITY OR HETEROGENEITY IN POPULATIONS

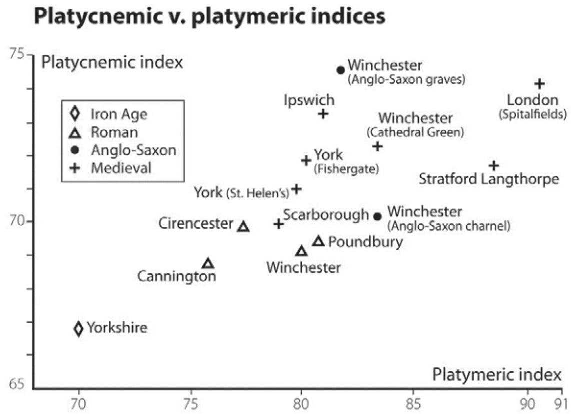
To what extent are the populations being considered relatively homogeneous, or are they to some extent mixed? A long-term problem in archaeology is the question of cultural change being the result simply of cultural intrusions or human movement. Clearly this is also a demographic question, but it tends not to be asked, and for good reason. For how do we determine how cosmopolitan a community is at a biological level? Studies of ancient DNA are helping to resolve the problem, but somewhat expensively. Another simpler answer may be to evaluate the standard deviations of the measurements taken on the cemetery groups—provided the sample sizes are large enough. As a measure of dispersion about the mean of a dimension, the standard deviation gives some indication of changes in the normal distribution expected for a particular measurement. If it is noticeably larger than expected, then it could well be indicating heterogeneity. In Illus. 4.110 standard deviations are plotted for skull length and breadth for various Winchester samples, together with some comparative series. It will be seen that there is a tight cluster of plots for the majority of samples, and this indicates the normal range of variation in the size of the two standard deviations. The Ipswich Dominican Friary, Winchester Anglo-Saxon, and Winchester medieval series stand out to a moderate degree, and it can be reasonably questioned whether this indicates the degree of 'foreign' elements in these communities. The most distinctive groups are Roman (York and Ancaster), but not the Winchester Romano-Britons. This does seem to emphasize again the variable composition of the Romano-British communities, made up as they must have been of indigenous Iron Age people and other European elements.

iii. PHYSICAL CONTRASTS: WINCHESTER AND BEYOND

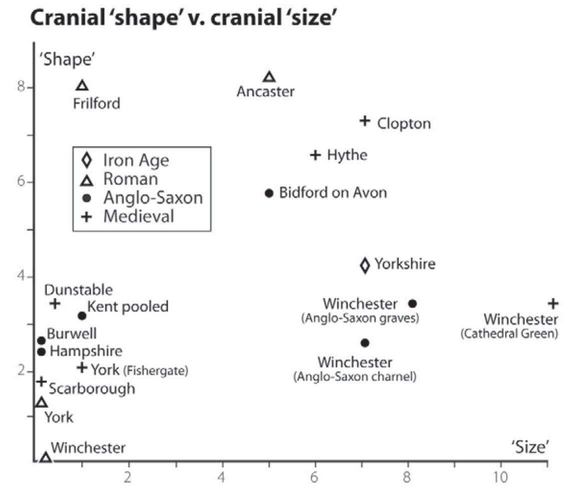
From a general lack of evidence for malnutrition of the kind which would significantly affect growth and health in childhood, it can be concluded that the population of Winchester was generally in reasonable health. This is not to exclude the possibility of a case or two of rickets or scurvy, but generally the skeletal evidence would not support a conclusion of common, endemic, nutritional stress. It can therefore be concluded that growth was not significantly stunted. However, from studies on secular trends for stature and other body dimensions in various recent populations, it is clear that mild environmental factors may influence growth potential,[11] so differences in early British populations are likely to be a combination of genetic factors and environmental conditions. In Illus. 4.111, mean stature estimates for males and females are given for a range of English groups. Sample sizes are variable, but some are substantial. It can be seen that mean stature varies over about 10 cm, with individual ranges being greater still. Smaller mean statures tend to be Romano-British, including the pooled Winchester group. There is much overlap between Anglo-Saxon and later medieval means, although the tallest mean statures appear to be Anglo-Saxon including the Winchester Cathedral Green series. The extent to which these differences reflect genetic variation is clearly debatable. The shorter Roman stature could be a reflection of intrusive elements in the population, and Italian stature today is less than for populations in northern Europe. In contrast, the variation in later groups could be a combination of intrusive genetic factors (Anglo-Saxons) and the variable nutritional status of the urban and rural groups represented in these samples. The Winchester Anglo-Saxon statures would certainly argue for a healthy nutritional status for these townspeople.

Other dimensions of the postcranial skeleton are linked to factors of growth and sexual dimorphism, and in some instances probably to genetic and biomechanical factors. Variation in the shape of long bone shafts has attracted interest for more than a century, particularly of the proximal femur and tibia. The platymeric index (FeD1 × 100/FeD2) indicates the degree of antero-posterior flattening in the upper femoral shaft. The platycnemic index (TiD2 × 100/TID1) indicates the degree of medio-lateral flattening in the tibia. The femoral index is more sexually dimorphic than that for the tibia. The mean difference between the sexes for the femoral index is in the order of 3.2, but only 1.6 for the tibia. However, both show considerable inter-population variation, as shown in Illus. 4.112, with the extremes of the mean index ranges represented by the Yorkshire Iron Age series and the Spitalfields (London) medieval cemetery. The Roman (and Cannington) groups cluster together and are closest to the late prehistoric sample. The Anglo-Saxon

[11] Eveleth and Tanner 1976.



Illus. 4.112. Mean platymeric indices plotted against mean platycnemic indices for Winchester Cathedral Green samples and comparative English samples.



Illus. 4.113. Cranial 'shape' plotted against cranial 'size' for Winchester Cathedral Green samples and comparative English samples.

and medieval groups from Winchester occupy roughly a somewhat intermediate position, but extend towards the medieval series from Spitalfields. It is tentatively suggested on this evidence that we are looking at variation influenced by how urban and sedentary the populations were.

iv. CRANIOMETRIC VARIATION

Far more differences are seen in the region of the head, which is composed of a series of separately developing bones, influenced by other growing structures such as the teeth, brain, and eyes. Although tests of significance between pairs of means do not always indicate changes through time or regionally, there are clearly secular trends in shape, from the neolithic to the post-medieval period.[12] More sensitive evaluation of population change and affinities is to be undertaken multifactorially, by combining a series of different measurements for each group, and comparing them as if in three dimensions. While in the main body of the report, canonical variate analysis has been used,[13] the final comparisons here use the Penrose 'size and shape' statistical method of population comparison.[14] In particular, the need here is to integrate and compare the Winchester Roman data with the other Winchester and comparative series, with a view to making a final assessment of overall similarities or differences in Winchester groups and beyond over 1300 years.

Data on Winchester and other samples were assembled for this final craniometric comparison, and the 'size' and 'shape' results are presented in Illus. 4.113. Because of problems of comparability or smallness of sample, seventeen groups were finally selected for multivariate comparison. These may be listed as follows:

(a) Winchester pooled Romano-British series[15]
(b) Winchester Cathedral Green Anglo-Saxon graves

[12] Brothwell and Krzanowski 1974.
[13] Gower and Digby 1984.
[14] Penrose 1947; 1954.
[15] Excluding Lankhills, see Table 4.21.

(c) Winchester Cathedral Green Anglo-Saxon charnel
(d) Winchester Cathedral Green medieval combined series
(e) Ancaster (Lincs.) Romano-British cemetery
(f) York (Fishergate) medieval cemetery (Period 6)
(g) Hythe (Kent) charnel house
(h) Yorkshire Iron Age
(i) Clopton (Cambs.) medieval cemetery
(j) Frilford (Berks.) Romano-British series
(k) Dunstable (Beds.) medieval Galley Hill cemetery
(l) Scarborough (Yorks.) medieval series
(m) York pooled Romano-British series
(n) Burwell (Cambs.) Anglo-Saxons
(o) Bidford-on-Avon (War.) Anglo-Saxon cemetery
(p) Kent pooled Anglo-Saxons
(q) Hampshire pooled Anglo-Saxons

All the populations are specifically compared with the Winchester pooled Romano-British series, which is seen in Illus. 4.113 at the intersection of the 'size' and 'shape' axes. The 'distances' on the graph of each group from the Winchester pooled Romano-Britons indicates the degree of biological affinity of each comparative group, based on seventeen variables. Although the York pooled Romano-Britons appear to be similar to the Winchester group, the Frilford and Ancaster Romano-British groups are distinctive. This again raises the question of what in fact the ethnic composition of these Romano-British communities was. As regards the Anglo-Saxons, three of the closest groups in 'shape' are the pooled Hampshire Anglo-Saxons (Alton, Winnall II, and Worthy Park), the Winchester Cathedral Green Anglo-Saxon graves and the Anglo-Saxon charnel series, suggesting perhaps a not insignificant genetic contribution by Romano-Britons to the later communities. Finally, how different were the medieval groups? Although there is considerable variation in the medieval groups, both in 'size' and 'shape' terms, the Winchester Cathedral Green combined medieval series is most distinctive on 'size' differences and moderately in terms of 'shape'. The Winchester groups, from Roman to medieval times, thus show variation, but there would also seem to be evidence from the craniometric analyses of some gene flow and biological influence through the centuries.

PART 5
THE POPULATION OF WINCHESTER: A MILLENNIUM OF CONTINUITY AND CHANGE

by CAROLINE M. STUCKERT

1
INTRODUCTION

THE CHANGING fortunes of Winchester's population as it was transformed from Romano-British in the fourth century to Anglo-Saxon in the eighth century, and then again to medieval in the fourteenth century, tell a remarkable story revealed, in part, through the surviving skeletons of its inhabitants. We do not have the whole story, but we have a large window through which to view significant portions of it as the centuries roll by. In earlier sections of this volume we have presented snapshots of each era as seen through specific sites or clusters of sites. These samples can be directly compared to each other within certain classes of data. However, it is important to remember that they are not necessarily complete nor fully accurate proxies for the living populations they represent.

In the following pages we will attempt to pull this story together by using osteological data to compare the Winchester populations through time. The Romano-British population is represented primarily by data from the 1967–72 excavations at the Lankhills School, and by the site of Victoria Road West, with reference to other excavations where possible. The Anglo-Saxon and medieval populations are represented by the excavations at Cathedral Green. The transitional phase of Roman to Early Anglo-Saxon is represented by a group of sites in adjacent areas of Hampshire, as there is currently no identified skeletal material dating to the fifth to seventh centuries from Winchester itself. To the extent possible, we will look at changes and continuities in population structure, health, and lifestyle within the context, outlined briefly, of external conditions that affected them. In this way we hope to identify any chronological trends in the data, and to throw light on the lives the people created for themselves as well as the lives that were created for them by heredity and external forces.

2

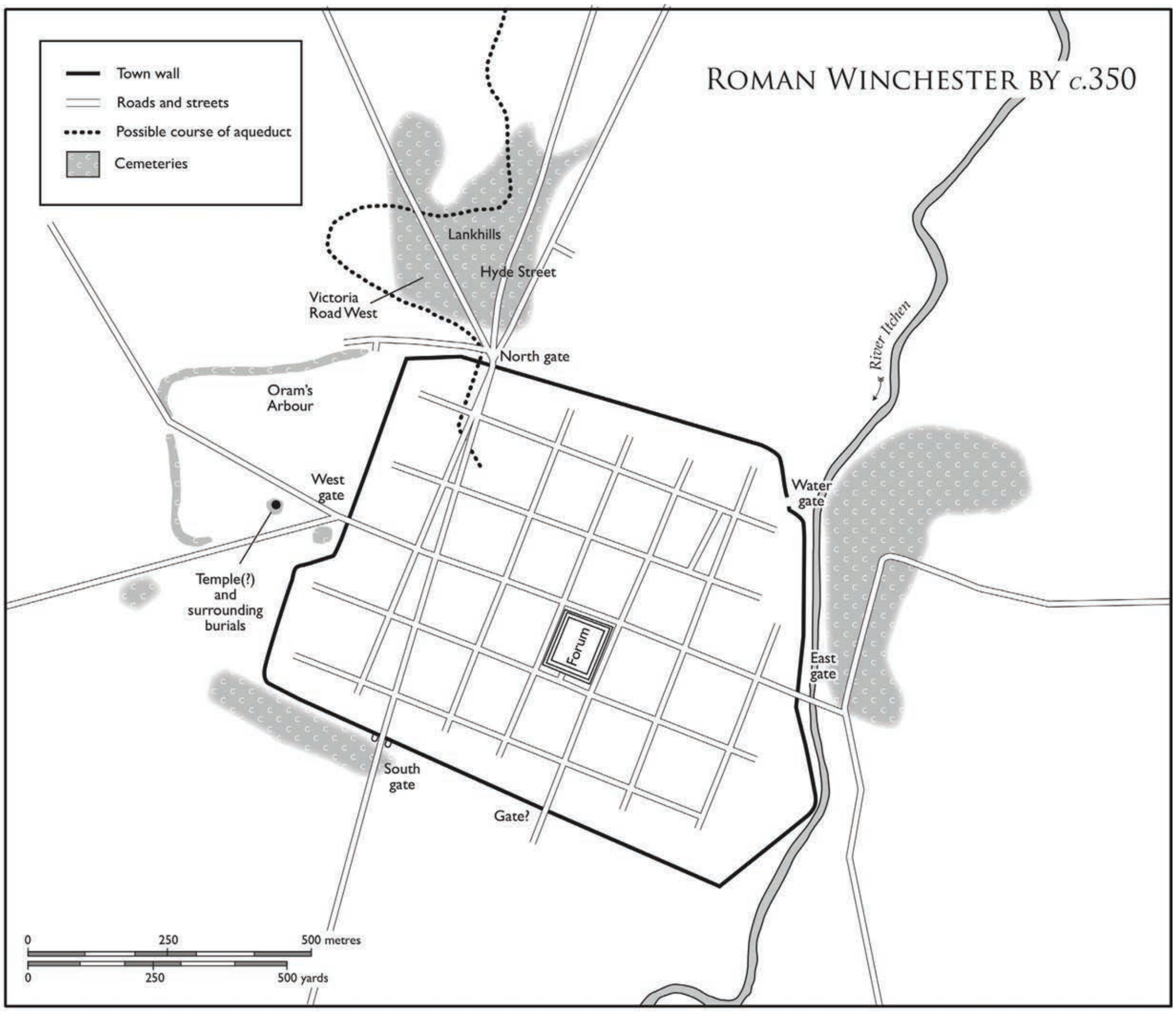
POPULATION CONTINUITY AND CHANGE

Population size fluctuated through time in response to epidemics, famines, and socio-political changes, although accurate numbers are elusive. In Roman Britain as a whole, the population may have reached at least three or four million, attaining its apex, at least in rural Britain, in the early fourth century, and subsequently beginning to decline.[1] It has been suggested that the population in Winchester increased during the fourth century, based in part both on a large increase in cemetery burials, and a reorganization of the town shortly after the middle of the fourth century (Illus. 5.1).[2] This reorganization demolished public buildings and large town houses, reorganized the water supply, laid out large areas of compounds within the walls, and added bastions to the defences. However, it may also be suggested that the post-350 period began to see a decline in Winchester's population. In these later years of the fourth century burials at Lankhills began to thin out, as represented especially in Areas E and O of the cemetery, dated post-370.[3] These changes in the organization of the town were mirrored in other Romano-British towns as well, and reflected the increasing political turmoil of the later fourth century, perhaps a response in part to repeated Pictish and Scottish incursions in the north,[4] but also to the need for greater military security throughout the country. Ultimate collapse followed over a period of several decades extending into the fifth century, spurred on not only by the effective withdrawal of Roman administrative support with the departure of Magnus Maximus and his army after 383, but by changes in the economy as well, which may have been driven in part by environmental changes.

The population of Winchester was never totally homogeneous during the centuries covered by this study. The Roman conquest of Britain introduced people from other parts of Britain and the empire into the native population, adding a cosmopolitan element. In the fourth century, despite Winchester's apparent role as an administrative and military centre, this admixture is however largely invisible, and must have been comparatively small. Most people would have been local, and if not from the city of *Venta* itself, at least from the surrounding communities in Hampshire.

Within Lankhills 1967–72 itself changes in the population can be seen starting in approximately 350 when comparing the earlier phase of the site (Area W, dated to 310–370/90) and the later phases (Areas F, E, O, all dated post-350), although most of these changes are not statistically significant.[5] The proportion of children increased from 27% in Area W to 33% in Areas F, E, O. Taking into consideration Victoria Road West, which may have terminated somewhat later, the proportion of children jumped to 44%. The proportion of males to females also shifted. While the site as a whole was evenly balanced, there was a preponderance of females in the earlier phase, which switched to a preponderance of males in the later phase. There were subtle changes in the physical appearance of the population as well, although these did not reach statistically significant levels. While dolichocranial and brachycranial individuals were well represented in the population,

[1] Jones 1996, 13, 16.
[2] Biddle and Kjølbye-Biddle 2007, 189.
[3] WS 3.ii, 118.
[4] Salway 1998, 360–1, 375–81, 402–5, 419–23; Mattingly 2006, 235–8.
[5] For details, see pp. 16–71.



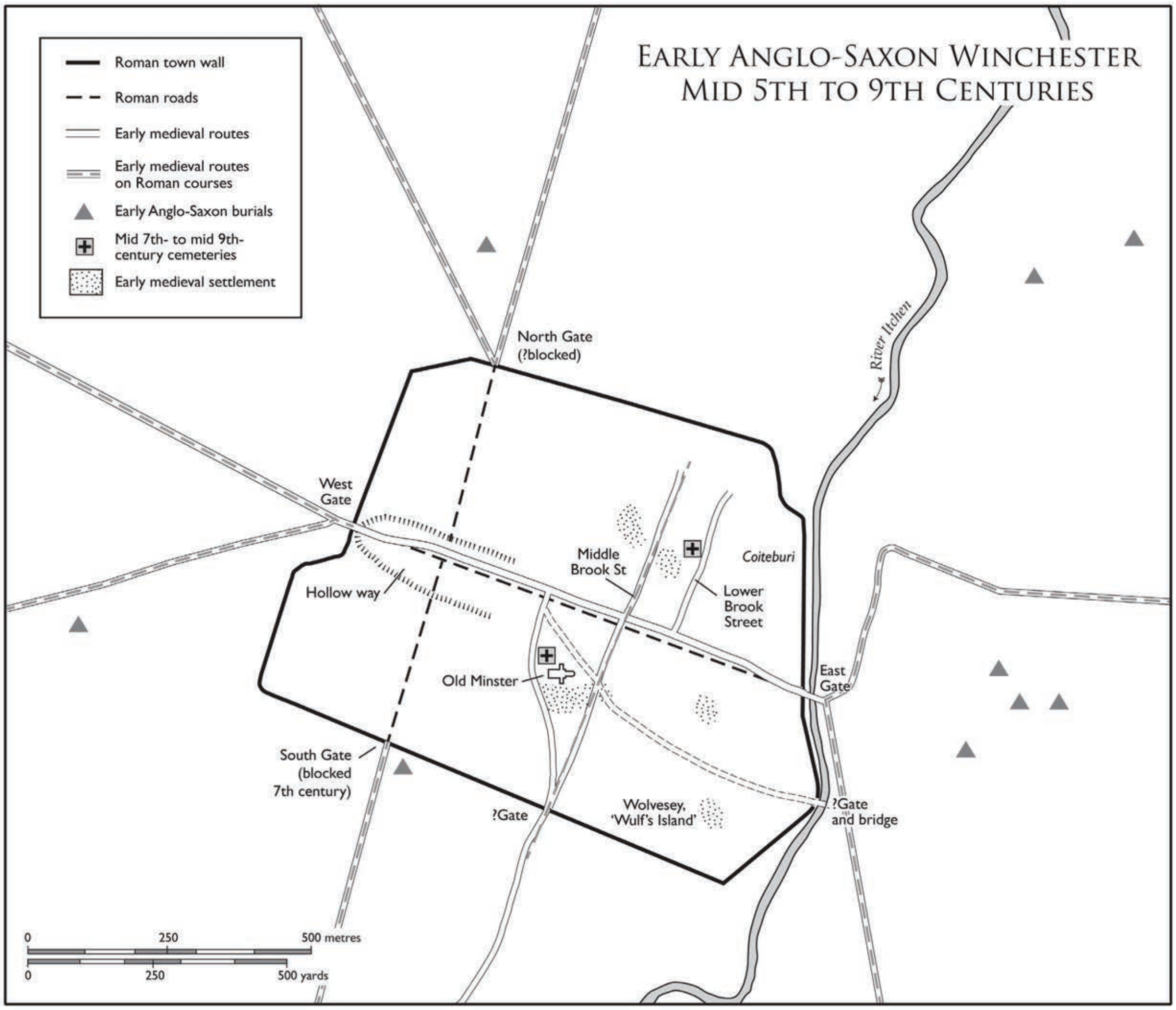
Illus. 5.1. Late Roman Winchester, *c.*350

the majority of individuals were mesocranial. After 350, there was a higher proportion of dolichocranial individuals, which slightly lowered the cranial indices (males from 77.1 to 75.6, females from 78.9 to 75.7). However, Victoria Road West did not continue this pattern, which may suggest that different segments of Romano-British society in Winchester were using the two sites. Alternatively, it may simply be a function of sampling, recovery, and preservation.

Excavations at Lankhills in 1967–72 and again in 2000–5 revealed a total of 24 individuals who were identified as possibly 'Pannonian' based on their grave goods, and an additional six who were identified as possibly Saxon based primarily on their burial rite.[6] With the exception of one burial from the 2000–5 excavations dated to 270–350, and two others that could only be dated to the fourth century,[7] all these 'foreign' burials are dated to at least 350 or later, going into the fifth century. However, interpretative caution regarding the ethnicity of these individuals is indicated.

[6] WS 3.ii, 377–403; Booth et al. 2010, 423.

[7] OA Graves 99, 930, and 1070; Booth et al. 2010, 69, 234, 150.



Illus. 5.2. Early to Mid Anglo-Saxon Winchester, 5th to 8th centuries

Several recent studies employing strontium and oxygen isotopic analyses evaluated a total of 58 individuals from both excavations at Lankhills to determine if the cultural affiliation of the burial rite and accompanying grave goods matched the biological ethnic origins of the individuals.[8] In the 'Pannonian' samples from the 1967–72 excavations (nine actually tested out of the 16), four turned out to be of local origin while five were foreign, from at least three different parts of Europe. Of the nine 'local' burials sampled for control purposes, seven were indeed local, and two originated abroad. A similar pattern was found in the samples tested from the 2000–5 excavations. Individuals identified as foreign archaeologically turned out to be local in all except one case. However, six of those identified archaeologically as local turned out to be foreign biologically. An additional six had isotopic signatures suggesting they were from other parts of Britain, primarily the west or the north. The results indicate that material culture often did not match up with biological origin, and that processes of assimilation and acculturation took place quickly. Most of the 20 individuals who could

[8] Evans et al. 2006; Eckardt et al. 2009; Chenery et al. 2010, 421–8.

be identified as foreign and the six individuals from other parts of Britain dated to post-350. Quantitatively, these samples are small, and are not representative of the site as a whole, as they were chosen to answer a specific set of questions. However, they do demonstrate that biologically foreign individuals were buried at Lankhills, although often with native customs, and that most of them date to the later time period. This raises the possibility that their presence might be related to the changes reflected in the layout of Winchester in the last half of the fourth century, and that they may be contributing to the differences seen between the earlier and later samples from the Lankhills 1967–72 excavations.

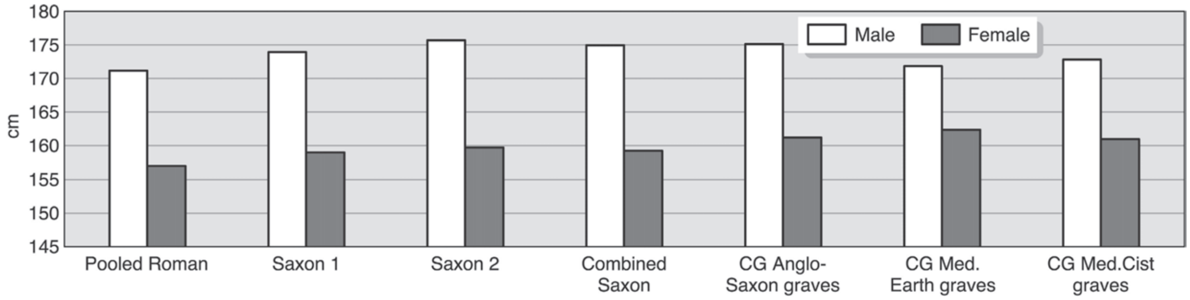
By the mid-fifth century, a greatly reduced Winchester within the town walls seems to have been largely emptied of residential population, and the picture remains clouded until the mid-seventh century, although there is evidence for Anglo-Saxon activity in the form of fifth- and sixth-century potsherds and plough marks found at several locations (Illus. 5.2).[9] Some of the land within the town walls seems to have been given over to agriculture, but there may have been six or more localized settlements of some sort within Winchester, which appears to have continued as a centre for administrative authority and overlordship of the surrounding territory.[10] This was a time of deteriorating climate and shrinking population. Between the fifth and seventh centuries the evidence we have for the composition of the population comes primarily from cemeteries located outside the walls in the surrounding regions of Hampshire. In this study, these have been represented by the sites comprising the Saxon 1 and Saxon 2 samples, although a number of additional sites and finds have been identified more recently.[11] As was true for the Roman period samples, there are ambiguities in the chronology of the Early Anglo-Saxon samples, and it should also be noted that there is a chronological overlap between the latest burials in these samples and the earliest Anglo-Saxon burials in Winchester at Cathedral Green.

The univariate and multivariate analyses in Part 3 have demonstrated that there was strong underlying genetic continuity with the Romano-British population in Hampshire during these turbulent years of the fifth to seventh centuries. With the exception of a very small, late sample from Lower Brook Street in Winchester,[12] all the Early Anglo-Saxon cemeteries used in this study were rural, and located on or near pre-existing boundaries or roads. In addition to a decline in population, they may also represent a redistribution of residence out of a decaying urban area, especially in those cemeteries closer to Winchester itself.

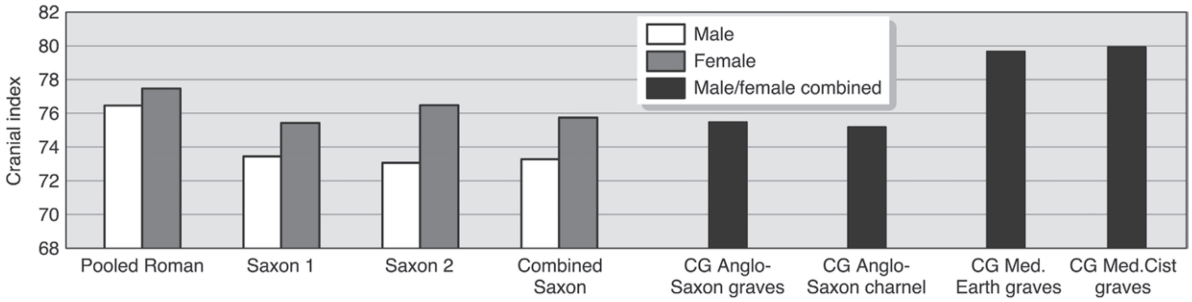
Continental Germanic peoples in unknown numbers clearly did arrive in Hampshire in the fifth to seventh centuries. The osteological evidence suggests that the numbers were small, although increasing through time, and that the immigrants were predominantly, although not exclusively, male. Female values for stature, cranial index, and t-tests on cranial measurements indicate no significant differences from Romano-British females.[13] The male values for stature, cranial index, and cranial measurement t-tests all differ significantly from their Romano-British counterparts, at levels that are initially low, but increase through time (Illus. 5.3 and 5.4).

Male stature increased from a mean of 171.1 cm in the Pooled Roman sample to 173.9 in the Saxon 1 sample, and 175.7 in the Saxon 2 sample. However, as health status and nutrition can play a role, these figures should be treated cautiously.

[9] Biddle and Kjølbye-Biddle 2007, 195.
[10] ibid. 203.
[11] ibid. 199.
[12] For a fuller description of this sample, see above, pp. 210–11, and see below, pp. 421–2.
[13] See Part 3, Tables 3.9, 3.12, 3.18, and 3.19.



Illus. 5.3. Mean stature, Roman to medieval



Illus. 5.4. Mean cranial indices, Roman to medieval

Cranial indices in males decreased from 76.5 in the Pooled Roman sample to 73.5 in the Saxon 1 sample, and to 73.1 in the Saxon 2 sample, indicating a trend to increased long-headedness. The contribution of the incoming Germanic peoples to the structure of the population may be reflected in the results from these variables. In appearance, the males (and to a much lesser extent the females) from the Early Anglo-Saxon samples had longer, narrower, and higher skulls than their Romano-British predecessors.

However, multivariate tests are far more powerful discriminators than univariate tests. Multivariate tests employing non-metric traits, which have a genetic component, may give a more accurate assessment of genetic relationships than tests using metric traits, which may be more subject to environmental influences. Romano-British and Early Anglo-Saxon females did not differ significantly from each other across any of the samples in any of the multivariate metric or non-metric tests. These samples are notable primarily for their similarity. The same similarity for males was present in the multivariate non-metric tests. In the multivariate metric tests, the Romano-British and Saxon 1 males did not differ significantly from each other. However, the Saxon 1 and Saxon 2 males did differ, as did the full Roman and Saxon samples. These findings reinforce the suggestion of underlying continuity of earlier populations with detectable, low levels of change through time in the composition of the population. DNA studies conducted to date do not challenge these findings for this part of Britain.

