Skeletal characteristics and population demography as reflected by materials from Toutswe tradition sites in eastern Botswana, west of the Shashe-Limpopo basin

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I hereby declare that the dissertation

Skeletal characteristics and population demography as reflected by materials from Toutswe tradition sites in eastern Botswana, west of the Shashe-Limpopo basin

which I

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am submitting to the

University of Pretoria

Department of Anatomy

for the degree

MSc with specialization in Anatomy

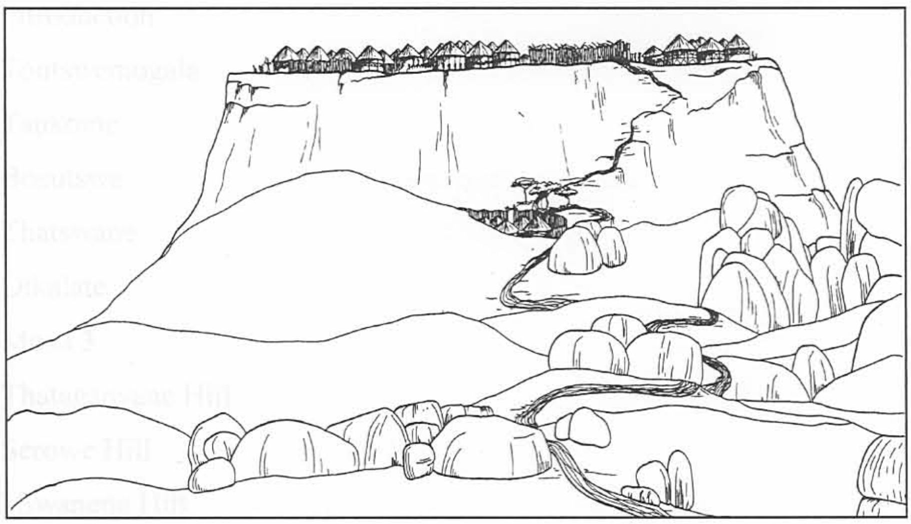
is my own work and has not been submitted by me to any other university for degree purposes

Morongwa Nancy Mosothwane

2004/03/02

Date

'The year is 1026 A.D. almost a thousand years ago. The place is a hilltop called Toutswemogala, about 50 kilometers north of present- day Palapye... It is early in the morning. The sun is just peeking over the horizon and the cattle are slowly making their way down the narrow path from the hilltop to the pastures below. In the distance a lion's roar can be heard echoing between the hills (James and Jocelyne Denbow)'.



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This research was approved by BNMMAG and permitted by the Office of the President, Gaborone, Botswana.

ABSTRACT

Eighty-four skeletons pooled from 10 Toutswe tradition sites in east central Botswana are used to investigate the lifestyles of Early Iron Age inhabitants of Botswana. The Toutswe people arrived in central Botswana at approximately AD 700 into a land previously occupied seasonally by hunter-gatherers. The investigation entails an assessment of the demographic profile, gross pathology, dental health and characteristics as well as skeletal growth of the Toutswe polity. Macroscopic observation of age markers, sex indicators, skeletal and dental lesions is the main tool used in the analysis.

The sites from which the skeletons come from are characterised by similar ceramics and settlement layout. From the archaeological point of view, it has been accepted that while these were different villages or towns, the communities were culturally homogeneous. There is no evidence to suggest that the communities were genetically heterogeneous and this investigation took on a premise that the skeletons are of the same population affinity.

The low frequencies of nonspecific markers of stress and the absence of chronic infection suggest that the communities were generally healthy especially when compared to K2/Mapungubwe people. However, the demographic profile, which is characterised by high infant mortality, suggests that the children may have been more prone to acute diseases. Degenerative diseases and traumatic lesions are within frequencies often reported in southern African prehistory and there is a possible case of DISH. The analysis of dental health suggests that the diet of the Toutswe people was non-cariogenic.

Note on terminology

Quite often people use Toutswe and Toutswemogala (hill) interchangeably to mean either the Toutswe tradition or Toutswemogala Hill from which Toutswe tradition derives its name. In this study, the author has tried to use terminology proposed by Denbow (1983a). Toutswemogala (occasionally sited as Toutswemogala Hill or Toutswe Hill) refers to the actual site while Toutswe refers to a tradition defined on the basis of a ceramic typology. In earlier publications (e.g., Lepionka 1971; 1978; 1979; Welbourne 1975; De Villiers 1976) the site was erroneously spelt, as Tautswe or Tautswemogala but this spelling has not been used in the text.

Data pooled from K2 and Mapungubwe has been used for comparison with Toutswe results. Unless otherwise stated, the pooled data is denoted as K2/Mapungubwe.

Abbreviations

BNMMAG – Botswana National Museum Monuments and Art Gallery
UB – University of Botswana

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1. INTRODUCTION

Toutswe tradition is one of the earliest manifestations of complex Iron Age communities in the interior of Southern Africa. It was one the 'kingdoms' that rose and fell within the Shashe–Limpopo basin. The Toutswe people occupied the western side of the basin. Dates from different sources place it between A.D. 700 and 1250 (Denbow 1982; 1983a; Hall 1987; Reid 1998). The Toutswe capital is believed to have been Toutswemogala, a settlement located on a flat-topped hill 40 km north of Palapye. During its prosperity, the community had two additional large centers at Bosutswe and Shoshong (Denbow 1982; 1983a; 1999; Hall 1987; Kiyaga-Mulindwa 1993; Lane et al.1998).

Toutswe sites are located in the east central part of Botswana, an area characterised by unpredictable rainfalls, cold winters and hot summers and seasonal grasslands. Countless hills, escarpments and low lands intertwine with each other forming a landscape of complex relief (Cooke 1982; Reid 1998). To the northwest of the Toutswe area are wet flat lands of numerous saltpans of which the largest is Sua Pan. The western frontiers of the Toutswe complex lie along the eastern borders of the Kalahari Desert.

Initial research at Toutswemogala consisted mainly of surface collections of pottery by Laidler from South Africa in the 1930s (Lepionka 1978; Denbow 1983a; Campbell 1998; Reid 1998). Excavations on the site began in the early 1970s and were carried out by Lepionka. He concluded that the site was closely related to the Mapungubwe complex on the eastern side of the Limpopo River. During excavations by Lepionka (1977; 1978) numerous human graves were found. In 1978, Denbow conducted a survey of the east central part of the country and reported around 250 archaeological sites, all of them with remnants of Toutswe pottery (Denbow 1979a; 1982; 1983a; Campbell 1998). He began systematic excavations at numerous sites for his Ph D project in the early 1980s.

Archaeologists have used the spread and evolution of ceramic decoration motifs and distribution of cultural artifacts such as glass beads to suggest an active interaction between Toutswe and K2/Mapungubwe peoples. In fact, it has been proposed that the

Toutswe people may have moved eastwards to K2/Mapungubwe when their environment became less productive (Denbow 1983a; Huffman 1986; Hall 1987; Reid 1998).

The arrival of the people associated with the manufacture of Toutswe ceramics in east central Botswana marked an introduction of new ways of life and changes in social and economic systems, which affected not only the new arrivals but also the hunter-gatherers who had inhabited the area for centuries before (Denbow 1982; 1983a; 1990; 1999). There was obviously an increase in population density, which in turn reduced the ratio of resources to people.

Archaeologists have worked extensively in the Shashe-Limpopo area over the last several decades and have come up with theories that link prehistoric inhabitants of the basin. Contrary to this, physical anthropologists have only focused on the eastern side of the area where skeletons from sites like Schroda, K2 and Mapungubwe have been analysed (Galloway 1937; 1959; Gardner 1963; Meyer 1998; Steyn 1994; Steyn and Nienaber 2000). In a nutshell, much is known about the cultural evolution and transformations of the entire area while our knowledge of the health, skeletal characteristics and demographic profiles of the area is skewed towards the east.

Studies of human skeletal remains in South Africa gained popularity at the beginning of the twentieth century. The early and middle parts of the century were characterized by a hype of research on the issue of racial characteristics of archaeological and modern non-white inhabitants of South Africa. The issue of racial characteristics of archaeological versus modern populations was intriguing for two reasons. First it was proposed that modern populations had arrived in southern Africa from central and west Africa shortly before the arrival of whites in the Cape (Hall and Morris 1983). The second reason was based on the idea that the people responsible for the manufacture of eloquent gold and other metal artifacts and ceramics found at places like Mapungubwe and Great Zimbabwe were not originally from Africa. It was proposed that elaborate gold burials from Mapungubwe were of a distinct 'Boskop" race that had no genetic links with modern black populations. The aims of most studies were to find proof in the form of population characteristics that black South Africans were new in the area just like white South Africans (Galloway 1937; 1959; Keen 1947; Singer 1958; Gardner 1963; De Villiers 1968b; Rightmire 1970).

As a result of the quest to place the origins of South African blacks within a framework of temporal and biological contexts, physical anthropology became biased in two ways. The first bias relates to the fact that cranial remains were given more attention than the postcranial skeleton. Cranial morphological and metric characteristics are the prime source of information for determining racial affinity from skeletal remains. It was therefore inevitable that emphasis was placed on craniology (Keen 1947; De Villiers 1968b; Krogman and İşcan 1986; İşcan and Kennedy 1989; Novotny et al. 1993). Postcranial skeletons were only given brief descriptions. The second bias relates to the use of adult skulls to assess racial features. Subadult skulls are known to posses little, if not complete absence, of racial indicators and therefore much of the discussions of human skeletal remains were focused on adult samples. Similar to the postcranial skeleton, infants, juveniles and adolescents were not studied in detail. It has thus been the case that physical anthropological literature dated to the early and middle twentieth century is devoid of a body of information on issues pertaining to health, diet and palaeodemography of prehistoric populations in South Africa.

In order understand past population dynamics and characteristics, physical anthropologists study human skeletal remains (Brothwell 1981; Ubelaker 1989a). These studies allow researches to make inferences on the various aspects of populations such as the demographic profile, health and diet. Basic demographic elements, which are age, sex and population affinity can be determined from skeletal remains using a variety of techniques ranging from macroscopic visual observation to more complex of studies like bone histology (e.g., Krogman and İşcan 1986; İşcan and Kennedy 1989).

The last two to three decades marked the beginning of a new era in research based on human skeletal remains in South Africa. Studies took on a new approach towards the assessment of the general well-being and adaptation to the environment of prehistoric populations. The relationships between prehistoric populations and their environments became important aspects of research. The sciences of palaeopathology, palaeonutrition and palaeodemography, which had been applied elsewhere in and out of Africa, (e.g., Brothwell and Sandison 1967; Brothwell 1968; Armelagos et al. 1972) were introduced to South Africa. Morris' (1984) analysis of the protohistoric human skeletons from the Cape and western Orange Free State is one of the earliest texts encompassing the new approach in studies of prehistoric human skeletal remains. Other equally important studies were conducted by Patrick (1989) and Steyn (1994) based on Oakhurst and K2/Mapungubwe skeletal collections respectively. These samples had been excavated decades before but only their cranial characteristics had been studied in detail (e.g., Galloway 1937; 1959; Gardner 1963).

The new focus of attention in human skeletal remains studies brought with it changes relating to 'raw material' from which data was sourced out. Firstly, the postcranial skeleton was brought to parity with cranial remains in terms of value of data collection. Thus there was a move away from an almost exclusive discussion of cranial remains in the literature to the discussion of the complete skeleton. Secondly infant, juvenile and adolescent skeletons became as important as adult skeletons. Infants and juveniles are highly prone to diseases and stress and therefore provide substantial records of pathogen invasions, environmental insults and nutritional constraints experienced by prehistoric populations (Krogman and İşcan 1986; İşcan and Kennedy 1989). Developmental defects of enamel and lines of arrested growth are some of the lesions associated with stress experienced during the early years of life. In addition, high infant mortality and morbidity are general indicators of magnitude of environmental insults on populations. Therefore, both young and adult samples are needed to evaluate health and diet problems of prehistoric populations.

Notwithstanding the fact that early studies of human skeletal remains in South Africa were limited to racial issues, they do signal active research during those years. This is in contrast with other parts of southern Africa, for example, Botswana, Namibia and Zimbabwe. In Botswana excavations were rare for instance, the first excavation were done in 1970 (Lepionka 1971; 1977; 1978; 1979) and for almost a decade, no active fieldwork took place (Denbow 1983a; Campbell 1998). Activity in South Africa was not only fueled by the desire to identify prehistoric races but also by the desire to collect elaborate burial goods such as the gold rhino, beads and vessels found at Mapungubwe.

The search for gold burials lead to a serious problem in the sense that even untrained people went about raiding sites in search of gold and possibly other valuable materials (Gardner 1963; Meyer 1998). Consequently there was no attention paid to stratigraphic contexts within which human remains and cultural artifacts were found. At the time Botswana was considered a land with no Iron Age prehistoric occupation because of its dryness. It was though that the only groups to have occupied Botswana were the San hunter-gatherers and with that in mind there was no reason to search for gold burials in Botswana.

The skeletons from Toutswemogala (Lepionka 1977; 1978) were handed to De Villiers (1976) for analysis. Her study was focused on racial affinity, as was the fashion at the time. The bulk of her report centers on describing cranial features, age and sex of both adults and younger individuals. The report by De Villiers (1976) is the first analysis of human skeletal remains from Botswana but entails only a limited aspect of the Toutswemogala population. It should, however, be kept in mind that the sample was too small to be used for issues like health, diet and demography of this prehistoric population.

Besides De Villiers' (1976) work on the Toutswemogala skeletons, there was another study involving stable isotope analysis in some Toutswe skeletons by Murphy (1996). Murphy' study has some limitations. Firstly, the sample used is very small, using about 47 individuals (Murphy 1996: 332-333). The sample was drawn from only three sites (Toutswemogala, Taukome and Kgaswe B-55) to the exclusion of materials from other Toutswe sites that had been excavated at the time. Secondly, the skeletons from Toutswemogala were not labeled and therefore any future follow-up study would be difficult to identify those used by Murphy (1996).

A survey of the archaeology and physical anthropology literature of southern Africa yielded some interesting observations. Some of the published reports claim to have drawn their data from the broader southern African context, not just South Africa itself, (e.g., Hall and Morris 1983; Maggs 1984; Hall 1987). A closer look at these reports shows most of the data was actually drawn from South African sources with little reference, if any, to places like Botswana, Lesotho and Swaziland. At first glimpse of the title of the paper by Hall and Morris (1983), one would hope to find reference to De Villiers (1976), because the Iron Age skeletons used in the assessment are supposedly from southern Africa. In the 1987 book by Hall, there is little reference to archaeological sites in Botswana and only those in central east are included while a lot more sites had been reported in Botswana at the time. Once again the book title indicates coverage of much of southern Africa. It is thus clear that there is a lack of published material on past populations outside of South Africa.

Archaeological sites located on the western side (Toutswe type) and the eastern side (K2 and Mapungubwe complex) of the Shashe-Limpopo river basin are a testimony of some of the complex, independent and self-sustained political entities that existed in the interior of southern Africa between approximately one thousand and five hundred years ago (Denbow 1983a; 1990; 1999; Maggs 1984; Huffman 1986; 1989; Hall 1987; Lane et al. 1998). These polities interacted with each other economically, politically and socially at some point in time. It is worth noting that these polities were not contemporaneous as the Toutswe occupation preceded the rise of K2 and Mapungubwe. However, the fall of Toutswe and the beginning of K2/Mapungubwe occupation overlapped (Denbow 1983a; Hall 1987; Kiyaga-Mulindwa 1993; Lane et al. 1998).

Little is known about the health and skeletal characteristics of the pre-K2/Mapungubwe inhabitants of the Shashe-Limpopo area from the scanty Early Iron Age human remains obtained from Schroda, Happy Rest and Pont Drift (Steyn and Nienaber 2000; Steyn 2003). There are currently only eight Early Iron age individuals available for study and this number is too small to allow for conclusive statements. The skeletons from Toutswe sites present a good sample size from which the pre K2/Mapungubwe lifestyles can be inferred from, but bearing in mind the spatial contexts within which these polities existed.

The aims of this study are geared towards the development of physical anthropology in Botswana, and comparing the result with observations made in South Africa. It is probably appropriate to mention that the author does not imply that this report will automatically lead to the establishment of physical anthropology as an independent subject in relevant institutions at Botswana, but that it would most highly likely provoke further investigations by the author and international anthropologists on human skeletal remains from Botswana. The aims of the current study are thus as follows:

1. To mark the beginning of the use of human skeletal remains in the analysis of prehistoric populations in Botswana. No well-detailed studies on this nature have been done before although human skeletons in Botswana have been available for analysis in the last 45 years.
2. To assess the skeletal characteristics of people from a well-known Early Iron Age ceramic tradition in east central Botswana. The assessment includes the palaeodemography, palaeopathology, dental health and characteristics and

skeletal growth of the Toutswe children. From these analyses, inferences on the health of the Toutswe communities would be made.

3. To document in detail the human skeletal remains from Toutswe tradition sites. The documentation will list all individual skeletons, skeletal parts, preservation conditions and any other important information.
4. To bring to the attention of archaeologists the value of the analysis of human skeletal remains in piecing together the prehistory of Botswana. This will provide alternative scenarios alongside the use of material culture when interpreting the archaeology of Botswana.
5. To evaluate similarities and differences between Toutswe and other prehistoric populations known in South Africa, particularly the K2/Mapungubwe communities, and other parts of the world. This would hopefully promote an awareness of the Toutswe population as an integral part of the much broader Shashe-Limpopo skeletal collections.
6. To provide an alternative body of information relating to the health and demographic profile of Early Iron Age inhabitants of the Shashe-Limpopo basin. There are currently a few human skeletal samples from Early Iron Age sites in the area, thus making it difficult to make inferences on the pre-K2/Mapungubwe communities.

In this study, a sample of 84 individuals from 10 sites associated with the Toutswe tradition has been analysed. The skeletons included in this study have been excavated between the early 1970s (Welbourne 1975; De Villiers 1976; Lepionka 1977; 1978; 1979) and 2003.

An age estimate is assigned to each individual, and sex determined in adults. Stature is also estimated for adults. An assessment of the presence of skeletal and dental lesions is performed on all present remains and the lesions are described and used to make inferences on the general health of the Toutswe people. An evaluation of the dental characteristics of Toutswe people are carried out and the results compared to samples from different parts of South Africa and other places. Skeletal growth is assessed from lengths of long bones of infants, juveniles and older children. In cases where information was available, descriptions of burial styles are given.

Preservation of individuals varies within sites and across sites. Burials from Thatswane are the worst preserved. This site was severely destroyed by burrowing animals when found in the late 1970s. Some of the burials from Kgaswe B-55 appear to have been under good preservation conditions but were destroyed during excavation (Denbow 1983b; Murphy 1996).

Many problems were experienced due to lack of proper maintenance of human skeletal remains. Records indicating where individual skeletons were obtained from on the site and even principal archaeologists who excavated some of the burials were either not made at all or have been misplaced. In order to solve some of the problems and to prevent similar problems in future, a list of recommendations to the BNMMAG and UB will be made.

2. LITERATURE REVIEW

2.1 Introduction

The earliest dates of Iron Age occupation in Botswana come from Maunatlala site dated ca 300 to 400 A.D. in the east central side of the country. The site has evidence of short-term occupation with little investment on construction (Denbow 1983a; 1986; 1999; Kiyaga-Mulindwa 1993; Segobye 1998). Dense Early Iron Age settlements on the Shashe-Limpopo basin began around the eighth century A.D. in eastern Botswana and in the northern region of South Africa as well in the southern parts of Zimbabwe (Maggs 1984; Hall 1987; Denbow 1982; 1983a; 1984a; 1986; 1999; Kiyaga-Mulindwa 1993). Prior to this date there is hardly any evidence to suggest long-term occupation of this interior region by Iron Age farmers and herders. Debates on where the people came from are still ongoing, and are beyond the scope of this research, but there is a general agreement that they came from somewhere in east and central Africa.

Another question is how these groups traveled to reach southern Africa. Different views regarding this question have been expressed with some anthropologists and archaeologists arguing for multiple bands or waves of different people coming around the same time but using different routes. The other school of thought argues that a group of Iron Age farmers seeking better life conditions kept on moving down south slowly (Denbow 1983a; 1990; Maggs 1984; Huffman 1986; 1989). These people would have settled at different places for some years and then relocated southwards once conditions became unfavorable (Denbow 1983a; 1990; Maggs 1984; Reid et al. 1998). By so doing they would have eventually arrived in southeastern Africa to become what we today recognise as Early Iron Age communities.

Evidence in the form of archaeological sites, pottery and other artifacts indicates that shortly before the turn of the eight century A.D., the first group of Bantu-speaking migrants had reached southwestern Zimbabwe and the northern parts of South Africa. These were the people responsible for making the Zhizo type of ceramics and hence are called the Zhizo people or communities (Huffman 1986; Denbow and Wilmsen 1986; Hall 1987; Denbow 1990; Kiyaga-Mulindwa 1993; Segobye 1998). Between A.D. 700 and A.D. 900, Taukome ceramics were well established in eastern Botswana by people with very close links or relations to the people making Zhizo ceramics elsewhere in the region (Denbow 1983a; Huffman 1986; 1989). Whether the Taukome pottery people were an offshoot of the Zhizo pottery people has not yet been clearly proved.

The Kgalagadi desert covers about 84% of Botswana and could not have supported long term and large-scale human occupation. The eastern side of Botswana, on the other hand, is more fertile than the vast western desert. The soils in the thin eastern strip of land are slightly more fertile than the western sands and the annual rainfall can to some extent support food producing activities (Cooke 1982; Denbow 1983a; Denbow and Wilmsen 1983; Segobye 1989; Reid et al. 1998). Despite being a better area than the west, rainfall in the east is unreliable in terms of its timing and amounts. Periods of draught are common. The soils have rather poor fertility and water retention qualities are not very good (Denbow 1983a; Segobye 1989) and as a result crop failure is common. Risks of crop failure are much higher and more common as compared to problems and difficulties of animal husbandry. Thus the area is better suited for animal production than it is for crop production (Denbow 1979; 1984a; Denbow and Wilmsen 1983). Despite conditions in eastern Botswana, the area is currently the most populated. The same kind of situation appears to have been the case in the past with most of the prehistoric settlements being concentrated along the east (Denbow and Wilmsen 1983; Denbow 1986; Segobye 1998).

The Toutswe type-sites and those of the later traditions like Mapungubwe and Zimbabwe (and even the more recent Moloko) stretch along the eastern strip of land in Botswana. Prehistoric settlements along eastern and northern Botswana have been divided into two major groups: those on the Kalahari sandveld and those on the eastern hardveld (Denbow and Wilmsen 1983; Denbow 1986; 1984b). The eastern hardveld happens to be associated with Toutswe settlements and it has a higher number of archaeological sites compared to the sandveld.

Research on the Toutswe Tradition dates back to the 1930s when Laidler made surface collections from Toutswemogala having been informed of this 'magnificent hill of the gods' by the Ellenbergers (Lepionka 1978; Denbow 1983a; Campbell 1998; Reid 1998; Segobye 1998). Laidler's intention was to establish ceramic typologies from southern Zimbabwe, eastern Botswana and northern Transvaal in South Africa. The ceramic clusters could then be used to establish ancestral links to Bantu ethnic groups in the region (Denbow 1983a; Campbell 1998; Segobye 1989). Lepionka did the very first excavations at this site almost forty years later in 1970. Lepionka's aim was to find out whether Toutswemogala was an Early Iron Age or Late Iron Age site. His approach was similar to that of Laidler in that he treated the site as a single polity occurring on the margins on the Kgalagadi desert. During his expedition, more than twenty burials were found (Lepionka 1971; 1978; 1977; De Villiers1976; Murphy 1996).

It was not until the late 1970s when Denbow identified at least 320 more archaeological sites with Toutswemogala characteristics within a confined locality, that people began to appreciate the complexity of this archaeological phenomenon (Denbow 1979; 1982; 1983a; Campbell 1998; Reid 1998; Segobye 1998). It was then that the idea of Toutswe Tradition and Toutswe communities/people was developed. Lepionka's excavations were the only source of reference at the time when Denbow began excavating again at Toutswemogala and at other related sites of Taukome, Thatswane, Lechana, Maipetwane, Serokolwane and Kgaswe B-55 in the late 1970s and early 1980s (Denbow 1982; 1983a; 1986; Reid 1998).

Denbow used aerial photography to identify other sites in the vicinity of Toutswemogala. Vitrified cow dung and buffalo grass became key factors in identifying sites from aerial photographs (Denbow 1979; 1983a; 1983b; Campbell 1998). Vitrification occurs when deposits of cow dung are burnt at high temperatures on locations where cattle kraals had been previously located (Thy et al. 1995; Reid 1998). In some instances, these vitrified deposits have altered the soil's chemical composition by increasing its acidic content, and a grass species called '*cenchrus ciliaris*' or buffalo grass invades and monopolizes the vegetation on this acid soil. Buffalo grass localities appear as 'bald spots' on aerial photographs (Denbow 1979; 1983a; Hall 1987; Reid 1998). Vitrified cow dung is not only important in identifying archaeological sites in eastern Botswana, but it is also very useful in the reconstruction of the cattle population owned by the Toutswe people. Buffalo grass does not necessarily equate to Toutswe sites but it is a feature always associated with deep middens, which in eastern Botswana happens to be Toutswe sites (Denbow: personal communication).

By the late 1970s, Denbow's survey and excavation results revealed that the Toutswe complex was actually an Early Iron Age phenomenon, which occurred sometime between A.D. 700 and A.D. 1300. He further argued that its earliest ceramic assemblages were somewhat similar to those of the Zhizo Tradition on the southwestern part of the modern day Zimbabwe (Denbow 1983a; Maggs 1984; Huffman 1986; 1989; Reid 1998; Reid et al. 1998). He argued that different communities who shared ideas and information across space made the pottery. Manufacturing and decoration techniques were basically similar suggesting a strong sharing of ideas between the Taukome and Zhizo people.

The layout of Toutswe settlements presents a three-tier pattern of hierarchy. The pattern is based on size, location and length of occupation of a site (Denbow 1982; 1983a; 1984a; 1986; 1990; 1999; Hall 1987; Segobye 1989; 1994; 1998; Kiyaga-Mulindwa 1993). At the lowest level are class 1 sites where middens range between 1000 and 5000 square meters. Evidence from some class 1 sites strongly indicates that these sites were occupied for a period often not exceeding 50 years (Denbow 1983a; 1984; Reid 1998). They often have shallow dung deposits ranging between 10 and 25 cm. Another characteristic feature of class 1 sites is that they appear to have been occupied only once with no subsequent reoccupation (Denbow 1982; 1983a; 1984; Reid 1998). From those at which burials were recovered, the burials were almost always inside cattle kraals e.g. at Lechana (Denbow 1979b; 1983a). Class 2 sites were much larger and indicate periods of much longer occupation (200-300 years) by comparison to class 1 sites. Successive re-building, as seen from some stratigraphic layouts, is an indication of reoccupation of these sites at different times in the past. Their middens are on average 10 000 square meters in size and around 150 cm in depth (Denbow 1982; 1983a). Some of these sites have small stonewalls associated with later periods of occupation. Middens on Class 3 sites range between 80 000 and 100 000 square meters and exceed 150 cm in depth. Cultural deposits on these sites indicate that the sites were reoccupied at different periods. To date, only three class 3 settlements are known namely: Toutswemogala, Bosutswe and Shoshong, all of which are at least 100 km away from each other (Denbow 1982; 1983a; 1990; 1999; Segobye 1989; 1994; 1998).

Evidence for mixed farming by Toutswe Tradition societies comes in form of bones of cattle, sheep and goats from many of the sites as well carbonized remains of sorghum, beans and cowpeas from Thatswane and Kgaswe B-55 (Welbourne 1975; Denbow 1983a; 1986; 1999; Plug 1996; Reid 1998). In recent years, few chicken bones (*Gallus domesticus*) of most probably Indonesian origin were found at different levels of

Bosutswe (Denbow 1999). European rats (*Rattus rattus*) were also found though they would not have formed part of the food mainstay (Plug 1996; Denbow 1990; 1999). Wild fauna and flora made a significant contribution to the diet at most sites. It is therefore not far fetched to argue that the Toutswe people had a wide range of food resources (Welbourne 1975; Denbow 1983a; 1999; Plug 1996; Reid 1998; Reid et al. 1998; Segobye 1998).

During the Taukome phase ceramics were mostly decorated with single, and very rarely multiple, bands placed higher on the neck. The bands were of incision lines filled with diagonal combstamps (Denbow 1983a; 1990). Occasionally, the vessels were decorated on the body with triangles, which were not filled or sometimes they were decorated with single incision or combstamp lines. Plain beakers were more common than decorated ones during this phase.

The decoration technique remained as combstamping but the motif changed slightly and new types of vessels were introduced during the Toutswe phase. The bands around the neck were thinner and placed lower than previously. The triangles on the body were now always filled with either incision lines or comb stamps (Lepionka 1971; 1978; Denbow 1983a). Beakers were decorated with zigzag incision lines on the body filled with comb stamps. On rare occasions, multiple incision lines were placed at the bottom of the beakers. There were plain bowls and thick-rimmed bowls. On the lips of thick-rimmed bowls a continuous or discontinuous band of comb stamps was the main form of decoration (Denbow 1983a).

The K2 and Mapungubwe complex has been known and investigated in detail and in isolation from the rest of the Shashe-Limpopo area for many decades (e.g. Galloway 1937; 1959; Gardner 1965; Huffman 1986; 1989; Hall 1987; Steyn 1994; Meyer 1998). This was partly due to the misconception that the rather dry grasslands with unreliable rainfall on the fringes of the Kalahari had not been occupied by farmers/Iron Age people in prehistoric times. Most of the earliest anthropological and historical documents about Botswana assumed that the only societies to have ever settled in the area were the Basarwa hunter-gatherers (Denbow 1983a; 1999; Segobye 1989; 1994; 1998; Kiyaga-Mulindwa 1993).

Evidence in the form of ceramics, beads, metal implements, ornaments etc, indicates an active interaction between the Toutswe people and those of other traditions in northwest Botswana, southern Zimbabwe and northern South Africa. For instance, earlier ceramics from Taukome (A.D. 700) resemble those of Zhizo in Zimbabwe (Denbow 1982; 1983a; 1984b; Huffman 1986; 1989; Reid 1998). Sites closest to the Shashe-Limpopo confluence have been found with ceramics similar to those from the Mapungubwe complex while sites on the southern frontiers of the Toutswe extent suggest ties with Eiland ceramics coming in from the south (Denbow 1983a; Huffman 1989; Reid 1998; Segobye 1998). In addition to these indigenous artifacts is a whole array of glass beads coming in from the Indian Ocean trade. By 1000 AD glass beads from the Far East had reached places like Kgaswe B-55 (Denbow 1982; Segobye 1998). Gold copper and other metal wares were also in circulation throughout the region e.g., a gold bracelet had found its way to Bosutswe by 1000 AD from sources near Francistown, more than 200km away (Denbow: personal communication). Figure 2.1 shows some of the Toutswe type-sites mentioned in the text.

2.2 Toutswemogala

Toutswemogala is located about 50km north of Palapye, a modern town in east central Botswana (Figure 2.1). It is a flat-topped narrow hill of approximately 50m at the highest point. The hill is approximately 700m long and its widest part is on the eastern section where its maximum diameter is over 100m (Figure 2.2). On the surface are several stone cairn features and a large semi-circular stonewall measuring about 15m at its widest (Lepionka 1971; Denbow 1983a). Within the wall are two circular pits filled with softer soil, one in the center and one near the wall. The pits were tentatively identified as fire pits. Lepionka excavated the site for the first time during the winter season of 1970 (Lepionka 1971; 1978; Welbourne 1975; Denbow 1983a; Segobye 1989; 1994; Reid 1998). His main intention was to find out if the site fell into the Early Iron Age or Late Iron Age sequence of the Shashe-Limpopo.

A series of excavation trenches were set up and excavated in arbitrary levels. It is currently difficult, if not impossible, to understand Lepionka's excavation trenches to identify where each burial was found because of the inexplicit manner in which he wrote his report. There are a lot inconsistencies in the manner in which he labeled burials and presumably other finds (Murphy 1996). For instance, the Lepionka (1977) report mentions different burials in terms of chronological burial numbers whereas the burials were sent to De Villiers under a different identification system for analysis (Welbourne 1975; De Villiers 1976; Lepionka 1971; 1977; 1978; Murphy 1996). The two systems are unfortunately not easy to correlate or match. The author attempted to match burial descriptions given by Lepionka to skeletal descriptions given by De Villiers, but only a few were possible to match (e.g., Toutswemogala Burials 4 and 6). For example, Lepionka had labeled Toutswemogala Burial 4 in the current study as '5R135 first half burial at bedrock isolated skull, north end' (Lepionka 1971; 1978; De Villiers 1976). The remains are currently labeled in the format used by De Villiers and the author has since assigned the burials numbers that may not necessarily be consistent with Lepionka's. Special mentions are made where matches were possible to establish. The most unfortunate result of this is that most of the burials now lack information on burial styles. A general statement regarding the burials is that most, if not all of them, were horizontally flexed and oriented to the west.