The four centuries encompassed by the Cathedral Green Anglo-Saxon burials saw the transformation of England from essentially tribal territories to full nationhood. It is clear that by the mid-seventh century Winchester was beginning to revive, reincarnated as the Anglo-Saxon town of *Wintancœster* thanks to the attention of the West Saxon kings and the revived Christian church.[14] At approximately this time, the Old Minster was founded by King Cenwealh of Wessex, and burials commenced on the site now known as Cathedral Green, first around the Old Minster and subsequently in and around the New Minster after its founding *c.*901–903, continuing until the dedication of the Norman cathedral almost two centuries later.[15] During this period Winchester was a royal and ecclesiastical community, although not fully urban, but it clearly served as a major administrative centre for king and church. It contained a royal palace, a monastery that was also the bishop's seat, probably at least some private estates of high-ranking individuals, and a market on the main street through the town.[16] At least five Kings of Wessex were buried in the Old Minster in the seventh to ninth centuries.[17]

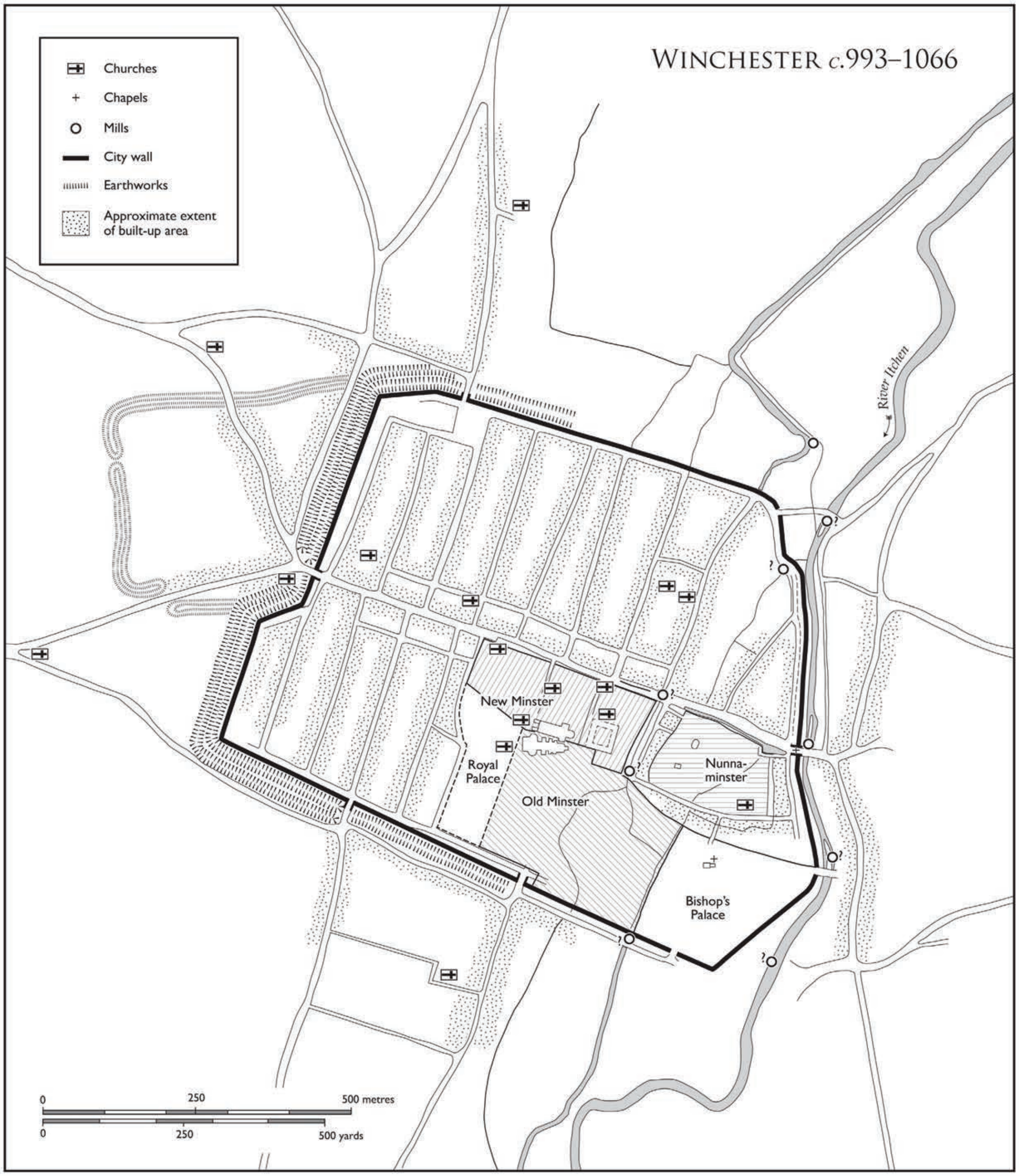
In the ninth century Winchester was redesigned as a new fortress town, or *burh*, by King Alfred, probably between *c.*880 and 886, as part of his system of defences for Wessex against Danish attack.[18] New supplies of water were brought into the town, and a new street grid pattern was established which was gradually fully populated over the next two centuries (Illus. 5.5).[19] Winchester's mint was also established during this period.[20]

Approximately 2,056 individuals are represented in the Cathedral Green Anglo-Saxon graves and Anglo-Saxon charnel. To what extent did they, and the later medieval sample, represent continuity with the earlier local population? The answers to these questions are complicated by the fact that in this study different statistical techniques which are not directly comparable were used by different investigators who were working at different times with different data sets.[21] In Part 3, quantitative analyses used pooled groups of sites based on geography and chronology, whereas in Part 4 most sites were treated individually. However, three of the sites involved (Worthy Park, Alton, and Winnall II) have been used in both analyses, suggesting that it may be possible to integrate and compare the results.

Cranial indices were not broken down by sex in the Cathedral Green samples. However, in Parts 2 and 3 the sexes have been separated, making direct comparisons with the later material imprecise. As Illus. 5.4 shows, the mean cranial indices in the Cathedral Green Anglo-Saxon graves and Anglo-Saxon charnel are within the range of the earlier Saxon 1, Saxon 2, and Combined Saxon samples, suggesting a close relationship. This suggestion is further reinforced by the canonical analyses[22] which point to the close clustering of the Anglo-Saxon groups tested, including Winnall II, Worthy Park, and Alton, all of which comprised part of the Combined Saxon sample in Part 3.

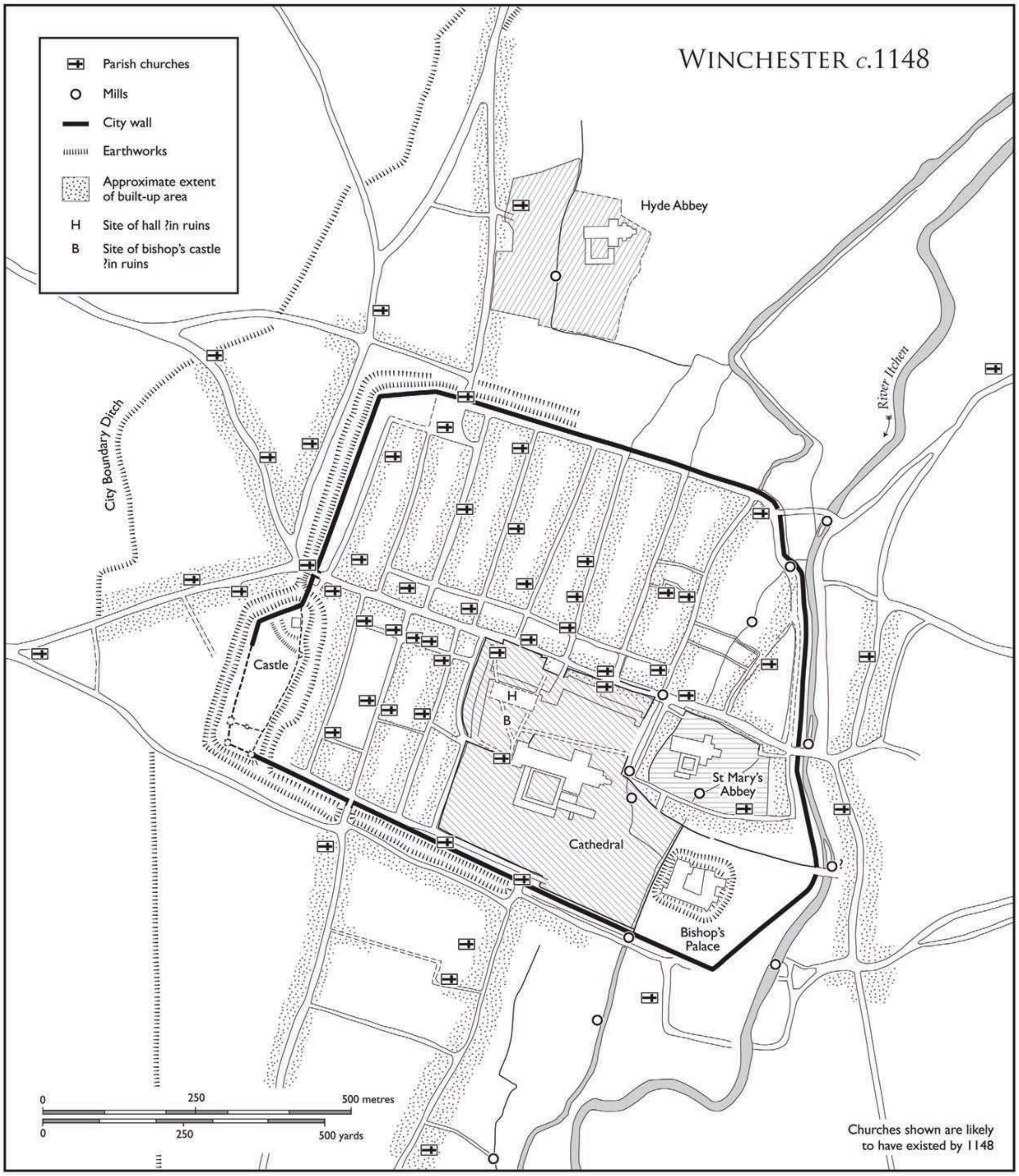
The stature data also tend to support a close relationship between the Hampshire Early Anglo-Saxons of the fifth to eighth centuries as represented in the Combined Saxon samples, and those of the seventh to eleventh centuries as represented in the Cathedral Green samples.[23] Cathedral Green statures were calculated only for the Anglo-Saxon graves, excluding the Anglo-Saxon charnel. However, these show mean male statures which are almost identical to those of the Combined Saxon sample (Cathedral Green Anglo-Saxon graves = 175.1 cm; Combined Saxon = 174.8 cm). Female statures are almost as close (Cathedral Green Anglo-Saxon graves = 161.2 cm; Combined Saxon = 159.1 cm), with the difference being well within the 3.94 cm standard deviation on statures calculated from femora.[24] The gradual progression in female mean stature through time from the

[14] Biddle and Kjølbye Biddle 2007, 194–5.
[15] See pp. 261–4 and WS 4.i, forthcoming.
[16] Biddle 1973, 246.
[17] ibid.
[18] WS 1, 450.
[19] ibid. 450–1.
[20] WS 8.
[21] See above, pp. 224–37, 388–90.
[22] See above, pp. 322–3, 387.
[23] Table 5.1.
[24] Trotter and Gleser 1952; 1958.



Illus. 5.5. Late Saxon Winchester, *c.*993–1066

Pooled Roman sample (157.0 cm) to the Combined Saxon sample (159.0 cm), to the Cathedral Green Anglo-Saxon graves sample (161.2 cm) may suggest that increasing numbers of non-native women were entering the population, but it might also be related to changes in diet, nutrition, and disease loads. The same general pattern, at a less pronounced level, is seen in the males.



Illus. 5.6. Winchester *c.*1148

The greatest change in the biological composition of the population in Winchester appears to have occurred in the medieval period between *c.*1100 and the mid-sixteenth century, as represented by the medieval earth and cist burials at Cathedral Green dating from *c.*1200 to *c.*1540 (Illus. 5.6). This is also a period for which we have documentary evidence of ethnic change in the Winchester population. Documentary sources indicate that in the mid-eleventh century 85% of the property holders in Winchester had Old English names, while approximately 4% had Scandinavian names and an additional 8% had Germanic names, although this may represent naming conventions used for individuals who were actually English.[25] As was pointed out above,[26] around the beginning of the twelfth century the number of English personal names in the Winchester records dropped to under 30% while the number of Germanic names increased to nearly 60%. Further, the English appeared no longer to hold property in the High Street, but to have been concentrated in the suburbs outside the West Gate, suggesting a loss of status. These changes are undoubtedly related to the Norman Conquest of 1066, and the replacement of one ruling elite by another.

Osteologically, the greatest changes also appear to be seen between the Cathedral Green medieval samples and all the earlier samples, reflecting the effects of the Conquest on this particular community over the following several centuries. Male mean stature dropped back to levels close to those seen in the Romano-British samples, although female stature means did not. They remained close to the means found in the Cathedral Green Anglo-Saxon graves. Skulls also became notably rounder, with cranial indices approaching 80, as opposed to cranial indices ranging from 73.1 (Saxon 2 males) to 75.5 (Cathedral Green Anglo-Saxon graves) in the earlier Anglo-Saxon samples. In this respect, the Romano-British samples were intermediate between the Anglo-Saxon and medieval samples. As the trend to increasing brachycephalization appears to have been widespread in Europe at this time, it may be reflecting more generalized environmental influences rather than population movements, but this must remain conjectural.

Another factor suggesting change in the ethnic composition of the population may be reflected in the frequency of M3 agenesis, a trait under strong genetic control. In the Lankhills and Victoria Road West samples, M3 agenesis occurs in between 12% and 15% of adults.[27] A very similar frequency ranging between 10% and 15% is also seen in the Combined Saxon and Cathedral Green Anglo-Saxon samples, but jumps to 19.3% in the Cathedral Green medieval earth graves and 23.8% in the medieval cist graves.[28] Supporting and reinforcing the results from the stature and cranial index data, the canonical analyses of skull measurements show the Anglo-Saxon samples clearly separated from medieval skeletal series, not only in Winchester but also elsewhere.[29] As these analyses took into account multiple cranial dimensions, they are more likely to indicate genuine differences between groups than cranial index considered in isolation.

[25] WS 1, 463–4.

[26] See above, p. 273.

[27] See Part 2, Tables 2.57 and 2.61.

[28] For Combined Saxon see Part 3, Table 3.45. For Cathedral Green Anglo-Saxon and medieval, see Part 4, Table 4.24.

[29] See Part 4, Table 4.20 and Illus. 4.13–4.23.

3
HEALTH AND LIFESTYLE

THE CLIMATE in Britain from approximately 100 BC through the Roman period was generally warm and dry, with conditions somewhat better than today.[30] However, in approximately AD 400 a rather abrupt shift to wetter and colder conditions took place. A cold period unmatched until the twelfth century occurred between approximately 350 and 500, reaching its climax in the first decade of the fifth century and resulting in colder winters and wetter summers, which would have negatively affected agricultural production.[31] There was also flooding along the coasts in the fourth and fifth centuries, including the Solent.[32] These factors, coupled with population declines and governmental taxation policies (taxes to support the army were paid in wheat), would have contributed to declining agricultural and economic conditions as well as increased opportunities for epidemics and other non-epidemic diseases, hastening the ultimate collapse of Romano-British society. These changes would also have contributed to the weakening of a population already under stress from evolving political and social conditions. Periodic famine was almost certain, and was reported in parts of the Roman Empire repeatedly in the fourth and fifth centuries.[33] Epidemics and plagues were also reported for many parts of the Empire during this period, but there is no secure documentary evidence for similar events in late Roman and sub-Roman Britain, although they probably occurred. The *famosa pestis* alluded to by Gildas may have occurred in the first half of the fifth century, but cannot be accurately dated.[34]

The interaction of political instability, economic decline, deteriorating climate, poor harvests, famine, disease, and barbarian incursions led to a substantial drop in population over the next several centuries. Between the mid-sixth and late-seventh centuries, Britain's population may have been reduced by half.[35] Archaeological evidence from Winchester points to an associated shrinkage of land use,[36] even as Winchester was in the process of becoming an important centre for both the Church and the Wessex royal house. This is the period of our Saxon 1 and Saxon 2 samples, all of which (except St Mary's and St Pancras) came from rural areas outside Winchester and had some significant differences in diet, health, and lifestyle from both their predecessors and successors.

In England more data upon which to base population estimates become available from numerous documentary sources after approximately AD 1000, including the Domesday Book of 1089. A recent study by Broadberry, Campbell, and Leeuwen has reconciled and re-evaluated prior British population figures given by such noted authorities as Postan, Russell, Darby, and Harvey for the period 1086–1541.[37] They conclude that by 1086 England had a population of approximately 1.71 million, which rose to a high of 4.75 million in 1290, dropped to 4.12 million by 1325 after the Great Famine of 1316–7, recovered to 4.81 million on the eve of the Black Death in 1348, and plummeted to 2.6 million by 1351. It continued to drop thereafter, reaching a nadir of 1.9 million in

[30] Jones 1996, 188.
[31] ibid. 190–2.
[32] ibid. 200.
[33] ibid. 236–7.
[34] ibid. 238–9.
[35] ibid. 241.
[36] See Illus. 5.2.
[37] Broadberry et al. 2010.

1450, and rose only slowly until reaching 2.83 million in 1541.[38] Although Winchester was administratively and ecclesiastically one of the largest and most important towns in Britain through much of this period, with an estimated population of 8,000 by 1148,[39] Hampshire was not one of the most populous counties. In 1086 it had an estimated population of 65,702, which represented 3.85% of the population in England.[40] The most populous county, Norfolk, was estimated to have over twice as many people. By 1290 the population of Hampshire had grown in absolute numbers to over 94,000, but it had declined to 1.98% as a percentage of the total population. The county recovered somewhat, but by 1600 still only represented 2.53% of the national population.

The causes of these population fluctuations were multifactorial, and have elicited much debate on the nature of medieval economy, social structure, land use, urbanization, and a host of other factors.[41] It is not our task to take on these broader issues, but two in particular deserve some attention here, as they can have important repercussions for individuals and communities regarding the adequacy of their diets, the robusticity of their immune systems, the diseases to which they may have been exposed, and their consequent ability to live long, healthy lives. The first of these is the interaction of famine and climate, as changes in weather patterns between warm and cold, wet and dry, can have a profound impact on agricultural yields and spoilage, and as a result, on the presence or absence of starvation. Parenthetically, it is important to note that in agricultural economies operating at or just above subsistence level, climatic deterioration is not the only cause of famine. Crop destruction or seizure related to conflict can have the same results, at least on a local basis.

We have already noted the climatic deterioration that set in relatively suddenly between *c.*400 and 425, when the weather shifted from warm and dry during the Roman period to cool and wet during the Early Anglo-Saxon period.[42] This lasted for several hundred years, although there were fluctuations within the cycle. A possible famine occurred in 873, and there must have been others. This climate cycle ultimately culminated in an unusually warm period known as the Medieval Climatic Anomaly between *c.*950 and 1100,[43] a period of national political consolidation that includes the later Cathedral Green Anglo-Saxon samples. In spite of generally good climatic conditions, the *Anglo-Saxon Chronicle* records at least nine episodes of harsh winters, famines, fevers, and mortality between 962 and 1125, some of which may have been regional rather than national in nature.[44] Subsequently the climate cooled gradually until the steep, sustained drop in temperatures known as the Little Ice Age. Recent research has shown that the onset of this event can be dated very precisely to between 1275 and 1300, followed by substantial intensification between 1430 and 1455, and can be linked to four massive sulphur-rich volcanic explosions over a fifty-year period.[45] It may be no coincidence that these years also saw some exceptionally wet periods with famine brought on by ruined crops between 1270 and 1272, drought leading to famine in 1288, and the great drought and famine of 1316–17, which resulted in a negative growth rate in England of −1.3% between 1315 and 1325,[46] and may have killed as much as 15% of the population.[47]

The nutritional deficits brought on by crop failures and famine can significantly weaken populations and make individuals more susceptible to disease than they might be under more positive circumstances. Plagues and epidemics affecting large elements of the population can be

38 Broadberry et al. 2010, Table 6.
39 See above, p. 273.
40 Broadberry et al. 2010, 24–5, Table 8.
41 cf. Horrox and Ormrod (eds.) 2006.
42 See above, p. 401.
43 Mann et al. 2009.
44 Garmonsway 1975, 114–256.
45 Miller et al. 2012.
46 See above, p. 271. See also Broadberry et al. 2010, 18, Table 4.
47 Rigby 2006, 14.

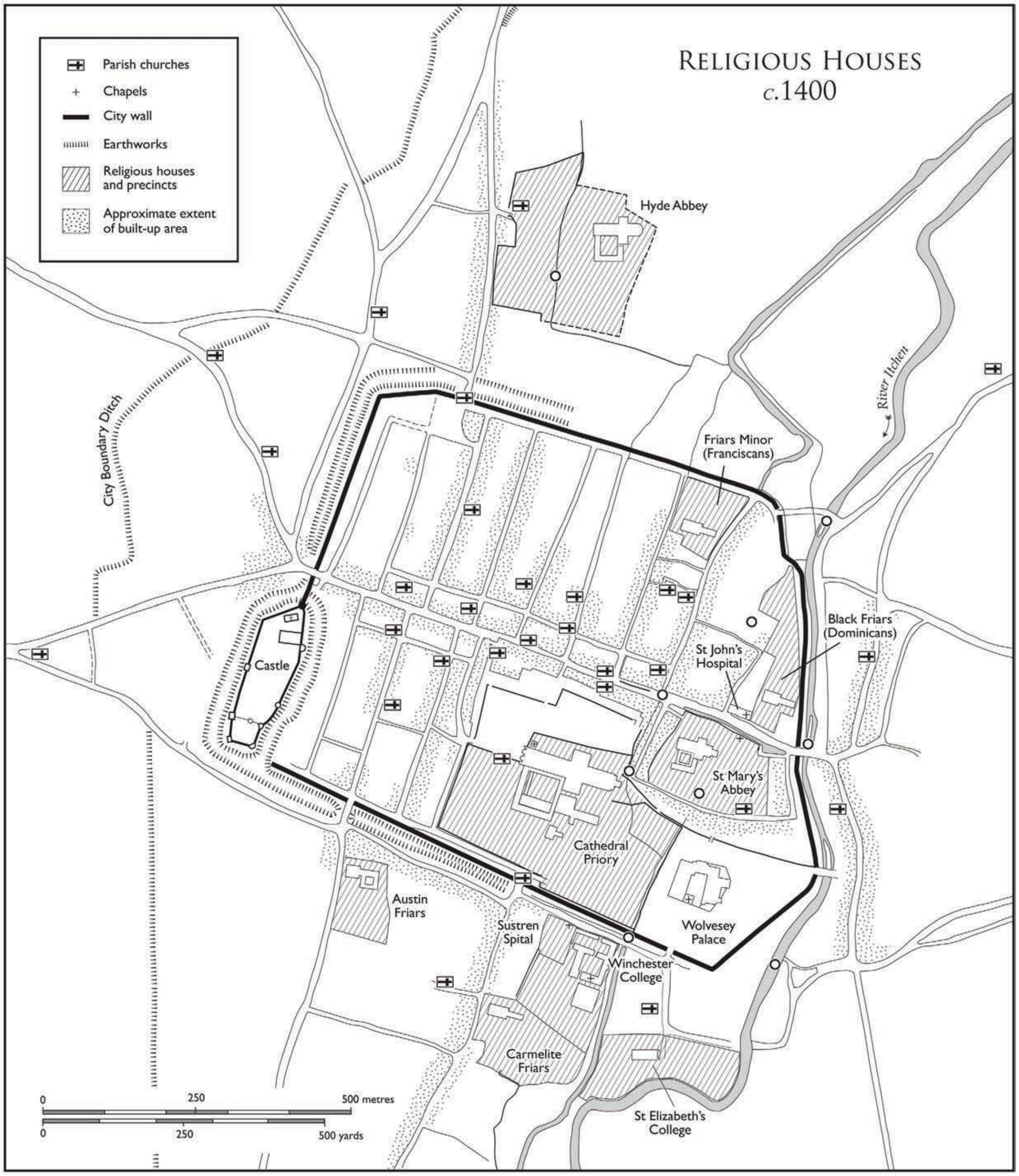
caused by many different pathogens. However, they kill so quickly that normally they will not be directly detectable in skeletal remains, although more chronic infections can be found. To a great extent we must rely on scanty and vague documentary sources for information, so there is much we cannot know. The *famosa pestis* of the sub-Roman period, about which there is much debate, has been mentioned above.[48] The *Anglo-Saxon Chronicle* records a 'great pestilence' in 664 and possibly another plague in 896.[49] Anglo-Saxon records mention at least 49 outbreaks of epidemics, many relatively minor, in Britain between 526 and 1087.[50] Other epidemics, perhaps localized, of infections such as pneumonia or dysentery must have occurred, and there is recent evidence to suggest that malaria may have been present in eastern England in the period between 410 and 1050.[51] The great plague, of course, was the bubonic plague known as the Black Death, which arrived in Winchester in 1349, and was followed by recurrences nationally in 1361, 1369, and 1375.[52] Further episodes of plague were reported in Winchester in 1361, 1369, 1379–83, 1389–93, and on at least thirteen occasions in the following century.[53] In Hampshire the population declined by approximately 33% between 1290 and 1377 as a result of the combined effects of the fourteenth-century famines and plagues.[54]

The citizens represented by the Cathedral Green medieval samples would have been greatly affected by these conditions. The number of medieval burials at Cathedral Green jumped dramatically from 42 in the Generation 2 (*c.*1240–1289) to 101 between approximately 1280 and 1320 (Generation 3), the period of the Great Famine. The number jumped again to 171 in the period between 1320 and 1360 (Generation 4), during which the Black Death arrived. The highest number (222) occurred during Generation 6 (*c.*1400–40), a period of intensification of the effects of the Little Ice Age,[55] and a time when the population of Winchester itself was shrinking although that of the country as a whole was increasing (Illus. 5.7).[56]

These episodes of plague and climate shift cannot be considered causal, as many other factors related to the loss of Winchester's status as a privileged royal town were present,[57] but they do suggest that climate, famine, and plague were additional sources of stress on the population.

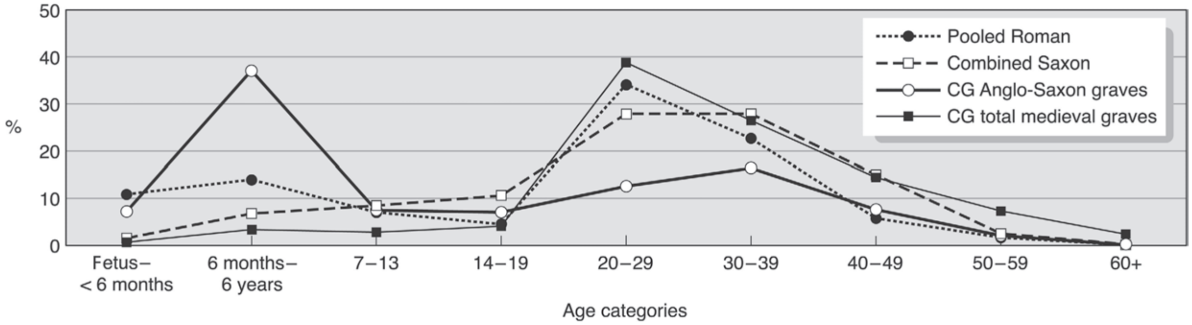
The age distributions of the Winchester Roman through medieval samples are shown in Illus. 5.8. It becomes immediately apparent that an unusually high proportion of children from Cathedral Green Anglo-Saxon graves died in the six-month to six-year interval, and that the adult Combined Saxon and Cathedral Green Anglo-Saxon graves both had a modal age of death (30–39 years) later than the Pooled Roman or Cathedral Green medieval samples (20–29 years). Some of the variation in the childhood mortality patterns is undoubtedly due to problems of incomplete excavation and differential preservation and recovery, especially in the Combined Saxon and Cathedral Green medieval samples, where the modal age at death for subadults was in the 14–19 year bracket. In these two samples the ratio of children to adults was abnormally low (Combined Saxon adult/child ratio, 77 : 23; Cathedral Green medieval adult/child ratio, 91 : 9).[58] The Cathedral Green Anglo-Saxon graves, on the other hand, exhibited an adult/child ratio of 41 : 59,[59] suggesting that it was fully representative of the Winchester Anglo-Saxon population between the seventh and eleventh

48 See above, p. 401.
49 Garmonsway 1975, 35, 89–90.
50 McNeill 1976, 142.
51 Gowland and Western 2012.
52 See above, p. 272.
53 Mullan 2007.
54 Broadberry et al. 2010, 26, Table 8.
55 See above, pp. 265–7.
56 WS 1, 508.
57 ibid. 506.
58 See Part 3, Table 3.3 and Part 4, Table 4.2.
59 See Part 4, Table 4.2.



Illus. 5.7. Winchester *c.*1400

centuries. The overall pattern of age distribution of the Cathedral Green medieval graves more closely resembles the Winchester Pooled Roman sample than the immediately preceding Anglo-Saxon samples. This suggests there may have been factors affecting the lifestyle and health of the



Illus. 5.8. Age distributions, Roman to medieval

people that were shared by both periods, but were less evident in the less urbanized Anglo-Saxon populations.

The data on stature and sexual dimorphism may give further indications that individuals in the medieval samples were biologically stressed in a way that the Anglo-Saxon samples, and to a lesser extent the Romano-British samples, were not. Table 5.1 shows a steady mean height increase through time in males, which is sharply reversed in the medieval male samples, dropping to values seen almost a thousand years earlier in the Lankhills males. The difference in male statures between the Pooled Roman sample, the Saxon 2 sample, and the Combined Saxon sample is statistically highly significant.[60] Although not tested, the difference in mean stature between the Pooled Roman sample and the Cathedral Green Anglo-Saxon graves is likely to be significant as well. Given the similarity in mean stature of the Romano-British and medieval male statures, the difference between the male medieval and Anglo-Saxon statures is probably also significant. Stature averages for females, on the other hand, show a progressive if somewhat irregular increase through time. The Cathedral Green Anglo-Saxon and medieval female mean statures are between 1.7 cm and 5.9 cm taller than the preceding samples, and some of these differences may be meaningful, especially those that lie outside the 3.94 cm standard deviation of the samples.

The dimorphism index (DI), expressing the ratio of male to female height, has been used in some studies as a marker for malnutrition caused by protein deficiency, with greater impact on juvenile males leading to reduction in adult male stature.[61] While the figures used here have not been tested for statistical significance, certain trends can be discerned. Sexual dimorphism in stature decreases through time in the Winchester Romano-British samples, and then increases sharply in the Early Anglo-Saxon samples (Table 5.1). While none of these indices are low enough to suggest serious malnutrition, they may indicate that the Early Anglo-Saxons were eating more protein and were better nourished than their predecessors. This may not be surprising given the more rural environment in which the Early Anglo-Saxons lived. The DI is notably lower in the Cathedral Green medieval samples, especially the medieval earth graves, suggesting that these populations may have been experiencing lower levels of protein consumption and poorer nutrition. Alternatively, one must also consider the possibility that the changes in male stature, and consequently DI, were due to an influx of short males, as historical records document alterations in the population composition of Winchester at this time.[62] However, this assumes a large group of immigrant males who were in fact

[60] See above, pp. 219–21 and Table 3.9.

[61] See above, pp. 69–70.

[62] See above, pp. 270–3.

TABLE 5.1

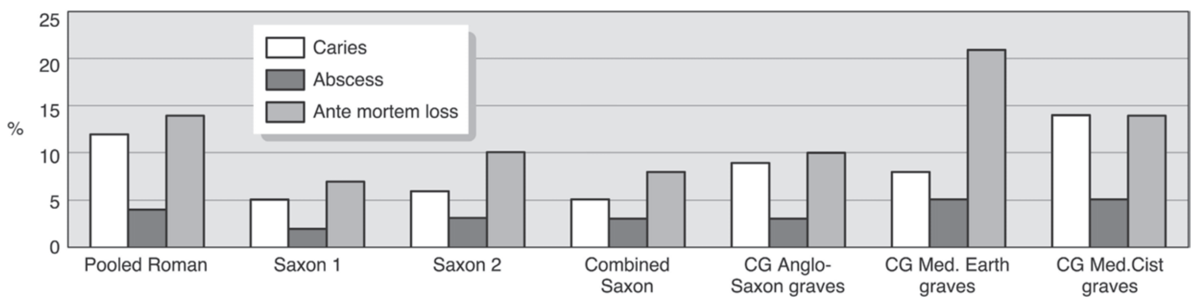
Stature in centimetres and sexual dimorphism, Winchester Romano-British and medieval samples

	ROMANO-BRITISH				EARLY ANGLO-SAXON			CATHEDRAL GREEN		
	Lankhills Area W	Lankhills Area F, E, O	Victoria Road West	Pooled Roman	Saxon 1	Saxon 2	Combined Saxon	Anglo-Saxon graves	Medieval earth graves	Medieval cist graves
Males	171.9	171.1	169.9	171.1	173.9	175.7	174.8	175.1	171.8	172.8
Females	156.5	158.3	157.4	157	158.9	159.6	159.1	161.2	162.4	160.8
DI	109.8	108.1	107.9	109	109.4	110.1	109.9	108.6	105.8	107.5

TABLE 5.2

Percentages of dental pathology, Winchester Romano-British and medieval samples

			Cathedral Green		
	Pooled Roman	Combined Saxon	Anglo-Saxon graves	Medieval earth graves	Medieval cist graves
Caries	12	5	9	8	14
Abscess	4	3	3	5	5
Ante mortem loss	14	8	10	21	14



ILLUS. 5.9. Dental pathology: Winchester Roman-British and medieval samples compared

short, for which there is no osteological evidence. The dental data, discussed below, would tend to strengthen the argument for a nutritional basis for the changes seen in the DI.

The percentage frequency for caries, abscess, and ante mortem tooth loss, based on the individual tooth or socket (TPR) is presented in Table 5.2 and Illus. 5.9. Similarity in patterning within the stature data and the dental data will be immediately apparent. While the frequency of abscess is approximately the same across all groups, the same is not true for frequency of caries or ante mortem tooth loss. For both of these pathologies, frequencies are high in the Pooled Roman sample and also in the Cathedral Green medieval samples. Interestingly, the rate of caries in the Cathedral Green medieval earth graves is very similar to both the Cathedral Green Anglo-Saxon graves and Combined Saxon sample, but both the Pooled Roman and Cathedral Green medieval cist grave samples are between four and six percentage points higher. At the same time, the medieval earth graves have by far the highest level of ante mortem loss (21%), while the loss rates for the Pooled Roman and medieval cist grave samples are identical (14%) and are considerably higher than either of the Anglo-Saxon samples (8% and 10% respectively). The higher frequency of caries and ante mortem loss in the Pooled Roman and Cathedral Green medieval cist grave samples does not appear to be related to the demographic structure of the samples, as both these groups have a younger modal age at death than the Anglo-Saxon samples. The extremely high rate of ante mortem tooth loss in the Cathedral Green medieval earth grave sample suggests that oral health was significantly worse in this group. Certainly the medieval samples as a group, as well as the Pooled Roman sample, exhibit poorer dental health than the Anglo-Saxon samples, although the last lived longest. This may be due in part to differences between urban and rural lifestyles and differences in diet.

Because of the way information was collected and analysed when these studies were first completed several decades ago, we do not have the kind of quantitative disease and trauma data across all samples that would be most useful for making comparisons. However, results can be obtained from the Lankhills and Cathedral Green skeletal series for certain pathologies relating to nutritional status, infectious disease, and trauma. Pathologies were not recorded in the original study on the skeletons comprising the Saxon 1 and Saxon 2 samples, as that study's research design concentrated on population comparisons. However, those sites have now been published, so some information can be added.

The vitamin deficiency diseases of scurvy and rickets were found in both the Roman period as represented at Lankhills, and in the Cathedral Green Anglo-Saxon and medieval graves, but were not reported in any of the individual sites comprising the Saxon 1 and Saxon 2 samples. Although no cases of scurvy were seen in the Lankhills 1967–72 samples, five cases were noted in the later 2000–5 excavations. One case was diagnosed in the Cathedral Green Anglo-Saxon samples, but none were seen in the Cathedral Green medieval samples, which may suggest that vitamin C deficiency, while not rampant, was more prevalent in Romano-British Winchester than in the later life of the city. The carbon and nitrogen isotopic analyses of children in the Lankhills 2000–5 excavations revealed that only one infant in the sample had values consistent with exclusive breast-feeding, and that the remaining infants under the age of two may have been only partially breast-fed, leading to malnutrition.[63] Rickets, usually a severe childhood vitamin D deficiency, appears to have been more common than scurvy in most time periods, although neither disease was reported in the Saxon 1 or Saxon 2 samples. Eight cases were found at Lankhills (three in the 1967–72 sample, five in the 2000–5 sample), while six were seen in the Cathedral Green Anglo-Saxon graves and ten in the medieval graves.

Cribra orbitalia were found in 25% of children at Lankhills (1967–72 and 2000–5 combined) and in 15% of the total Lankhills sample, approximately evenly distributed between males and females, with a slight preponderance of females. At Worthy Park, a Saxon 1 site, cribra orbitalia were reported in three adult females and nine juveniles, yielding a CPR (Crude Prevalence Rate) of 8.9%.[64] Although not reported at the other Saxon1 and Saxon 2 sites, [65] this relatively low CPR helps buttress the suggestion that these Early Anglo-Saxons may have been somewhat healthier than their predecessors or successors. Cribra orbitalia were noted as being present in 23.6% of the Cathedral Green Anglo-Saxons and 17.0% of the Cathedral Green medieval skeletons, with approximately even

[63] Cummings and Hedges 2010, 415.

[64] Roberts and Cox, 2003, 21, 187.

[65] Possibly because it was not looked for. This may be, in part, a diagnostic issue, at least at some sites.

distribution between the sexes that slightly favoured females. The degree was rarely extreme, which was also the case in the earlier Romano-British samples.

Non-specific periostitis of the tibia was reported in 4.5% of the tibiae at Lankhills,[66] while 20 examples were found in the Cathedral Green Anglo-Saxons and an additional 47 were noted in the Cathedral Green medieval samples. Frequencies were not calculated as part of the original study,[67] but it has been reported elsewhere that the frequency varied from 10% to 20% in the Cathedral Green medieval samples.[68] If so, this may suggest that this pathology was more prevalent in the medieval period in Winchester than in either the preceding Anglo-Saxon or Roman periods, although the reasons for this are unclear. It might be related to changes in modes of dress, or differences in nutrition, disease loads, or trauma resulting in increased physiological stress. In the Saxon 1 and Saxon 2 sites, non-specific periostitis of the tibia was reported only once, at Alton,[69] but the quality of the skeletal reports is uneven, especially in the older monographs, raising the possibility that this pathology, and other unreported lesions, may in fact have been present but were undiagnosed.

Pulmonary disease, possibly tuberculosis, was found in two individuals in the Lankhills 2000–5 sample, three individuals in the Cathedral Green Anglo-Saxon graves, and an additional three individuals in the Cathedral Green medieval samples. Skeletal tuberculosis is usually secondary to lung or lymph node infection, and is involved in only approximately 5% to 7% of cases.[70] Thus, although it could not be diagnosed, approximately 50 to 60 individuals in each sample might have been ill with tuberculosis, and there would be further individuals with asymptomatic infections. In a larger sample of thirteen sites classified as early-medieval by Roberts and Cox (*c.*410–1050) a CPR of 0.9% was given, [71] although in the Saxon 1 and Saxon 2 sites a possible case of tuberculosis was found only at Alton.[72]

Leprosy, on the other hand, appeared entirely absent from both Lankhills samples, nor was it reported for any of the Saxon 1 or Saxon 2 samples. While it is thought the disease may have arrived in Britain with the Roman legions, it did not become common until the medieval period.[73] A possible case of leprosy from approximately 700 was found at Winchester's Southgate in a skeleton which appeared as though abandoned against the outer face of a rough wall blocking the gate, but the diagnosis is uncertain.[74] Two suspected cases were found amongst the skulls of the Cathedral Green Anglo-Saxon charnel, and an additional two were seen in the medieval earth graves. Recent excavations by the University of Winchester at the leper hospital of St Mary Magdalen on the outskirts of Winchester have revealed what may be the earliest, and only, pre-Conquest leprosarium in Britain, the earliest phases dated by radiocarbon to 970–1030.[75]

Patterns of trauma differed greatly between the Romano-British samples from Lankhills and the Cathedral Green Anglo-Saxon and medieval samples. Decapitations, which occurred in 13 burials at Lankhills (1967–72 and 2000–5 combined), were not seen in the Cathedral Green samples. One definite decapitation, and a second possible decapitation, was found at Winnall II, one of the Saxon 2 samples, but decapitations were not reported in any other Saxon 1 or Saxon 2 sites.[76]

[66] 1.7% at Lankhills 1967–72, 8.5% at Lankhills 2000–5; see Part 2, Table 2.75.

[67] See above, pp. 347–50.

[68] Price 1975, 367.

[69] Evison 1988, 59.

[70] Steinbock 1976, 175.

[71] Roberts and Cox 2003, 184.

[72] Evison 1988, 59.

[73] Roberts and Manchester 1995, 147.

[74] Biddle 1975, 117–18.

[75] Roffey and Marter 2010.

[76] Meaney and Hawkes 1970, 30.

Skull trauma was also relatively uncommon at Lankhills, having been identified in only eight individuals, although a further eight were diagnosed with nasal fractures. There was no evidence of any blade cuts suggestive of weapons. Possible sword cuts to the skull were found on one individual at the Saxon 1 site of Alton.[77] None were identified at Droxford or Worthy Park. However, three individuals at Worthy Park sustained injuries that might have been caused by conflict, including Burial 57, 'a miserable little man' with a possible healed slash wound on the forehead that 'does not suggest the high drama of a sword slash: more likely a sleazy brawl with carver, cleaver, or garden hoe'.[78] In the Saxon 2 sites, possible sword cuts were found at Ports Down[79] and Snell's Corner,[80] but were demonstrably absent at Winnall II. Ports Down and Snell's Corner are located closer to the coast than Winchester, raising the possibility that the weapons injuries seen on individuals at those sites, while not frequent, may have been related to the conflict resulting from the arrival of small groups of Germanic warriors. Both Cathedral Green Anglo-Saxon samples yielded numerous examples of cranial weapons injuries and skull fractures. At least 10 were found in the Anglo-Saxon graves, and an additional 19 in the Anglo-Saxon charnel. Given the seventh- to eleventh-century date of most of this material, at least some of these injuries can perhaps be attributed to the tribal conflicts and Danish attacks taking place during those years. Roberts and Cox have calculated a CPR of 2.6% overall for weapon injuries in the Early Medieval period (*c.*410–1050) which they point out is probably low.[81] There were also eleven examples in medieval graves: two from cist graves and nine from earth graves. Skull injuries described as 'crater' lesions were found in seven skulls from the Anglo-Saxon charnel and one medieval grave, but were not seen at Lankhills. The origin of these lesions is obscure, but causes might include healed depressed skull fractures or healed, possibly incomplete trephinations. The CPR for cranial weapon injuries at twenty-one sites in the Late Medieval period (*c.*1050–1550) calculated by Roberts and Cox was 2.12%.[82]

Fractures of postcranial bones were found in all samples. The tibia and fibula were the most commonly fractured bones both at Lankhills and also amongst the Cathedral Green Anglo-Saxons. However, the ulna was fractured as often as the tibia and fibula in the Cathedral Green medieval samples. In the 1967–72 Lankhills sample fractures were more common in males than in females (30:8), and were more frequent in Area W, the earlier phase of the cemetery (18:10). No fractures were reported at the Saxon 1 site of Droxford, perhaps due to the poor condition of the bone. Two fractures of the clavicle were found at Alton[83] while fractures of the radius and ulna were most common at Worthy Park.[84] No fractures were seen at Ports Down or Winnall II, while there was one fracture of the tibia and fibula at Snell's Corner.[85] With the exception of Worthy Park, fractures were found predominantly in males at all these sites. Fractures also occurred more frequently in males than in females in the Cathedral Green Anglo-Saxon and medieval samples, by a factor of approximately 2:1, which is almost the same ratio as found at Lankhills 1969–72 and 2000–5 combined.[86] Fractures were slightly more common in the Cathedral Green medieval samples than in the Anglo-Saxon samples. However, it is notable that fractures were found more frequently in

[77] Evison 1988, 59.
[78] Hawkes and Grainger 2003, 172.
[79] Brothwell 1968, 39.
[80] Cave 1956, 169. Roberts and Cox 2003, 217, classify this as a trepanation, but Cave states clearly that these are 'non-fatal instrumental wounds of the skull' involving slicing and incising, which could also have been caused by weapons or other sharp implements.
[81] Roberts and Cox 2003, 169.
[82] ibid. 275.
[83] Evison 1988, 60.
[84] Hawkes and Grainger 2003, 170.
[85] Cave 1956, 158.
[86] See above, p. 135.

medieval earth graves than in medieval cist graves (27 : 14) in spite of the fact that there were greater problems of excavation and bone preservation in the earth graves.

When cranial cuts and fractures, 'crater' lesions, and postcranial fractures in the Cathedral Green Anglo-Saxon graves and medieval samples are considered together as a group of traumatic conditions and examined in a chronological perspective, the Anglo-Saxon period appears to have been considerably more violent than the medieval period. The frequency for these combined injuries rose to 7.0% amongst Anglo-Saxons, whereas it sank to 2.3% in the total medieval sample. There was three times as much trauma (4.0%) in the medieval cist burials as was found in the medieval earth burials (1.3%) when the two burial types were evaluated separately. Even allowing for problems of excavation, this suggests a genuine difference in the levels of physical hardship experienced by the two groups. Interestingly, of the 21 priests identified in the medieval burials at Cathedral Green, 14 of them were cist burials.[87] Some chronological patterns emerge as well when the trauma data are examined by 'generations', omitting the Anglo-Saxon charnel, which had only a *terminus ante quem*. The Anglo-Saxon figures here are taken from the burials at the Old Minster, as only three examples of fracture or skull pathology were seen in the Anglo-Saxon New Minster generations. Although sample sizes are small, the single most violent generation in the Anglo-Saxon grave sample appears to have been Generation 10 (870–890), when 17.2% of the trauma occurred. This is the generation during which Winchester was converted into a *burh* as part of King Alfred's defences against Danish attacks. No trauma was found in the first three 'generations', but 55.2% of all trauma found fell between Generations 4 and 10 (750–890). None at all was seen in the successive decades between 890 and 917, and low levels continued until Generation 17 (972–980), when there was an increase to 13.8%. Thereafter low levels of trauma were found in the remaining generations. The pattern in the medieval burials differed, as it was more consistently distributed through time than were the Anglo-Saxon traumatic pathologies. The highest level of trauma came in medieval Generation 5 (1360–1400), with a frequency of 25% of all trauma seen in the medieval samples. Very little trauma was seen in the last two generations (1440–1520), which experienced levels of only 4.2% per generation, and none of this occurred in the medieval cist burials. This was also a period when Winchester was in decline.

Traumatic amputations were diagnosed both in the Roman period and the medieval period, where they were found more frequently at Lankhills (a total of four in both excavations) than at Cathedral Green (one medieval). No amputations were diagnosed in the Cathedral Green Anglo-Saxons. The amputations at Lankhills consisted of one individual exhibiting a bilateral transmetatarsal amputation of the feet and three individuals with amputations of fingers. All these cases were male. Amputation of the forefeet was clearly deliberate, and may have been punitive, or necessitated by disease. The finger amputations might have been accidental, but the possibility was raised in at least one case that the amputations might have been done deliberately to avoid military service.[88] On the other hand, the medieval example was the amputation of a right hand immediately above the wrist in a mature female from a cist grave (MG 184) dated to Generation 4 (1320–1360). While this might have been a surgical amputation, the suggestion also was made that this might be punitive.[89] The *Anglo-Saxon Chronicle* records that for the year 1125, on orders of King Henry I, all the moneyers in England were to be taken to Winchester, castrated, and have their right hands

[87] WS 4.i, forthcoming.
[88] See above, pp. 98–100.
[89] See above, pp. 382–3.

amputated because of currency manipulation and devaluation. This was done between Christmas and Epiphany.[90] Here we have a documented precedent for punitive hand amputation. If similar practices endured for another two centuries, perhaps the woman (if the skeleton was sexed correctly) pursued a similar occupation or committed a like crime.

[90] Garmonsway 1975, 255.

4
DISCUSSION

The population of Winchester through time can be thought of as a stream with tributaries feeding into it at various points along the way. The tributaries vary in size, and in their impact on the composition of the stream. The cemetery samples forming the body of this study suggest that there was notable underlying continuity in the structure of the population from the Romano-British through the Anglo-Saxon periods, with the greatest shift in population structure coming as a consequence of the Norman Conquest. Why this should be so is not fully clear. It may be due at least in part to Winchester's role as a royal and ecclesiastical centre, which might have attracted nobility, clergy, attendants, craftsmen and other specialists from the Continent to this particular community. The evidence from personal names would tend to support this hypothesis.[91] It must be emphasized that this effect may be localized to Winchester, and should not be extrapolated to wider regions of England without further study.

This is not to say the earlier population was entirely homogeneous; it was not. There are hints and suggestions in the data that the presence of foreigners in the Roman period at Lankhills may be just barely detectable in the differences between the earlier and later phases of the cemetery, but this is a very small tributary flowing into the larger stream bed. In the following centuries the data indicate small but increasing numbers of Germanic arrivals, possibly in two waves, a slightly larger and growing tributary flowing into the stream.

Both the osteological and documentary data suggest that the Norman Conquest resulted in the greatest changes to the composition of the population as reflected in the differences between the Cathedral Green medieval samples and the earlier ones; a very large merger with a second stream. Notably, these changes appear to have primarily affected males, at least in the Roman and Early Anglo-Saxon periods. The females in these two eras are very similar. Both the Cathedral Green Anglo-Saxon and medieval females are slightly taller than their earlier counterparts, but the differences may not be significant, and could be due to many factors. The multivariate analyses in Part 4 suggest some differences between individual sites, but hypothesize some degree of gene flow and mating isolation in small communities to account for it, rather than major changes in the genetic structure of the populations, except for the Anglo-Saxon and medieval samples, which are clearly separated. It must be emphasized that these results apply to Winchester and its immediate environs only. The pattern of population change through time could vary greatly in other parts of Britain.

There are notable differences in indicators of health between the samples in this study, some of which appear to be related to the fact that the Romano-British and medieval samples come from fully urbanized environments, while the Early Anglo-Saxon samples are essentially rural and the Cathedral Green Anglo-Saxon samples come from a much less developed town. Adults in the urban Romano-British and medieval samples had a younger modal age at death than their Anglo-Saxon

[91] See above, pp. 272–3.

counterparts. The rural Early Anglo-Saxon samples had better dental health as reflected in frequency of caries, abscess, and ante mortem tooth loss. Similarly, mean male stature was lower in the Romano-British and medieval samples than in the Anglo-Saxon samples, suggesting poorer nutrition.

With regard to disease, tuberculosis, rickets, and scurvy appear to have been present in both the Lankhills samples and the Cathedral Green Anglo-Saxon and medieval samples, although the frequency of occurrence cannot be compared. Cribra orbitalia, possibly due to iron deficiency anaemia or megaloblastic anaemia, was also universally present, having been found in 15% of the Romano-British sample, 23.6% of the Cathedral Green Anglo-Saxons, and 17% of the Cathedral Green medieval sample. Non-specific periostitis of the tibia was also present from the Roman through medieval periods, with the suggestion that it may have increased in frequency through time from fairly low levels in the Romano-British skeletons. Leprosy was absent from the Roman Lankhills samples, but was clearly present in medieval Winchester. Four possible cases were found at Cathedral Green, two from the Anglo-Saxon charnel and two from medieval contexts, in addition to the medieval leprosarium at St Mary Magdalen.

Patterns of trauma changed greatly through the millennium covered in this study. Pathology indicating blade cuts such as might have been made by swords was virtually absent from the Romano-British samples at Lankhills, although they were found in a few cases at other contemporary cemeteries in Winchester.[92] However, there was evidence for blunt-force trauma to the skull in seven individuals at Lankhills. The fractures and injuries seen in the Romano-British skeletons are more likely to have resulted from occupational hazards and the routines of daily life than from warfare or high levels of interpersonal conflict.

Blade injuries and possible blunt-force skull trauma were far more common in the Cathedral Green Anglo-Saxon and medieval samples, possibly reflecting the increased violence of the times. When considered as a complex of trauma including blade cuts, cranial and post-cranial fractures, and 'crater' lesions, the Anglo-Saxon seventh to eleventh centuries were the most violent, especially the decades from 870 to 890, during King Alfred's wars against the Danes. It is further notable that in the medieval period trauma was unevenly distributed between earth graves and cist graves, being three times more common in the latter. While fractures cannot be considered directly indicative of warfare, they do contribute to the picture of a hazardous lifestyle in this period, especially for males, and especially when considered in relationship to other types of trauma.

Decapitation, found in 13 individuals at Lankhills, was absent from the later samples. This is surely due to the change in belief systems and the abandonment of non-Christian burial rituals after the Christianization of the Winchester area in the seventh century.

There is osteological evidence to suggest that the Cathedral Green medieval earth and cist graves may have contained individuals of different social standing. Males in the medieval cist graves were slightly taller on average than their earth grave counterparts. Further, the cist graves had higher rates of caries and ante mortem tooth loss, suggesting a diet richer in sugars and polysaccharides such as the glucans of starch. These tentative findings could only be verified with trace element isotopic analyses. Cist graves also had a much higher frequency of M3 agenesis, which, since that trait expression has a strong genetic component, may suggest individuals in those graves formed a slightly different group biologically. If the cist graves represented the upper echelons of medieval

92 See above, p. 141.

TABLE 5.3

Comparison of study samples with national samples

	Mean stature, male	Mean stature, female	Caries, TPR	Abscess, TPR	Ante mortem loss, TPR	Cribra orbitalia, CPR	Enamel hypoplasia, CPR	Weapon injuries, number of individuals	Decapitation, number of individuals	Amputation, CPR	Tuberculosis, CPR	Leprosy, number of individuals	Rickets, number of individuals	Scurvy, number of individuals
ROMAN														
Lankhills 1967–72	172 cm	157 cm	12.0	4.0	11.0	15.0	51.0	0	7	<0.1	0	0	3	0
National sample	169 cm	159 cm	7.5	3.9	14.1	9.6	13.5	6	12	0.9	0.5	–	14	–
ANGLO-SAXON														
Combined Saxon[1]	175 cm	159 cm	5.0	3.0	8.0	31.8[2]	51.9[3]	5?	1[4]	0	1 case	nr	nr	nr
CG Anglo-Saxon	175 cm	161 cm	9.2	3.2	10.0	23.6	20 cases	29?[5]	0	0	3 cases	2	6	1
National sample	172 cm	161 cm	4.2	2.8	8.0	7.6	18.8	36	15	1.0	0.9	18	2	3
MEDIEVAL														
CG medieval, total	–	–	–	–	–	17.0	2 cases	11[6]	0	1 case	3 cases	2	10	0
CG medieval earth	172 cm	162 cm	8.1	4.5	20.7	–	1 case	9[7]	0	0	–	2	na	0
CG medieval cist	173 cm	161 cm	14.4	5.0	13.7	–	1 case	2[8]	0	1 case	–	0	na	0
National sample	171 cm	159 cm	5.6	3.1	19.4	10.8	35.4	154	0	0	0.9–1.9	43–116	25	2

National samples taken from Roberts and Cox 2003, Tables 8.1, 8.2, 3.16, 3.17, 3.18, 3.29, 3.30, 3.8, 4.2, 4.10, 4.11, 4.12, 4.32, 5.2, 5.4, 5.10, 5.21, 5.24, pp. 189, 248

1 See above, p. 212
2 Worthy Park only
3 Alton = 1/45, Worthy Park = 53/59
4 Winnall II
5 Cranial lesions only
6 Cranial lesions only
7 Cranial lesions only
8 Cranial lesions only

Winchester society, it would not be surprising to encounter the majority of priests among this group. On the other hand, the medieval earth graves exhibited greater numbers of cases of non-specific tibial periostitis, more head trauma, more ante mortem tooth loss, and more postcranial fractures than did the cist graves. However, these numbers should be approached with caution, as the true prevalence of these conditions cannot be calculated. The earth grave males were shorter than their cist grave counterparts, and the dental pathology profile of the earth grave sample suggests a simpler diet. If the biological differences between these two groups do represent class distinctions, those distinctions may also be reflected in the burial rites used for them.

Parts 2 and 4 respectively place Winchester's Romano-British, Anglo-Saxon, and medieval populations within their wider geographical and chronological context. As might be expected, the people of Winchester most closely resembled those closest to them geographically and chronologically, although all these peoples were living within a constantly shifting mosaic of climate, social structure, economy, immigration, and disease. However, to gain a slightly broader perspective, Table 5.3 compares the sites used in this study with more comprehensive national samples as given by Roberts and Cox.[93] While more data have become available in the last ten years, this was still the most complete summary available at the time of writing this volume. It should be noted that the Anglo-Saxon national sample is dated from *c.*410–1050, thus covering the periods represented by both our Combined Saxon and Cathedral Green Anglo-Saxon collections.

Table 5.3 should be thought of primarily as a heuristic tool, since many of the figures it contains can only be considered approximations, subject to revision with further research. Combined Saxon stature and dental data comes from this study,[94] but information on pathologies was derived from published site reports and often cannot be quantified beyond indicating the number of cases identified. In general, where a determination can be made, the Winchester samples from all time periods conform to patterns seen in the national samples. Winchester males in all time periods appear to be slightly taller than the national samples, while the Winchester females are shorter than the national sample in the Roman period, more or less the same as the national sample in the Anglo-Saxon period, and slightly taller than the national samples in the medieval period. However, these differences are small, and are not likely to be highly meaningful. With regard to dental data, although the specific percentages vary, the samples in this study are consistent in pattern with the national samples, showing higher levels of caries, abscess, and ante mortem tooth loss in the Roman and medieval periods than in the Anglo-Saxon era.