A total of eight burials were found inside the wall (Lepionka 1971; 1977; Welbourne 1975). At the base of the central pit an adult burial was found in association with five complete pots. From the same burial, an iron bracelet and a piece of bone amulet were found. Two more burials were found outside the pits, an infant and a juvenile. The juvenile had been buried with a pot. In addition to these, an isolated right half of a skull was found close to the wall (Lepionka 1971; 1978). Several complete pots had been intentionally placed on hut floors. Among these were two of the same shape; one containing fine hematite powder and the other one containing remains of an infant (Lepionka 1971; 1977; 1978).

2.3 Taukome

Taukome is situated on a hilltop of about 70m in height, approximately 30km west of Toutswemogala (Figure 2.1) (Denbow 1982; 1983a; Hall 1987). It is an outcrop in basalt soils about 15km east of the Kgalagadi escarpment. The National Museum site number for Taukome is 26-B2-6. It is a class 2 site of the Toutswe settlement hierarchy (Denbow 1983a; 1984a; Reid 1998). Four small middens are situated on this hilltop alongside a large mound of approximately 70m in diameter. A semi-circular stonewall about 80m southeast of the mound is the only one of its kind on the hilltop. The wall is about 50 cm high and encloses an area of about 6 square meters. Taukome was first excavated in 1979 by Denbow as part of his Ph. D. research work. Excavation trenches were all located on the northern half of the mound. A deposit of about 150 cm in depth was uncovered. The stratigraphy indicates that the site was occupied for approximately 300 years. Throughout the 300-year span, small kraals were built successively on top of each other. Charcoal samples collected at different levels were used to calculate radiocarbon dates (Denbow 1982; 1983a).

By comparison to results from Toutswemogala, it appears that the upper dung level (15-25 cm) at Taukome was deposited around the same time when the earliest deposits at Toutswemogala were being accumulated. A conclusion based on these dates is that, of all the Toutswe type settlements, Taukome was most probably the first to be occupied (Denbow 1983a; 1984; Segobye 1989; 1994; Reid 1998). Several features ranging from human burials to animal kraals were excavated. A total of five burials were excavated from this site.

2.4 Bosutswe

Bosutswe is a low flat-topped hill approximately 85 km north west of Serowe (Figure 2.1). The hill is approximately 200m long in the east-west dimension and 200m in a north-south axis (Denbow 1986; Plug 1996). From a few meters away, a small prominent midden in the center of the site can be seen (Figure 2.3). The politics and dynamics of Iron Age communities in eastern Botswana are best understood from the site of Bosutswe. This site was occupied almost continuously for a period of slightly over 1000 years and thus presents a clear and uninterrupted sequence of events all of which can be observed from a single stratigraphy (Denbow 1986; Plug 1996; Segobye 1998). Moreover, it presents us with a wide variety of evidence for social, political, economic and ritual activities. As mentioned earlier this is a class 3 site which means that it was not used for a single or few activities but instead it hosted a whole wide range of events carried out for survival.

The stratigraphic context of Bosutswe is one of the best in terms of indicating internal as well external dynamics from one tradition or population to the other in southern Africa. Excavations at Bosutswe uncovered over four meters of cultural deposits of which the bottom two meters provides strong evidence of occupation of the site by people making Toutswe ceramics for a period of roughly 400 years (Denbow 1990; 1999).

Past occupation periods at Bosutswe have been divided into five phases. Denbow argues that during the first phase, the Zhizo decedents of the first group of Bantu speaking migrants from central and eastern Africa had reached Bosutswe shortly before A.D. 700. By A.D. 900, small settlements had been established in the neighboring hills at Mmadipudi, Kolokome and other places (Denbow 1990; 1999). This is termed the Taukome phase at Bosutswe.

By A.D. 1000 the second phase of occupation had been well established. This phase was marked by a substantial increase in the number of cattle and emphasis on social as well as political stratification, i.e. the beginning of what we today see as a three-tier settlement pattern, and thus the Toutswe phase had been developed. Furthermore, there was a substantial extent of interaction with outside communities as marked by the presence of cowry shells and glass beads from the Indian Ocean. The Toutswe period lasted up to around A.D. 1200. The Toutswe ceramics appear to have been developed from the earlier Taukome wares (Denbow 1983a; Huffman 1986; 1989).

The end of phase two and the beginning of phase three overlap. Phase three, which occurred between A.D. 1150-1300, is associated with the Mapungubwe period. Some major shifts within the internal structures of the communities occurred during this phase, for instance, cattle were now moved from the village centers to peripheral areas, a system that probably led to the concept of the modern day cattle post. Political and other important leaders now moved up the hill unlike in earlier periods when they were located in the valleys and low-lying lands. During this time, Bosutswe became incorporated into the western frontiers of the Mapungubwe hegemony in the Limpopo valley (Maggs 1984; Huffman 1986; Hall 1987; Denbow 1990; 1999). Ceramics with punctate decorations were introduced. A rather peculiar ash deposit has been found to occur consistently throughout the different excavation units. Denbow's (personal communication) interpretation of this is that the site may have been burned around A.D. 1300 marking the termination of the Mapungubwe phase and the beginning of the Zimbabwe phase.

The fourth phase lasted between A.D. 1300 and A.D. 1450 and is associated with the Zimbabwe period. During this period, only a small population of the local elite occupied the hilltop with subordinates down below. Deposits associated with the

Zimbabwe period are shallow and lack ornate artifacts normally associated with the rulers or elite. No elaborate stonewalls were built on the site during this phase and thereby strongly suggesting that the site had been reduced to a marginal and a far less important village (Denbow 1999). Ceramics continued to have punctate arcades and graphite finish was introduced. It is during this period that the earliest evidence of manufacturing ostrich eggshell beads on the site and the manufacture of bronze occurs. Cloth may have also been manufactured around this time as suggested by spindle whorls found. Gold appears around this time. The fifth and final phase of occupation has left very little archaeological evidence. This phase occurred around A.D. 1700 and did not last for too long. The seven semi-circular walls found today on the hilltop are associated with this phase. Its ceramics were presumably developed from the earlier punctate wares of the Mapungubwe and Zimbabwe periods (Huffman 1986; Denbow 1999). For further information regarding ceramic decoration techniques and motifs, the reader is referred to Denbow 1983a.

During the 1990 excavations at Bosutswe no burials were found, but instead an interesting artifact in the form of a gold bracelet was uncovered. However, the bangle came from the level associated with the Zimbabwe period. This is the only piece made from gold ever found on any of the Toutswe type settlements (Denbow: personal communication). The site was excavated for the second time in 2001. It was during this time that the first burial from the site was found and it remained the only burial from this site until 2002 when an additional 13 burials were excavated. Of these 13, it was decided that at least three were post-Toutswe as their graves appeared to have been dug into the earlier Toutswe deposits (i.e. the graves had been dug into Toutswe deposits which were already in existence). The decision was reached following discussions between the author and JR Denbow, the principal archaeologist working on the site. These were Bosutswe Burials 1, 2 and 10, which could have been from either the Mapungubwe or the Zimbabwe period. The burials have therefore been excluded from this study.

2.5 Thatswane

Thatswane is a class 2 site located approximately five kilometers south of Toutswemogala (Figure 2.1). On this site, vitrified dung deposits are inter-stratified with midden soils (Denbow 1982). The earliest date of this site was calculated to A.D. 925 ± 80 from samples obtained below a one meter thick deposit of vitrified dung. A burned post from a grain bin at a higher level provided the latest date that was calculated to be A.D. 1110 ± 75. The entire grain bin had been burned and it contained well-preserved and carbonized remains of beans and sorghum (Denbow 1983a; 1990; Reid 1998). The site had been destroyed by burrowing animals (Figure 2.4) causing displacement of some artifacts and human bones. During the excavations, six burials were found.

2.6 Dikalate

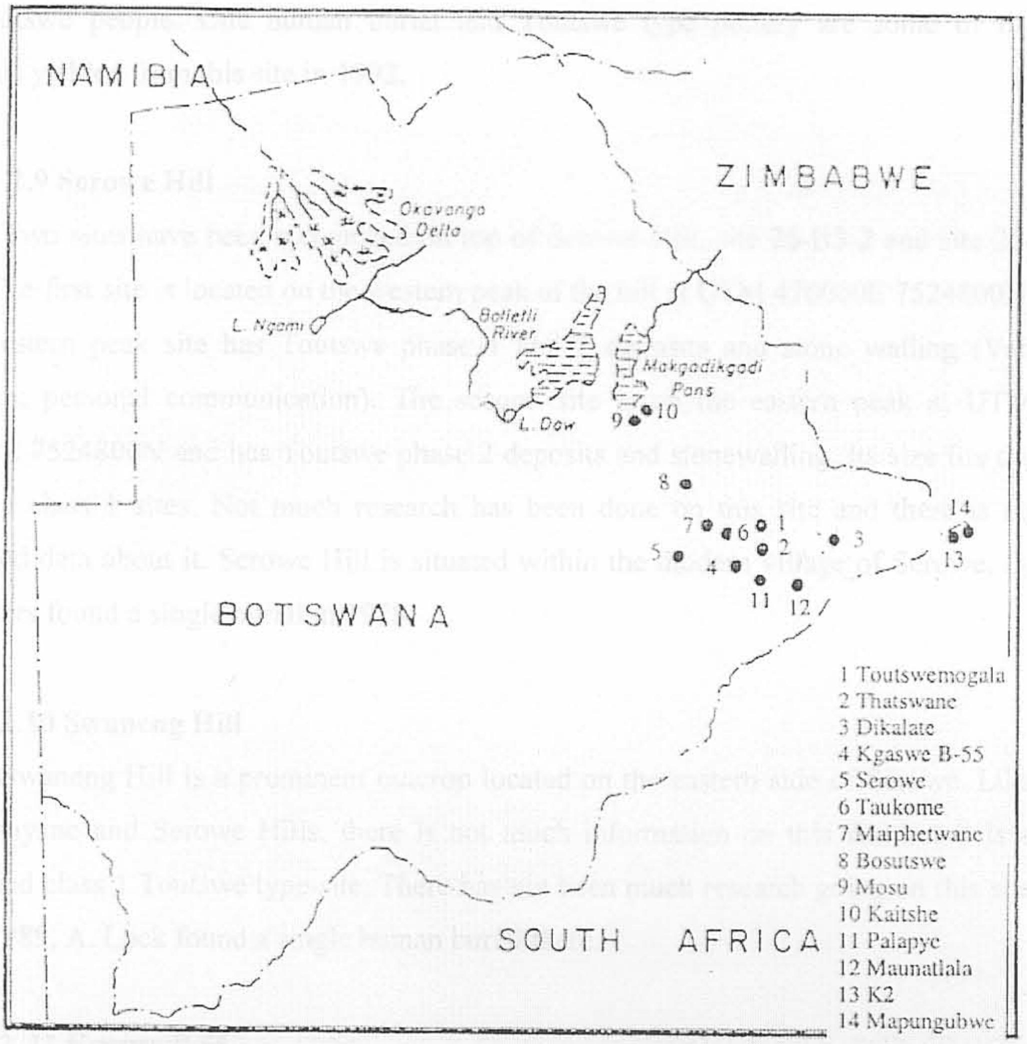
On a series of low lands and small hills to the north of Palapye, about 20km east of Toutswemogala (Figure 2.1), lies a number of archeological sites of different traditions. The sites were surveyed and excavated between 1998 and 1999 by Dr Andrew Reid (Reid 1999a; 1999b). The project was done as an archaeological reconnaissance of the area that was to be developed into a game park (Reid 1999a; 1999b). Of the several sites found, site 27-A2-18 is of relevance to the current study as it is the only one of Toutswe affinity and is the only one to have yielded human skeletal remains (Reid 1999a).

The main midden of the site is located on a plateau about two-thirds up the hill. It has a buffalo grass patch. Remnants of mud built grain storages presumably associated with latter communities fleeing the Difaqane wars (Reid 1999a; 1999b) are preserved underneath some rocks. A shallow grave of an infant was excavated by the author in the middle of this site.

2.7 Mosu 3

Mosu is an area situated along the southeastern margins of the Sowa Pan (Figure 2.1). The area has been surveyed and excavated by Reid and Segobwe, professional archaeologists from the University of Botswana. A series of sites dated between the 9th and 13th centuries A.D. were found along the escarpment (Reid and Segobye 1997; 2000). These are possibly the northern most sites associated with Toutswe occupation and like other sites they were reoccupied at different time periods. The sites are mostly located on hilltops scattered around the southeastern margins of Sowa Pan. Two human burials were found on shallow graves, one at Mosu 1 (1997) and the other at Mosu 3 (1998).

Figure 2.1 Some Toutswe sites in east central Botswana



2.8 Thataganyane Hill

Thataganyane Hill has a museum site number 26-B3-3 and is located at UTM 470100E 7525300N. The site is situated on a small hill north of Serowe Hill within the village modern of Serowe. It is reported to have a Toutswe phase 1 and 2 (Van Waarden: personal communication). Unfortunately there has not been much excavations and reports based on this site. The site appears to have been one of the class 1 marginal settlements of the Toutswe people. One human burial and Toutswe type pottery are some of the materials yielded from this site in 1992.

2.9 Serowe Hill

Two sites have been recognized on top of Serowe Hill, site 26-B3-2 and site 26-B3-1. The first site is located on the western peak of the hill at UTM 470000E 7524800N. This western peak site has Toutswe phase 1 and 2 deposits and stone walling (Van Waarden; personal communication). The second site is on the eastern peak at UTM 470300E 7524800N and has Toutswe phase 2 deposits and stonewalling. Its size fits the Toutswe class 1 sites. Not much research has been done on this site and there is no published data about it. Serowe Hill is situated within the modern village of Serowe. D. Schermers found a single burial in 1978.

2.10 Swaneng Hill

Swaneng Hill is a prominent outcrop located on the eastern side of Serowe. Like Thataganyane and Serowe Hills, there is not much information on this site but it is a confirmed class 1 Toutswe type-site. There has not been much research going on this site but in 1989, A. Lock found a single human burial there.

2. 11 Kgaswe B-55

Work on the Kgaswe sites began in 1982 following a request by the Shell Oil Company for an archaeological reconnaissance of the area that was to be developed into a coal mine (Denbow 1983b). The reconnaissance work was carried out between the end of 1982 and the beginning of 1983 and a total of 65 archaeological sites were reported. Of these 65 sites, Kgaswe B-55 was excavated and mapped and it has been found to fall within the class 1 Toutswe type of sites.

It has a low lying midden of approximately 7000 square meters which is about one meter deep (Denbow 1983b; 1990). The central midden had been disturbed by rodent activities and was under threat of advancing farming activities by people who were living around it at the time. It was recommended that the entire site be excavated by heavy plant machinery so as to be able to map it and also because there was not enough time to perform the conventional way of excavating (Denbow; personal communication).

The site provides a unique and complete picture of settlement layout of one the Toutswe tradition sites. House remains surrounded a central midden and among other things found on the midden, were male burials. Female burials were placed on the outer boundary of the site (Denbow 1986; 1990; Reid 1998). Figure 2.5 shows the settlement layout of the site with male burials in the central midden (Denbow 1986; 1990). Remains of 19 houses and 27 burials were found. One of the house structures had in it a complete pot containing over 2600 glass beads, 5000 ostrich egg shell beads and about 50 meters of wound wire necklace. Nothing of this sort has ever been found on any Iron Age sites in southern Africa (Denbow 1986; 1990; Reid 1998).