The comparative data on cribra orbitalia and enamel hypoplasia tentatively suggest that these conditions may have been more prevalent in Winchester than they were at a national level. Weapon injuries were not seen in the Lankhills 1967–72 sample, were uncommon in the national sample, but occurred more frequently in the later time periods, both in Winchester and nationally. Decapitations were not reported for any medieval samples, but a more recent and comprehensive study of this pathology includes medieval decapitations.[95] However, it is noteworthy that while 13 were found at Lankhills (seven in the 1967–72 excavations, six in the 2000–5 excavations), none were found in the later time periods in the Winchester samples, with the possible exception of two at Winnall II, where the initial diagnosis may have been incorrect.[96] Lesions suggestive of possible tuberculosis were seen at low levels in all samples except Lankhills 1967–72 (although possible cases

[93] Roberts and Cox 2003.

[94] See above, pp. 219–21, 238–54.

[95] Tucker 2012a.

[96] ibid., 165.

were found at Lankhills 2000–5),[97] as was also true of rickets. Scurvy was rarely found, and leprosy was not seen in any of the Roman samples, nor in the Combined Saxon samples.

The sites included in this study have produced a vast body of bioarchaeological data, demographic, morphological, and pathological. They have the advantage over many other sites of spanning a millennium of occupation and encompassing thousands of burials. While much more can be done, the people of early Winchester have now taken their place among the annals of early British populations.

[97] See above, pp. 138–9, 145.

APPENDICES

APPENDIX A
OTHER BURIAL GROUPS FOUND 1961–1971

by MARTIN BIDDLE *and* †BIRTHE KJØLBYE-BIDDLE
with skeletal inventory by Pauline Sheppard
and a comparative note *by* Sue Browne

A SMALL number of other skeletal groups of Roman (usually late Roman), Anglo-Saxon, and medieval date were found elsewhere during the excavations of 1961–71. These are described briefly below but are too small to be included in the statistical analyses and are therefore not included in Part 2, with the Lankhills cemetery, or in Part 4, with the Anglo-Saxon and medieval burials.

i. A PREHISTORIC CREMATION GROUP

During excavation of a circular gully of Iron Age date sealed below the western rampart of the Roman town at Tower Street in 1964 (Illus 1.2), two cremation burials, both adult, one possibly, the other probably male, were found in Pits 48 and 71 within the eastern part of the area enclosed by the gully.[1] Cremation 71 included a pottery bowl of earlier Iron Age or even late Bronze Age date. The cremation burials may not be associated with the use of the enclosure which has been interpreted as a circular shrine and may be of later date (Final phase 1).

ii. LESSER ROMANO-BRITISH BURIAL GROUPS OUTSIDE THE WALLED CITY[2]

Ashley Terrace (Site code AST 64)

Twelve burials were found in 1964 cut into the partly silted ditch of the pre-Roman Oram's Arbour enclosure (Illus 1.2).[3] Four infant inhumations were deposited in Final phase 3 (late 3rd to 4th century); two adult and five infant inhumations in Final phase 4 (mid-4th century); and

[1] Biddle 1965, 234, Pl. LXVIII; full publication in WS 3.i. Dr D. R. Brothwell kindly examined the cremations.

[2] The cemeteries of Roman Winchester as they were known up to 1978 are mapped and discussed by Giles Clarke in Winchester Studies 3.ii, 4–11, Figs. 1 and 2. See also Illus. 1.2, and below, p. 423, n. 29. From 1971 to 1986 the City Archaeologist undertook major excavations in the cemeteries outside the north and east gates, as well as recording a number of lesser finds, all fully published in Ottaway et al. 2012.

[3] Biddle 1965, 231–3; full publication in WS 3.i.

one cremation burial in the topsoil of Final phase 5 (late 4th to 5th century).[4] These twelve burials, described below, can now be seen as part of the use for burial in the later Roman period of the line of the partly silted northern and western ditch of the Iron Age Oram's Arbour enclosure.[5]

AST Grave 1, Fph 4 (Pph 4). Neonate+. Position not recorded. Skull, upper torso only. Mid-4th century.

AST Grave 2, Fph 4 (Pph 4). (1) Female, adult. Stature 160–161 cm. Supine, head to west. Associated with infant in Grave 5. Headless skeleton. Articular facets of some ribs show osteophytosis and destruction of articular cartilage. Mid-4th century. (2) Infant, 6–18 months. Healed greenstick fracture of rib with calcified haematoma. Associated with adult burial in Grave 2. Mid-4th century.

AST Grave 3, Fph 3 (Pph 3). Fetus. Fetal position. Late 3rd to 4th century.

AST Grave 4, Fph 3 (Pph 3). Neonate+. Supine, head to east. Mandible un-united, temporal united, sphenoid lesser wings united. Late 3rd to 4th century.

AST Grave 5, Fph 3 (Pph 3). Neonate+. Laid out at same level as the adult skeleton in Grave 2. Late 3rd to 4th century.

AST Grave 6, Fph 3 (Pph 3). Neonate+, 0–6 months. Position not recorded. Deciduous incisors just erupting. Late 3rd to 4th century.

AST Grave 7, Fph 4 (Pph 4). Male, adult. Stature 178 cm. Prone, head to east. Lower half of body and legs only. Healed fractures of left fibula and right metacarpal 5. Calcified origin of the popliteus. Mid-4th century.

AST Grave 8, Fph 5 (Pph 5). Cremation burial, ?adult. Burnt fragments, no recognizable features. Late 4th to 5th centuries.

AST Grave 9, Fph 4 (Pph 4). Neonate. Position not recorded. Upper half of skeleton only. Mid-4th century.

AST Grave 10, Fph 4 (Pph 4). Neonate. Fetal position, head to west. Very fragmentary, skull, humerus, and tibia. Mid-4th century.

AST Grave 11, Fph 4 (Pph 4). Fetus/neonate. Disturbed. Most of skeleton present. Mid-4th century.

AST Grave 12, Fph 4 (Pph 4). Fetus/neonate. Found in silt below silting line. Fragments of skull, vertebrae, ilia, and humerus only. Mid-4th century.

Oram's Arbour: graves (Site code OA 67)

Excavations in 1967 on the west side of Oram's Arbour uncovered the ditches of an inturned entrance into the Iron Age enclosure (Illus 1.2).[6] After the ditch had been substantially filled (Final phase 4, 2nd to ?3rd century), a pebbled road with roadside ditch was laid through the entrance (Final phase 5, late 3rd to ?4th century), and soil began to build up over the road (Final phase 6, 4th to ?9th century). Early in this period, the four inhumation burials described below were cut into the chalk on the inner lip of the now mainly filled ditch on the north side of the entrance (Final phase 7, ?late 4th century). These consisted of one infant, one child of seven years or so, and one double burial consisting of an adult female placed on top of an adult ?male. There were no associated finds, but the assumption is that these are late Roman roadside graves. This view is perhaps supported by fragments of human bone in layers of Final phase 4, described below, which suggest the presence of burials in this area from the second or third century onwards. Further scattered fragments of bone in layers of Final phases 6 and 15 were perhaps also derived from Roman burials in this area.

[4] For similar cremation burials placed in the topsoil and covered only with turf, see WS 3.ii, 128–9, and cf. Booth et al. 2010, 471, for their possible removal by truncation of the upper deposits of the 2000–5 site.

[5] See Ottaway et al. 2012, 133–73.

[6] Biddle 1968, 251–7: full publication see WS 3.i.

OA Burial 1, Fph 7 (Pph 13).[7] Infant, 6–18 months. Crouched, east to west. Most of skeleton present. ?Late 4th century.

OA Burial 2, Fph 7 (Pph 13). Female, adult. Stature 157–158 cm. Supine, head to north. Pelvic girdle and legs only. There is osteophytosis at the margins of the body of L3. The right foot has a hallux valgus. ?Late 4th century.

OA Burial 3, Fph 7 (Pph 13). ?Male, adult. Stature 165–170 cm. Supine, head to north. Legs, forearms, and hand only. DJD of the terminal articulation of the right great toe. Faint cut marks on both anterior and lateral aspects of the femora. ?Late 4th century.

OA Burial 4, Fph 7 (Pph 14). Child, 7–9 years. Supine, head to north. Most of skeleton present. Possible spina bifida occulta, damaged S3. ?Late 4th century.

Oram's Arbour: unassociated fragments of human bone (Site code OA 67)

OA, Ditch fill, Fph 4 (Pph 3).

?Female, adult. Left mastoid, two skull fragments, incisor, and four ribs. One rib with cystic cavity in lower border. 2nd to ?3rd century.

OA, Ditch fill, Fph 4 (Pph 4).

Adult. Skull fragments. 2nd to ?3rd century.

Adult. Two skull fragments and two fibula fragments. 2nd to ?3rd century.

Child. Fragment of right orbit. 2nd to ?3rd century.

Adult. Distal left humerus. Mild DJD of the elbow joint. 2nd to ?3rd century.

Adult. Two skull fragments. 2nd to ?3rd century.

OA, Soil build-up over road, Fph 6 (Pph 12).

Adult. Fragment of maxilla, six skull fragments, vertebrae, ilium, carpal, and tarsal bones. Cervical spondylosis. 4th to ?9th century. RF 1018.

OA, World War II defences, Fph 15 (Pph 20).

Child. Skull and radius. 1940. RF 1098.

9 Clifton Road (Site code 9CLR 73)

In 1973 a single adult skeleton was discovered in the front garden of 9 Clifton Road on the west edge of Oram's Arbour, outside the line of the western ditch of the Iron Age enclosure (Illus. 1.2).[8] The burial was assumed to be Roman and to form part of a scattered cemetery of burials of Roman date along and beside the line of the ditch. The remains consisted of a male adult skull. Caries, aspect unspecified, were present in the premolars and molars.

The Blue Boar, 24–25 St John's Street (Site code 24–25 SJS 71)

In April 1971 observation during the construction of a soak-away in the garden of the house known as Blue Boar, at the corner of Blue Boar Hill and St John's Street, in the eastern suburb of the Roman city (Illus 1.2), revealed four intercutting inhumations, one with the head to the east and hobnails at the feet.[9] This burial is of 4th-century type, and the other three are presumably of the same date. All four probably formed part of the east cemetery of the Roman town.

Winnall Railway Cutting (Site code WC 71)

In 1971 a narrow strip of untouched ground lying between the east side of the cutting for the

[7] The designation 'OA' in these burial numbers refers to Oram's Arbour, not to Oxford Archaeology, as used in designating skeletons from the 2000–5 Lankhills excavations discussed in Part 2.

[8] Rescue observation by the Winchester Research Unit, February 1973. Ottaway et al. 2012, 306, West Suburb Gazetteer Site 3, Grave 1.

[9] Rescue observation by the Winchester Research Unit, April 1971, recorded in Site Notebook 318 in the Unit Archive. See now Collis 1978, 60–1; and Ottaway et al. 2012, 319, East Suburb Gazetteer Site 33.

former Didcot, Newbury, and Southampton Railway and an adjacent sunken lane was stripped following the discovery of graves exposed in the side of the cutting (Illus 1.2).[10] The graves were suspected to be part of the 6th-century cemetery known as Winnall I discovered in this area by the digging of the railway cutting in 1884.[11] They proved instead to form a group of five adult graves of the mid- to late 4th century (Final phases 2 and 3). Since the site lies 650 m north-east of the walled city, the burials were probably part of a small cemetery associated with an extra-mural settlement, rather than an extension northwards of the east cemetery of the Roman town.

iii. ROMANO-BRITISH INFANT BURIALS FROM WITHIN THE WALLED ROMAN TOWN

The late Roman extra-mural burials at Ashley Terrace and Oram's Arbour, described above, included ten infant burials. A further eight infant burials were found in late first-century and later contexts within the walls (Illus 1.2).

BS (Brook Street), Fph Roman 53 (Pph 8), 2nd–late 3rd century. Neonate.
CG (Cathedral Green), Fph 7 (Pph 231), late 2nd century. Fetus.
CY (Castle Yard), Fph 3 (Pph M36), mid-1st century. Fetus/Neonate.
CY (Castle Yard), Fph 5 (Pph M38), *c.*AD 80. Fetus/Neonate.
CY (Castle Yard), Fph 5 (Pph M38), *c.* AD 80. Neonate plus, 1 month.
WP (Wolvesey Palace), Fph 10 [?6] (Pph 671), AD 75–150. Fetus/Neonate.
WP (Wolvesey Palace), Fph 10 [?6] (Pph 672), AD 75–150. 9–15 months.
WP (Wolvesey Palace), Fph 27 (Pph 199), *c.* 150–170. Neonate to 6 months.

These eight infant burials date between mid-first and the second half of the second or early third century AD. No later infant burials were found in the excavations of 1961–71 within the area of the walled city. It may be significant in this context that the Roman settlement was not fully walled before about AD 200 and may not therefore have been legally regarded as a walled entity until then. It is apparently the case that infants below a certain age were not included in the prohibitions under Roman law against burial or cremation within the walls of a town.[12] The negative evidence from Winchester for the burial of infants within the limits of the fully walled town after about AD 200 may suggest that this exemption was not observed in the later Roman period, when some infants at least were buried in the extra-mural cemeteries.

In addition to these eight infant graves, isolated infant bones were recovered in small numbers from Roman deposits on these same sites within the walled area. It can probably be assumed that these isolated bones came from other infant burials on these sites disturbed by later Roman activity, and this may also explain the occurrence of isolated infant bones in medieval deposits on the same three sites.

[10] Biddle 1975, 119–20; Ottaway et al. 2012, 320, East Suburb Gazetteer Site 42; full publication in WS 3.i.
[11] Meaney and Hawkes 1970, 1–6.
[12] The fullest discussion appears now to be that by Soren and Soren (eds.) 1999, 477–527, on the excavation and interpretation of the Roman infant cemetery at Poggio Gramignano, Lugnano in Teverina, in Umbria, Italy.

iv. ROMANO-BRITISH SUB-ADULT AND ADULT REMAINS FROM WITHIN THE WALLED ROMAN TOWN

Isolated adult human bones from Roman deposits within the walled area are more difficult to explain. Such bones were found at Assize Courts North, Brook Street, Cathedral Car Park, Tower Street, and Wolvesey Palace (Illus. 1.2). The clearest case is provided by the almost complete skeleton of a boy of seven to eight found in the upper fill of the well in the courtyard of Roman Building II.1 on the Cathedral Car Park site in a deposit of the late third to mid-fourth century (CACP 61, Trench X, layer 17: Final phase 20 (Pph 148)). Most elements of the skeleton were present but the bones of the left hand and the lower left leg and foot were absent. While an accident cannot be ruled out, the evidently clandestine disposal of the body suggests that the presence of juvenile (but not neonate or infant) and adult human bones in deposits of Roman date within the walled area have to be regarded as exceptional. Occasional finds of adult human remains in medieval deposits on sites within the walls not associated with known medieval burials (such as Castle Yard and Wolvesey Palace) might be of residual Roman date but are otherwise inexplicable.

v. LESSER BURIAL GROUPS OF POST-ROMAN AND MEDIEVAL DATE

South Gate (Site code SG71; Illus 1.2)

Two adult female burials were found in 1971 lying in the top of a silted ditch outside the wall blocking the Roman south gate (Final phase 16).[13] Burial 1 was extended on its back, head to the west. Calibrated radiocarbon dates from the skeleton were AD 650–82 (HAR 364) and AD 690–830 (HAR 294), which recalibrated by the Ralph-Michael-Han calculations used at the time would suggest a date between 670 ± 90 and 700–30 ± 70.[14] Burial 2 was crouched, lying on its left side with the legs tightly drawn up, the right hand between the thighs, the left arm bent up with the hand below the head. The position of the body suggests that this is not a formal burial, but simply the position in which the person died. This could also be true of Burial 1, but it is not so clear. Neither body was in a grave, but both were at some point covered by falls from the decay of the adjacent blocking wall. Four human bones from the preceding Final phase 15 (5th to 7th century?) are probably unconnected with these two bodies.

Lower Brook Street: at the churches of St Mary in Tanner Street and St Pancras (Site code BS 65–71; Illus 1.2)

Excavation beneath the site of the church of *St Mary in Tanner Street* in 1971 revealed a small cemetery of five extended inhumations with their heads to the west (Final phase 1).[15] One grave was empty (Grave 22), but the others contained adult burials. Two were unaccompanied, but the body in Grave 25 had a copper-alloy buckle and iron knife, while in Grave 23 an elaborate necklace of gold and garnet pendants, gold and silver *bullae*, and glass beads, together with a collar of 27 overlapping silver

[13] Biddle 1975, 117–18; full publication in WS 3.i.
[14] Biddle 1975, 118, cf. p. 103, n. 4; Biddle and Kjølbye-Biddle 2007, 193; full publication in WS 4.i.
[15] Biddle 1975,. 303–5, Figs. 12 and 13, Pls. LI, LII*a,* LIII*a*; full publication in WS 5.
[16] These finds are fully published and their implications discussed by Sonia Hawkes in WS 7.ii, **1429**, **1957–2004** (Grave 23), and **1097** and **2687** (Grave 25).

rings was found around the neck and on the chest.[16] These objects suggest a date in the second half of the 7th century. The necklace in Grave 23 and the simple grave goods in Grave 25 are typical of a cemetery of the so-called 'late phase' of 'pagan' Saxon burial, when those buried were probably already Christian or were strongly influenced by Christian practice. Radiocarbon dates of cal AD 675–885 (HAR 1564) and cal AD 685–895 (HAR 1738) at 1 sigma from the bones of Grave 25 and 23 respectively are in agreement with the date of late seventh to early eighth century suggested by the phasing and by grave goods.[17]

The excavation of the overlying church of St Mary produced only one burial, the grave of an adult woman lying at the east end of the north aisle (Grave 2, Final phase 70, 15th to ?16th century).[18] The burial lay either in front of or partly below an altar at the east end of the aisle, or should be regarded as lying immediately north of the principal altar at the east end of the church. In either case, the burial was presumably of a parishioner of relatively high status, perhaps a benefactor of the final extension and reconstruction of the church in the mid- to late 15th century, when the north and south aisles were added (Final phase 30).

The church of *St Pancras* lay 50 m west of St Mary's. Excavation of St Pancras in 1968–71 revealed a series of burials within the church and two external burials which either pre-date the church or are contemporary with its construction (Final phase 8A, ?8th to 9th century; the church as constructed in Final phase 9, ?9th to 10th century).[19] Grave 20 lay within the north-west angle of the nave and was sealed by the first floor, but may have cut through the construction level of the north wall. A radiocarbon date of cal AD 675–885 (HAR 758) at 1 sigma was obtained from the bones.[20] Grave 21 lay well south of the first church, in an area later partly covered by the south porticus of Period II (Final phase 11, 10th to ?11th century). Radiocarbon dates of cal AD 555–665 (HAR 753) and cal A.D. 890–1010 (HAR 1488) at 1 sigma were obtained from the bones.[21] An Anglo-Saxon gravestone showing the Hand of God holding the Cross, built into the 14th-century foundations of the reconstructed west front,[22] and a *titulus* stone inscribed HIC in Anglo-Saxon capitals, probably from a burial formula of the *Hic pausat . . .* or *Hic requiescat . . .* type, found in a context of the early to ?mid-11th century in the adjacent House XII,[23] may come from these or other graves of this cemetery. If so, they support the view derived from the stratification that the burials are closely related to the first phase of the church, rather than to a distinct earlier cemetery, as at St. Mary's. A date in the 9th or 10th century, rather than any earlier, seems likely.

No further burials were made on this site until the 13th or early 14th century (Final phase 14). From this time onwards thirteen burials were placed inside the church, all in significant positions, in the north aisle, between the piers of the north nave arcade, down the central axis of the nave, and before the altar in the south chapel.[24] Their disposition may suggest that some of the successive enlargements of the church were associated with legacies or gifts from people intending to be buried there.[25] The last recorded burial was that of John Baker in 1503, who willed that his body should be buried in the chapel of St Catherine which may have been at the end of the south aisle where three bodies lay before the probable site

17 Jordan et al. 1994, 228, 231.
18 WS 2, 763, Fig. 89.
19 Biddle 1975, 319, Fig. 16; full publication in WS 5.
20 Jordan et al. 1994, 217
21 ibid. 216, 224.
22 WS 4.i, Illus. 114, No. 97: *BS WS* 270.
23 WS 4.i, Illus. 114, No. 108, *BS WS* 271.
24 Biddle 1975, 319, Fig. 16; full publication in WS 5.
25 WS 2, 741–4, Fig. 85.
26 ibid. 743.

of the altar.[26] Details of these burials, all within the church and all probably of members of families relatively high in the social scale of the later medieval city, will be given in WS 5. To the extent that the physical condition of the bones permitted, the earliest phase skeletons from St Mary's and St Pancras are included in the analyses reported here in Part 3.[27]

Staple Gardens

Excavations inside the walls at Staple Gardens in 1985, 1989, and 1994 uncovered as many as 284 burials (Illus. 1.2). The cemetery was initially regarded by the excavators as dating from the seventh century onwards because sealed by a postulated westward extension of St George's Street, an element in the planned system of streets laid out in the later ninth century. Subsequent analysis has shown that the burials were not sealed by a part of the street system and that the first burials are to be dated to the late ninth century.[28]

vi. STAPLE GARDENS AND OTHER WINCHESTER ANGLO-SAXON AND MEDIEVAL SKELETAL SERIES: A COMPARATIVE NOTE

by Sue Browne

Comparison of the adult : immature ratio of the Anglo-Saxon samples from Staple Gardens and some other sites in or near Winchester (Table A.1) reveals that the proportion of immature individuals (approximately a third) in the sample from Staple Gardens is similar to the ratio in the Anglo-Saxon samples from Cathedral Green and Worthy Park, higher than that for Winnall II (20%), and lower than that for the Old Dairy Cottage (48%) and the Roman cemeteries (40%).[29] However, it can be seen from Table A.1 that different workers define the boundary between adult and immature differently, a factor which may well be influencing the results for Winnall II. Any similarity between the sample from Staple Gardens and the six medieval samples in Table A.1 is lacking. Immature individuals comprise just over 60% of two of the six medieval samples and 90% of a third, and the other three samples consist of between 86% and 96% adults.

Detailed comparison of the age distribution in the samples from other sites is mostly impossible because of the different ageing methods used by different workers, but those that can be compared (the Roman cemeteries, Staple Gardens, Cathedral Green (Anglo-Saxon graves and charnel combined) and Cathedral Close (medieval)) are analysed in Table A.2. Each of the three larger immature samples

[27] See above, pp. 210–11.

[28] *MB writes:* The dating of the Staple Gardens cemetery to the Middle Saxon period was initially accepted by both Kjølbye-Biddle (1992, 224) and Geake (1997, 156: gazetteer entry with earlier references; the additional 180 graves mentioned are a misunderstanding). For growing doubts concerning the interpretation of the site, see WMS Newsletter 19 (Aug. 1994), 4–6. Detailed examination of the excavation records by Birthe Kjølbye-Biddle in 1999 demonstrated that the correct number of burials was probably 284 and that they were in fact later (not earlier) than the supposed extension of the street: letter, BKB to Kenneth Qualmann, 23/8/1999.

[29] *MB writes:* The Roman cemeteries discussed here include parts of the northern, eastern, and western cemeteries, but do not include Lankhills. Since this earlier study was done, the other Roman cemeteries have been published in Ottaway et al. 2012. The Anglo-Saxon and medieval samples discussed here are: St Mary's Abbey, located in eastern Winchester between The Broadway and Colebrook Street, partially underneath the modern Guildhall and Visitor Centre; Winnall II, to the north-east of the city; Worthy Park, to the north of the city at Kingsworthy; Old Dairy Cottage, at Harestock outside the city to the north; Cathedral Close, two areas slightly south-west of the cathedral excavated between 1990 and 1992, and south of the cathedral in 1993; St Maurice's church, excavated in 1958 on the High Street; King Alfred Place on the site of Hyde Abbey; and Crowder Terrace in the western suburbs, off the Romsey Road. References to these sites will be found in Table A.1; cf. Illus. 1.2.

TABLE A.1

Adult : Immature ratios in samples from selected Roman, Anglo-Saxon, and medieval sites in or near Winchester

	Adult		Immature		Reference
	%	Age	%	Age	
(a) *Roman*					
Selected Roman cemeteries (N = 359)	60	17–25+	40	0–20	Browne 2012, Table 19
(b) *Anglo-Saxon*					
Staple Gardens (N = 264)	69	17–25+	31	0–20	this report
St Mary's Abbey (N = 5)	0	17–25+	100	0–20	Browne 1986 (unpublished)
Cathedral Green* (N = 1001)	73	20+	27	0–19	WS 9.i, Table 4.2
Winnall II (N = 45)	80	15+	20	0–15	Meaney and Hawkes 1970
Worthy Park (N = 98)	72	18+	27	0–18	Hawkes and Grainger 2003
Old Dairy Cottage (N = 25)	52	18–25+	48	0–20	Cherryson et al. forthcoming
(c) *Medieval*					
St Mary's Abbey (N = 26)	96	17–25+	4	0–20	Browne 1986 (unpublished)
Cathedral Close (N = 86)	86	17–25+	14	0–20	Browne 1994 (unpublished)
Cathedral Green** (N = 258)	91	20+	9	0–19	WS 9.i, Table 4.2
St Paul's + St Maurice's Churches (N = 21)	38	young adult+	62	0–20	Adams and Sheppard 1978, Wells in Collis (ed.) n.d.
Crowder Terrace, Mews Lane (N = 81)	10	18–22+/18+	90	0–17	Henderson 1981
King Alfred Place	39	18–24+	61	0–18	Anderson 1998 (unpublished)

* Anglo-Saxon graves + Anglo-Saxon charnel ** Medieval earth graves + medieval cist graves

TABLE A.2

Percentage age distribution in samples from Winchester

(a) Immature	0–6 months	7 months–6 years	6–20 years/ 7–19 years		
Selected Roman cemeteries (N = 144)*	49	20	31		
Staple Gardens (N = 82)	8	37	55		
Cathedral Green** (N = 183)	13	60	27		
Cathedral Close, medieval (N = 8)	(1)	(3)	(4)		
(b) Adult	**17–25 years/ 20–24 years**	**25–35 years/ 25–34 years**	**35–45 years/ 35–44 years**	**45 years+/ 45–59 years/ 60 years+**	**Adult**
Selected Roman cemeteries (N = 215)*	20	16	8	12	43
Staple Gardens (N = 182)	15	15	10	11	48
Cathedral Green*** (N = 117)	21	36	25	18	–
Cathedral Close, medieval (N =48)	12	4	10	17	56

Where N = <20, the number of individuals is shown in brackets
* Sites excavated since 1989 not included in this sample: Browne 2012, Table 19 ** = Anglo-Saxon graves + Anglo-Saxon charnel
*** = Anglo-Saxon graves

shows a different distribution of mortality; individuals between the age of 6 and 20 years are most numerous (55%) in the sample from Staple Gardens and a similar distribution is seen in the small sample from Cathedral Close. The very young (0–6 months) form 49% of the Roman cemeteries sample, and in the sample from Cathedral Green (Anglo-Saxon graves and charnel combined) 60% of the individuals are aged between 6 months and 6 years.

The adult samples from the Roman cemeteries, Staple Gardens, and Cathedral Green (Anglo-Saxon graves) seem to show an increase in life expectancy through time, but there is a disparity in the proportion of individuals who were not aged more precisely than 'adult', which

TABLE A.3

Percentage age distribution, adults 17–45 years, Winchester samples

	17–25 yrs/ 20–24 yrs	25–35 yrs/ 25–34 yrs	35–45 yrs/ 35–44 yrs
Selected Roman cemeteries (N = 96)	46	35	19
Staple Gardens (N = 73)	37	38	25
Cathedral Green* (N = 96)	26	44	30
Cathedral Close medieval (N = 13)	(6)	(2)	(5)

Where N = <20, the number of individuals is shown in brackets * = Anglo-Saxon graves

TABLE A.4

Percentage sex distribution by age, Winchester samples

	17–25 years/ 20–24 years	25–35 years/ 25–34 years	35–45 years/ 35–44 years	45 years+/ 45–59 years
(a) Males				
Selected Roman cemeteries (N = 60)	38	33	23	5
Staple Gardens (N = 39)	20	31	18	31
Cathedral Green* (N = 65)	21	37	21	20
(b) Females				
Selected Roman cemeteries (N = 39)	46	36	10	8
Staple Gardens (N = 51)	35	29	20	16
Cathedral Green* (N = 45)	20	38	31	11

* = Anglo-Saxon graves

may be biasing the results. Considering just the adults aged between 17 and 45 years (Table A.3), more adults (46%) died young (aged under 25 years) in the Roman cemeteries sample than in the Anglo-Saxon samples. The Cathedral Close medieval sample is too small to be meaningful.

In the adult sample from Staple Gardens, males (42%) just outnumbered females (40%). Analysis of the sex distribution in the samples from other sites indicated that males predominated in the Roman cemeteries sample, in both the Anglo-Saxon and medieval samples from Cathedral Green, and in the medieval sample from Cathedral Close, while females were more numerous in the medieval sample from St Mary's Abbey, and in the pooled Anglo-Saxon and medieval samples. In the sample from Staple Gardens, the death rate was higher in females than in males in all but the oldest age group. It was higher in females than in males in the younger age groups but higher in males in the older groups in the medieval sample from Cathedral Close, and lower in females (or equal to that of males) in all age groups in the other two samples. However, 57% of the Staple Gardens sample were females while between 59% and 61% of the other samples were males.

To investigate further, the male and female samples were analysed separately (Table A.4). In the samples from both Staple Gardens and the Roman cemeteries the female death rate is highest in the group aged 17–25 years, and decreases with advancing age. In both male and female samples from Cathedral Green the death rate is highest in the group aged 25–35 years, followed by the group aged 35–45 years. By contrast, in the Roman cemeteries sample the male death rate is highest in the youngest age group and decreases with increasing age. Females from Staple Gardens had a shorter life expectancy than males from that site and also a shorter life expectancy than both males and females from the Anglo-Saxon graves at Cathedral Green.

The stature (mean and range) of males and

TABLE A.5

Stature in metres, sites in or near Winchester

	N	Mean	Range
Males			
(a) *Roman*			
Selected Roman cemeteries	79	1.68	1.53–1.79
(b) *Anglo-Saxon*			
Staple Gardens	55	1.69	1.60–1.85
Cathedral Green, Anglo-Saxon graves	87	1.75	1.58–1.88
Worthy Park	23	1.74	1.58–1.89
Old Dairy Cottage	9	1.74	1.67–1.83
(c) *Medieval*			
St Mary's Abbey	9	1.73	1.63–1.82
Cathedral Close	19	1.73	1.59–1.84
Cathedral Green, medieval cist graves	50	1.73	1.60–1.84
Cathedral Green, medieval earth graves	67	1.72	1.62–1.86
St Paul's+St Maurice's churches + Crowder Terrace	5	1.71	1.67–1.75
King Alfred Place	5	1.71	1.67–1.78
Females			
(a) *Roman*			
Selected Roman cemeteries	57	1.58	1.46–1.74
(b) *Anglo-Saxon*			
Staple Gardens	58	1.58	1.47–1.68
Cathedral Green, Anglo-Saxon graves	61	1.61	1.46–1.83
Worthy Park	27	1.61	1.52–1.71
Old Dairy Cottage	5	1.62	1.53–1.67
(c) *Medieval*			
St Mary's Abbey	11	1.59	1.55–1.64
Cathedral Close	14	1.59	1.50–1.69
Cathedral Green, medieval cist graves	58	1.61	1.50–1.74
Cathedral Green, medieval earth graves	90	1.62	1.43–1.79
St Paul's + St Maurice's churches + Crowder Terrace	3	1.59	1.50–1.71
King Alfred Place	7	1.61	1.49–1.70

females from sites in and near Winchester is summarized in Table A.5. The individuals from Staple Gardens are generally slightly shorter than Anglo-Saxon and medieval males and females from other sites, the mean height for males at Staple Gardens (1.69 m) being just greater than the Roman cemeteries mean (1.68 m), and the mean height for females at Staple Gardens (1.58 m) being the same as the Roman cemeteries mean.

Comparative data for the cranial index in males and females from other sites are scarce (Table A.6). Although there is a moderately wide range of individual variation in skull shape as reflected in the cranial index, the mean for males and females from Staple Gardens is dolichocranial (long-headed), while the mean for the Roman and medieval samples is mesocranial, or, in the case of the females from St Mary's Abbey, brachycranial (round-headed).

The recording of the frequency of non-metric characters in samples from these sites is patchy, metopism[30] being the trait which is most commonly reported. There seems to be considerable variation in the frequency of this character, it being higher in the sample from

[30] 'Metopism' as used here means a full metopic suture running from nasion to bregma on the external plate of the skull; cf. Brothwell 1981, 93. This was the most generally understood definition of the term at the time this report was written.

TABLE A.6

Cranial indices, samples from Winchester

		Males	Females
Selected Roman cemeteries	mean	75.7 (N = 35)	76.7 (N = 15)
	range	69.3–82.6	70.2–83.1
Staple Gardens	mean	73.8 (N = 15)	750.0 (N = 23)
	range	68.5–79.5	67.4–82.2
St Mary's Abbey	mean	78.3 (N = 6)	82.6 (N = 9)
	range	77.3–80.8	750.0–90.4
Cathedral Close	mean	78.2 (N = 9)	77.9 (N = 5)
	range	74.1–85.9	73.7–830.0
King Alfred's Place	mean	79.8 (N = 5)	77.3 (N = 5)

TABLE A.7

Frequency of metopism at sites in or near Winchester

	Entire sample		Males		Females	
	%	N	%	N	%	N
(a) *Roman*						
Selected Roman cemeteries	10.1	139				
Eastern cemetery only				1/18		2/14
(b) *Anglo-Saxon*						
Staple Gardens	15.0	100	9.1	44	21.1	52
Cathedral Green*			6.7	209	9.2	21
Worthy Park	8.9	56				
(c) *Medieval*						
St Mary's Abbey	19.0	21		1/8		2/10
Cathedral Close	9.1	22		0/15		2/7
Cathedral Green**			9.2	173	9.2	98
King Alfred's Place	6.2	16				

Where N = <20 at sites studied by the writer, the number of metopic individuals is shown, instead of a percentage frequency.

* Anglo-Saxon graves + Anglo-Saxon charnel ** medieval earth graves + medieval cist graves

Staple Gardens than in all the other samples apart from St Mary's Abbey (Table A.7). The frequency is very much higher in females than in males in the sample from Staple Gardens. Although the samples are small, analysis of the distribution between males and females from the other sites studied by the writer seems to indicate a similar sex-linked difference in the frequency of this trait. In the medieval burials from St Mary's Abbey and Cathedral Close combined, one male out of 23 scored (4.3%), and four females out of 17 scored (23.5%), are metopic. Unfortunately data by sex for the Roman cemeteries as a whole are not available, but in the burials from the Eastern Roman cemetery, one male out of 18 scored (5.6%) and two females out of 14 scored (14.3%) show metopism. As yet, there is some uncertainty about the extent to which metopism is genetically determined, but the frequency of 21% in 52 females at Staple Gardens, seen against the background of similar data from other sites in Winchester, appears to be an indication of either some environmental factor which influenced females in preference to males, or the presence of closely related females at these sites. It is

TABLE A.8

Oral pathology in samples from Winchester

(a) Distribution in the entire sample	Caries		Abscess		Ante mortem loss	
	%	N	%	N	%	N
Selected Roman cemeteries	6.5	2448	2.3	3469	15.4	3469
Staple Gardens	4.8	2184	20.0	3034	10.2	3034
Worthy Park	3.2	1217	1.8	1227	6.8	1227
St Mary's Abbey, medieval	30.0	268	0.4	525	13.1	525
Cathedral Close	13.4	291	6.2	323	17.6	323
King Alfred Place	2.1	—	3.1	—	5.4	—

(b) Distribution by sex (percentage with sample size in italic)	Caries		Abscess		Ante mortem loss	
	male	female	male	female	male	female
Eastern Roman cemetery	5.7 *369*	12.5 *176*	10.0 *410*	1.3 *223*	80.0 *410*	14.8 *223*
Staple Gardens	50.0 *934*	4.9 *1088*	2.5 *1343*	1.8 *1481*	14.9 *1343*	6.9 *1481*
Cathedral Green*	3.5 *1988*	4.8 *972*	20.0 *3203*	1.8 *1582*	50.0 *3268*	8.1 *1614*
Worthy Park	4.2 *525*	2.9 *550*				
St Mary's Abbey, medieval	4.3 *115*	2.6 *116*	1.2 *173*	0 *264*	8.7 *173*	17.8 *264*
Cathedral Close	15.6 *109*	10.0 *160*	11.1 *117*	3.1 *196*	36.7 *117*	7.6 *196*
Cathedral Green**	60.0 *1956*	5.2 *1437*	2.1 *2751*	2.3 *2033*	9.8 *2831*	90.0 *1981*
King Alfred Place					4.5 *112*	6.1 *147*

* Anglo-Saxon graves + Anglo-Saxon charnel
** medieval earth graves + medieval cist graves

hoped that the accumulation of more data on the frequency and distribution of metopism will lead to a better understanding of the precise significance of its occurrence in the future.

The oral pathology observed in the adult and adolescent sample from Staple Gardens is within the range of variation recorded for other sites in or near Winchester (Table A.8). However, analysis of the distribution of oral pathology in males and females reveals many inter-site differences. Probably these differences are partly due to the small samples from some sites, but the much higher frequency of ante mortem tooth loss in males (15%) than in females (7%) from Staple Gardens perhaps indicates a difference in the diet or oral hygiene of the males and females who were buried at this site.

APPENDIX B
STATISTICAL METHODS OF DETERMINING SEX DEVELOPED FOR THE STUDY OF THE HAMPSHIRE ROMANO-BRITISH AND EARLY ANGLO-SAXON SKELETAL SAMPLES

by CAROLINE M. STUCKERT

i. INTRODUCTION

BETWEEN 1977 and 1979 this author used the technique of discriminant function analysis to augment information obtained by morphological designation of sex in a large sample of skeletal material from the Romano-British and Early Anglo-Saxon periods in Hampshire. The study divided this material into three chronologically and culturally defined groups which were referred to as 'Pooled Roman' (Lankhills 1967–72 and Victoria Road West), 'Saxon 1' (Droxford, Alton, and Worthy Park, Kingsworthy), and 'Saxon 2' (Snell's Corner, Portsdown, Winnall II, and St Mary's and St Pancras, Winchester). The results of that study are described in this Appendix.

The statistical technique of discriminant analysis has been applied to problems of assigning sex to skeletal material by many different authors.[1] Sometimes the need is forensic, when one wishes to determine the sex of a single bone or limited number of bones from a single individual as an aid to identification. At other times the need is archaeologically derived, and precise designations of sex are a necessary preliminary to any further demographic or comparative population studies. For forensic purposes, standards derived from known sex populations of similar assumed genetic background can be applied.[2] For archaeological samples, however, regression equations must be derived from individuals sexed morphologically, and then discriminant functions are extended to individuals of unknown sex.

The variables selected for discriminant function analysis of sex usually reflect the investigator's desire to answer one of two questions: either, 'To what extent is this particular bone diagnostic as a predictor of sex in this population?' or, 'Given limited skeletal material for this individual, what sex is it?'

In attempting to answer the first question, investigators usually choose measurements which include all dimensions of the bone, and which reflect the belief that metrically expressed sex differences are a result both of gross size differences and also of qualitative differences in robusticity. These studies attempt to set standards for use in different populations, so that historically the

[1] cf. Pons 1955; Hanihara 1958; Giles 1970; Spradley and Jantz 2011.
[2] Stojanowski and Duncan 2009.

TABLE B.1

Sexing with discriminant functions: code numbers assigned to variables

Code	Variable	Description	Code	Variable	Description
1	CRANLG	cranial length	17	LFMXLG	L femur, maximum length
2	CRANBR	cranial breadth	18	LFPSLG	L femur, physiological length
3	CRANHT	cranial height	19	LFAPSD	L femur, proximal sagittal shaft diameter
4	MINFRBR	minimum frontal breadth	20	LFPLSD	L femur, proximal transverse shaft diameter
5	BASTBR	biasterionic breadth	21	LFMXHD	L femur, maximum head diameter
6	NSBRCH	nasion-bregma chord			
7	BRLMCH	bregma-lambda chord	22	RTMXLG	R tibia, maximum length,
8	LMOPCH	lambda-opisthion chord	23	RTPSLG	R tibia, physiological length,
9	FRARC	frontal arc	24	RTTCD	R tibia, transverse cnemic diameter
10	PARARC	parietal arc	25	RTSCD	R tibia, sagittal cnemic diameter
11	OCCARC	occipital arc			
			26	LTMXLG	L tibia, maximum length
12	RFMXLG	R femur, maximum length	27	LTPSLG	L tibia, physiological length
13	RFPSLG	R femur, physiological length	28	LTTCD	L tibia, transverse cnemic diameter
14	RFAPSD	R femur, proximal sagittal shaft diameter	29	LTSCD	L tibia, sagittal cnemic diameter
15	RFPLSD	R femur, proximal transverse shaft diameter			
16	RFMXHD	R femur, maximum head diameter			

TABLE B.2

Test designations for discriminant functions

Test	Variables	Test	Variables
BOD1	1 2 3 12 16 22	FEM7	12 16
BOD2	17 21 26	FEM8	17 21
LEG1	12 15 16 22 25	FEM9	16
LEG2	17 20 21 26 29	FEM10	21
LEG3	12 15 22 25	FEM11	14 15
LEG4	17 20 26 29	FEM12	19 20
LEG5	12 16 22	TIB1	22 24 25
LEG6	17 21 26	TIB2	26 28 29
FEM1	12 15 16	TIB3	22 25
FEM2	17 20 21	TIB4	26 29
FEM3	12 14 15	TIB5	23 24 25
FEM4	17 19 20	TIB6	27 28 29
FEM5	13 15 16	CRAN1	1 2 3
FEM6	18 20 21	CRAN2	1 2

Note: the coefficients associated with the variables in each test will be found in Tables B.3–B.5
The formula for calculating sex is $y = c + b_1x_1 + b_2x_2 + b_3x_3 \ldots + b_jx_j$ where C is a constant, b is the coefficient of the anatomical measurement, and x represents the anatomical measurement variable. The sectioning point is O. Negative values of y indicate a female, positive values indicate a male.

question of discrimination of sex on metric criteria has been closely bound up with questions of distinguishing populations on metric criteria.[3]

Some studies have examined the question of determining sex by population group using combinations of bones.[4] This approach has been followed here, in the hope of maximizing accuracy. However, recognizing the fragmentary nature of much of this sample, discriminant functions utilizing isolated bones were also developed. The variables originally included in the research design are listed in Table B.1, along with their numerical codes, which are used in Table B.2 for ease of reference.

[3] Birkby 1966. [4] Thieme and Schull 1957; Giles 1970.

The cranial variables were restricted to those measurements taken on the cranial vault, as the majority of skulls were so fragmentary that more extensive use of cranial facial measurements would not have yielded any worthwhile results. In the final tests only three measurements of the cranial vault were used. These were intended to provide measurements across the major directional axes of the skull. In addition, some of the measurements of the calotte listed in Table B.1 would have provided essentially redundant information in the discrimination while raising the degrees of freedom in already small samples. Thus, they were not actually used.

Postcranial variables were confined to the femur and tibia only. These bones, being relatively large, were far more likely to have survived than were arm bones, pelves, vertebrae, or scapulae. The survival factor was an extremely important one for this collection. In addition, being weight-bearing structures, they may reflect to a higher degree differences in sex arising from size and robusticity.

Twenty-eight tests were run, using different combinations of these variables. These tests are listed in Table B.2. These tests combined, in sequence, variables of the cranium, femur, and tibia by side; the femur and tibia together by side; and each individual bone, by side where relevant. Because sample sizes were generally small, in no case were more than six variables used in any one test. The full testing sequence was run three times, once for each group, as pooling of different cultural and chronological groups with unknown biological relationships was not considered desirable.

Most, but not all, of the variables incorporated in this study have been used by other investigators.[5] However, they have generally included a larger number of variables in each discriminant function than was deemed warranted by the present sample.

ii. METHODS

The literature on the development and use of mathematical multivariate regression techniques is well documented.[6] The formula used here for the calculation of sex is $y = c + b_1x_1 + b_2x_2 + b_3x_3 \ldots + b_jx_j$ where y is the individual's sex, c is a constant, b is the coefficient of an anatomical measurement, and x represents the actual measurement itself. In order to permit use of the equation to estimate sex for individuals of unknown gender, the equation must first be solved for values of b, c, and y in a sample of known sex. In this study, the individuals who could be sexed morphologically represent that sample. The constant, c, in this equation is always a negative number that serves to reduce the sectioning point between male and female to zero. Without this constant, it would be necessary to calculate the numerical value for the midpoint between group means for males and females in every equation. That midpoint would then become the traditional sectioning point,[7] and the calculated numerical values for y for all individuals of unknown sex are then compared with it. Use here of a constant that defines the male/female boundary as zero simplifies application of the discriminant functions. If the calculated value for y on an unknown individual is a positive number, the individual is male. If the calculated value of y is a negative number, the individual is female. The further removed from zero the value of y becomes, in either direction, the greater the likelihood that sex has been accurately designated.

The late Dr John S. deCani, former Chairman of the Statistics Department, Wharton School, University of Pennsylvania, designed a computer

[5] Hanihara 1958, 1959; Giles and Elliot 1963; Giles 1970.

[6] Giles and Elliot 1963; Howells 1969; Giles 1970.

[7] Hanihara 1958.

program in APL that would take designated bone measurement variables (x) and, for each sample, calculate the coefficients (b), and constant (c), the F score for significance, along with associated degrees of freedom, and the Z score for error. These data are presented in Tables B.3 to B.5. The tables can then be used to sex unknowns. For example, using tables B.1, B.2, and B.3, the test FEM2 in the Roman sample would actually be written out as follows:

y = −66.239 + (−0.053) maximum length left femur + (0.234) transverse shaft diameter left femur + (1.864) maximum head diameter left femur.

The positive or negative value of y resulting from substitution of the appropriate femoral measurements in the equation, and solving it, would then indicate that individual's status as a male or female.

iii. RESULTS

The discriminant tests, as they were actually run on the computer, were contingent on the presence of at least one individual of unknown sex with the requisite measurements. If such an individual was not present, the test was deemed unnecessary, and the computer programme would not execute it. Thus, all the tests listed in Tables B.3 to B.5 were actually applied to individuals of unknown sex. When a test could not be applied, that fact is indicated by the comment, 'No observations on at least one variable'. Unfortunately, the fragmentary nature of much of the material precluded the successful use of BOD1 and BOD2 in any sample. Thus it is not possible to determine how successfully individuals in these samples could have been sexed using combined cranial and postcranial measurements.

In the Roman sample, which was much larger than the other two, all tests were significant at least at the 0.001 level, and usually far beyond that. In the two smaller samples all tests were significant, but in certain instances, most frequently involving tests incorporating shaft diameters, the levels of significance were reduced somewhat. In the Saxon 1 sample, both CRAN1 and CRAN2 were significant at the .01 level. In the Saxon 2 sample, LEG4, LEG6 and TIB1–3 were significant at the .01 level, while LEG2 and LEG3 were only significant at the .05 level.

The Z score, converted to a percentage and subtracted from 1, yields the expected percentage of individuals whose sex is misclassified. In this study, the expected per cent misclassification ranges from a low of 1% using the LEG1 test in the Saxon 1 sample, to a high of 23% using the CRAN2 test in the Roman sample. A great majority of the tests have expected misclassification rates between 3% and 15%. This compares favourably to other work in the field,[8] and is as good as or better than the expected error rates based on morphological sexing by experienced observers.[9]

When the expected error rates in the individual groups of tests are examined, it becomes clear that the LEG tests as a group hold up quite well. These tests, using combined femoral and tibial measurements, could be performed on the Saxon samples only. In the Saxon 1 sample all LEG tests have expected misclassification percentages of less than 10%, most of which are in the 3% to 6% range. With the exception of LEG3 and LEG4, which use combined maximum lengths and shaft diameters and reach expected misclassification rates of 20%, the same is true of the Saxon 2 sample.

[8] cf. Howells 1966; Hanihara 1958; Giles 1970; Black 1978; DiBennardo and Taylor 1979.
[9] cf. Krogman 1962, 149.

TABLE B.3
Discriminant functions, Roman sample

TEST	FEM2	FEM4	FEM8	FEM10	FEM11	FEM12	
Coefficients of variables	−0.0532 0.1244 1.8635	0.0377 0.4573 0.5287	−0.0608 1.9814	1.5249	0.7173 0.405	0.6092 0.6091	
Constant	−66.2392	−45.09	−65.14	−69.6906	−31.2509	−35.256	
F	78.684***	50.220***	142.529***	299.768***	68.974***	79.507***	
df	3, 84	3, 111	2, 99	1, 112	2, 137	2, 130	
Z	1.693	1.1832	1.7134	1.634	0.9988	1.1116	
% expected misclassified	4.55	11.90	4.36	5.16	15.87	13.35	
% misclassified, males	0	12.86	0	1.56	17.33	7.80	
no. misclassified, males	0/53	9/70	0/61	1/64	13/75	6/77	
% misclassified, females	5.71	13.33	4.88	6.00	12.30	16.07	
no. misclassified, females	2/35	6/45	2/41	3/50	8/65	9/56	
TEST	**TIB1**	**TIB2**	**TIB3**	**TIB4**	**TIB5**	**TIB6**	**CRAN2**
Coefficients of variables	0.0187 0.4548 0.7888	0.0203 0.5397 0.5362	0.0282 0.903	0.0354 0.6464	0.0207 0.4163 0.7247	0.0221 0.5358 0.4924	0.181 0.1074
Constant	−43.4919	−37.5155	−39.8948	−34.0174	−40.81	−36.2442	−49.0429
F	63.663***	57.119***	88.903***	75.269***	59.463***	55.645***	24.086***
df	3, 119	3, 126	2, 120	2, 127	3, 123	3, 129	2, 99
Z	1.2753	1.1684	1.2253	10.0908	1.2114	1.1362	0.7326
% expected misclassified	10.03	12.10	10.93	13.79	11.31	12.71	23.27
% misclassified, males	9.72	10.81	9.72	12.16	12.16	12.16	16.18
no. misclassified, males	7/72	8/74	7/72	9/74	9/74	9/74	11/68
% misclassified, females	7.84	7.14	7.84	12.5	9.43	6.78	14.71
no. misclassified, females	4/51	4/56	4/51	7/56	5/53	4/59	5/34

No observations on at least one variable: BOD1, BOD2, LEG1–LEG6, FEM1, FEM3, FEM5–FEM7, FEM9, CRAN1. *** = $p < 0.01$

The FEM tests, using various combinations of femoral measurements, do almost as well. The expected misclassification percentages generally range between 3% and 16%, with only one test, FEM1 in the Saxon 2 sample, which exclusively uses shaft diameters, ranging as high as 23%. The TIB and CRAN tests are somewhat weaker, but still within acceptable limits. With a few exceptions, the expected misclassification rate tends to vary between 10% and 15%.

The rate of observed error in classifying individuals of known sex was generally fairly close to the expected error. Wide deviations usually appear to have been related to small sample sizes and are thus largely a statistical artefact. There appear to be no really meaningful differences between males and females in classification accuracy, except possibly in the Saxon 2 sample, where males seem to be accurately sexed less frequently.

All tests on postcranial material were segregated according to side of the body. While bilateral differences were present, the expected misclassification rate rarely varied from one side to the other by more than two percentage points. Nor was there any consistency of side. Thus, there is no reason to think that sexing based on one side of the body is to be preferred over the other.

In sexing the unknowns, there was a total of 34 individuals in the full sample for whom some or all of the needed measurements were available. Of these, it was possible to designate sex for 28 individuals, including five from Lankhills. In

TABLE B.4
Discriminant functions, Saxon 1 sample

TEST	LEG1	LEG2	LEG3	LEG4	LEG5	LEG6
Coefficients of variables	0.1918	0.0396	0.111	0.0494	0.1114	−0.0314
	0.1451	0.0163	0.3357	0.6404	1.7073	1.3381
	1.6409	1.2161	−0.116	−0.062	−0.1837	−0.0085
	−0.3614	−0.1694	0.8038	0.9354		
	1.3804	1.2376				
Constant	−79.1220	−54.0273	−44.1481	−52.6174	−61.3772	−44.5577
F	11.8857	11.3804	8.6252	13.3696	15.0503	16.8112
df	5, 10	5, 14	4, 18	4, 22	3, 13	3, 18
Z	2.2984	1.9126	1.3343	1.5096	1.7536	1.569
% expected misclassified	1.10	2.81	9.18	6.55	4.01	5.48
% males misclassified	0	0	7.69	8.33	0	0
no. males misclassified	0/9	0/10	1/13	1/12	0/9	0/11
% females misclassified	0	0	10.00	0	0	9.09
no. females misclassified	0/7	0/10	1/10	0/12	0/8	1/11

TEST	FEM1	FEM2	FEM3	FEM4	FEM5	FEM6	FEM7	FEM8	FEM9	FEM10	FEM11	FEM12
Coefficients of variables	−0.0667	−0.0545	0.044	0.0356	−0.0750	−0.0640	−0.0561	−0.0492	1.4541	1.1716	0.9917	0.9425
	−0.0469	0.0869	0.9468	0.7800	−0.0487	0.1145	1.8206	1.4829			0.3671	0.9261
	1.9703	1.5091	0.1732	0.8391	20.0435	1.5734						
Constant	−59.4230	−48.7783	−49.1343	−63.3974	−59.3485	−48.7468	−58.9916	−46.6507	−67.0454	−54.0233	−37.2742	−54.4313
F	20.4855	19.062	13.5299	26.8635	20.858	19.4425	31.9978	32.9793	68.342	67.9508	18.5079	39.9334
df	3, 16	3, 19	3, 29	3,36	3, 16	3, 19	2, 18	2, 22	1, 20	1, 24	2, 31	2, 38
Z	1.8686	1.6593	1.1514	1.4583	1.8856	1.6758	1.7956	1.6621	1.7698	1.6214	10.0675	1.4144
% expected misclassified	3.07	4.95	12.51	7.21	2.94	4.65	3.59	4.85	3.84	5.16	14.23	7.93
% males misclassified	0	0	11.11	0	0	0	0	0	0	0	15.79	9.52
no. males misclassified	0/11	0/12	2/18	0/20	0/11	0/12	0/11	0/13	0/12	0/14	3/19	2/21
% females misclassified	0	9.09	20.00	5.00	0	0	0	8.33	0	8.33	20.00	5.00
no. females misclassified	0/9	1/11	3/15	1/20	0/9	0/11	0/10	1/12	0/10	1/12	3/15	1/20

TEST	TIB1	TIB2	TIB3	TIB4	TIB5	TIB6	CRAN1	CRAN2
Coefficients of variables	0.0007	0.0099	0.0285	0.0134	0.0003	0.0148	0.5283	0.4358
	0.6574	0.1473	0.7325	0.6890	0.6176	0.2803	−0.0680	0.0734
	0.5733	0.6175			0.7249	0.5052	0.0017	
Constant	−34.6742	−28.0244	−34.3579	−28.1611	−38.8021	−28.9430	−89.9112	−92.3799
F	14.2923	12.2487	20.5521	18.956	20.134	13.9258	6.9162**	14.7974**
df	3, 25	3, 27	2, 26	2, 28	3, 32	3, 34	3, 12	2, 21
Z	1.2644	1.1337	1.2139	1.1308	1.3352	1.0849	1.2300	1.1366
% expected misclassified	10.38	9.18	11.31	12.93	9.01	13.79	10.93	12.71
% males misclassified	13.33	7.14	13.33	7.14	11.11	5.88	25.00	8.33
no. males misclassified	2/15	1/14	2/15	1/14	2/18	1/17	2/8	1/12
% females misclassified	7.14	11.76	7.14	11.76	11.11	14.29	0	8.33
no. females misclassified	1/14	2/17	1/14	2/17	2/18	3/21	0/8	1/12

All F scores are significant at $p < 0.001$ unless otherwise indicated. ** = $0.01 > p < 0.001$. No observations on at least one variable: BOD1, BOD2.