Figure 2.2 Aerial view of Toutswemogala (photo courtesy of JR Denbow)

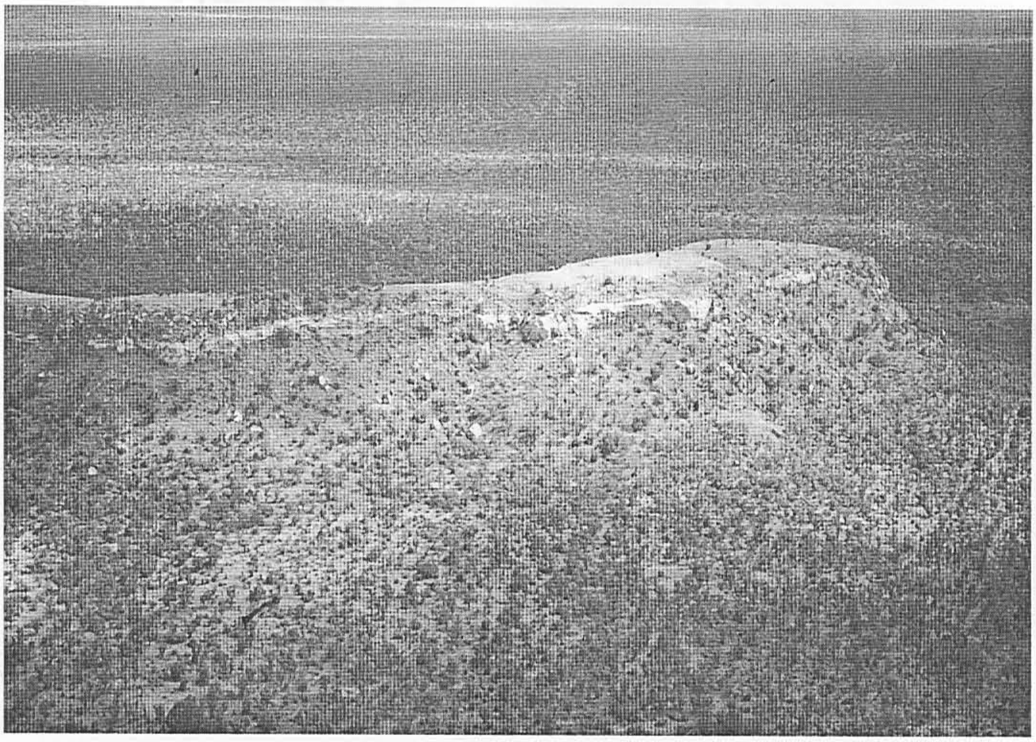


Figure 2.3 Bosutswe viewed from the south (photo courtesy of JR Denbow)

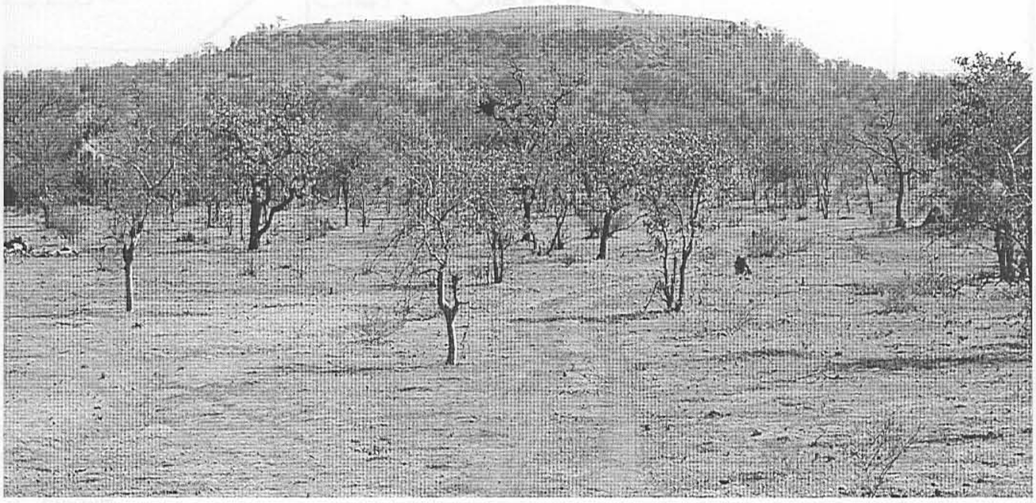
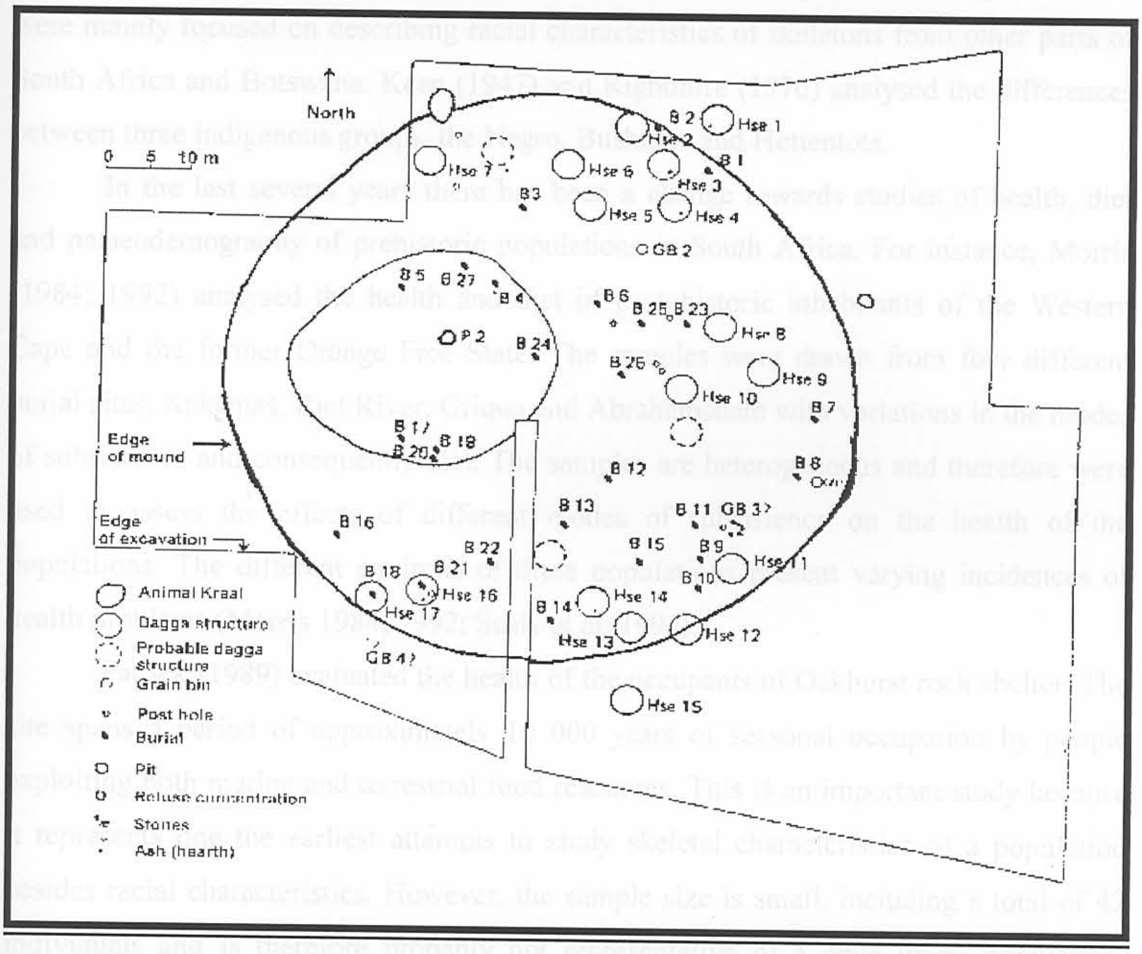


Figure 2.4 Base of excavation unit at Thatswane (photo courtesy of JR Denbow)

Figure 2.5 Map of features and burials at Kgaswe B-55 (Denbow 1999)



Most of the earliest studies on human skeletal remains in South Africa were focused mainly on identifying skeletons in terms of their racial or ethnic affiliation and to a lesser extent on age and sex. Archaeologists and anthropologists were mainly interested in classifying ceramics and then using racial or ethnic identities defined from human skeletal remains to equate ceramic traditions to specific ethnic or racial groups (Galloway 1937; 1959; Keen 1947; Singer 1958; Gardner 1963; De Villiers 1976).

Galloway analysed human skeletal remains from K2 and Mapungubwe and the main purpose of his study was to assess the cranial characteristics of the individuals so as to describe the racial characteristics of prehistoric inhabitants of the area (Galloway 1937; 1959). The study concluded that most of the individuals were of Bush-Boskop affinity with Negroid characteristics. A latter study by Gardner was basically the same in terms of its objective and its conclusion was that the K2 people belonged to a proto-Hottentot population (Gardner 1963). Other studies by Rightmire (1970) and De Villiers (1976) were mainly focused on describing racial characteristics of skeletons from other parts of South Africa and Botswana. Keen (1947) and Rightmire (1970) analysed the differences between three indigenous groups, the Negro, Bushmen and Hottentots.

In the last several years there has been a change towards studies of health, diet and palaeodemography of prehistoric populations in South Africa. For instance, Morris (1984; 1992) analysed the health and diet of protohistoric inhabitants of the Western Cape and the former Orange Free State. The samples were drawn from four different burial sites, Kakamas, Riet River, Griqua and Abrahamsdam with variations in the modes of subsistence and consequently diet. The samples are heterogeneous and therefore were used to assess the effects of different modes of subsistence on the health of the populations. The different environs of these populations present varying incidences of health problems (Morris 1984; 1992; Sealy et al. 1992).

Patrick (1989) evaluated the health of the occupants of Oakhurst rock shelter. The site spans a period of approximately 10 000 years of seasonal occupation by people exploiting both marine and terrestrial food resources. This is an important study because it represents one the earliest attempts to study skeletal characteristics of a population besides racial characteristics. However, the sample size is small, including a total of 42 individuals and is therefore probably not representative of a once living population. Moreover it does not allow for an evaluation of changes in health, diet, mortality patterns and population growth of the 10 000 years of occupation.

Another example comes from the K2 and Mapungubwe human skeletons, which were studied by Steyn (1994). The sites are associated with the Late Iron Age period on the Limpopo basin. The occupants of these sites were agriculturalists who supplemented their diet with wild animals. Results of the health and palaeodemography of the K2 and Mapungubwe skeletons are given in detail in different chapters of this study since they were used for comparison with the Toutswe skeletons.

In northeast Africa, the skeletons from Sudanese Nubia have been studied extensively (e.g., Armelagos et al. 1972; Martin et al. 1984; 1985; Ariaza et al. 1993). A decade of excavations on Sudanese Nubian sites along the Nile River in the northern Africa has yielded hundreds of human skeletal remains spanning a periods over 10 000 years. The Sudan sites provide one of the best profiles of the transition from Mesolithic hunter gathering to domestication of plants and animals (Armelagos et al. 1972; Martin et al. 1984; 1985). From each phase of occupation, substantial samples of human skeletal remains of different ages and sexes have been found. Numerous studies of these skeletons have covered topical issues of skeletal growth (e.g., Armelagos et al. 1972) health and diet (Martin et al. 1984; 1985; Ariaza et al. 1993), nutrition, population growths, mortality patterns over time, and the effects of changes in modes of subsistence of population health and growth.

3. MATERIALS AND METHODS

3.1 Materials

Archaeological human remains and cultural artifacts excavated from various parts of Botswana are submitted to the BNMMAG in Gaborone for storage. However, materials excavated by archaeologists from UB are kept at the Archaeology Division of UB for some time before being forwarded to the museum. Materials used for this study were all obtained from these two institutions. It was mostly through the literature and the author's knowledge that it became known how many burials had been unearthed from which sites. Neither the BNMMAG nor UB have catalogues for burials. The situation at the museum is worsened by mixing up individual skeletons in the past, when rearranging the storage facilities. Most of the boxes containing human burials are not labeled as such and therefore many boxes had to be unpacked in search of human remains. The skeletons from Toutswemogala were labeled on paper that was then stuck using tape. Most of the tapes had fallen off and thus making it even more difficult to identify the skeletons according to Lepionka's system. It will not come as a surprise should more burials be found after completion of this study, because the author's access to the BNMMAG and UB storage facilities was limited.

The literature was used to cross check the number of burials that were reported from different sites, and to use that as a basis for which boxes to search for relevant materials. For instance, Denbow (1983a) reported five burials from Taukome and therefore the search for Taukome burials was conducted until all burials had been found. On the other hand, other burials are known to have been excavated in the past especially by the university researchers but could not be found. In 1997 and 1998, for example, two burials were excavated at Mosu 1 and Mosu 3 respectively (Reid and Segobwe 1997; 2000) but the burial from Mosu 1 has been misplaced and was therefore not included in the current study sample. Table 3.1 summaries a list of burials known to have been excavated at various sites some of which were not available for analysis. The total number of burials reported from each site, date of excavation and the researcher who excavated the burial(s) is indicated where possible.

As mentioned previously, many of the skeletons were unfortunately mixed/commingled and some are missing. These are obviously difficult to analyse, but an attempt was made to establish the minimum number of individuals using mandibles or maxillae of incomplete and commingled remains.

During the winter season of 2002 the author set out with a team of archaeology students and professionals from Botswana and the USA on an excavation expedition in Bosutswe. The season produced 13 burials that were then exported to Pretoria along side skeletons from other sites for analysis. The remains of one adult from Mosu and an infant skeleton from Dikalate were studied at the UB where they were currently being in stored.

Table 3.1. Summary of burials obtained from different sites.

Site name	Reported Burials	n	Date Excavated	Principal Researcher	Current Location
Bosutswe	14	11	2001-2	JR Denbow	BNMMAG
Thatswane	6	4	1979	JR Denbow	BNMMAG
Taukome	6	6	1979	JR Denbow	BNMMAG
Lechana	2	0	1979	JR Denbow	BNMMAG
Maiphetwane	?	0	1979	JR Denbow	BNMMAG
Phate Hill	1	0	?	AK Segobye	BNMMAG
Toutswemogala	?	31	1970s	L Lepionka	BNMMAG
Kgaswe B-55	27	27	1983	JR Denbow	BNMMAG
Mosu 3	2	1	1998	A Reid	UB
Thataganyane	1	1	1992	?	BNMMAG
Kaitshe	1	0	1997	A Reid	UB
Dikalate	1	1	1999	A Reid	UB
Serowe Hill	?	1	1978	D Schemers	BNMMAG
Swaneng Hill	?	1	1989	A Lock	BNMMAG
Total	?	84			

n - number of skeletons included in the current study sample

?- information not known

3.2 Age estimation

Introduction

Estimation of age from the human skeleton and dentition is important in any study of palaeodemographic nature. The use of human hard tissue to estimate age was popularised some decades back (e.g., Todd and Lyon 1924; 1925; Massler et al. 1941; Schour and Massler 1941; Anderson et al. 1976; Fazekas and Kosa 1978). It continues to form a significant part of the physical anthropology literature (e.g., Ferembach et al. 1980; Van Beek 1983; Krogman and Iscan 1986; Ubelaker 1987; 1989a; İşcan 1989; İşcan and Kennedy 1989; Konigsberg and Frakenberg 1992; Novotny et al. 1993; Scheuer and Black 2000).

Skeletal aging techniques range from simple observation of gross morphology and metric evaluation to more complex studies of bone histology and cementum annulation and others (Ferembach et al. 1980; Krogman and İşcan 1986; İşcan 1989; İşcan and Kennedy 1989; Maples 1989; Novotny et al. 1993). Gross morphological observations techniques include, among others, changes in the pubic symphysis, closure of cranial sutures, degeneration of sternal ends of ribs, development and eruption of teeth, dental wear and fusion of epiphyses (Todd and Lyon 1924; 1925; Meindl and Lovejoy 1985; 1989; Krogman and İşcan 1986; İşcan 1989; Novotny et al. 1993; İşcan et al. 2000; Loth and İşcan 2000a). Metric evaluation involves the measurement of maximum lengths of various long bones and matching the measurements to dental ages (Fazekas and Kosa 1978; Sundick 1978; Ubelaker 1987; Kosa 1989).

It is important that each population group be studied so as to better understand ages at which different teeth erupt within that group. MacKay and Martin did one of the earliest works of determining ages at which teeth erupt among the Bantu people of Africa in 1952. Their study included a total of 680 boys and 603 girls all under the age of 20 years. The children were from the Msambweni area in Kenya (MacKay and Martin 1952). Comparison of their results to those from other areas revealed that deciduous teeth of the Bantu children erupt slightly later than and were shed a bit earlier than those of their British counterparts. Early loss of deciduous teeth meant that the Bantu children then had permanent teeth appearing slightly earlier than those of other races. Moreover, the processes occurred slightly earlier in females than in males (MacKay and Martin 1952; El-Nofely and İşcan 1989).

Various bones or parts thereof attain maturity stages at different times. During early years of life, bones are characterized by growth through increment in dimensions of individual bony masses and through fusion of related bony masses to form single bone units (Fazekas and Kosa 1978; Krogman and İşcan 1986; İşcan 1989; Ubelaker 1989a; İşcan and Kennedy 1989; Loth and İşcan 2000a; Scheuer and Black 2000). Once adulthood is reached, remodeling and resorption becomes the main activity in bone tissue. Processes associated with changes in the morphology of bone as a result of age are commonly referred to as degenerative conditions.