TABLE B.5

Discriminant functions, Saxon 2 sample

TEST	LEG1	LEG2	LEG3	LEG4	LEG5	LEG6
Coefficients of variables	−0.0427	0.0875	0.0780	0.1186	−0.0619	0.0838
	−0.2610	0.1883	0.0116	0.6150	1.2470	10.0175
	1.2971	1.1238	−0.0681	−0.1617	0.0230	−0.1470
	−0.0432	−0.1654	0.3214	0.5989		
	−0.5146	−0.1786				
Constant	−34.4391	−30.8959	−21.0185	−33.8699	−38.9339	−30.6913
F	8.5208	4.9775*	3.9735*	5.4789**	14.2575	9.5471**
df	5, 14	5, 11	4, 22	4, 17	3, 16	3, 14
Z	1.6891	1.4354	0.8323	1.1252	1.5831	1.3569
% expected misclassified	4.55	7.49	20.33	12.92	5.71	8.69
% misclassified males	0	10.00	25.00	14.29	8.33	20.00
no. misclassified males	0/12	1/10	4/16	2/14	1/12	2/10
% misclassified females	12.50	0	18.18	12.50	0	0
no. misclassified females	1/8	0/7	2/11	1/8	0/8	0/8

TEST	FEM1	FEM2	FEM3	FEM4	FEM5	FEM6	FEM7	FEM8	FEM9	FEM10	FEM11	FEM12
Coefficients of variables	−0.0331	−0.0219	0.0518	0.0056	−0.0359	−0.0239	−0.0299	−0.0138	1.2625	0.8345	0.6395	0.9115
	−0.1495	−0.0803	0.2512	0.7719	−0.1441	−0.0812	1.3482	0.9111			0.1754	0.4294
	1.4199	0.9964	0.0496	0.4164	1.4379	1.0105						
Constant	−46.8708	−33.8334	−31.0219	−35.1849	−46.8044	−33.6813	−49.7807	−36.2423	−59.0327	−39.0718	−21.4914	−36.6938
F	22.9400	10.9163	9.2963	10.0097	23.0372	10.9595	35.4541	18.0714	86.9551	45.4980	10.9641	18.8588
df	3, 24	3, 18	3, 34	3, 27	3, 24	3, 18	2, 25	2, 20	1, 30	1, 25	2, 39	2, 32
Z	1.6706	1.3368	0.8927	1.0659	1.6741	1.3394	1.6615	1.3160	1.7025	1.321	0.7454	1.1105
% expected misclassified	4.75	9.01	18.68	14.23	4.75	9.01	4.85	9.34	4.46	9.34	22.66	13.35
% misclassified males	5.88	14.29	18.18	15.00	5.88	14.29	5.88	14.29	5.00	12.50	24.00	13.04
no. misclassified males	1/17	2/14	4, 22	3/20	1/17	2/14	1, 17	2/14	1/20	2/16	6/25	3/23
% misclassified females	0	12.50	12.50	18.18	0	12.50	0	11.11	0	9.09	23.53	8.33
no. misclassified females	0/11	1/8	2/16	2/11	0/11	1/8	0/11	1/9	0/12	1/11	4/17	1/12

TEST	TIB1	TIB2	TIB3	TIB4	TIB5	TIB6	CRAN2
Coefficients of variables	0.0059	0.0004	0.0109	0.0170	0.0114	−0.0343	0.4021
	0.1187	0.2786	0.4373	0.4486	0.1319	0.4907	0.1124
	0.3923	0.3875			0.4810	0.5387	
Constant	−17.8333	−19.4513	−18.3858	−21.1385	−22.9461	−17.0770	−92.0008
F	5.7027**	6.6639**	8.8103**	9.7044	9.4156	10.2846	13.9055
df	3, 24	3, 28	2, 25	2, 29	3, 32	3, 32	2, 16
Z	0.8220	0.8329	0.8174	0.8064	0.926	0.9602	1.2488
% expected misclassified	20.61	20.33	20.61	20.90	17.62	16.85	10.56
% misclassified males	18.75	21.05	18.75	15.79	14.29	15.00	10.00
no. misclassified males	3/16	4/19	3/16	3/19	3/21	3/20	1/10
% misclassified females	8.33	15.38	8.33	23.08	6.67	18.75	0
no. misclassified females	1/12	2/13	1/12	3/13	1/15	3/16	0/9

All F scores are significant at $p < 0.001$ unless otherwise indicated. * = $0.05 > p < 0.01$. ** = $0.01 > p < 0.001$. No observations on at least one variable: BOD1, BOD2, CRAN1.

two cases in the Saxon I sample, different tests produced conflicting estimates of sex. In those cases the final determination of sex was based on the results of the most significant test with the least expected error.

iv. DISCUSSION

It is clear that all of these tests are sufficiently robust so that their use presents no statistical problems. With few exceptions, the tests also sex as well as or better than a trained observer using morphological criteria. This is not to suggest that discriminant function sexing should replace morphological sexing, however. Discriminant function sexing, being based primarily on criteria of size and robusticity, cannot take into account possibly important anatomical details noted by an observer. In the absence of most morphologically significant detail, however, such as the pelvis or large portions of the skull, using discriminant functions may help to augment a thin or marginal database.

In this study using both the femur and tibia was found to be more effective than tests on isolated bones. Of the three individual bones utilized, tests on the femur were most diagnostic, especially those employing femoral head diameter. It has been well known for some time that femoral head diameter is a good indicator of sex.[10] Tibial and femoral shaft diameters, however, whether used singly or in pairs, appear to be comparatively weak aids in sex designation. In terms of long bone shaft lengths, either the morphological or physiological length seemed to discriminate equally well.

While these discriminant functions have been derived from an archaeological sample, and are thus subject to the issues inherent in formulating such standards from a population whose age and sex cannot be absolutely documented, their results are consistent with the sexing of these samples done on morphological grounds, and they have the added advantage of being standards derived specifically for early Romano-British and Anglo-Saxon populations, rather than a general 'white' sample. Thus they are potentially more accurate, and may have wider applicability to other skeletal samples from these time periods in Britain.

[10] Krogman 1962; Stewart 1979.

APPENDIX C
GRAVE CONCORDANCE: ANGLO-SAXON AND MEDIEVAL BURIALS FROM THE OLD MINSTER AND CATHEDRAL CEMETERIES

by CAROLINE M. STUCKERT

NM, New Minster; OM, Old Minster; M, male; F, female; I, sex indeterminate; A, adult; C, subadult; n/a, number not assigned; XXXIII* baulk between trenches XXXIII and XXXII; ** burial from excavations at Cathedral Car Park; DCN, Data Code Number.
Page numbers are given only where information appears additional to that provided by the illustrations or tables noted and the pages on or opposite which they occur.

Grave/ Skull number	Year	Trench/Layer	Cist	DCN	Sex	Age	Generation	Reference
Anglo-Saxon Graves								
ASG 26	1963	VIII		26	F	A	NM V	Tab. 4.36
ASG 44	1963	VIII		44	M	A	NM VII–VIII	Tab. 4.34; Illus. 4.85a–b; p. 364
ASG 81	1964	XA		81	F	A	NM IV	Tab. 4.36
ASG 88	1964	XA/Burial 6		88	M	*c.*23	NM I	Tab. 4.36; Illus. 4.100c; p. 377
ASG 97=83	1964	XA		97	?F	A	OM 8	Tab. 4.36
ASG 122c	1965	XXII/165		368	M	A	OM 20	Tab. 4.34
ASG 124	1965	XXIV		124	M	A	OM 21	Tab. 4.36; p. 357
ASG 237	1967	XXVI		237	I	*c.*9	OM 8	p. 340
ASG 253	1967	XXVI		253	I	neonate	OM 9	Tab. 4.36
ASG 255	1967	XXXIII/417		255	M	A	OM 14	Illus. 4.33f; p. 305
ASG 274	1967	XXVI		274	M	A	OM 10	Tab. 4.36
ASG 284	1967	XXIX		284	M	*c.*20	OM 5	Tab. 4.36
ASG 295	1967	XXIX/398		295	F	45+	OM 10	Tab. 4.36; Illus. 4.76a; Illus. 4.107a; pp. 356, 381
ASG 296	1967	XXIX/398		931	I	*c.*6	OM 17	p. 319
ASG 320	1967	XXIX/401		320	I	*c.*2	OM 12	Illus. 4.40f; p. 314
ASG 324	1967	XXIX/408		n/a	F	A	OM 13	Tab. 4.36; Illus. 4.65; pp. 344, 381
ASG 366	1967	XXIX/480		n/a	I	infant	OM 9	Tab. 4.36
ASG 382	1967	XXIX/512		381	?F	A	OM 10?	Tab. 4.36
ASG 383	1967	XXIX/481		383	I	A	OM 14	p. 313
ASG 387	1967	XXIX/521		387	M	A	OM 8	Tab. 4.36
ASG 390	1967	XXIX/523		390	I	14–16	OM 12	Illus. 4.33d; p. 305
ASG 408	1968	XXXV/318		408	I	A	OM 20	Tab. 4.36
ASG 409	1967	XXIX/541		409	I	*c.*10	OM 13	Illus. 4.39b
ASG 417	1967	XXXVI/823		417	M	A	OM 17	Tab. 4.34; Illus. 4.87a
ASG 440	1967	XXXIII/863		440	M	A	OM 14	Tab. 4.36
ASG 441	1967/8	XXXVI/900		n/a	M	A	OM 7	Tab. 4.34; Tab. 4.36
ASG 449	1968	XXIX/580		n/a	M	A	OM 9	Tab. 4.34; Illus. 4.86b; p. 364
ASG 460	1968	XXIX/597		460	F	A	OM 10	Tab. 4.36; Illus.4.107b
ASG 473	1967/8	XXXIII		816	I	A	OM 16	p. 332
ASG 476	1968	XXIX/627		476	I	*c.*3	OM 6	Tab. 4.36
ASG 483	1968	XXIX/641		483	M	A	OM 10	Tab. 4.36

Grave/ Skull number	Year	Trench/Layer	Cist	DCN	Sex	Age	Generation	Reference
ASG 533	1968	XXXVI		533	M	A	OM 16	p. 319
ASG 547	1968	XXIX		547	I	A	OM 6	Tab. 4.36
ASG 558	1967	XXX		558	M	A	OM 16	Tab. 4.36
ASG 574	1968	XXXIII		574	I	*c.*18 mo.	OM 16	p. 338
ASG 579	1968	XXXVI		n/a	M	A	OM 17	Tab. 4.36
ASG 587	1968	XXXIII/Area F	587	M	A		OM 17	Tab. 4.36
ASG 600	1968	XXXIII/729		600	M	A	OM 17	Tab. 4.36; Illus. 4.102b; pp. 378, 381
ASG 620	1968	XXXVI		620	F	A	OM 10	Tab. 4.36; p. 377
ASG 641A	1968	XXXVI/Area C		641	F	A	OM 18	Tab. 4.35; Illus. 4.38e; p. 314
ASG 646	1968	XXXIII/757		646	M	A	OM 4	Tab. 4.34
ASG 652	1967/8	XXX/562		652	F	A	OM 14/15	Tab. 4.36; Illus. 4.95d
ASG 695	1968	XXXIII		673	M	A	OM 7	Tab. 4.36
ASG 747	1969	Reopening		n/a	I	infant	OM 8	p. 319
ASG 757	1969	Reopening		757	M	A	OM 19	Tab. 4.36
ASG 763	1969	Reopening		763	M	A	OM 18b	Tab. 4.36
ASG 783	1969	XL/492		958	?F	A	OM 21	Illus 4.41a; p. 315
ASG 821	1969	Reopening/869		953	?M	A	OM 8	Illus. 4.40i
ASG 839	1969	XL/794		839	I	*c.*14	OM 18b	Illus. 4.40j
ASG 846	1969	XL/818		835	F	A	OM 18a	Illus. 4.40a; p. 314
ASG 867	1969	XL/1060		867	M	A	OM 19	p. 360
ASG 874	1969	XL/852		874	M	A	OM 18b	Illus. 4.41b; p. 315
ASG 883	1969	XL/994		883	I	*c.*2	OM 21	Illus. 4.40h; p. 315
ASG 903	1969	XXXIX/617		903	I	*c.*6	OM 7	p. 319
ASG 932	1969	XL/1085		952	I	*c.*3	OM 13	Illus. 4.46; p. 319
ASG 940	1970	XLII/47		940	M	middle aged	–	Illus. 4.44; p. 319
ASG 943	1970	XLII/162		943	M	A	–	Tab. 4.36
n/a**	1961	IX/29, Pit 5		n/a	I	A	–	Illus. 4.40d
30**	1961	XI/43		n/a	I	C	NM 10–11 cent.	Illus. 4.84a–b; p. 363
Anglo-Saxon Charnel								
ASC Skull 6	1969	XXXIX/280		6	F	A	–	Tab. 4.34
ASC Skull 16	1969	XXXIX/280		16	F	A	–	Tab. 4.34
ASC Skull 20	1969	XXXIX/280		20	I	A	–	Illus. 4.33c
ASC Skull 35	1969	XXXIX/280		n/a	I	A	–	Tab. 4.34
ASC Skull 103c	1969	XXXIX/280		732	I	A	–	p. 314
ASC Skull 117	1969	XXXIX/280		117	M	A	–	Tab. 4.34; Illus. 4.85c; p. 364
ASC Skull 120A	1969	XXXIX/280		120	M	A	–	Tab. 4.34; Illus. 4.86a; p. 364
ASC Skull 140	1969	XXXIX/280		140	M	A	–	Illus. 4.38d
ASC Skull 169	1969	XXXIX/280		n/a	F	A	–	Tab. 4.34
ASC Skull 230	1969	XXXIX/280		230	M	A	–	Tab. 4.35
ASC Skull 261	1969	XXXIX/280		261	M	A	–	Illus. 4.33b
ASC Skull 275	1969	XXXIX/280		n/a	I	A	–	Tab. 4.34
ASC Skull 317A	1969	XXXIX/280		317	M	A	–	Illus. 4.33j
ASC Skull 412	1969	XXXIX/280		n/a	?F	A	–	Illus. 4.40b; p. 315
ASC Skull 433	1969	XXXIX/280		n/a	I	A	–	Tab. 4.34; p. 367
ASC Skull 497	1969	XXXIX/280		n/a	M	A	–	Illus. 4.33e
ASC Skull 573	1969	XXXIX/280		573	M	A	–	Tab. 4.35; Illus. 4.90
ASC Skull 630	1969	XXXIX/280		630	M	A	–	Illus. 4.38g
ASC Skull 631	1969	XXXIX/280		631	M	old	–	Tab. 4.34
ASC Skull 670	1969	XXXIX/280		n/a	M	middle aged	–	Tab. 4.34
ASC Skull 697	1969	XXXIX/280		697	M	A	–	Tab. 4.35
ASC Skull 702A	1969	XXXIX/280		702	M	A	–	Tab. 4.34; p. 371
ASC Skull 703	1969	XXXIX/280		703	M	A	–	Tab. 4.34
ASC Skull 707	1969	XXXIX/280		n/a	I	A	–	Illus. 4.33a
ASC Skull 734	1969	XXXIX/280		n/a	I	A	–	Illus. 4.82a
ASC Skull 775	1969	XXXIX/280		n/a	M	A	–	Tab. 4.34; Illus. 4.88a–b
ASC Skull 795A	1969	XXXIX/280		n/a	M	A	–	Tab. 4.34
ASC Skull 806	1969	XXXIX/280		n/a	I	A	–	Tab. 4.34
ASC Skull 808	1969	XXXIX/280		n/a	I	A	–	Tab. 4.34
ASC Skull 824/833	1969	XXXIX/280		n/a	M	A	–	Tab. 4.34
ASC Skull 893	1969	XXXIX/280		893	M	A	–	Illus. 4.38b

Grave/ Skull number	Year	Trench/Layer	Cist	DCN	Sex	Age	Generation	Reference
ASC Skull 895	1969	XXXIX/280		895	M	A	–	Tab. 4.35
ASC Skull 938	1969	XXXIX/280		n/a	I	A	–	Illus. 4.31; Illus. 4.35
ASC Skull 939B	1969	XXXIX/280		n/a	M	A	–	Illus. 4.34
ASC Skull 950	1969	XXXIX/280		950	M	A	–	Tab. 4.35; Illus. 4.91; Illus. 4.92
ASC Skull 1000	1969	XXXIX/280		801	M	A	–	Tab. 4.35
ASC Skull 1033	1969	XXXIX/280		831	M	A	–	Tab. 4.35
ASC Skull 1127	1969	XXXIX/280		842	M	A	–	Illus. 4.38c
ASC Skull 1132	1969	XXXIX/280		845	F	A	–	Tab. 4.34
ASC canine	1969	XXXIX/280		n/a	I	A	–	Illus. 4.40e
ASC molars	1969	XXXIX/280		n/a	I	A	–	Illus. 4.40c
ASC skull	1969	XXXIX/280		n/a	I	C	–	Tab. 4.34
ASC hip frags.	1969	XXXVIII/105		n/a	I	A	–	Illus. 4.72a
ASC radius	1969	XXXIX/280		n/a	I	A	–	Tab. 4.36; Illus. 4.101c
ASC tibiae	1969	XXXIX/280		n/a	I	A	–	Tab. 4.36
ASC vertebrae	1969	XXXVIII/105		n/a	I	A	–	Illus. 4.79a
ASC vertebrae	1969	XXXIX/280		n/a	I	A	–	Illus. 4.80
Anglo-Saxon isolated bones								
skull	1966	XXVII/19		117 (med)	M	A	–	Tab. 4.34; Illus. 4.87b
skull	1968	XXIX/617		903	I	C	–	Illus. 4.45
ulna	1970	XL/900		n/a	I	A	–	Tab. 4.36; Illus. 4.100b
ulna	–	unstratified		n/a	I	A	–	Tab. 4.36
skull	–	XXVII/264		n/a	I	A	–	Tab. 4.34
right fibula	1970	XL/147		n/a	F	A	–	Tab. 4.36
Medieval Cist Graves								
MG 118	1965	XXIV/48	Cist VI	n/a	I	A	5–6	Illus. 4.58b
MG 155	1966	XXXII	'Gr 161'	n/a	M	35–45	4	Tab. 4.36; pp. 308, 378
MG 159	1969	XXXIX	Cist IV	n/a	M	elderly	6	Tab. 4.36; Illus. 4.102a
MG 163=378	1969	XXXIX/33	Cist VIII	1000	F	*c.*42	3	p. 332
MG 164	1969	XXXIX	Cist IX	n/a	M	A	3	Tab. 4.36
MG 165	1969	XXXIX	Cist XI	1017	M	A	2	Tab. 4.36; p. 368
MG 169	1969	XL/132	Cist II	n/a	M	A	4	Tab. 4.35; p. 370
MG 171	1969	XL	Cist IV	n/a	M	A	2	Tab. 4.36; Illus. 4.97a
MG 173	1969	XL	Cist VI	n/a	M	A	2	Illus. 4.43a
MG 180	1966–68	XXIX	Cist II	116	F	*c.*31	4	p. 316
MG 184	1966–68	XXIX	Cist VI	13	?F	*c.*39	4	Tab. 4.36; Illus. 4.109; p. 382
MG 190	1966–68	XXVI/XXVII	Cist I	n/a	M	A	5	Tab. 4.36
MG 196	1966–68	XXVI/XXVII	Cist VII	8	M	*c.*55	2	Illus. 4.58c; p. 316
MG 198	1966–68	XXX	Cist XXI	n/a	F	*c.*21	3	Tab. 4.36; Illus. 4.108a–b; p. 381
MG 202	1966–68	XXVI/XXVII	Cist XIII	n/a	F	A	7	p. 319
MG 203	1966–68	XXVI/XXVII	Cist XIV	118	M	*c.*47	3	p. 319
MG 205	1966–68	XXVII	Cist XVI	131	M	*c.*58	7	Illus. 4.52; p. 316
MG 216	1966–68	XXX	Cist II	n/a	M	45–50	5	Illus. 4.83
MG 225	1966–68	XXX	Cist XII	101	M	*c.*51	6	Tab. 4.34
MG 228	1966–68	XXX	Cist XVI	139	M	*c.*51	6	p. 319
MG 234	1966–68	XXX	Cist XXI	n/a	M	45+	3	p. 269
MG 238	1966–68	XXX	Cist XXV	97	F	*c.*30	5	Tab. 4.36
MG 240	1966–68	XXX	Cist XXVIII	20	F	*c.*48	6	p. 319
MG 253	1966–68	XXX	Cist XL	100	F	aged	5	p. 341
MG 263	1996–98	XXX	Cist L	91	M	*c.*44	1	Tab. 4.36; p. 378
MG 269	1966–68	XXX	Cist XXII	44	M	30–40	1	Illus. 4.56b, p. 332
MG 271	1966–68	XXX	Cist LVIII	74	M	*c.*50	4	Illus. 4.56a, p. 332
MG 297	1966–68	XXXIII	Cist II	142	M	*c.*34	6	Illus. 4.37
MG 300	1966–68	XXXIII	Cist V	45	M	*c.*32	3	p. 285
MG 312	1966–68	XXXIII	Cist XVI	n/a	M	A	6	Illus. 4.73b
MG 321	1966–68	XXXIII	Cist XXV	n/a	F	A	1	Tab. 4.36
MG 328	1964	XXXVI	Cist IV	52	?M	21	3	Illus. 4.43b
MG 337	1966–68	XXXVI	Cist XIII	133	F	*c.*23	2	pp. 316, 319
MG 340	1966–68	XXXVI/12	Cist X	164	M	A	3	Illus. 4.32; Illus. 4.33i; Illus. 4.36e; Illus. 4.51
MG 345	1966–68	XXXVI	Cist XXI	n/a	I	11–14	1	Illus. 4.38f

Grave/ Skull number	Year	Trench/Layer	Cist	DCN	Sex	Age	Generation	Reference
MG 352	1966–68	XXXVI	Cist XXVII	104	F	21	2	Illus. 4.43c
MG 355	1966–68	XXXVI	Cist XXXII	n/a	F	A	1	p. 319
MG 357=333	1966–68	XXXVI	Cist IX	103	F	A	1	Illus. 4.58a
MG 359	1966–68	XXXVI	Cist XXXVI	n/a	M	A	1	Tab. 4.36; Illus. 4.100d
MG 367	1969	XXXVIII	Cist IV	n/a	M	A, young	5	Tab. 4.34; Tab. 4.36; Illus. 4.101a; pp. 368, 378
MG 371	1969	XXXVIII	Cist VIII	n/a	?F	A	2	Tab. 4.36
MG 389	1969	XXXVIII/12	Cist XXVI	n/a	I	*c.*16	1	Illus. 4.66; pp. 315, 344
Medieval Earth Graves								
MG 688	1965	XX	–	–	M	A	5–6	Frontispiece
MG 702	1965	XXII	–	n/a	F	A	5–8	Illus. 4.73a
MG 703	1965	XXII	–	n/a	M	A	5–8	Illus. 4.68b; p. 344
MG 745	1965	XXII/35	–	n/a	M	A	–	Illus. 4.43d
MG 803=364A	1968	XXXII/22	–	n/a	M	A	6	Tab. 4.36; Illus. 4.100e
MG 811	1970	XLIV	–	n/a	M	A	–	Illus. 4.38a
MG 846	1966	XXIX	–	17	M	50+	5	Illus. 4.61; p. 336
MG 854	1966–68	XXX	–	73	M	*c.*34	4	Illus. 4.69
MG 855	1966–68	XXX/4	–	146	M	*c.*21	8	Illus. 4.39c; p. 310
MG 876	1966	XXVI/4	–	n/a	F	A	5	Tab. 4.36; Illus. 4.106a–c
MG 877	1966	XXVI	–	n/a	F	A	5	Tab. 4.36; p. 380
MG 890	1966	XXVI	–	n/a	I	15–16	5	Illus. 4.40g; Illus. 4.67; p. 344
MG 892	1966	XXVI/4	–	n/a	F	A	5	Tab. 4.36
MG 898	1966	XXVI	–	125	M	*c.*60	5	Illus. 4.81; p. 319
MG 899	1966	XXVI	–	124	?F	A	5	Tab. 4.36; Illus. 4.100a
MG 905	1966	XXVI	–	n/a	F	A	7	Tab. 4.36; Illus. 4.97b
MG 907	1966	XXVII	–	156	?M	*c.*36	8	Tab. 4.35; p. 370
MG 931	1966	XXVII/4	–	10	F	*c.*28	–	Illus. 4.33g
MG 942	1966	XXVII	–	n/a	–	–	–	p. 312
MG 1009	1966–68	XXXVI	–	143	M	*c.*27	3	Tab. 4.34
MG 1100	1969	XXXIX/33	–	833	M	A, young	–	Illus. 4.39a; pp. 312–13
MG 1120	1969	XXXIX/110	–	n/a	I	A	–	Tab. 4.36
MG 1146	1969	XL/147	–	n/a	F	A, young	1	Tab. 4.36; Illus. 4.98a–b; p. 377
Medieval isolated bones								
leg bones/rickets	1966	–/4		n/a	I	*c.*6	–	Illus. 4.62
vertebrae, T3–T12	1964	unstratified		n/a	I	A	–	Illus. 4.79b
hip fragments	1964	unstratified		n/a	I	A	–	Illus. 4.72b
left radius	1964	unstratified		n/a	I	A	–	Tab. 4.36; Illus. 4.101b
tibia, dislocated	1965	unstratified		n/a	I	A	–	Tab. 4.36; Illus. 4.105a–b
right ulna	1965	XXIV		n/a	I	A	–	Tab. 4.36; Illus. 4.100g
right ulna	–	CGW Tip		n/a	I	A	–	Tab. 4.36; Illus. 4.100f
right tibia/fibula	1966	XXV		n/a	M	A	–	Tab. 4.36; Illus. 4.95c
fibula	1966	XXVI/4		n/a	I	A	–	Tab. 4.36; Illus. 4.95e
right tibia/fibula	1966	XXVI		n/a	I	A	–	Tab. 4.36; Illus. 4.95b
left tibia/fibula	1966	XXIX/7		n/a	I	A	–	Tab. 4.36; Illus. 4.95a
right tibia	1969	XXXVIII/12		n/a	I	A	–	Illus. 4.68a
mandible	1966	XXXIII*/4		43	M	A	–	Illus. 4.42
right tibia	1966	XXXIII*/4		n/a	M	A	–	Tab. 4.36; Illus. 4.99
right tibia/fibula	–	unstratified		n/a	I	A	–	Illus. 4.103a–b
bregmatic bone	1964	unstratified		n/a	I	A	–	Illus. 4.33h
calotte	–	XXIV		128	I	A	–	Tab. 4.34; p. 368
cranium	1964	cooler/7		240	M	A	–	Tab. 4.34
cranium	1964	cooler/13		246	?F	A	–	Tab. 4.34; p. 370
cranium	1964	cooler/23		256	M	A	–	Tab. 4.34; p. 370
cranium	1964	cooler/25		257	?M	A	–	Tab. 4.34
cranium	–	XXIV		n/a	I	A	–	Tab. 4.34
cranium	–	unstratified		na	I	A	–	Tab. 4.34
cranium	–	unstratified		na	I	A	–	Tab. 4.34
hallux valgus	–	unstratified		n/a	I	A	–	Illus. 4.77
fused tibia/fibula	–	unstratified		n/a	I	A	–	Tab. 4.36; Illus. 4.71a–b
femora	–	unstratified		n/a	I	A	–	Illus. 4.82b
left shoulder	–	XXX		n/a	I	A	–	Tab. 4.36

Grave/ Skull number	Year	Trench/Layer	Cist	DCN	Sex	Age	Generation	Reference
left radius head	–	unstratified		n/a	I	A	–	Tab. 4.36
ulna	1964	unstratified		n/a	I	A	–	Tab. 4.36
ulna	–	BK XXII/XXV		n/a	?F	A	–	Tab. 4.36
metacarpal	1965	XXIV		n/a	M	A	–	Tab. 4.36
left ulna	–	XXV		n/a	I	A	–	Tab. 4.36
right humerus	–	unstratified		n/a	I	A	–	Tab. 4.36
cranium	–	unstratified		n/a	M	A	–	Illus. 4.85d
Isolated finds								
tibiae	–	unstratified		n/a	I	A	–	Illus. 4.70a–e
mandible	–	unstratified		n/a	I	A	–	Illus. 4.39d
vertebrae L2-L5, sacrum	–	unstratified		n/a	I	A	–	Illus. 4.76b
femora	–	unstratified		n/a	–	–	–	Illus. 4.63
vertebrae	–	unstratified		n/a	I	A	–	Illus. 4.78a–b
femora	–	unstratified		n/a	I	A	–	Illus. 4.74a–f
femur	–	unstratified		n/a	I	A	–	Illus. 4.75

APPENDIX D
GLOSSARY[1]

Abscess. An abnormal cavity within a solid tissue formed as a result of an acute **Inflammation** (q.v.), usually in response to bacterial infection, and filled with **Pus** (q.v.). It may develop a sinus by which it drains to the surface of the body, or into a body cavity, or its contents may eventually be engulfed by macrophages or may calcify.

Aetiology. The study of the causation of disease, often used in the sense of the cause of a particular disease.

Agenesis. The failure of a tissue or structure to develop.

Amputation. The severance of a part of the body either through its surgical removal, a traumatic injury, or disease.

Anaemia. The inadequacy or failure of the capacity of the blood to carry oxygen as a consequence of its having a diminution in haemoglobin concentration to values below normal.

Among the numerous causes of anaemia are: (i) a fault in general DNA synthesis; (ii) a failure in haemoglobin production because of a lack of available iron; (iii) a defect in the production of one or both of the polypeptide chains of haemoglobin; (iv) a failure to produce enough red cells, with or without a failure to produce the other cell lineages of bone marrow, either because of a defect in bone marrow stem cells or erythropoietic stem cells or because of an abnormality in their environment that prevents their proliferation or because of their replacement by a neoplasm (e.g. **Leukaemia**); (v) the production of red cells that are abnormally fragile or of the wrong size or shape, so that they are broken down excessively within the body and especially in the spleen; and (vi) an excessive loss of red cells by bleeding, either internally into a body cavity or externally, for example from the body surface, the gut, the airways, or the reproductive tract.

Many of these anaemias cause feed-back changes in the blood, which themselves may lead to additional forms of anaemia and diagnostic confusion, for example an iron-deficiency anaemia (which is a hypochromic anaemia) may be accompanied by a microcytic anaemia (in which the red cells are abnormally small).

Typical causes and consequences of these defects in each category are as follows:

(i) A lack of vitamin B12 and/or folic acid arising from a dietary deficit or, for vitamin B12, chronic atrophic gastritis in which an autoimmune attack on the gastric mucosa leads to destruction of the parietal cells and a failure to produce the intrinsic factor which is required for the uptake of vitamin B12. In the latter case especially there is a dramatic florid reactive change in the bone marrow with haemopoietic tissue replacing fat and later, 'expansion' of bone marrow spaces to the bone surface. Immature and unusually large cells are released into circulation, causing Megaloblastic anaemia (or Pernicious anaemia).

(ii) A lack of iron as a result of absolute dietary deficiency or its sequestration by (e.g.) phytic acid from cereals. This causes iron deficiency anaemia, a form of hypochromic anaemia.

(iii) In α and β thalassaemia there is a deficit in the synthesis of the α and β chains of haemoglobin respectively, leading to the production of abnormal haemoglobins that injure the formation of red cells and so cause anaemia. In sickle cell anaemia (a haemolytic anaemia) a point mutation at the sixth residue of the β-chain produces a haemoglobin in homozygotes that is of low solubility in its reduced (de-oxygenated) state, so that it forms quasi-crystals and so damages red cells peripherally in the body, with a range of consequences.

(iv) Failure of cell production leads to aplastic anaemia in which the haemopoietic bone marrow becomes severely acellular, but reactive change in consequence is not possible. This condition can be rapidly lethal.

(v) Many mutations can affect red cell shape, especially those in spectrin and ankyrin, two proteins associated with the distinctive biconcave shape of the red cell. Several mutations can lead to hereditary spherocytosis, in which the red cells are spherical and tend to obstruct the finest

[1] The editors thank the anonymous external reviewer who graciously provided this glossary. Terms were compiled from the following sources: Mitchinson et al. 1996, Taussig 1984, Mays 2010, Roberts and Manchester 2010, McGee et al. (eds.) 1992, Anderson 1984, and Cotran et al. 1994.

vascular channels and to move very slowly through the spleen, where they are attacked. The result is that their half-life in circulation is abnormally short.

(vi) Severe haemorrhage tends to be lethal, but lesser degrees of bleeding lead to anaemia. Among commoner causes leading to anaemia today are heavy menstruation, chronically bleeding haemorrhoids, low grade (non-catastrophic) bleeding from oesophageal varices (in some forms of hepatitis and in alcoholism) or from peptic ulcers (in cases of *Helicobacter pylori* infection). **Typhoid fever** (q.v.), tuberculosis, and helminthic infections can also lead to anaemia.

Ankylosing spondylitis (Marie-Strumpell's Disease). An autoimmune condition affecting victims carrying the HLA-B27 histocompatibility antigen. It is strongly heritable and is particularly found in males. Its effects are dominantly seen in the axial skeleton and particularly in the sacroiliac joints. Beginning in adolescence to early adulthood, there is fusion of small joints of the spine and/or the vertebral bodies by way of bony outgrowths lying parallel to the long axis of the spine. There is extensive remodelling of bone usually starting from the lumbar spine and progressing upwards, accompanied by pain and restriction of movement. In this condition there is erosion of the cartilaginous joints in the axial skeleton, unlike their preservation in **Diffuse idiopathic skeletal hyperostosis** (DISH) (q.v.).

Ankylosis. The fusion together of two bones which have previously formed a flexible or moveable joint, so that the joint becomes completely and permanently immobile.

Arthritis. This is a term which is often applied in a wide sense to include both true inflammatory conditions of joints and conditions which are not inflammatory in origin, but may lead to inflammation in overlying or associated tissues as the disorder progresses. Usually 'arthritis' refers to diarthrodial joints, i.e. those with a fluid-filled joint cavity lined with synovium, which itself overlies the articular cartilage which covers the bone of the joint.

The cartilage forms an elastic cushion in which the tensile meshwork of collagen fibres pulls inward against a heavily glycosylated matrix (largely of hyaluronan, glycosaminoglycan, and glycoprotein) which tends to hydrate and swell outward. At the synovial surface the collagen fibres run circumferentially and cover the surface of the synovium as a 'corset'. If this is damaged it is not repaired and the balance of forces is lost, causing the cartilage to swell and ultimately degenerate (see **Osteoarthritis** below). It is the initiation of injury to this collagenous layer which distinguishes the various types of arthritis.

(i) **Septic arthritis** occurs when the synovial fluid and synovium are infected with pathogens which are usually bacteria, but rarely fungi or protozoa either from the bloodstream or as a result of injury to the joint or a compound fracture (q.v.). Acute **Inflammation** occurs. This may resolve, but if it leads to suppuration there is extensive damage to the joint, granulation tissue forms on the articular surfaces, this ossifies, and the joint becomes ankylosed and fixed. In **Tuberculous arthritis** a chronic inflammation is present from initial infection and may lead to the formation of granulomata and caseation. **Syphilitic arthritis** is rare and usually transient.

(ii) **Rheumatoid arthritis** is an articular consequence of an autoimmune response to components of connective tissues more generally and is really part of a syndrome in which other tissues are also involved. The synovium is the initial site of attack and is heavily infiltrated by lymphocytes and plasma cells which may be organized into germinal centres (called rheumatoid nodules). A few acute inflammatory cells may also be present. The disease may resolve or remit, but if damage progresses there is irreversible change and **Granulation tissue** (q.v.) grows in from the edges of the joint. This is 'Pannus', which progressively undermines the cartilage and covers the surface of the bone. The joint fibroses and ossification may occur, causing ankylosis. The tissues around the joint can also become involved and partial disarticulation and distortion, termed 'subluxation', may result.

(iii) **Gout** is the consequence of one of several heritable and metabolic disorders that lead to an increase in systemic serum urate concentration or, rarely, a more local abnormality in the handling of urate. Crystals of monosodium urate form, especially in joints, and set off severe acute inflammation. The crystals are engulfed by neutrophil polymorphs and the inflammation subsides, only to recur as the crystals burst the membranes of the vesicles in which they have been engulfed, so killing the polymorphs and releasing the crystals—plus inflammatory mediators. Attacks of acute gout can involve several such painful cycles before dying away. In time, partially calcified deposits of monosodium urate in fibrocartilage of joints and elsewhere may form, as masses called 'Tophi'. This is **Chronic tophaceous gout**. In any case, a joint affected by gout may progressively degenerate through consequent **Osteoarthritis** (q.v.). Gout only occasionally occurs before middle age.

(iv) **Pseudogout** is caused by the deposition of needle-like crystals of calcium pyrophosphate. Though its aetiology is different from that of gout, its pathogenesis is similar, but it causes less severe symptoms than gout and does not produce tophi. It is a disease of middle to old age.

(v) **Osteoarthritis** (also termed **OA**, **Osteoarthrosis**, and **Degenerative arthritis**) is a common arthropathy in which inflammation of the joint plays no part in its aetiology or early pathogenesis, though secondary inflammation of the immediately surrounding tissue commonly occurs once the disease is established. The changes seen in OA can also follow initiation by truly inflammatory arthropathies (such as (iv) above), once the integrity of the surface of articular cartilage is compromised. OA is often set off by trauma to a joint, as a result of heavy usage, too great a repeated use, or a single substantial injury. The collagen at the interface of the synovium and the articular cartilage becomes damaged so that the cartilage swells locally and begins to fail. Its surface chondrocytes die and the matrix starts to crack and flake. Though a reactive division of deeper chondrocytes occurs, a full repair is not possible and fissures begin to develop in the cartilage matrix (called 'fibrillation'). These progress and eventually reach the subchondral bone. By this stage reactive changes in the bone have already begun and progressed for some time, so that an excess of bone matrix and thick trabeculae have already formed while the most superficial osteocytes have died. As bone begins to bear on bone it becomes polished and eburnated (q.v.) and osteophytes may appear, but ankylosis generally does not occur. True inflammation of the remnants of the synovium may occur at a rather late stage as fragments of debris are shed into the joint space. This is a chronic inflammation.

Of other forms of arthritis some are transient, leaving no permanent evidence on bones, or are now rare. **Neuropathic arthropathy** is of some importance and was formerly encountered as a complication of tabes dorsalis in syphilis and can occur in leprosy. Essentially, an insensitive joint becomes subject to repeated injuries and because no pain is sensed these may be substantial. Consequently florid OA develops and the joint acquires large osteophytes, eventually becoming grossly remodelled and abnormal ('Charcot's joint').

Atrophy. The degeneration of an organ or tissue so that its normal function is impaired or lost.

Auditory torus, *see* **Torus auditivus**.

Bony prominences. Knobs of secondary bone deposition seen in various sites, but especially around joints. They may indicate unusually heavy use of a joint in some particular way leading to stress of tendons and/or ligaments and their secondary, local calcification. See **Enthesophyte**.

Calcification. The deposition, pathological or physiological, of calcium salts within a tissue. The final stage in tissue necrosis (q.v.) in some sites is for the fibrous scar tissue to become calcified. This local pathological process is **Dystrophic calcification**.

An excessive production of parathyroid hormone leads to elevation of serum calcium concentrations and loss of calcium from bone. A consequence can be the widespread deposition of calcium salts in arteries, the heart muscle, the bronchial and alveolar walls, and the gastric mucosa. This is termed **Metastatic calcification**. The physiological deposition of calcium in bone, as hydroxyapatite, is usually termed **Mineralization**. The conversion of a tissue to bone by the organized deposition of hydroxyapatite in Haversian systems (osteons) is **Ossification** (q.v.).

Calculus. A hard deposit upon the teeth (also called tartar), especially at the gingival margins, containing bacteria, bacterial exopolysaccharide, actinomycetes salivary glycoproteins, and degraded food debris.

Callus. The distinctive tissue of bone repair. At the time of initial fracture (q.v.) there is bleeding from small blood vessels in the bone itself and in the tissues nearby, so that a haematoma (q.v.) forms around and across the fracture site. This is rapidly invaded by ingrowing granulation tissue (q.v.), which covers the ends of the broken bones and extends some way under the periostium and endosteum, from which primitive osteoblast precursors move into it. Callus formation now begins as these differentiate into osteoblasts (q.v.) which begin to deposit 'osteoid' matrix, containing collagen, glycosaminoglycan, and various glycoproteins. If the injury is kept reasonably immobile the osteoid is then mineralized to form 'Woven Bone', but if too much movement occurs differentiation towards cartilage follows and mineralization fails, leading to the development of a 'False joint' (q.v.).

If repair proceeds normally, the woven bone undergoes progressive remodelling by the coordinated activity of osteoclasts and osteoblasts and the masses of callus at the broken ends of the bone grow towards each other, meet, and fuse, so further protecting the injury from undue movement. Most of the callus developed up to this point is **External callus**, on the outside of the bone, derived from periosteal osteoblasts. **Internal callus**, formed within the bone, and **Intermediate callus**, developed across the broken ends, grow more slowly, but add further reinforcement as they develop. The mass of callus is now termed **Provisional callus** and has formed typically by about four weeks from initial injury. Gradual further remodelling continues as the bone becomes able to withstand gradual loading and may continue for many months or more. As remodelling occurs the size of the callus diminishes, but some permanent thickening of the bone may remain. Bone repair is very demanding of energy, and malnutrition may lead to its being slowed or impaired, as may specific deficiencies of vitamins such as D and C.

Cancer. Originating as a term for solid malignant neoplasms (q.v.), particularly carcinomata (q.v.), it is used commonly to include both carcinoma and sarcomata and, often, all forms of malignant neoplasm including lymphomata, leukaemias, and neoplasms arising in the brain.

Carabelli's cusp. A supernumery cusp sometimes found on the lingual aspect of the molar teeth.

Carcinoma. A **Malignant neoplasm** (q.v.) arising from epithelial tissue.

Cleft palate. A palate in which there is a central deficit arising from the failure of the primordia of the two palatine bones to rotate into position and align along the future palatine suture during embryogenesis.

Congenital absence. The congenital **Agenesis** (q.v.) of a structure such as a tooth.

Cribra orbitalia. Areas of perforation of the surface of the bone of the upper parts of the orbit. They are considered to represent reactive bone-marrow expansion in anaemia. Where they are florid this is certainly pathological, though a few or solitary perforations of the bone can occur as the result of the idiosyncratic tracks of small blood vessels. A similar appearance can also be given by the loss of bone surface post mortem. It is not clear what type of anaemia can give rise to cribra orbitalia, but anaemia arising from folate or vitamin B12 deficiency may well be the most likely. See also **Porotic hyperostosis**.

Crowding. The consequence of the development of too many teeth for the space available to accommodate them, so that they become disorderly, misaligned, and rotated. **Impaction** (q.v.) may also occur.

Cyst. This term is used for several histologically different entities, all of which are roughly spherical or multilocular in shape:

(i) **Simple cysts** of glandular origin appear as fluid- or gel-filled cavities lined by epithelial tissue arising from the gland or duct in which they occur.

(ii) **Bone cysts** are simple, benign radiolucent defects of bone, typically found in metaphyses of juveniles. The lesion thins the bone and may appear to expand it. It is lined by fibrous tissue, but there may also be evidence of haemorrhage and inflammation.

(iii) **Aneurysmal bone cysts** are rapid-growing and often multilocular masses, mostly found in the metaphyses of long bones and in the spine. They are highly vascular and osteolytic. Their internal spaces contain blood and are lined by macrophage-like cells and giant cells, while their septa contain fibroblasts and macrophages, as well as scattered osteoclasts. There may also be evidence of new bone deposition.

(iv) **Hydatid cysts**. Tapeworm cysts are spherical cysts of cestode worms in which the scolex (head) of the worm forms an invagination of the cyst wall. If the cyst is activated by ingestion, the head evaginates and attaches to the intestinal wall. Tapeworm cysts may be killed by calcification within the tissue where they occur or, in some species of tapeworm, they may enlarge and proliferate, forming multiple daughter cysts (with scolices) within themselves. This can cause life-threatening lesions in tissues such as brain.

Decapitation. The traumatic amputation of the head either as the cause of death, or as an event occurring post mortem.

Diabetes. An excessive production of urine, usually accompanied by frequent micturition, dryness of the mouth and mucosae, and a decline in tissue turgor. The two principal types are:

(i) **Diabetes insipidus**, in which the urine is copious, dilute, and contains very little or no glucose. The blood glucose concentration is generally within normal limits. In some cases there can be evidence of abnormality of the sella turcica of the skull.

(ii) **Diabetes mellitus** is a variable overproduction of urine, with a marked glycosaemia, though the urine is dilute in other respects. The blood glucose concentration is elevated above the normal range, often to a considerable degree. There are two principal types of diabetes mellitus:

In **Diabetes mellitus type I** there is lowered secretion of insulin by the pancreas, as a result of the pathological destruction of some or all of the β-cells of the Islets of Langerhans. Responses to administered insulin are normal. An autoimmune killing of β-cells is indicated by inflammation of the Islets in most cases and the trigger may well be a viral infection such as infant rubella, mumps, or coxsackie B in individuals with a genetic susceptibility. Most victims are children, juveniles, or young adults. The onset can be quite sudden. Until modern times, and the availability of insulin treatment, this disease was highly and rapidly lethal.

In **Diabetes mellitus type II**, the more common type, the secretion of insulin is normal or elevated, but there is an impaired response to insulin. Many victims live with their disease for extended periods before diagnosis and it seems likely that in the past the same was true. Type II diabetes is part of a complex metabolic syndrome of diabetes, obesity, and any of a range of other conditions including gout and **DISH** (q.v.). Complications of diabetes mellitus arise largely from elevated blood glucose concentrations and the attendant 'glycation' (or non-enzymatic glycosylation) of proteins, especially on the endothelium of small blood vessels. The microangiopathy that results can lead to retinal damage; injury to renal glomeruli, eventually leading to diabetic nephropathy and renal failure; peripheral vascular disease, especially in the feet, eventually leading (in conjunction with neuropathy) to gangrene of the toes; increased risks of infection of the skin, urinary tract, and mucosae, and of TB. In addition to the neuropathy of diabetes, there is an increased systemic risk of atheroma, hypertension, infarction, and stroke.

Diaphysial aclasia or **Metaphysial aclasia.** A failure of the diaphysis (syn. metaphysis) or shaft of a long bone to fuse with the centres of ossification at its ends (the epiphyses) either because the bone is juvenile (i.e. a physiological aclasia) or abnormal (a pathological aclasia). Fusion occurs when the growth plates of the bone mineralize and so stop growing. This occurs physiologically at different ages in different bones, covering a range of approximately 14–22 years in males and 13–21 years in females, and so it affords a means of estimating age in the skeletons of juveniles and young adults. In pathological conditions fusion can variously be delayed or advanced. It should be noted that normal patterns of fusion are somewhat variable in what appears to be a genetically determined manner, which can be of use in indicating relationships between skeletons. The condition can occur between centres of ossification elsewhere, leading multiple exostoses and osteochondromata to occur throughout the skeleton. See also **Osteochondroma**.

Diffuse idiopathic skeletal hyperostosis (DISH; Forestier's Disease). A condition in which there is an **Ossification** (q.v.) of the anterior longitudinal ligament of the spine and the adjacent (paraspinal) tissues giving the appearance of solidified, flowing candlewax. Cartilage and synovium are spared (unlike their erosion in **Ankylosing spondylitis** (q.v.)), but there is eventual spinal fusion, especially in the thoracic spine, though the surfaces of the vertebral bodies and the apophysial joints remain intact, with their joint spaces. Elsewhere in the skeleton there is new bone formation at the origins and insertions of tendons and ligaments, which distinguishes DISH from **Ankylosing spondylitis** (q.v.). At least four vertebrae must be fused for a definitive diagnosis of DISH. This condition shows associations with **Diabetes mellitus type II** (q.v.) and obesity in modern populations.

Dislocation. Dislocation of a joint occurs when one of the bones of a joint is forced out of its normal position relative to the other, either temporarily or permanently. While commonly seen in ball and socket joints as a result of trauma, it may also occur where a joint is malformed and the ball may easily slip from the socket, for example, in hip dysplasia.

Double teeth. A malformation arising from the partial or total splitting of a tooth bud.

Dysplasia. A rather vague term with different meanings or implications in different settings. As applied to cells it means an abnormality of cellular form, or the form of organelles in the cell. In tissues it means a disturbance of tissue architecture, often arising from a change in cell form, sometimes (but not always) implying a potential for neoplastic change. It is also used to describe a developmental abnormality, e.g. of the articulation of the hips.

Eburnation. The polished or burnished appearance of bone surfaces that have been bearing and moving upon each other directly, as a result of the loss of articular cartilage in advanced osteoarthritis. Typically the bone involved is thickened, hard, sclerotic, and substantially acellular. Movement of eburnated joints is usually very painful.

Enamel hypoplasia. The inadequate or incomplete deposition of enamel upon a tooth.

Enamel pearl. A local deposition of hard tooth enamel as a small rounded mass or knob, upon a tooth which otherwise shows a failure or impairment of enamel deposition.

Enthesophyte. A general term for the calcified bony projections left on bones where the origins or insertions of tendons or ligaments have undergone calcification. They are usually regarded as indicative of a reactive change caused by excessive or repeated stress and are often considered as markers of particular occupations in life.

Epidemic. Something extending beyond its normal area of occurrence (in which it is **Endemic**). Usually applied to infections. Typically epidemic infections show a sudden rapid spread from an initial focus, a period of high prevalence in a population with low resistance, and then a phase of either low general incidence, oscillating occurrence, or disappearance and non-recurrence.

Exostosis. A non-malignant and, strictly, non-neoplastic outgrowth of bony tissue projecting from a bone, arising as a developmental defect (as in **Osteochondroma**, q.v.) or as a response to trauma or infection as in subungual exostoses (e.g. of toes or fingers).

False joint. An unusual outcome of a previous fracture, especially in ribs, where though **Callus** (q.v.) forms at the fracture site, the fracture is not fully immobilized, with the consequence that the woven bone that is first laid down does not become fully mineralized and the two sides of the fracture develop into two mineralized bones with a flexible fibrocartilaginous zone between them, the organization of which comes to resemble a joint.

Flaring. A term applied to vertebral bodies which, as a result of stress, undergo new bone deposition around their rims, so exaggerating their biconcave profiles, but without progression to distinct **Osteophytes** (q.v.).

Fracture. A break in a bone (or other rigid object) to produce two or more parts which are either separate or remain partially conjoined. In long bones the principal types are: (i) **Transverse**, in which the fracture plane is at right angles to the long axis of the bone; (ii) **Oblique**, in which the plane is at an angle to the long axis of the bone with no rotation; (iii) **Spiral**, which is also oblique, but with rotation so that the fracture may have a series of offset planes; (iv) **Comminuted**, in which several pieces of bone are split away in differing planes; (v) **Greenstick**, in which the fracture is incomplete, with possible internal splitting of the bone roughly at right angles to the main fracture so that the bone may be bent. This last is most in common in juveniles. Where the broken end of a fractured bone is displaced so that it perforates the surrounding soft tissue and reaches the surface the fracture is described as **Compound** (vi) and carries the risk of infection.

Compression fractures occur in the spine, when one or more vertebral bodies collapses roughly in the direction of the long axis of the spine, usually to give a wedge shape to the bodies involved. See also **Spondylolysis**.

The skull is the most common site for **Depressed fractures**, resulting from blunt impacts of weapons or other objects, or received in falls. In these an area of the skull is driven inward with fractures at both outer and inner tables and displacement of bone inward.

Microfractures of the outer table are often seen along incised wounds from edged weapons and rarely at the inner table if a stab passes across the skull. They are also seen in fresh trepanations and at the site of arrow and cylindrical spear wounds where the missile was rotating on impact.

Eponymous names are given to some common or distinctive types of fracture, such as **Colles' fracture** of the wrist, resulting from falling forward onto a resistant surface, while putting the hands out protectively, and **Pott's fracture** of the ankle caused by tripping.

Pathological fracture is a general term for any fracture resulting from the (often slight) loading of a bone weakened by any pathological process.

Frostbite. The necrosis of the extremities (toes, fingers, ears, etc.) as a result of tissue damage caused by freezing.

Gout, *see* **Arthritis**.

Granuloma. A mass of activated macrophages, closely interlocking with and adherent to each other, usually surrounded by a cuff of lymphocytes. Multinucleate giant cells may be present, formed by the fusion of macrophages, and there may be necrosis at the centre of the granuloma. Granulomata may form within tissues as a response to an infective agent, such as a bacterium (as in **Syphilis** and **Tuberculosis**, q.v.) a fungus, or a protozoon, or in response to foreign bodies such as mineral dusts or cotton fibres. Rarely granulomata are found which are without obvious cause and which probably arise from a dysfunction of the immune system (as in Wegener's granulomatosis). **Granuloma** is distinct from **Granulation tissue** (q.v.).

Granulation tissue. This tissue forms as a response to injury and is an early stage in the repair of most tissues. It is a loosely formed mass of connective tissue containing fibroblasts, macrophages, and a mixture of inflammatory cells, with an abundant ingrowth of young budding capillaries of which the endothelial cells are conspicuous. It later undergoes 'Organization' into more mature and tightly formed tissues. It is quite distinct from **Granuloma** (q.v.).

Greenstick fracture, *see* **Fracture**.

Haematoma. A collection of extravasated blood (i.e. outside a blood vessel) retained within a tissue. A bruise is a common example.

Haemorrhage. A term meaning a loss of blood, usually, but not always, from a larger blood vessel to the exterior of the body, into a body cavity, or into a tissue. In the last, it may form a **Haematoma** (q.v.).

Hyperdontia. The presence of more teeth than normal.

A developmental abnormality in which additional tooth buds have been produced and have developed into identifiable teeth.

Hyperossification. An overdevelopment of bone at any site, often seen in the edges of the bones of the skull and especially of the cranium. The bone may be somewhat sclerotic.

Hyperostosis. The deposition of an excess of bone and bone mineral, so that the bone may appear thickened beyond normal limits, without there being a disproportion of bone mineral to cells. It can be a reactive change in bone. See also **Porotic hyperostosis**.

Hyperplasia. The increased production of the normal cells of a tissue by cell division, so that the tissue increases in size. This process is under physiological control, though it may be reactive to a pathological stimulus ('Pathological Hyperplasia') and so is to be distinguished from **Neoplasm** (q.v.). Extracellular matrix may also increase as a consequence of the increase in the population of cells that produce it, as in **Enamel hyperplasia** of the teeth (not to be confused with **Enamel hypoplasia** (q.v.)).

Hypertrophic spondylitis, *see* **Spondylitis**.

Hypoplasia. The decreased production of the normal cells of a tissue by the physiological down-regulation of cell division or by a defect in the regulation of cell division. Deposition of extracellular matrix may also decline in consequence. In **Linear enamel hypoplasia** of teeth, there is a transient failure of enamel deposition during tooth development as a result of inadequate nutrition or illness.

Idiopathic. Of unknown causation. See also **Aetiology**.

Impaction. A term commonly used of teeth. It means that the movement of a tooth during eruption has been arrested by its coming into contact with an obstacle, either another tooth or bone, into which it is said to have impacted.

Inflammation. The set of responses made by the body to local cell injury or infection. It is of two general kinds:

(i) **Acute inflammation** is a group of generic responses to injury, including an increase in blood flow in the area affected, a rise in capillary permeability with the formation of an **Exudate**, an attachment of cells called **Neutrophil polymorphs** to the capillary endothelium ('margination') after which they move across the endothelium ('diapedesis') into the tissue spaces around the site of injury. The neutrophil polymorphs can engulf a wide range of bacteria and have several mechanisms for killing them, though they die in the process and may contribute to forming **pus** (q.v.).

(ii) **Chronic inflammation** is characterized by the presence in tissues of activated macrophages which arise by the emigration and simultaneous activation of blood monocytes, in response to injury. The macrophages are larger phagocytic cells than the polymorphs and they engulf the dead polymorphs, cell debris, and bacteria (alive or dead) and process the results, which they can then present to the immune system after emigrating through the lymphoid system to lymph nodes or by forming **Granulomata** (q.v.) and communicating with lymphocytes more locally.

NB. The terms **Acute** and **Chronic,** as applied to inflammation, no longer carry their common meaning. While acute inflammation occurs very rapidly and chronic inflammation develops more slowly, there are cases where inflammation is of the chronic type *ab initio* or acute inflammation persists. Hence 'Acute' implies a form of inflammation dominated by the presence of neutrophil polymorphs in tissues and 'Chronic' implies the presence of macrophages and, usually, lymphocytes.

Ischaemia. A condition in which a tissue receives an inadequate inflow of blood for any reason, so that it has a subnormal supply of oxygen and nutrients. If the deprivation is severe enough for a sufficient period infarction may result.

Kyphosis. A pathological distortion of the normal curvature of the spine in the median sagittal plane so that the normal convex thoracic curvature becomes more pronounced. The victim appears to bend forward and to show a humped back. Causes can include tuberculosis (Pott's spine), osteoporosis, and compression fractures. It can also be occupational. See also **Scoliosis**.

Leprosy. An infection with *Mycobacterium leprae*, which colonizes macrophages. There are two extreme forms: (i) **Lepromatous leprosy** (LL), in which there is a high tissue burden of the bacterium especially in the skin and peripheral nerves, but a weak immune response with either no formation of **Granulomata** or a few being formed but without epithelioid macrophages, and (ii) **Tuberculoid leprosy** (TL), in which the tissue burden of bacteria is very low and the immune response is strong, with the formation of abundant, classical **Granulomata** resembling those of **Tuberculosis** (q.v.). A wide range of intermediate forms also exists and the infection can also be subclinical or possibly transient. The classical appearance of leprosy is that of the LL form, which is more common. The pathogen is of low infectivity and many victims show abnormality of their immune (T helper-cell) responses. Historically many victims were also malnourished.

Leukaemia. A family of malignant neoplasms of the various lineages of the blood-forming cells. Though they are not solid tumours, they are related to the **Sarcomata** (q.v.) and lymphoid leukaemias can develop in the later stages of **Lymphomata** (q.v.). Because they arise in lineages which give rise to freely circulating cells they are naturally invasive and tend to arise and occur in bone marrow and in places to which their normal counterparts migrate. The criteria of invasion are harder to apply in practice to sarcomata and to neoplasms originating in the brain than they are to **Carcinomata** (q.v.), leading sometimes to diagnostic problems. Some leukaemias principally occur in children and young adults.

Linear enamel hypoplasia, *see* **Hypoplasia**.

Lipping. The development of a rim or lip of bone around the edge of a flexible joint as a result of its being stressed. This can be physiological, for example in pregnancy or in early childhood, or pathological, for example as a consequence of malformation or disease of the intervertebral joints or vertebrae being stressed. If the stress continues the lip may extend locally to form **Osteophytes** (q.v.).

Lordosis. A term describing the anterior convexity (i.e. the curving forward) of the spine in the lumbar region. It is often applied to mean an increased anterior convexity beyond the normal range in the lumbar region. It should be noted that lordosis is not the true opposite of **Kyphosis** (q.v.), in which there is increased posterior convexity in the thoracic spine. Both lordosis and kyphosis occur in the same plane as each other, but in opposite directions and at different levels of the spine, while scoliosis occurs in a plane at right angles to them.

Lymphoma. A solid neoplasm of lymphoid tissue. Lymphomata occur in a wide variety of sites, reflecting the diversity of lymphocytes and their patterns of recirculation. They show greater diversity in their behaviour, cell-surface biochemistry, and biology than in their gross histology. They are related to the sarcomata and to the lymphoid leukaemias. Some principally affect children and young adults.

Mastoiditis. This usually means an acute inflammation of the mastoid bone and the lining of its air cells, in which neutrophil polymorphs are reacting to an infection with any one of several microrganisms (including species of *Haemophilus*, *Streptococcus*, *Pseudomonas*, *Proteus*, and rarely, *Mycobacterium tuberculosis*) most of which usually reach the bone as a result of a middle-ear infection (**Otitis media**). This, in turn, can arise as a result of an infection ascending by way of an Eustachian tube from the throat. An **Abscess** (q.v.) may form, which may drain through the tympanic membrane. If a chronic inflammation follows, serious consequence may ensue, including permanent deafness and infection of the brain leading to death.

Metastasis. A term used to describe the spread of a neoplasm (or, rarely, an infection) from its site of origin to a distant site with which it is not contiguous (i.e. it differs from local spread). Such dissemination is via blood vessels, lymphatics, cerebrospinal fluid or across body cavities.

Metopism. In this condition the metopic suture, which runs from the nasion to the bregma and separates the two frontal bones of the skull in the neonate and infant, persists to some degree in the adult. The extent of this persistence is variable, with many adult skulls showing a trace of the suture externally (i.e. at the outer table) for up to 2 cm above the nasion, but few showing the suture for the whole distance to the bregma. Internally, the suture can appear to be persistent for a greater distance, but the edges of frontal bones are often thickened at the inner table, making accurate observation more difficult. Often the two frontal bones are fused internally in places, but rarely the two bones can separate completely along the whole suture line. Because there is no standard definition or set of descriptive criteria for metopism, it is difficult to make accurate comparisons between frequencies of the condition described by different authors.