Consequent to the fact that various bones mature at various ages, numerous techniques have been developed to estimate age from fetal stages to old ages. It has been recognized that some morphological features are only reliable and accurate age indicators within a specific period of the life span and may become less reliable or completely irrelevant in some periods. For example, lengths of long bones are accurate when estimating ages of fetuses and young individuals and their reliability decreases with age so that by the late adolescent they become useless (Sundick1978; Fazekas and Kosa 1978; Ferembach et al. 1980; Johnston 1982; Krogman and İşcan 1986; Ubelaker 1987; 1989b; Scheuer and Black 2000). Like wise, the remodeling of the true ribs does not take place until about the early twenties and only become more reliable and accurate with increase in age (İşcan 1989; Oettlé and Steyn 2000; Loth and İşcan 2000a).

The most highly accurate method of age determination on immature human skeletal remains is the assessment of dental development and eruption (Massler et al. 1941; Schour and Massler 1941; MacKay and Martin 1952; Ubelaker 1987; 1989b; Loth and İşcan 2000a). Initial calcification, eruption and completion of roots are good indicators of age as these processes occur within a specific period of time with slight differences between males and females and between populations (Van Beek 1983; El-Nofely and İşcan 1989; Loth and İşcan 2000a). The sequence of dental development and eruption is well known and it has been found to be fairly consistent throughout different racial groups. There may be slight variations in the timing of eruption though (Van Beek 1983; Ubelaker 1989a; Loth and İşcan 2000a).

Guidelines for determining dental age in form of charts have long been established, by researchers like and Massler and coworkers (1941), Schour and Massler 1941 and Ubelaker (1989a). These charts have been used extensively in the literature (e.g. Krogman and İşcan 1986; İşcan 1989; Loth and İşcan 2000a; Scheuer and Black 2000) and are thus regarded as reliable and accurate tools to assist in dental aging. It is worth noting that this chapter will only focus on those techniques that have been used in the current study to estimate age.

Any attempt to reconstruct the life style of human from skeletal and dental remains is clouded by problems and limitations. Problems encountered in age estimation from skeletal and dental remains have been discussed in detail by numerous authors (e.g., Buikstra and Konigsberg 1985; Krogman and İşcan 1986; Ubelaker 1987; İşcan and Kennedy 1989, İşcan 1989; Maples 1989; Loth and İşcan 2000a). Variations in times of reaching maturity or specific developments exist between populations and hence standards for age estimation are population and sex specific (MacKay and Martin 1952; Ubelaker 1978; Buikstra and Konigsberg 1985; Krogman and İşcan 1986; İşcan and Kennedy 1989; Loth and İşcan 2000a). Therefore, when estimating age it is important to use a reference sample that is as close to the study sample as possible. Variations also exist between sexes within the same population. When dealing with skeletal material whose sex cannot be determined, results of age estimates should be of a range that encompasses both sexes (Krogman and İşcan 1986; Ubelaker 1987; İşcan 1989; Loth and İşcan 2000a). Furthermore, there has to be an emphasis on the use of various methods and bones available in order to limit the effects of inaccuracy detected in each method as well as to minimise inaccuracy resulting from variations between populations and reference samples populations (Ferembach et al. 1980; Konigsberg and Frakenberg 1985; Maples 1989).

Newborn/fetal

Lengths of long bones are commonly used to estimate age of newborn/fetal skeletons, for two main reasons. Firstly, they provide results of high accuracy with a margin of error of one month (Sundick 1978; Fazekas and Kosa 1978; Krogman and İşcan 1986; Ubelaker 1987; 1989b; Kosa 1989; Scheuer and Black 2000). Secondly, long bones preserve better than tooth germs in the archaeological record. For instance, in the current study, tooth germs were hard to come by whereas long bones were more readily available. The Fazekas and Kosa (1978) standards are used worldwide as they are based on adequate samples and they have been proved to be highly accurate. This study used the Fazekas and Kosa (1978) standards.

Another method used to assist in aging newborn/fetal remains is assessment of fusion of bony masses forming the temporal bone. During the eighth fetal month, the tympanic ring fuses to the squama (Fazekas and Kosa 1978; Kosa 1989; Scheuer and Black 2000) so that at birth two bony masses, the petromastoid and the squamotympanic represent the temporal bone.

Zero to five years

The most important age related skeletal changes during the first five years of life is the continued development and subsequent eruption of deciduous teeth (Massler et al. 1941; Schour and Massler 1941; Van Beek 1983; Krogman and İşcan 1986; Ubelaker; 1989a; 1987; Iscan 1989; İşcan and Kennedy 1989; Scheuer and Black 2000). Eruption of deciduous teeth begins with the central incisors of the mandible at about six months, followed by lateral incisors at approximately nine months, first molars at 12 months, canines and second molars at 18 months and 24 months respectively. At approximately three years all deciduous teeth are in occlusion and permanent teeth do not show until the sixth year of life (Massler et al. 1941; Schour and Massler 1941; Ubelaker 1987; 1989a; van Beek 1983; Loth and İşcan 2000a). An acknowledged dental development and eruption chart developed by Ubelaker (1989a) was used to determine dental ages of immature skeletons. The age estimates were made broader to encompass sex differences.

Long bone lengths continue to be very useful age indicators during these years. In cases where long bones were not present (e.g., Bosutswe Burial 4), cranial measurements were used as substitutes. This individual is represented by a partially complete calvarium only. Cranial measurements are less accurate than long bone lengths and thereby producing slightly wider age ranges. The data used for craniometric aging was obtained from K2 skeletons (Steyn and Henneberg 1997a).

Developments occurring during the first year of life are that the left and right halves of the mandible fuse to each other at about six months and the posterior fontanelle closes (Loth and İşcan 2000a; Scheuer and Black 2000). The petromastoid and squamotympanic parts fuse to each other so that by the end of the first eighteen months there is one bony mass making up the temporal bone. On the sphenoid bone, the greater wings fuse to the body (Scheuer and Black 2000).

After birth the anterior fontanelle reduces in size but does not attain complete closure until about the second year of life (Loth and İşcan 2000a; Scheuer and Black 2000). The metopic suture, which divides the frontal bone into left and right parts between the nasion and the bregma closes at approximately two to three years but in some rare instances, a patent metopic suture just above the nasion, may remain open throughout adulthood (Loth and İşcan 2000; Scheuer and Black 2000). Between one and three years the lateral parts of the occipital bone fuse to the squama so that the occipital bone is represented by two bony masses at the end of the third year of life.

On the vertebral column, between the third cervical vertebra and the fifth lumbar vertebra, three bony masses represent each segment at birth. Neural arches fuse to each other during the first year of life and neurocentral fusion takes place between two and three years. At the end of four years, most vertebral segments are represented by single bony masses (Scheuer and Black 2000).

Five to 15 years

Eruption of permanent teeth is an important characteristic feature between five and 18 years. The sequence of permanent teeth eruption begins with the first molars at approximately six years and follows with eruption of central incisors at six to seven years, lateral incisors at seven to eight years, first premolars at about nine years, second premolars between nine and 11 years. Canines and second molars erupt at about 11 and 12 years respectively (Massler et al. 1941; Schour and Massler 1941; Anderson et al. 1976; Ubelaker 1989a; Van Beek 1983; Hillson 1996; Loth and İşcan 2000a). Third molars are more varied as they may erupt between 17 and 21 years. In some individuals they do not develop at all. The period between six and 11 years is characterised by a mixture of deciduous and permanent teeth with deciduous teeth being replaced by permanent teeth.

Between five and seven years, the lateral parts and basilar part of the occipital bone fuse and hence the occipital bone is represented by one bony mass at the beginning of the eighth year (Scheuer and Black 2000). Lengths of long bones are still good indicators of age during this period.

13 to 20 years

The main process of growth during adolescence is the fusion of epiphyses of major bones and this process takes on a known pattern. The process begins with fusion of the elbow at approximately 12 to 14 years followed by the hip, ankle, knee, wrist and finally the shoulder at about 18 years (Krogman and İşcan 1986; İşcan 1989; Ubelaker 1989b; Loth and İşcan 2000a). By the mid twenties most of the fusion lines are partially or completely obliterated. More detailed descriptions of ages of epiphyseal fusion are provided in the literature (e.g. Ferembach et al. 1980; Krogman and İşcan 1986; İşcan 1989; Scheuer and Black 2000). As mentioned previously, third molars may erupt towards the end of adolescence.

20 years and over

Recent developments in the field of forensic anthropology have revealed that age from mature or adult human skeletal remains can be estimated from the sternal ends of the third to fifth ribs (Maples 1989; İşcan 1989; Loth and İşcan 1994; 1996; 2000a; Oettlé and Steyn 2000). The method was first developed for Americans and it has since been tested on different population groups. A recent case study conducted by Oettle and Steyn (2000) focused on South African blacks to test the degree of accuracy of using rib phase analysis for age determination. Results from this study indicated that among South African black males, initial changes take a bit longer to show but as soon as the process starts, changes occur rapidly (Oettlé and Steyn 2000).

Following the study by Oettlé and Steyn (2000), a model with ribs at different phases for aging purposes was developed. The model is available at the Department of Anatomy, University of Pretoria, and was used in the current study to help estimate ages of adults from Toutswe sites. South African blacks are currently the closest reference material for human skeletal material from Botswana. İşcan

By the end of 25 years all permanent teeth are in occlusion and beginning to show varying degrees of dental wear. The medial end of the clavicle fuses between 25 and 30 years and the sphenooccipitalis at the base of the skull closes between 27 and 30 years (Loth and İşcan 2000a; Scheuer and Black 2000).

Cranial sutures have been used for many decades to estimate age of adults (Todd and Lyon 1924; 1925; Meindl and Lovejoy 1985a; Ubelaker 1987; 1989a; Krogman and

İşcan 1986; Masset 1989; Novotny et al. 1993; Loth and İşcan 1994; 2000a). Closures of cranial sutures are one of earliest features identified as indicators of maturity. The process begins endocranially and continues ectocranially (Todd and Lyon 1924; 1925; Meindl and Lovejoy 1985a; Masset 1989; Krogman and İşcan 1986).

Acknowledged systems of scoring cranial suture closures and converting those scores into age are available in the literature (e.g., Meindl and Lovejoy 1985; Krogman and İşcan 1986; Masset 1989; Novotny et al. 1993; Loth and İşcan 1994; 2000a). The sutures are divided into various parts and scored for the degree of closure on a scale of zero to four. The results are then added to determine a composite score, which is then used the estimate the individual's age (Meindl and Lovejoy 1985a; Krogman and İşcan 1986; Masset 1989; Novotny et al. 1993; Loth and İşcan 2000a).

Problems arising from the use of cranial sutures to estimate age have been discussed extensively in the literature. The rate at which sutures close varies from one individual to the other even if the individuals were drawn from the same population. Some individuals have premature closure while in some old adults the sutures may still be visible. They can only be used to give wide age ranges, as they are varied between individuals and less accurate (Meindl and Lovejoy 1985a; Buikstra and Konigsberg 1985a; Krogman and İşcan 1986; Maples 1989; Masset 1989; Loth and İşcan 1994; 2000a; Konigberg and Frakenberg 1992; 2002).

During adulthood the skeleton undergoes degeneration especially on the vertebral column and major weight bearing joints. Lesions produced by degenerative diseases are not good indicators of skeletal age but they have proved to be useful when usual age indicators have not been preserved. Most degenerative diseases begin in the fourth decade of life but the rates at with lesions develop differs from one individual to the other. Such lesions can give ideas regarding wide possible age ranges. Dental wear is also an indicator of age that can be used in the absence of other age indicators. Dental wear is not an accurate method because of individual variation (Krogman and İşcan 1986; Ubelaker 1989a; Maples 1989; Walker et al. 1991). The rate at which an individual's teeth are worn depends mainly on their diet and therefore if the diet of a community were fairly the same, then they would tend to show fairly similar degrees of dental wear in every age category (Walker et al. 1991).

3.3 Sex determination

Debates regarding estimation of sex of immature individuals from skeletal remains have been on going for sometime now e.g. Saunders (1992). Many sex specific features are absent during childhood and only develop during puberty by hormonal and genetic stimuli (St Hoyme and İşcan 1989). Research has been done on the so-called sexually dimorphic traits of the mandible of juveniles (e.g., Schutkowski 1993; Loth and İşcan 2000b). While some anthropologists argue that the shape of the chin of juveniles is a reliable sex indicator (Schutkowski 1993; Loth and Henneberg 2001; Loth and İşcan 2000b), recent work has shown that the trait was more accurate on males than on females but that its overall accuracy is very low (Scheuer 2002). Moreover, the method is inconsistent. Although standards for determining sex of fetal and infant remains are available, their accuracies are often too low and therefore do not give one strong confidence for accurate results. As a result no attempts were made to determine sex of infants, juveniles and subadults.

The pelvis

Determination of sex from skeletal remains is most highly accurate and dimorphism readily observable from the pelvic bones of mature individuals (Washburn 1949; Singh and Potturi 1978; Kelley 1979; Ferembach et al. 1980; Brothwell 1981; Krogman and İşcan 1986; St Hoyme and İşcan 1989; Loth and İşcan 2000b). It is on the pelvis that sex specific changes take place as females mature in preparation for child bearing. The changes may be initially subtle but become very distinct towards the end of the second decade of life. The female pelvis is characterised by a wide sciatic notch, wide subpubic angle, short and broad sacrum, a small acetabulum, and other features (Singh and Potturi 1978; Kelly 1979; St Hoyme and İşcan 1989; Krogman and İşcan 1986; Loth and İşcan 2000b)

On the male, the sciatic notch is narrow and so is the subpubic angle and the sacrum is long and thin. The acetabulum of a male is larger by comparison to that of a female. If all or most of the pelvic bones are present and can be articulated, a male will be marked by a heart shaped pelvic inlet and a female has an oval inlet shape (Washburn 1949; Krogman and İşcan 1986; St Hoyme and İşcan 1989; Loth and İşcan 2000b). The presence of parturition scars is useful in identifying females who had been pregnant before. However, its absence does not necessarily mean the individual was a male as it has been found that not all females develop such scars.

Cranium

Certain features of the skull of an adult are instrumental in identifying sex of an individual. A study done by De Villiers (1968a) on South African blacks (Bantu-speaking Negro) identified several sexually dimorphic features on the skull. The features are either morphologic or metric. Some of the features identified include rounded supraorbital margins, robust muscle attachments, prominent glabella, large supra orbital ridges all of which are indicative of a male. A female, on the other hand, will have sharp supraorbital margins, a small mastoid process, etc (De Villiers 1968a; Krogman and İşcan 1986; Loth and İşcan 2000b). In addition to these features, males tend to have large teeth with wide gonials whereas females tend to have small teeth.

On the mandible a squared, or angular, chin is indicative of a male whereas the female chin is rounded (De Villiers 1968a; Loth and Henneberg 1996; Loth and İşcan 2000b). In more recent developments, it has been found that the ramus of the mandible continues to grow straight in adult females while in males it flexes at the occlusal level (Loth 1996; Loth and Henneberg 1996; Loth and İşcan 2000b). The sexual dimorphism of the ramus of the mandible is a fairly new discovery and as such requires more work to improve its accuracy and consistency. Attempts to tests the accuracy and consistency of the mandibular ramus flexture indicate that the method is not very reliable (e.g., Hill 2000; Kemkes-Grottenthaler et al. 2002).

Various cranial measurements and indices can be used to determine sex but these are known to be population specific (De Villiers 1968a; Meindl et al. 1985).

Size differences

In addition to these morphological methods, is metric analysis (Steyn and İşcan 1999; Loth and İşcan 2000b; Asala 2001). Measurements of various bones are used to develop various formulae (e.g., multiple discriminant functions), which can be used to determine sex especially when the skeletons are fragmentary. These are very population specific (Black III 1978; Macho 1991; İşcan and Miller-Shaivitz; 1984; Meindl et al. 1985; Steyn and İşcan 1997; 1999; Loth and İşcan 2000b; Asala 2001).

Metric analysis employs the use of a few measurements of a single long bone and each measurement is matched with data obtained from South African blacks (e.g., Macho 1991; Steyn and İşcan 1999; Asala 2001; Loth and İşcan 2000b). The femur has been found to a very reliable and most accurate bone to use for sex determination followed by the humerus (Black III 1978; Loth and Henneberg 1996; Steyn and İşcan 1999, Loth and İşcan 2000b). In addition to lengths, diameters and circumferences, indices can be used to determined sex. Metric indices in sex determination are most useful when dealing with fragmentary remains (Kelley 1978; Loth and İşcan 2000b).

This method of sex determination tends to be most useful in determining sexes of bones found in isolation and it was also used to confirm results where morphological methods seemed uncertain or where relevant bones for morphological assessment were either missing or damaged. It is important to bear in mind that size alone is not always a good indicator of sex and can only be used to give tentative results.

3.4 Stature

Stature increases between birth and adolescence. During adulthood, it is relatively unchanging and it decreases towards senility (Brothwell 1981). From the study of twins it has been found that stature is influenced genetically determined and that environmental factors play a small role in influencing an individual's stature. It has been found that stature varies from one individual to the other even if the individuals are from a homogeneous population. However, females tend to have a smaller mean stature than males in most populations (Brothwell 1981).

Estimation of stature from skeletal material is based on the relationship between lengths of bones, especially limb bones, and stature (Sjovold 2000). Estimation of maximum living stature of adults was based on regression equations based on data from South African blacks (Lundy 1983; Lundy and Feldesman 1987). Lengths of long bones of adults were used in combination or individually to estimate stature. Bones used in this study included the humerus, femur and tibia. They were measured using a standard osteometric board and landmarks described in the literature (e.g. Brothwell 1981; Moore-Jansen et al. 1994; Buikstra and Ubelaker 1994). The measurements were taken to the nearest centimeter. Appendix 1 shows various measurements taken on each individual including cranial measurements. Only complete bones of the left side were used but substituted with their right counterparts if the former were missing or incomplete. Incomplete bones were excluded. Stature was estimated for adults only. For each individual, bones with the lowest standard error were selected for stature estimations. To calculate stature, measurements of bone are inserted in to appropriate regression equations (Lundy 1983; Lundy and Feldesman 1987).

3.5 Other observations

Cranial and postcranial measurements (Appendix 1 and 2 respectively) were taken on each individual where possible. The measurements were used for various purposes e.g., for determining sex on some individuals, estimating age of infants and juveniles and assessment of skeletal growth. Data obtained from age estimates of individuals was used to reconstruct the palaeodemography of the study population. Each bone was assessed for lesions associated with pathology and trauma. Teeth were measured and assessed for dental pathology and dental wear. Methods used assess each of these are given in detail at the relevant chapters or sections.

4. GRAVE DESCRIPTIONS AND SKELETAL ANALYSIS

4.1 Introduction

In this chapter each skeletal analysis and a brief description of burial style and burial goods are given where possible. The skeletons are described in order of their numbering at sites except the Toutswemogala skeletons, which have been given burial numbers in the order that they were analysed by the author. Additional information from some sites is given in brackets next to numerical burial numbers. Burials from Taukome and Thatswane were given numeric burial numbers. The burials were each identified by a feature given a numeric number that was not necessarily corresponding to the burial number because some of the features found were not burials (Denbow 1979b; 1983a). No attempts were made to decode the site labels of the Toutswemogala burials. Some of the burials from Toutswemogala were assessed by Murphy (1996) for bone pathology, dental health and stable isotopes but the skeletons used were not labeled and hence no attempts were made to identify them in the current study.

Descriptions of burial styles of individuals excavated by different archaeologists depend entirely on the amount of information provided by the archaeologists. The author provided no additional information whatsoever. Where applicable, burial goods are also described. Unfortunately, most of the burial styles are incomplete or unknown. In the case of Kgaswe B-55 burials, the locations of each individual was interpreted from the map of the site (Denbow 1986).

Skeletal descriptions include preservation condition, age estimate, sex, bone pathology, dental pathology, stature and a brief conclusion. Sections of sex determination and stature estimation are not included on infants, juveniles and subadults because no attempts were made to determine their sex and stature. For individuals whose teeth were missing, a dental description section was not made and if no bone lesions were found, a brief note was only made in the conclusion section.

Incomplete skeletons from which age and sex could not be determined are listed in Appendix 3a and 3b for Toutswemogala and Taukome cases respectively.

4.2 Toutswemogala Burials

Toutswemogala Burial 1 (Pot burial from 10R140 1st half level 2)

Burial style

The grave was excavated by Lepionka (Lepionka 1977), but unfortunately the exact burial style and provenance of this individual is unknown since no records containing the information were available. It is, however, possible that the individual had been buried in a clay pot as suggested by the mentioning of 'pot burial' on the label made at the site, and the possible age of the individual.

Although Lepionka's report gives an account of the burial style and provenance of an infant buried in a pot (Lepionka 1977), it is difficult to verify which burial it is since De Villiers' (1976) report mentions two pot burials of infants. One of these infants, 10R 3 (10R0) pot burial level 4, has been classified as incomplete burial 11 in this study.

Preservation

The cranial and postcranial remains are complete and well preserved.

Age

The alveoli of the mandible indicate that most of deciduous teeth were developed but not erupted. The two halves of the mandible are not fused. Since tooth germs are missing, age was determined from the lengths of long bones. The individual was probably a newborn or late fetus

Bone pathology

There are no signs of pathology on the skeleton.

Conclusion

The skeleton indicates that the burial was of a newborn baby or late fetus. There are no signs of pathology on this skeleton.

Toutswemogala Burial 2 (185 R350 level 1 burial 2)

Burial style

Lepionka excavated the burial in the 1970s (De Villiers 1976) but there are no records of its provenance and burial style. The skeleton has been examined by De Villiers (1976).

Preservation

De Villiers' record of this particular burial indicates that the postcranial remains were not submitted to her for analysis (De Villiers 1976). However, a bag containing a postcranial skeleton with the same site label as the cranium was found and it matched the cranium in terms of age. The cranium and postcranial skeleton have been put together as belonging to the same individual. The remains are well preserved and complete.

Age

All deciduous teeth are in occlusion and the first permanent molars had erupted, but were below occlusion. Crowns of permanent central incisors of the maxilla were well developed, but not erupted. The age was estimated at 6 ± 1 years old.

Bone pathology

There is evidence of cribra orbitalia on both orbits as well as porotic hyperostosis above the mastoids.

Teeth

There are eight deciduous maxillary and five deciduous mandibular teeth. They include maxillary lateral incisors, four canines, three first molars and four second molars. In addition to these, four permanent first molars are present. Maxillary central incisors, mandibular incisors and a mandibular right first molar are all missing postmortem. A small amount of calculus is present on the buccal surface of the maxillary right second molar and there is very little wear on the teeth.

Conclusion

The individual was a young child of between five and seven years old. Besides a small amount of calculus, there are no other signs of dental pathology. The child had cribra orbitalia as well as porotic hyperostosis. .

Toutswemogala Burial 3 (10R135 burial bedrock north east)

Burial Style

The burial was excavated by Lepionka in 1970 (Lepionka 1977) and there are no records of the burial style and provenance of this individual. The skeleton has been previously examined by De Villiers (1976).

Preservation

The skeleton is incomplete and was poorly preserved. Most of the left side of the cranium and mandible are missing and postcranial bones are fragmented.

Age

The individual's dentition is mixed. Deciduous canines and molars are present in both the maxilla and the mandible. First permanent molars are in occlusion and so are the central incisors. In the mandible, the lateral incisors had erupted. Age was estimated to be six to eight years old.

Bone pathology

The right orbit is complete and has evidence for mild cribra orbitalia.

Teeth

A total of 23 mixed teeth (12 maxillary and 11 mandibular) were examined. Maxillary teeth present include deciduous lateral incisors, canines, first and second molars as well as permanent central incisors and first molars. Mandibular deciduous teeth are canines and all four molars and all four permanent incisors and a right first molar. There is little dental wear on the deciduous teeth. The mandibular right canine has pitting enamel hypoplasia.

Conclusion

The skeleton is that of a child between six and eight years old with evidence of cribra orbitalia and pitting enamel hypoplasia.

Toutswemogala Burial 4 (5R135 1st half burial at bedrock, isolated skull, north end)

Burial Style

The current burial number is consistent with Lepionka's (1977) numbering. It was one of the two burials found from underneath a deteriorated floor, next to a stonewall on the eastern side of the site (Lepionka 1977). It was difficult to determine whether the grave had been dug through the floor or not, since the floor itself had been eroded in some parts. The grave was of a skull buried in isolation, presumably for ritual purposes (Lepionka 1977).

Two burials of isolated skulls of immature individuals were found during excavation (burials 4 and 16 in this report). It was therefore not clear which of the two burials Lepionka referred to as Burial 4 since his report follows a different labeling system from the site labels found with the skeletons. The key feature was De Villiers' description of the skull as having San paedomorphic characteristics (De Villiers 1976, Lepionka 1978). The description is consistent with the skull labeled Burial 4 in the current study.

Preservation

The mandible is currently missing, but it was present at the time of excavation. De Villiers' description of the mandible (De Villiers 1976) was used to try to identify the mandible from those that had been placed in the same bag but none of them fitted the description. The remains comprise of a complete and well-preserved skull.

Age

The dentition is mixed and consists of maxillary deciduous first and second molars and permanent first molars. Anterior teeth were lost post mortem. Age of this individual was estimated to be 7 ± 1 years.

Bone pathology

A round hole is present on the left parietal bone. Its external margin is sharp and it has internal beveling, and could have been a result of trauma or a post depositional occurrence. A more detailed description of this hole is presented in chapter 6.

Teeth

Only six teeth were available for assessment of dental pathology. Large dentine patches are exposed but still surrounded by enamel on all four deciduous molars, whereas the first permanent molars are slightly polished.

Conclusion

The child was between six and eight years old. A round hole on the left side of the skull has been identified as a possible case of trauma.

Toutswemogala Burial 5 (Burial 3 10 R150)

Burial style

Lepionka excavated this burial (Lepionka 1977; 1978), but records of the burial style are currently not available and its provenance is unknown.

Preservation

The skeleton is not well preserved and is incomplete. De Villiers' report on this burial shows that the there were no cranial remains and teeth (De Villiers 1976), whereas the current examination included a fragmented skull and mandible and some teeth. The few bones present are fragmented and the skull is badly damaged. There are no facial bones.

Age

Though some of the teeth had been lost, it is evident that all deciduous teeth were in occlusion and that the first permanent molars had not erupted. Partially complete crowns of permanent maxillary central incisors and permanent canines are present. Elements of the occipital bone are not fused. On the basis of the few teeth found and the occipital bones, age of this individual was estimated to be 4 ± 1 years old.

Bone pathology

The little that remains of this skeleton has no signs of bone pathology.

Teeth

There were six deciduous maxillary and five mandibular teeth examined. Maxillary teeth found include central incisors, the right canine and first molar and both second molars. On the mandible, a left central incisor, lateral incisors, right canine and second molar were present. There is no evidence for dental pathology or dental wear on this individual.

Conclusion

The remains are of an infant of three to five years old. The skeleton displays no signs of pathology.

Toutswemogala Burial 6 (5R135 1st half burial, bedrock south end)

Burial Style

The grave was found in the 'middle area' of the site in square 10,15S (135E) 1015S (140E) (Lepionka 1977; 1978), about 6cm below a floor. The body had been horizontally flexed and was laid on its left side. A large flat stone had been placed over the pelvis. From the site map (Lepionka 1977; 1978), it is evident that the head had been oriented to the west and was facing a stonewall located on the eastern side of the site.

The burial number is consistent with Lepionka (1977; 1978). From the picture in Lepionka's (1977; 1978) report, the cranium has a well-pronounced occipital protuberance and two holes on the right parietal bone. The shapes of these holes and the occipital protuberance are similar to those identified on '5 R135 1st half burial, bedrock south end'. The skull had been stored in a box containing several other skulls without proper labeling. Its identification to this site label was based on the photos published in Lepionka and De Villiers' reports (De Villiers 1976; Lepionka 1977; 1978).

Burial goods

A bowl with a constricted neck was found next to the knees of this individual (Lepionka 1977; 1978). The bowl appears to have been complete and intact at the time of excavation. Attempts to find this bowl during this research were futile since it had been separated from the skeleton when stored.

Preservation

De Villiers' account of this burial stipulates that the postcranial skeleton was not present (De Villiers 1976), but a nearly complete set of postcranial remains with the same label as the skull were found and taken to be the same individual in the current study. Lepionka's report also indicates that this burial was complete (Lepionka 1977). The skeleton is nearly complete and is in good condition.

Age

The dentition is mixed. The maxillary deciduous right second molar is loose from the alveolus and its left counterpart is in place. The mandibular right deciduous first molar is still in place. First premolars and first permanent molars are in occlusion and thereby providing an age estimate of 10 ± 1 years old.

Bone pathology

Spina bifida occulta has been identified on the axis. A rounded hole with sharp external margins and internal beveling is present on the cranium. A more detailed description of the hole is made in chapter 6.

Teeth

A total of 22 teeth, eight maxillary and 14 mandibular, are present. Of these, three are deciduous second molars. A carious lesion is present on the maxillary right deciduous second molar. Pitting enamel hypoplasia is present on the mandibular central incisors while the mandibular canines have enamel hypoplastic lines. Advanced wear is noted on the mandibular deciduous second molars, the rest of the teeth are not worn.

Conclusion

The remains are of a child of between nine and 11 years old with a carious tooth and advanced dental wear. The child had a cleft neural arch of the axis and a possible traumatic lesion has been identified on its skull.

Toutswemogala Burial 7 (270 R360 level1 burial 2)

Burial style

Three individuals from the same box bearing the same site label were identified by De Villiers (1976). The skeleton described here is the third of these individuals as identified by De Villiers (1976). Lepionka excavated the grave and De Villiers examined the skeleton (De Villiers 1976; Lepionka 1977). Unfortunately there are no records of its burial style and provenance but some burial goods have been found in association with this skeleton. The second of these individuals has been labeled incomplete burial 12 in this study.

Burial Goods

An incomplete and fragmented metal artifact that appears to have been a bracelet was found in the box that contained the skeleton.

Preservation

The remains are well preserved and are nearly complete.

Age

All deciduous teeth are in occlusion and the permanent first molars are not erupted. The maxillary permanent central incisor crown is complete whereas crowns of permanent premolars and lateral incisors are incomplete. The basilar part of the occipital bone is not fused. Age has been estimated to 4 ± 1 years old.

Bone pathology

Assessment for bone pathology revealed no skeletal lesions.

Teeth

A total of 11 deciduous teeth (seven maxillary and four mandibular) are present. On the maxilla the right incisors and canine are missing postmortem. On the mandible all anterior teeth are missing postmortem. Maxillary incisors have small patches of dentine exposed by dental wear, and there is no other evidence for dental pathology on all teeth examined. The individual had good dental health.

Conclusion

The skeleton is of a juvenile of between three and five years old. No pathological lesions were observed.

Toutswemogala Burial 8 (125R185 level 1 burial)

Burial style

This burial was excavated by Lepionka and has been previously examined by De Villiers (Lepionka 1977, De Villiers 1976). There is no information regarding its burial style and provenance.

Preservation

The skull is fragmentary and the postcranial skeleton is incomplete and is poorly preserved.

Age

Most of the teeth are fragmented and incomplete and this hinders age estimation. The basilar and lateral parts of the occipital bone are not fused and long bone lengths suggest an age estimate of two to four years.

Bone pathology

The left temporal bone has porotic hyporostosis.

Teeth

Most of the teeth are fragmented and incomplete and were not measurable. Those that were possible to identify included two mandibular incisors, two mandibular molars and 3 maxillary molars all of which are deciduous. There are also three incomplete crowns of permanent molars. No signs of dental pathology were found on those teeth that were possible to identify.

Conclusion

The remains are of a child of approximately two to four years. The individual has evidence of porotic hyporostosis.

Toutswemogala Burial 9 (185 R350 level 1 burial 1)

Burial style

The burial was excavated by Lepionka and has been previously examined by De Villiers (De Villiers 1976; Lepionka 1977). Unfortunately there is no information regarding the burial style and provenance of the grave. The mandible had been stored in a box containing several other mandibles (of Burials 26-30) and it was identified by De Villiers' description of a left canine with a bifid root (De Villiers 1976).

Burial Goods

A wound metal ornament, presumably a bracelet and a copper bead were found in the bag containing the skeleton. The bracelet is fragmented and rusty and it appears to have been made from iron. The copper bead is complete and had turned bluish in color. Unfortunately, these artifacts are not mentioned in the literature and information regarding their exact location in relation to the skeleton is unknown.

Preservation

The calvarium is nearly complete but most of the face is missing; the mandible is complete and well preserved. The postcranial skeleton is fairly complete and well preserved. A small puncture mark was identified on the internal surface of the left mandibular angle and it appears to have resulted from post depositional processes.