Microdactyly. The presence of one or more abnormally short fingers or toes, as a result of their partial or complete agenesis.

Microdontia. The presence of one or more abnormally small teeth as a consequence of their partial or complete agenesis.

Myositis ossificans. The ossification of, or partially within, a muscle. There are two kinds:

(i) **Myositis ossificans progressiva** is a rare autosomal dominant condition generally becoming evident in childhood, in which muscles around the pectoral and pelvic girdles and the spine progressively ossify, with the deposition of cartilage, woven bone, lamellar bone, and fibrous tissue.

(ii) **Myositis ossificans traumatica** is a consequence of local injury to the soft tissue of a muscle, or its sheath, leading to a **Haematoma** (q.v.) or a small pool of exudate or, if infected, **Pus** (q.v.) which ossifies and, as the ossification continues, fuses with the underlying bone, upon which it is then seen as an irregular bony knob.

Necrosis. Pathological, *not* physiological, cell death, within a living organism and not consequential upon the death of the whole organism, in response to some cause external to the cell. Usually it involves clusters of damaged cells within a tissue and the cellular changes are distinctive. Typically, both the cell and its nucleus swell, organelles dilate, mitochondria swell excessively, and ribosomes detach from the rough endoplasmic reticulum and chromatin fragments as DNA breaks. The surface membrane forms blebs and then breaks. Inflammatory responses are induced in consequence of necrosis.

Neoplasm. While this term strictly means 'new growth' it is used in practice to mean the proliferation of the cells of a tissue, so that the tissue mass expands, by cell division, beyond its normal limit of size. It does not mean that the tissue necessarily grows more rapidly than normal, though this may be the case, but that its limit of size is either greater than normal, or, usually, is indefinite and not restricted by the normal methods of growth regulation. Neoplasms are therefore a subset of **Tumours** (q.v.), though the two terms are often used synonymously. Neoplasms are distinct from hamartomata and some teratomata, overproduction of extracellular matrix without cellular proliferation, and accumulations of intercellular fluid (oedema), all of which are sometimes called tumours.

Neoplasms are of two general categories:

(i) **Benign neoplasms** are localized at their site of origin and generally do not infiltrate surrounding tissues unless the tissue of origin is itself normally infiltrative, in which case they may infiltrate, but only to a limited (i.e. 'normal') degree. They are injurious only if they cause compression of other tissues or secrete hormones.

(ii) **Malignant neoplasms** spread beyond their site of origin so that they come to invade abnormally and cause tissue damage. Such invasion may be abnormal spread within an epithelium (which is hard to detect), spread across a basement membrane or into a nerve sheath (histologically local invasion), or more remote spread across body cavities, through blood vessels or lymphatics to form secondary masses physically separate from the original neoplasm. This is 'Metastatic Neoplasia', commonly termed **Metastasis** (q.v.). See also **Carcinoma**, **Sarcoma**, **Lymphoma**, and **Leukaemia**.

Neurofibromatosis. A neurofibroma is a thickening of an affected nerve and its sheath in which there is a mixture of fibroblasts and Schwann cells around the nerve fibres.

Ossicle. A small bone, used e.g. of the small bones of the inner ear and the supernumerary bones often found in suture lines (see **Wormian bones**).

Ossification. The physiological process of bone deposition, particularly as applied to the orderly deposition of bone mineral to produce normally organized lamellar bone.

(i) In normal bone development **Endochondral ossification** occurs in the long bones, pelvis, and the axial skeleton up to and including the lower parts (base) of the skull, as bones form from cartilaginous precursors and, subsequently, continue to grow at the growth plates.

(ii) **Intramembranous ossifaction** occurs where more primitive mesenchymal tissue ossifies without forming true cartilage, as a result of its differentiating focally into osteoblasts in centres of ossification which then deposit osteoid which subsequently mineralizes. This occurs in the membranous bones of the vault of the skull and in the clavicles.

(iii) **Appositional bone growth** is a related ossification process in which osteoblasts first deposit bone matrix onto woven bone or lamellar bone and then mineralize it, so adding to pre-existing bone. This process occurs continuously during the normal turnover of bone, its adaptation to load, and during bone repair. It may also occur pathologically as a response to local irritation of the periosteum, or where there is a continuing pathological process occurring in bone (e.g. damage from a metastatic neoplasm or a pathogen) or in the periosteum. Some disorders of bone metabolism can lead to abnormal appositional bone growth, as may several endocrine disorders.

(iv) **Heterotopic ossification** is ossification which occurs in the wrong place because of the inappropriate appearance of osteoblasts in that site. Its causes appear to be either an aberrant expression of genes regulating osteoblastic differentiation or an unusual local environment which encourages osteoblast precursors to settle down and differentiate, or a combination of both. An example is **Myositis ossificans progressiva** (q.v.).

Osteoblast. The cell of bone formation, which lays down bone matrix and mineralizes it. Osteoblasts arise by differentiation from the cells of the endosteum and periosteum or from circulating osteoblast precursors; they eventually become mature **Osteocytes**.

Osteochondritis dissecans. The local loss, in life, of part of the bone surface of a joint (most commonly the knee) by flaking or fragmentation of necrotic cortical bone as to expose the porous trabecular bone beneath.

The bone lost may form loose bodies in the joint or may be resorbed. The lesion is usually a few millimetres in diameter, well defined, and roughly circular with fairly smooth edges. It is thought that the focal bone necrosis which underlies the condition occurs as a result of an impaired local blood supply, though the reason for this is rarely evident. There are several eponymous names for this condition, depending upon the bone and site involved. It is usually seen in adolescents or young adults.

Osteochondroma. A bony mass protruding from the surface of a tubular or other bone formed by endochondral ossification in the region of, or formerly occupied by, the metaphysial growth plate. In life, its outer surface is capped by cartilage. It is usually considered as a developmental abnormality in which a portion of the growth plate has become displaced to grow laterally and form an exostosis. Though usually single, there is a hereditary form of osteochondroma in which multiple exostoses develop. Neoplastic transformation may occur in such cases.

Osteoclast. The cell type which breaks down bone matrix, removing the mineral from the matrix simultaneously with degradation of other non-mineral matrix components. Osteoclasts are of a different lineage from **Osteoblasts** (q.v.) and arise by differentiation from circulating precursors. With osteoblasts they maintain normal bone turnover and remodelling.

Osteoma. Osteoma is usually classified as a benign neoplasm of bone. The ivory osteoma is commonly found on the surface of the skull, especially at the outer table.

Osteomalacia. The equivalent disorder to **Rickets** (q.v.), but occurs in the more mature skeleton, where it is acquired after the closure of the metaphysial growth plates, so the pathological appearance is different. As in rickets, there is an underlying failure to mineralize bone properly, but in this case it is against a background of abnormal loss of bone mineral either as a result of inadequate uptake, through malabsorption or dietary deficiency of calcium or vitamin D, or as a consequence of excessive loss of bone mineral because of, for example, renal disease, diabetes, or excessively frequent pregnancy. The major effects are on the spine, which may show compression **Fracture** (q.v.) of vertebral bodies and increased lordosis, though pelvic deformity is sometimes seen. Deformity of long bones is highly unusual.

Osteomyelitis. Strictly an inflammation located in the marrow cavity (or bone medulla) and trabecular bone, arising from an infection. In practice such an infection and inflammation is likely to involve the whole thickness of the bone plus the periosteum and the term is usually used in the general sense of an infection of a bone by an organism such as *Staphylococcus durens*, usually eliciting an acute inflammation and producing pus. However, other organisms (especially *Mycobacterium tuberculosis*) may infect bones and the inflammation may be mixed or chronic in type. If a purulent exudate leaks under the periosteum it may calcify and subsequently ossify, causing massive irregular thickening of the bone.

Osteopenia. A deficit of bone mineral relative to the cellular content of a bone. It may arise from any of a number of causes, including: (i) vitamin D deficiency arising from defective synthesis, dietary insufficiency, or malabsorption; (ii) a range of renal dysfunctions including excess fluid and phosphate loss in diabetes; (iii) endocrine dysfunction, especially of the parathyroid gland and as a result of hormone-producing neoplasms; and (iv) some heritable defects of bone matrix which impair mineralization.

Osteophyte. A thin, roughly leaf-shaped or knob-like projection of new bone on the edge of a joint produced as a result of repeated, heavy, or excessive stressing of the joint. Less commonly osteophytes may occur on the joint surface near the margins of the joint. They represent a reactive compensatory change which reinforces the joint, but may ultimately restrict its movement.

Osteoporosis. A condition in which the mass of bone per unit area is diminished, while the ratio of bone mineral to non-mineralized matrix is normal. Thus, there is a deficit in total matrix, not of mineral alone. It arises from a change in the proportion of osteoblastic to osteoclastic activity, of whatever cause, so that there is a shift towards osteoclasis (bone degradation). It is usually a generalized condition, but localized forms are known including **Paget's disease of bone** (q.v.). Consequences can include bone deformity and fracture.

Otitis media. A formerly common condition in which there is bacterial infection of the middle ear, usually as a consequence of an infection's ascending to the Eustachian tube from the throat. See also **Mastoiditis.**

Overlapping. Teeth are described as overlapping if they appear to be misaligned in such a way that the lateral edge of one tooth comes to be partially in front of, or behind, the lateral edge of its neighbour. Commonly found in the anterior dentition, it is a result of crowding or early displacement of a tooth bud.

Paget's disease of bone (syn. **Paget's disease** or **Osteitis deformans**). This curious disease involves a dysregulation of bone synthesis and resorption initially within a limited area of the affected bone or bones, seeming to begin with increased resorption at the bone surface. Increased bone deposition follows, but in a disorderly manner, so that the microscopic architecture of the bone becomes highly irregular, with erratically arranged and uneven trabeculae and disarrangement of the Haversian systems. The bone becomes thickened, but weak, which can lead to the bowing of limbs, the sinking down of the calvarium, and bowing out of the parietal bones. Pathological fractures may occur in an affected bone. The lesion may continue to enlarge at its edges while becoming mostly quiescent more centrally. As bones distort, joints may become abnormally loaded and develop **Osteoarthritis** (q.v.) and, rarely, Pagetic bone may undergo neoplastic transformation into osteosarcomata of variable histological appearance. The disease is rare before the age of forty years. It has been associated with the presence of viral inclusion bodies within osteoclasts, but there are also indications of genetic susceptibility. It has been speculated that measles virus and/or canine distemper virus may be involved.

NB. Paget's disease of bone should not be confused with Paget's disease of the nipple, which is a form of breast carcinoma to which it is unrelated.

Periostitis. An inflammation of the periostium, often leading to new bone deposition at the surface of a bone and, if persistent, to bone thickening.

Plague. A general term for an epidemic of high mortality, usually applied to 'The Plague', which is an infection with *Yersinia pestis*. Three forms of infection with *Y. pestis* are known: (i) **Bubonic plague** is a form in which the pathogen is engulfed by macrophages and enters the lymphatic system, becoming concentrated in the lymph nodes, where it proliferates, causing swelling and necrosis. Necrotic axillary and inguinal nodes may swell to form 'Buboes' and burst through the overlying tissues; (ii) **Septicaemic plague** occurs where there is a high burden of the pathogen in the bloodstream and has a very high mortality rate; (iii) **Pneumonic plague** arises where the lungs become inflamed and oedematous, with the pathogen growing in the oedema fluid in the lungs. It is lethal.

Bubonic and septicaemic plague are transmitted by the bite of the flea of infected rodents, but both can evolve into pneumonic plague in which direct person-to-person transmission can occur by exhalation or droplet transmission. Species other than man can be infected and several kinds of small rodents are potential or known reservoirs of infection world-wide.

Porotic hyperostosis. A condition in which the surface of a bone shows a porous or spongy appearance because of thinning of the outer cortical bone so that the trabecular bone and marrow spaces can be seen at the bone surface. It is considered to be related to expansion of the haemopoietic tissue of the marrow and of trabecular bone, at the expense of cortical bone, in response to hypochromic **Anaemia** (q.v.), but it is by no means clear that this is always a simple relationship or that this is the predominant type of anaemia involved. The condition is principally seen in the calvarium and the orbits of the eyes, but it can occur elsewhere and be highly local, possibly suggesting that it can have other aetiologies as well. A further complication is that the appearance of porotic hyperostosis can be imitated by post mortem changes in bones in contact with soil, leading to its overdiagnosis in archaeological material. See also **Cribra orbitalia** and **Hyperostosis**.

Pus. The opaque liquid or semi-solid material resulting from many forms of acute inflammation. It consists of dead bacteria or other pathogens and the (now dead) neutrophil polymorphs that have killed them, suspended in a variable amount of tissue fluid and exudates. Some macrophages and necrotic tissue cells can also be present. Pus is found commonly in abscesses and around sites of infection and is often collected to form the contents of an **Abscess** (q.v.). Rarely pus may form from polymorphs alone reacting to local necrosis without infection.

Retained dentition. A persistence of part or all of the deciduous (primary) dentition beyond the point where it is normally shed, especially where some primary teeth persist into adult, or subadult, life. It can be associated with impaction and several types of misplacement of teeth.

Rickets. A failure of the normal mineralization of bone matrix in the juvenile skeleton, unlike **Osteomalacia** (q.v.). Hence, in rickets the cartilaginous growth plates and the bone are *both* affected, and this leads to a pathological outcome somewhat different from that in osteomalacia. In rickets there is a bowing of the metaphyses of the long bones, especially of the tibia, inadequate endochondral ossification and growth in bone length, exaggerating the tendency to a short stature caused by bowed long bones, broadening of epiphyses, and the formation of broad, knobbly costochondral junctions, leading to the 'rachitic rosary' along the sides of the sternum. The underlying causes of rickets are similar to those of osteomalacia, of which it is, in effect, a juvenile form.

Rotation of teeth. The turning of one or more teeth out of their normal alignment by rotation about their long axes. It is usually associated with crowding of teeth and is especially notable in the anterior dentition.

Sacroiliitis. Inflammation of, or around, the sacroiliac joints. It is usually applied to arthritic changes in the sacroiliac joints, for example in **Ankylosing spondylitis** (q.v.).

Sarcoma. A solid malignant neoplasm of mesenchymal origin (i.e. arising within connective tissue). The various types are generally named after their tissue of origin, thus cartilage gives rise to chondrosarcoma, bone to osteosarcoma, fibrous tissue to fibrosarcoma, etc.

Schmorl's nodes. These appear as depressions on the superior and inferior articular surfaces of vertebral bodies and they are considered to be a consequence of early degeneration of the intervertebral discs under pressure. They are associated with reactive hyperplasia of chondroblasts.

Sclerosis. The pathological hardening of a tissue, usually either by the deposition of collagen as in fibrosis or the deposition of additional calcium salts as in the pathological calcification of tendons, ligaments, and cartilage, or bone. In sclerotic bone there is an augmentation of matrix above normal levels relative to its content of cells, so that **Eburnated** (q.v.) bone may appear almost acellular.

Scoliosis. A lateral curvature of the spine at rest and not under a transient asymmetric lateral load, as in carrying a bag. It can arise from asymmetric muscle paralysis (e.g. from poliomyelitis), asymmetry of the legs or gait, injury to or disease of the spine or its associated musculature, or congenital malformation of the spine, pelvis, or legs. A **Compensatory scoliosis** is a corrective spinal response to an abnormality either within the spine or elsewhere, usually in the pelvis or legs. See also **Kyphosis.**

Scurvy. The deficiency disease resulting from an inadequate supply of vitamin C (ascorbic acid), whether the result of dietary insufficiency or malabsorption. Because the bodily reserves of vitamin C are small, a dietary deficit can have a clinical effect in about six to eight weeks, so, while the vitamin is normally in adequate supply in most diets, seasonal deficiency may easily occur. Additionally, the normal small intestine does not absorb vitamin C very efficiently, so parasites infesting the small intestine may seriously diminish uptake.

The major skeletal effects of scurvy are a consequence of the role of vitamin C in the hydroxylation of lysine and proline in collagen and the consequent impairment of its cross-linking. In the child, there is defective production of osteoid and consequent abnormality in epiphyseal bone growth and the development of the membranous bones of the skull. In the adult, these effects are much less, but subperiostial bleeding may occur (as also in the child), leading to secondary calcification. Mineralization is not directly impaired in scurvy.

Bleeding may occur in many sites in scurvy because of impaired blood clotting, but these are reflected skeletally only where they directly influence bones and joints or teeth. Epiphyses may be malformed in the child and in both children and adults secondary bleeding may make them abnormally knobbly or cause haemorrhage into joints. This can cause 'scorbutic rosary' of the chondrocostal joints resembling the 'rachitic rosary' of **Rickets** (q.v.). There is often gingival bleeding and the periodontal membrane may be abnormally weak and easily infected, leading to increased tooth loss. Anaemia tends to develop in prolonged scurvy either because the lack of vitamin C directly impairs dietary iron uptake, or because it increases haemorrhage, or because the vitamin C concentration is too low to protect reduced tetrahydrofolate. Hence the type of anaemia seen varies from forms typical of iron deficiency to megaloblastic types. Repair of bone is also impaired in scurvy, as a part of the general impairment of wound healing, because of the effects on the structure of collagen.

Shovelling. The peculiar shape of the incisor teeth where there is abnormal concavity, usually of their lingual aspects, relative to their lateral edges so that a shovel-like shape of the tooth results.

Smallpox. The major and much feared human disease caused by the pox virus *variola major*, which is now considered to be extinct in the wild, though it is still held in two secure laboratories for reference purposes should the disease ever reappear. The disease was contagious, with a mortality rate of *c.*50 per cent in recent times. Most survivors were to some degree disfigured. Transmission was by inhalation of infected household dust or by exhaled droplets from the airways of those carrying the virus.

After initial infection, the virus proliferated in macrophages, first near the site of infection, and then in lymph nodes draining the site, and finally throughout the body as a result of blood-borne spread. In the later stages of this dissemination the victim became febrile, with sweating, shivering, and severe malaise until the characteristic rash began to appear at two to three weeks from infection. The 'pocks' of the rash then developed from spots (macules) successively to papules, vesicles, pustules, crusted pustules, and, if the patient survived, began to heal slowly. However, in those patients who would die, the pocks became haemorrhagic and the fever returned. Thus, the disease was either quite rapidly lethal or the patient was severely ill for some time, but recovered. While a transient arthropathy could occur in smallpox it seems not to have been particularly common or to have had much permanent consequence. Hence though bone and bone marrow were certainly infected, any gross indication of smallpox would be in lines of arrested growth in the bones and lines of enamel hypoplasia in the teeth of those survivors who contracted the disease when young.

Spina bifida. A condition in which there is an incomplete fusion of the posterior neural arches of sacral and/or lumbar vertebrae, so that the spinal cord, its meninges, and the associated nerves are not protected by bone and are exposed dorsally to varying degrees. It is a neural tube defect. In severe cases the cord, etc. may protrude ('Spina Bifida Cystica') and there may be disability even if the malformation is less severe. Where the condition affects only a few vertebrae or the arches are substantially complete, the overlying tissues may afford appreciable protection to the cord, etc. and there may be no obvious abnormality or disability in life. This is **Spina bifida occulta**, which is moderately frequent in populations of north-west European derivation and is seen fairly often in archaeological material. Spina bifida is partially genetic in origin, but is also influenced by several nutritional deficiencies during fetal development, of which deficits in dietary folic acid and vitamin B12 are probably the most frequent, though inadequate intakes of selenium and zinc have also been implicated.

Spondylitis. Inflammation of an intervertebral vertebral joint, usually implying osteoarthritis of the joint with degenerative disc disease. Now a slightly archaic term and often replaced by **Spondylosis** (q.v.).

Spondylolysis. A defect of the neural arch of one or more vertebrae, usually seen in the lumbar region of the spine, so that the posterior part of the arch forms a separate bone. It is considered that the cause is a gradually developing fracture caused by heavy loading so that it can be regarded as a type of false joint.

Spondylosis. The changes seen in degenerative disc disease. These are the formation of new bone at the vertebral margins (i.e. Intervertebral Osteochondrosis), **Osteophyte** (q.v.) development, deterioration of the cartilaginous intervertebral disc with possible rupture, pitting of the bony surfaces of the vertebral body, and, often, the formation of **Schmorl's nodes** (q.v.). Inflammation is not implied as a primary event.

Stafne's defect of bone. A family of clinically asymptomatic defects found in the lingual aspect of the horizontal ramus of the mandible. Radiologically the defects, which are usually unilateral and solitary, appear cyst-like, with well-defined margins. Most occur between the angle of the jaw and the third molar, though a much rarer type (now called anterior Stafne bone defects) occur in the anterior part of the mandible. It was formerly considered that Stafne's defects arose from persistent remnants of cartilage, but it is now suggested that they arise from pressure caused by the submaxillary salivary gland (in most cases) or the sublingual salivary gland in the anterior form.

Supernumerary cusps. Extra cusps additional to those normally found upon a tooth. They are a developmental peculiarity of genetic origin.

Supracondylar process. A projection or knob of bone above the condyle of long bone in a joint.

Synostosis. A general term for the fusion of two bones, either physiologically during embryogenesis or pathologically.

Syphilis. A systemic and, usually, eventually chronic granulomatous disease produced by infection with the spirochaete *Treponema pallidum.* Infection is usually venereal, but can be congenital.

In venereal syphilis three more or less well-defined stages occur. Primary syphilis is characterized by a local lesion of skin or mucous membranes (a 'chancre') containing a mixed inflammatory infiltrate, including lymphocytes and macrophages, and abundant proliferating extracellular spirochaetes which rapidly spread via lymph and blood. Secondary syphilis develops in two weeks to three months from initial infection after an asymptomatic interval from the healing of the primary chancre and the onset of a strong immune response in the host. It is characterized by a rash which may be episodic and the development of foci of spirochaete proliferation widely through the body despite growing host resistance. After a further period of quiescence, which can be of several years' duration, tertiary syphilis develops, with the appearance of 'gummata', the characteristic **Granuloma** (q.v.) of syphilis, in which spirochaetes are found in small numbers within macrophages and giant cells within the granulomata.

Gummata can be found almost anywhere, but are typically in bones, liver, skin, spleen, and, rather more rarely, in brain and testis. Also, non-granulomatous inflammation may cause widespread injury including to bone surfaces (**Periostitis** (q.v.)) and blood vessels (e.g. syphilitic aneurysm).

In congenital infections (acquired transplacentally), infants may be born with a florid syphilitic rash and involvement of the airways (syphilitic 'snuffles'). Skeletal abnormalities may occur among other consequences and the incisor teeth may be malformed, when they erupt, into a notched peg-like shape ('Hutchinson's teeth'). Many infected fetuses die *in utero* and are stillborn or macerated and there is a high mortality (*c.*50%) in surviving infants even today.

Torus. A smooth rounded knob of bone developed either in response to some persistent irritation of the periosteum, principally around various openings in the skull, or at the junction of two centres of ossification (i.e. at, or near, a suture line). There are four types: (i) **Torus auditivus** occurs around the external auditory meatus and may cause deafness if large enough; (ii) **Torus mandibularis** occurs on the mandible; (iii) **Torus maxillaris** occurs on the maxilla; (iv) **Torus palatinus** occurs on the palate, usually on or near the palatine suture.

Transposition. A disorder of tooth development such that two adjacent teeth appear to have exchanged position.

Trauma. In its original sense trauma means injury and this remains its meaning in pathology, where it is generally applied to mean exogenous injury, whether from accidental mishap, over-usage, or violence, of a physical or, rarely, chemical origin. The term is not normally applied to injury purely consequent upon infection. Its recent and generally popular application to psychiatric injury is not relevant here.

Tuberculosis (TB). The disease resulting from an infection with *Mycobacterium tuberculosis hominis* or *M. tuberculosis bovis*. Infections with other Mycobacteria generally show a different pattern of disease (e.g. with *M. leprae*; see **Leprosy**), but the patterns are variable and the signs and symptoms of TB can overlap with those of other chronic granulomatous diseases, so definitive diagnosis depends on confirming the presence of the organism, which is difficult at best in archaeological material though DNA analysis offers some hope.

Infection is usually by inhalation of droplets from the coughing of an infected person and, in the nineteenth century and earlier, by the ingestion of contaminated milk or meat. The bacteria are engulfed, but not effectively killed, by macrophages in which they are transported. Most bacterial proliferation in TB is within macrophages. The regional draining lymph nodes become involved, forming part of a 'Ghon complex'. By this stage there has been activation of T-lymphocytes and release of various inflammatory mediators. If the T-helper cell response was strong enough the further progression of the disease may cease and, eventually, the Ghon complex may calcify (and be detected in archaeological material). Alternatively, if the response is not adequate wholly to contain the infection large, well-formed granulomata may appear and the disease may slowly disseminate, possibly over several years. This is **Classical TB**. If the immune response is weak **Miliary TB** develops and small millet-seed-sized and poorly formed **Granulomata** appear widely and rapidly. Death in TB can result from respiratory compromise, infection of the brain, secondary infections, or from the erosion of a major blood vessel, causing a lethal haemorrhage, often with vomiting of blood. Subclinical infection is fairly common today and may well have been so in the past, so that latent disease might well have developed into the clinical form in association with malnutrition or acquired immune deficit.

Tumour. An ancient general term for a swelling, which has gradually become used in common parlance as a synonym for a solid **Neoplasm** (q.v.).

Typhoid fever. An infection with the bacterium *Salmonella typhi* and the responses to it. Infection is by ingestion of contaminated food or water, or by contact with an infected human or animal carrier. The bacteria enter Peyer's patches of lymphoid tissue in the intestinal wall and thence gain entry to the bloodstream. Septicaemia follows, with toxaemia. The gut-associated lymphoid tissue becomes swollen and ulcers develop in the small intestine, which may perforate and bleed, either as bloody diarrhoea or simple bleeding. If untreated, up to one third of patients die from this within about three weeks from infection. Injuries from the bacterial toxin and immune responses may also occur in the heart, kidney, liver, gall-bladder, and elsewhere. Other species of *Salmonella* can infect man, but usually cause mild disease.

Typhus. A generic term for a family of similar diseases caused by any one of several species of *Rickettsia*. The spotted fevers are closely related. Epidemic typhus (caused by *R. prowazeki*) and endemic typhus (caused by *R. typhi*) are very widespread. The former is spread by the human body louse and the latter by rat fleas. Other rickettsial diseases, including other forms of typhus, are of a more restricted distribution and are largely spread by the bites of ticks, fleas, and mites. Most of these diseases can also be spread by the scratching of skin contaminated with the faeces of the vectors.

All *Rickettsiae* are obligate intracellular parasites akin to specialized bacteria, which colonize the endothelial cells of small blood vessels, especially capillaries, initially at the site of infection and later systemically. Swelling and damage to endothelial cells leads sequentially to capillary obstruction, thrombosis, sometimes to necrosis and a mixed inflammatory response. The resulting disease is of variable severity depending upon the species of *Rickettsia* involved and the strength of the host's responses. Latent infection and relapse can occur in patients with *R. prowazeki* infections, leading this form of the disease to recur in human populations without there being an animal reservoir. In other forms of typhus rodents such as mice are commonly reservoirs.

Varus deformity. The outward bowing of the legs ('bow legs') seen in rickets or **Paget's disease of bone** (q.v.). The opposite abnormality ('knock knees') is a valgus deformity.

Wormian bones. Ossicles formed in sutures of the skull, especially in the lambdoid, sagittal, and coronal sutures. They arise from the development of minor centres of ossification at a late stage in the growth of the skull shortly before the sutures begin to close and are under a high degree of genetic determination. They are a developmental variant rather than being pathological.

Wounds. Wounds on bones, unless acquired post mortem, must have passed through soft tissues, while soft-tissue injuries may or may not reach bone depending upon their depth, site, and direction.

Blade wounds to soft tissue are classified as: (i) **Incised wounds**, if the predominant direction of movement of the blade is in the plane of the surface being cut; (ii) **Chops**, if the predominant direction of movement of the blade is normal to the plane of the surface being cut (i.e. at right angles); (iii) **Lacerated wounds**, if the direction of movement of the blade is oblique to the plane of the surface being cut, especially if the blade is blunt. Incised wounds and chops have two straight edges, lacerated wounds have one straight edge and one rolled edge. An irregularity in the blade will produce marks in the direction of the cut, so that incised wounds and chops may show marks either along or at right angles to the wound respectively. In lacerated wounds such marks may be visible on the straight edge. Clearly some wounds will show features of both chopping and incision and be of a hybrid type produced by a slashing motion.

If a wound penetrates to and into bone, the marks of incision, chopping, or slashing will be similar to those in soft tissues, with two straight edges and any irregularities in the blade being reflected in the sides of the wound. Lacerated wounds have a different appearance in bone. One edge is straight, representing the lower side of the cut, while the upper side of the cut may be split (i.e. fractured) out as a flake of bone or the flake may be retained, but with a hairline fracture running out continuing the direction of movement of the blade, or the flake may be retained with or without a hairline crack, but be curved upward away from the blade, especially as the bone dries (as in much archaeological material). A blunt blade or a blade impacting at a very narrow angle may simply produce a surface abrasion or scrape on the bone.

Blunt objects, such as hammers, may fracture bone, often with displacement, and cause abrasions, but they tend to leave small flakes of bone turned inward at the edges of the wound, in the direction of movement.

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