Age

The lateral parts of the occipital are fused to the squama but not to the basilar part. Mandibular permanent first molars and central incisors are in occlusion along side deciduous lateral incisors, canines, first and second molars. The individual is estimated to have been about seven to nine years old.

Bone pathology

The left orbit is missing and the right orbit has evidence for cribra orbitalia.

Teeth

All maxillary teeth are missing. The left mandibular canine has a bifid root, a condition previously observed by De Villiers (1976). Other roots are not observable as they are still inside the alveoli. Small patches of dentine are exposed on deciduous lateral incisors, canines and molars. All permanent teeth are not worn. A thin enamel hypoplastic line is present on the permanent central incisors.

Conclusion

The skeleton is of a child aged between seven and nine years old. The individual has evidence for cribra orbitalia as well as an enamel hypoplastic lesion on an incisor.

Toutswemogala Burial 10 (20 R3 (20R0) level 4 burial)

Burial style

The burial was excavated by Lepionka and has previously been examined by De Villiers (De Villiers 1976; Lepionka 1977). There is no information regarding its burial style and provenance.

Preservation

The cranium and mandible are fragmentary and incomplete. However, the postcranial skeleton is nearly complete and is well preserved. Most long bones are intact.

Age

Most of the teeth are missing but the alveoli indicate that they had been present at the time of death. In the maxilla, the deciduous right canine and deciduous second molars had not erupted, whereas the deciduous first molars had erupted. Mandibular deciduous first molars had erupted. An incomplete crown of a permanent first molar is present. Age was estimated to be 18 ± 6 months.

Bone pathology

There are no indications of pathological lesions on any of the bones present.

Conclusion

The skeleton is that of an infant of between one and two years old.

Toutswemogala Burial 11 (5R135 1st half burial bedrock)

Burial style

The burial was excavated by Lepionka and the remains have been assessed before by De Villiers (De Villiers 1976; Lepionka 1977). There is no available information regarding its provenance and burial style.

Preservation

The cranium and mandible are missing but the postcranial skeleton is complete and well preserved.

Age

In the absence of the cranium and consequently also the teeth, age of this infant was determined from lengths of long bones and was estimated to have been zero to six months.

Bone pathology

There are no signs of pathology on the bones.

Conclusion

The remains are of an infant of between newborn and six months old with no indications of skeletal lesions.

Toutswemogala Burial 12 (15R0 burial inside of trench)

Burial style

This burial was excavated by Lepionka and has been examined by De Villiers (De Villiers 1976; Lepionka 1977; 1978). Unfortunately, there is no data regarding its provenance and burial style.

Preservation

The skeleton is incomplete and poorly preserved. The cranium and mandible are fragmented and a fragment of a tibia is the only long bone present.

Age

There are incomplete crowns of deciduous molars and the two halves of the mandible are not fused. Neural aches are not fused to each other. The age of this infant is estimated to have been approximately zero to six months.

Bone pathology

The skeleton has no indications of pathology.

Conclusion

The skeletal remains are of an infant of zero to six months old.

Toutswemogala Burial 13 (270R360 level 1 burial 3)

Burial style

Lepionka excavated the burial and De Villiers examined the skeleton (De Villiers 1976; Lepionka 1977; 1978). Unfortunately, there is no information regarding its provenance and burial style.

Preservation

The cranium is partially complete and the mandible is currently missing but it was present at the time of excavation (De Villiers 1976). Postcranial remains of the individual are in a fairly good condition.

Age

All components of the occipital bone are fused. Although most of the teeth are missing, a maxillary deciduous first molar and a permanent first molar were in use at the time of death. Age is estimated to be between seven and nine years old.

Bone pathology

There are no lesions associated with pathological conditions.

Conclusion

The remains are of a child of between seven and nine years old.

Toutswemogala Burial 14 (10R140 2nd half level 2 burial)

Burial style

Information regarding the burial style and provenance of this burial is not available. This burial was excavated by Lepionka and has been examined by De Villiers (De Villiers 1976; Lepionka 1977; 1978).

Preservation

The cranium is damaged and distorted on the right side in the parietal/frontal region. However, the rest of it is intact and in good condition. The mandible and the rest of the postcranial bones are complete and in excellent condition.

Age

The dentition of the individual is mixed. Deciduous canines and molars were in use and so were the first permanent molars. Maxillary permanent lateral incisors were not erupted and even though the permanent central incisors are missing, their sockets indicate that they had erupted. Age was estimated to have been 6 ± 1 years old.

Bone pathology

The right femur has evidence of healed trauma.

Teeth

The assessment included a total of 16 teeth (four deciduous canines, eight deciduous molars and four permanent first molars). There is only minimal dental wear on the deciduous teeth.

Conclusion

The remains are of a child aged between five and seven years. The child had experienced some trauma on the left femur, which had healed before the time of death.

Toutswemogala Burial 15

Burial style

The site label of this burial is missing and it is not clear whether or not De Villiers examined the skeleton. Its burial style and provenance are consequently unknown. It was excavated by Lepionka (Lepionka 1977).

Preservation

The skeleton is well preserved but is missing the cranium and mandible.

Age

None of the epiphyses are fused and in the absence of dentition, age could only be estimated on the basis of long bone lengths. Age of this individual is estimated to be seven to 10 years old.

Bone pathology

The skeleton shows no signs of pathology.

Conclusion

The remains are of a child of between seven and 10 years old.

Toutswemogala Burial 16 (10R135 burial 2, southwest corner, bedrock)

Burial style

The burial comprises of an isolated skull, which was excavated by Lepionka. It was included in the sample studied by De Villiers (De Villiers 1976; Lepionka 1977).

Preservation

The skull is fractured and is incomplete but the mandible is complete and well preserved.

Age

Most permanent teeth are in occlusion. Maxillary permanent second molars are below occlusion and the third molars are developed but not erupted. Age is estimated to be 11 ± 1 years old.

Bone pathology

There is well-developed cribra orbitalia in both orbits.

Teeth

A total of 26 out of 32 permanent teeth were assessed. The maxillary left lateral incisor is partially damaged and the mandibular right first premolar is missing. On the maxillary dentition, there are small carious lesions on both central incisors and these are located between the two teeth (interproximally). Medium sized deposits of calculus are present on the labial and lingual surfaces of mandibular incisors. Large dentine is exposed but still surrounded by enamel on maxillary central incisors. Possible dental mutilation of the maxillary central incisors was noted.

Conclusion

The skull is of an older child of between 10 and 12 years old. The individual had well developed cribra orbitalia. A possible dental modification of maxillary central incisors has been identified.

Toutswemogala Burial 17 (270 R360 level 1 burial 1)

Burial style

Lepionka excavated the skeleton and De Villiers examined it in the 1970s (De Villiers 1976; Lepionka 1977). There is no information regarding its burial style and provenance.

Preservation

The remains are poorly preserved, fragmented and incomplete.

Age

All permanent teeth are in occlusion except for the third molars, which had not yet erupted. None of the epiphyses are fused. Age is estimated at 10 - 12 years.

Bone pathology

There are no skeletal lesions on this individual.

Teeth

A total of 25 teeth, 12 maxillary and 13 mandibular, were present. The individual's maxillary lateral incisors are peg-shaped. Both maxillary second molars and a mandibular left central incisor have been lost post mortem. No dental pathologies are evident besides small dentine patches exposed on the maxillary central incisors and mandibular central and lateral incisors on the right side. A very small amount of calculus is present on the labial surface of the mandibular right lateral incisor.

Conclusion

The burial was of an individual aged between 10 and 14 years, with no indications of bone and dental pathology.

Toutswemogala Burial 18 (3R 150 (0R150) burial 2 level 3)

Burial style

The burial was excavated by Lepionka (Lepionka 1977) but unlike the others, it appears to have been excluded from the study done by De Villiers. The burial style and provenance of the grave are not known.

Preservation

The remains are poorly preserved and incomplete. Several small fragments represent the cranium, and the mandible is incomplete.

Age

In the mandible, the left deciduous molars are in occlusion and the first permanent molar had not erupted. A maxillary deciduous central incisor, first molar and two second molars are also present. Dental development suggests an age of 4 ± 1 years.

Bone pathology

There are no skeletal lesions associated with pathology.

Conclusion

The skeleton is of a juvenile aged between three and five years. There is no evidence for bone and dental pathology on this child.

Toutswemogala Burial 19 (Burial 125 R330 Level 1)

Burial style

Lepionka excavated this burial and it has been examined by De Villiers (De Villiers 1976). There is no information regarding the burial style of this individual and the provenance of the grave.

Preservation

The cranium is incomplete and the mandible is missing, although it was present at the time of excavation (De Villiers 1976). Some elements of this skeleton were stored at a completely different location from the rest of it. An incomplete skull, nearly complete vertebral column and some fragments of the pelvic girdle were found in a different box. They fit the description given by De Villiers (1976), which was used to identify the rest of the skeleton. The skeleton is fragmented but nearly complete and is mixed with fragments of animal bones. Both human and animal bones show varying degrees of exposure to fire (De Villiers 1976). Some of the bones are whitened while others are charred black.

Age

Age was determined from the sternal ends of ribs and they place the individual between 40 and 60 years old.

Sex

An incomplete os coxa shows a narrow sciatic notch and measurement of the diameter of the head of femur (50.61mm) indicates a male individual. In addition, the mastoids are large.

Stature

None of the long bones were complete and therefore it was not possible to calculate stature.

Bone pathology

Shafts of both femora and tibiae and some phalanges from the feet have been severely burnt and are charred. Fragments of the pelvic girdle, the head of the right femur and fragments of the distal ulnae are also burnt but not charred. Association with burnt animal bones suggests that the bones may have been burnt alongside pieces of animal flesh. The little that remains of the cranium does not have evidence of burning. Possible causes of these burnt bones include veld fires, which may have occurred after burial.

There are small osteophytes on some of the vertebrae and on the distal extremity of the left tibia a small bone growth was identified.

Conclusion

The remains are of an adult male aged between 40 and 60 years. It was not possible to estimate the individual's stature. The bones were burnt. Unfortunately the individual's teeth were not preserved and thus its dental health status is unknown.

Toutswemogala Burial 20 (10R135 Burial S)

Burial style

Lepionka excavated the burial and it has previously been examined by De Villiers (1976). Like most of the Toutswemogala burials, there is no information regarding the burial style and provenance of the grave.

Preservation

The remains comprise of a nearly complete skull with no facial bones, and a complete mandible. The postcranial skeleton is missing.

Age

All deciduous teeth are in occlusion and permanent molars are developed but not erupted. Components of the occipital bone are not yet fused. Age is estimated at 4 ± 1 years.

Bone pathology

The skull has no indications for pathology.

Teeth

All 10 deciduous mandibular teeth are present and they do not have any indications of dental pathology. All maxillary teeth are missing.

Conclusion

The individual was a juvenile of three to five years. No indications of pathology were found on teeth and bones.

Toutswemogala Burial 21 (Burial 1 No 8 square)

Burial style

The burial was found by Lepionka in 1970 (Lepionka 1977) but a skeletal report produced by De Villiers (1976) does not make reference to this individual. It is possible that it was not sent to De Villiers for analysis. Its burial style and provenance are unknown.

Preservation

The cranium and mandible are fragmented and distorted. The skeleton is generally incomplete and fragmented and was poorly preserved. There are gnaw marks on the mandible and on some long bone fragments, indicating that burrowing animals had disturbed the grave.

Age

All deciduous central incisors and first molars had erupted. It appears that the maxillary lateral incisors had not erupted. Canines had not erupted. Based on dental development, the infant was estimated to be 12 to 18 months old.

Bone pathology

There are no signs of bone pathology found.

Conclusion

Although the skeleton is incomplete, it was possible to estimate its age to between 12 and 18 months old.

Toutswemogala Burial 22 (15 R135 Burial)

Burial style

The burial was unearthed in the 1970s by Lepionka and it has been examined by De Villiers (De Villiers 1976). Its burial style and provenance are unknown.

Preservation

The cranium and mandible were present (De Villiers 1976) but are currently missing. The postcranial skeleton is partially complete.

Age

Unfortunately, neither sternal ends of ribs nor cranial sutures were preserved. It was therefore not easy to make an estimate of this individual's age. However, extensive vertebral pathology indicates an older individual of approximately 40 to 50 years.

Sex

The mandible and most bones of the pelvic girdle are missing. The maximum diameters of the heads of the humerus (44.7 mm) and the femur (46.4mm) both fall within the range for South African black males.

Stature

Stature of this individual was estimated from a combination of the physiological lengths of the femur and tibia. Results indicate that the individual was approximately 172 ± 2.56 cm in height.

Bone pathology

Osteophytes are visible around articular surfaces of the knee joint including the patella, and on most of the vertebrae. Four continuous lumbar vertebrae, between L2 and L5, are fused. The sacroiliac joint has not been preserved but based on the involvement of the lumbar vertebrae ankylosing spondylitis could have caused the condition.

Conclusion

The remains are of an adult male approximately 40 to 60 years old, and 172 ± 2.56 cm in height. Bones indicate that the individual had suffered from degenerative diseases affecting the knee and the vertebrae.

Toutswemogala Burial 23

Burial Style

The site label of this individual is missing and it is therefore uncertain whether De Villiers has examined the remains. The grave was found by Lepionka (1977; 1978). Its burial style and provenance remain unknown.

Preservation

The cranium and mandible are fragmented and distorted but the postcranial skeleton is nearly complete and well preserved.

Age

Most of the deciduous tooth crowns have been lost but a central incisor and a first molar are present and were not fully developed at the time death. Neural arches are not fused. The maximum length of the femur was also used to estimate its age. The remains are of a newborn/ fetus.

Bone pathology

The skeleton has no pathological lesions.

Conclusion

The remains are of a fetal/ newborn baby.

Toutswemogala Burial 24 (10R3 (10R01) Burial 1 sublevel 1)

Burial style

The skeleton was found during excavations conducted by Lepionka in 1970 and was examined by De Villiers (De Villiers 1976). Its provenance and burial style are not known. Two individuals from the same box were identified (De Villiers 1976) and the current burial number refers to the second one described by De Villiers. The first one has been classified as incomplete burial 1 in this report.

Preservation

The skeleton is incomplete and fragmentary.

Age

Teeth were not preserved and age was estimated from the length of the humerus, which indicates an age of approximately three to five years old.

Bone pathology

There are no indications for pathology.

Conclusion

The skeleton is of an infant of about three to five years old.

Toutswemogala Burial 25 (Toutswe Woman)

Burial style

The grave was excavated in the 1970s by Lepionka (1977; 1978). The burial had been reconstructed and was on display at the BNMMAG. Shortly before the beginning of this research, the display was photographed and removed. The skeleton was then made available to the author for analysis.

The description below is based on the museum display. The individual had been buried in flexed position and was on the left side (Figure 4.1). Its head was oriented to the west. The right elbow was on top of the right femur and both hands were underneath the head. Unfortunately there are no records indicating the provenance of the grave associated with this skeleton. The skeleton has become popularly known as the 'Toutswe woman'.

It appears highly likely that the skeleton was not sent to De Villiers for examination because in her report she identified only three adults, two complete and one isolated fragment. All three have been found and none of them fit the description of this individual.

Burial goods

A complete and intact clay pot was found between the head and the knees (the legs were flexed). The pot has a constricted and long neck and its opening faced upwards. The body of this pot was decorated with incised triangles filled with incised lines. A complete and intact bowl had been placed just below the knees with its opening tilted slightly downwards. Next to the bowl, a large beaker was laid with its mouth towards the pelvis. Both the beaker and the bowl have no decorations. Other large fragments of pottery were found in association with this burial.

Preservation

The skeleton is well preserved but its entire left side is missing. A brief and informal interview with one of the museum personnel who was involved in the Toutswemogala excavations in the 1970s revealed that none of the bones of this individual were separated from it at the time of making the display.

Age

The sphenooccipitalis is closed. Rib phase analysis suggests an adult of 30-50 years old.

Sex

The sciatic notch is wide and a preauricular sulcus is present. The individual was a female.

Stature

This female's stature was calculated from a combination of the physiological lengths of the femur and the tibia. An estimate of 170 ± 2.56 cm was obtained.

Bone pathology

Osteophytes had developed around the distal articular surfaces of the femur but are not present on the superior articular surface of the tibia. There are no other signs of bone pathology.

Teeth

The maxillary central incisors are missing postmortem and the rest of both maxillary and mandibular teeth are present. Dental wear ranges between exposure of medium sized patches of dentine to large dentine patches showing, but still surrounded by enamel in all teeth except third molars which are not worn.

Conclusion

The remains are of an adult female aged between 30 and 50 years whose stature was approximately 167 to 173 cm. She had suffered from some kind of degenerative condition that had affected her knee joint.

Figure 4.1 Reconstructed grave of Toutswemogala Burial 25 (Photo courtesy of BNMMAG)

Toutswemogala Burial 26

Burial style

Only the mandible is present. It is not clear whether this was an isolated find or whether the rest of the skeleton has been misplaced. Its provenance is unknown. Lepionka (1977; 1978) excavated the remains but it is not certain whether De Villiers examined them or not, since no site label was found. Moreover, the mandible has no special features that could be used to correlate it to any of the ones described by De Villiers. The mandible does not fit any of the skulls found without a mandible.

Preservation

A complete mandible represents this individual and the rest of the skeleton is missing. The mandible itself is well preserved.

Age

Deciduous incisors and first molars are in occlusion; canines and second molars are all below occlusion. Crowns of first permanent molars are present inside the alveoli. The individual's age is estimated to have been 18 ± 6 months old.

Teeth

Deciduous incisors, canines and first molars were examined for pathology. The right central incisor is missing postmortem. Pitting enamel hypoplasia was noted on the right canine.

Conclusion

The mandible is of an infant of approximately one to two years old. Assessment for bone pathology could not be carried out, as only the mandible is present. Its right canine has evidence for enamel hypoplasia.

Toutswemogala Burial 27

Burial style

This is another individual represented by a mandible only. It was excavated by Lepionka (1977; 1978) and due to lack of a site label it is not clear whether the remains were sent to De Villiers for examination in the past. Its burial style and provenance are unknown. It does not fit any of the skulls found without a mandible.

Preservation

An incomplete mandible and a fragment of the right ulna and other unidentified fragments are the only pieces present.

Age

Only the left half of the mandible is present and it indicates that the two halves of the mandible were not fused. Only one deciduous crown was preserved and the mandible indicates that most of the deciduous teeth had developed. The infant's age is estimated to be between zero and six months old.

Conclusion

The remains comprise of the left half of a mandible of an infant of zero to six months old.

Toutswemogala Burial 28 (5R150 Level 3)

Burial style

There are no records indicating the burial style and provenance of this burial. In addition, it is not clear whether or not this was a complete or isolated find. Lepionka excavated the skeleton. De Villiers' record (1976) reveals that two individuals both bearing the same site label were identified. The first of these identified by De Villiers is the one referred to as Toutswemogala Burial 28 in this report. The second individual was not found.

Preservation

The remains comprise of an incomplete left side of the body of the mandible only.

Age

The deciduous left molars and a maxillary second molar are in occlusion. Crowns of the left permanent lateral incisor and first molar are visible inside their sockets. These teeth give an age estimate of 3 ± 1 years.

Teeth

No signs of dental pathology were found.

Conclusion

The mandible belonged to an infant of approximately two to four years old.

Toutswemogala Burial 29

Burial style

There are no site records or subsequent reports indicating the provenance and burial style of this individual. It was excavated by Lepionka (1977; 1978) but since no site records associated with this individual were found, it is difficult to tell if De Villiers examined it or not. The remains have no specific features that could be used to identify it on De Villiers' (1976) report. The mandible does not fit any of the skulls identified without a mandible.

Preservation

The remains include an incomplete mandible, a few maxillary teeth and some unidentified fragments of the skull.

Age

A permanent maxillary canine and second molar, a mandibular canine, first and second molars, and a central incisor were recovered. A third molar crown was also found. None of them has complete roots. The individual was approximately six to 10 years old.

Teeth

Enamel hypoplastic lines were noted on a maxillary canine.

Conclusion

The mandible belonged to a child of between six and 10 years old.

Toutswemogala Burial 30 (255 R360 Burial 1 Level)

Burial style

This burial was excavated by Lepionka (1977) but there is no data to reveal whether or not this was an isolated find, or its provenance. De Villiers' report (1976) has no individual bearing this site label, and it has not been studied before.

Preservation

This individual is represented by the right side of the body of the mandible, an incomplete maxilla, fragments of the frontal, right temporal, right parietal and zygomatic bone.

Age

Most of the tooth crowns have been broken, but their roots are still in their sockets. Age was thus difficult to estimate since most of the teeth had been broken and the mandible itself is not complete enough to show whether third molars had erupted or not. Nevertheless, premolars and molars appear to have been in occlusion and show slight wear. The individual was possibly a young adult of 20 - 40 years.

Teeth

Almost all teeth have been broken and thereby making it impossible to assess the dental health of this individual.

Conclusion

The remains are of a mature individual of approximately 20 and 40 years old whose sex could not be determined.

Toutswemogala Burial 31 (270 R360 level 1 burial 2)

Burial style

The burial was excavated by Lepionka in the early 1970s (De Villiers 1976; Lepionka 1977) but there are no records indicating its location on the site. It has been studied by De Villiers before (1976).

Preservation

The cranium and mandible are missing and the postcranial skeleton is fragmented.

Age

Age of this individual was estimated from the length of the ulna and was about 10 ± 1 years old.

Conclusion

The skeleton is of a child of between nine and 11 years old. The skeleton shows no signs of pathology.

4.3. Taukome Burials

Taukome Burial 1 (Feature 1)

Burial Style

This grave was excavated by Denbow in the late 1970s (Denbow1 1979b; 1983a). Murphy (1996) included this individual when doing stable isotope analysis. The burial was found in Feature 1, which was about 65 cm below the surface on the northeastern corner of unit 2 in the brown silt manure (Denbow 1979b). It was marked by a concentration of stones. The bones were in a poor condition and some molars were found in a rodent burrow in the center of the square. Denbow (1983a: p113) gave the following description:

> " The stones overlay the burial of an adult male. The burial shaft had been dug through the overlying brown midden soil into the unburned dung of level VII below. The burial therefore post-dates the lower kraal. The burial was oriented with its head to the west and was lying in a flexed position on its left

side. The left hand was between the legs and the right arm was placed across the stomach. A rodent burrow was found just below the burial and the left tibia was missing. No grave goods were associated".

Preservation

The skeleton is incomplete but the bones present are in good condition. It is possible that the cranium and other missing bones could have been misplaced during storage, or after Murphy's (1996) analysis, as there is evidence that the skeleton was nearly complete at the time of excavation.

Age

Permanent teeth are severely worn suggesting long-term use. Ribs are at phase six and therefore the age is estimated to be 40 to 60 years old.

Sex

The individual was a male, as indicated by a narrow sciatic notch and a long and narrow sacrum. The skeleton is robust with evidence of strong muscle attachments especially on the ulnae.

Stature

Lower limb bones were not preserved hence stature of this individual was estimated from the length of the humerus. He was approximately 166 ± 4.46 cm tall.

Bone pathology

Osteophytosis around the articular surface of the body of S1 indicates that some degenerative disease affected this joint.

Teeth

A total of 30 permanent teeth (15 maxillary and 15 mandibular) were examined for dental pathology. The left maxillary first molar and the left mandibular central incisor have been lost after burial. On the maxilla, there is advanced dental caries on the buccal surface of the left third molar where more than half of this tooth is destroyed. Dental abscesses were also noted on the lingual surfaces of the left canine and first premolar. The alveoli bone around these teeth is eroded. Smaller abscess lesions are located on the buccal surfaces of the right first and second premolar. There is advanced dental wear with only roots remaining on the central incisors. Mandibular teeth have large dentine patches exposed but were still surrounded by enamel.

Conclusion

The remains are of an adult male aged between 40 and 60 years of about 161 to 171 cm in height. The individual has evidence for one of the arthritic diseases affecting the vertebral column. Some carious lesions as well as abscessing and dental wear on the teeth of this individual suggest poor dental health.

Taukome Burial 2 (Feature 3)

Burial style

Denbow excavated this burial in the late 1970s and the skeleton has been analysed by Murphy (1996) before. This burial came from underneath Feature 3 in unit 4 (18.30-19.10N; 3.30-4.10W), which was essentially a circular area containing pebbles and pieces of unburned dung (Denbow 1979b, 1983a). The feature was approximately 1.2 m in diameter and was 45 cm below the surface of Unit 4. The individual was tightly flexed and placed on its left side. The right arm was bent over the chest while the left arm was underneath the body (Denbow 1979b, 1983a). The skeleton was approximately 95 cm below the surface, just above cattle dung deposit. Two large stones had been placed near the knees.

Burial goods

From the grave fill, four small (2 x 3 mm) dark blue cane glass beads were found in the grave fill (Denbow 1983a). Their association to the grave was uncertain.

Preservation

A large open burrow was found just below the mid section of this burial and rodents may have removed some of the bones (Denbow 1979b). The cranium, right ribs, hands, feet and the lumbar vertebrae were missing.

Age

Epiphyseal lines are obliterated and permanent teeth are worn. Rib phase analysis used to estimate the age of this individual suggests an age of between 40 and 60 years old.

Sex

The individual has a small acetabulum, a wide sciatic notch and a short and broad sacrum. These features are indicative of a female.

Stature

Stature of this individual could not be estimated because no complete long bones were found.

Bone pathology

The mandible is deformed due to tooth loss. There are arthritic changes on the posterior surface of the proximal end of the right humerus. Osteophytes are present on the cervical vertebrae and around the articular surface of the first sacral vertebra.

Teeth

Only eight mandibular teeth were found. The left second and third molars and the right first and third molars were lost before death and their alveoli had closed and healed. Left incisors and the canines were lost postmortem. The anterior teeth are slightly worn but posterior teeth are severely worn. The distal half of the right second molar has been destroyed by severe dental caries.

Conclusion

The skeleton belonged to an adult female aged between 40 and 60 years. Skeletal lesions found on this female suggest that she had been affected by some degenerative arthritic condition. In addition, the individual had poor dental health as indicated by a large carious lesion and antemoterm loss of three mandibular molars.

Taukome Burial 3 (Feature 4)

Burial Style

Denbow unearthed the grave and was analysed by Murphy but did not produce stable isotope material (Murphy 1996). The grave was identified as feature 4 in Unit 6 (18-21N; 6-9W). This feature was near the western side of this unit. Remains of an individual were found inside one of the pots. The burial pot was still intact at the time of excavation. The infant was well articulated when found (Denbow 1979b) and therefore this was not a secondary burial.

Burial goods

Six pots placed on top of stones were found in association with this burial, with one of them containing the skeleton. The form and motif of decorations on these pots indicate that they were of the Toutswe type (Denbow 1979b; 1983a). Unfortunately the pots had been broken at the time of excavation.

Preservation

The skeleton is complete and well preserved.

Age

Neural arches are not fused and so are the two halves of the mandible. Development of crowns of deciduous teeth indicates an age of zero to six months.

Bone pathology

There are no indications of bone pathology on the remains.

Conclusion

The burial is of a newborn baby aged between zero and six months, found buried in clay pot. There are no indications of skeletal lesions.

Taukome Burial 4 (Feature 5)

Burial style

The burial was found next to the south wall of Unit 6 (18N; 6.77-7.10W), about 70 cm below surface. The individual was lying on its right side, in a flexed position (Figure 4.2). The head was oriented to the west (Denbow 1979, 1983a). A large stone had been placed over the head, resulting in severe damage. Another stone was placed over the feet and the right scapula rested on top of yet another stone (Denbow 1983a). Denbow excavated this skeleton, which appears not to have been included in the sample used by Murphy (1996). Murphy's report does not have Feature 5 Burial at Taukome.

Preservation

The cranium and mandible are missing but were present at the time of excavation. The postcranial skeleton is incomplete.

Age

In the absence of teeth to use for age determination, the individual's age was estimated from long bone lengths and was found to be about five to seven years old.

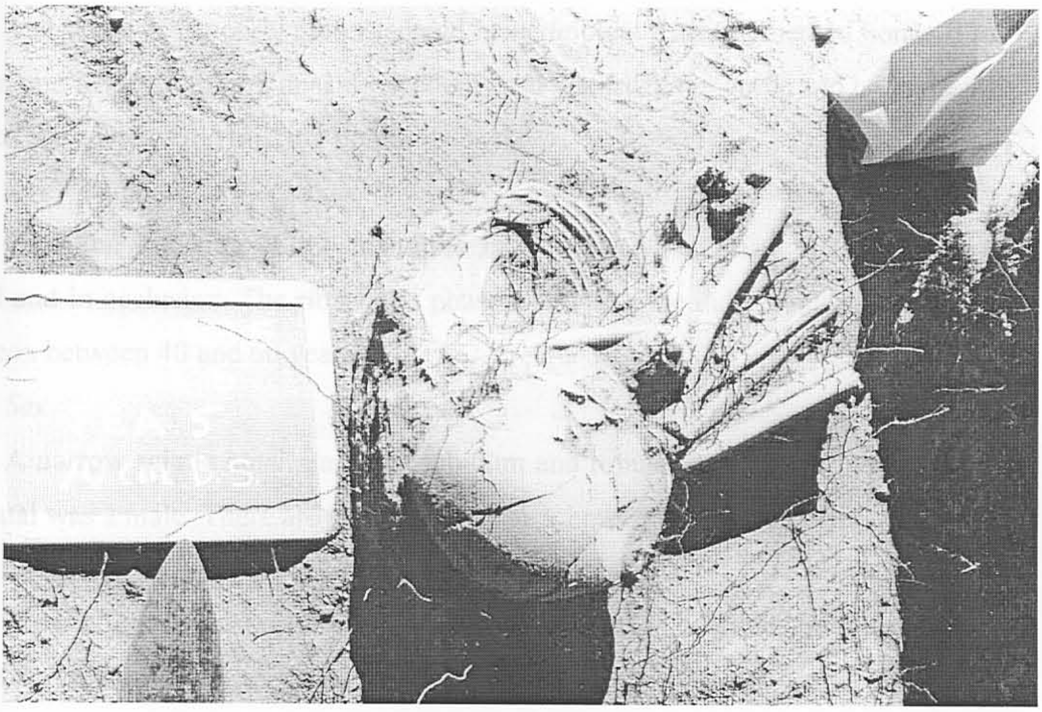
Bone pathology

There are no indications of bone pathology.

Conclusion

The remains are of a child of between five and seven years old. No signs of pathology were found on the skeleton.

Figure 4.2 Taukome Burial 4 in situ (Photo courtesy of JR Denbow)



Taukome Burial 5 (Feature 9)

Burial Style

The grave was found during excavations conducted by Denbow in the late 1970's and was probably not included in Murphy's sample since there is no burial associated with Feature 9 in Murphy (1996). About 100 m south of the main mound, a small pile of stones was excavated on a smaller mound (Denbow 1979b, 1983a). The pile was the only one of its kind on this side of the site. It turned out to be a human burial. The individual was on its right side with the head oriented to the west and the rest of the body to the east. The individual had been slightly flexed (Denbow 1979b).

Burial Goods

A large fragment of a beaker and a complete pot were found in association with this burial (Denbow 1979b; 1983a). These artifacts are associated with the Toutswe period.

Preservation

The skeleton is poorly preserved and is incomplete with fragmented bones. The cranium and lower limbs are missing. Rodents had disturbed the grave and had possibly removed the some of the missing bones.

Age

Only the left side of the mandible is present. All permanent teeth were fully erupted and in occlusion. The ribs are in phase 6 and thus the individual was estimated to have been between 40 and 60 years old.

Sex

A narrow sciatic notch, large acetabulum and robust os coxae all indicate that the individual was a male. There are strong muscle attachments on the humerus.

Stature

This individual's stature was not estimated because none of the long bones was complete enough to allow measurement.

Bone pathology

Osteophytes are present on the vertebral bodies. Sternal ends of the first ribs that are normally cartilaginous had calcified and were fused to the manubrium.

Teeth

There are only 10 mandibular teeth available; these include the left teeth from the central incisor to the second molar plus the right canine and first premolar. Large dentine patches are exposed but still surrounded by enamel in all but the right first premolar in which only the root remains. Periodontal disease is evident.

Conclusion

The skeleton is of an adult male aged between 40 and 60 years old. Arthritis had affected some of the vertebral elements of this individual. The individual has advanced dental wear and lesions on the alveoli suggest periodontal disease.

Taukome Burial 6

Burial style

Burial 6 from this site is of an isolated incomplete maxilla. (Denbow 1979b; 1983a) found in Feature 2 in unit 3. The feature was essentially a small pile of stones.

Murphy (1996) mentions 'skull burial' in her report, which could possibly be this individual.

Burial goods

A large fragment of a pot possibly associated with the burial was recovered.

Preservation

Rodents had disturbed the feature from which the maxilla was found (Denbow 1979b). A partially complete left side of the maxilla was the only bone found.

Age

Maxillary teeth were used to estimate the age of this individual. The premolars, first and second permanent molars were in occlusion. Third molars had not erupted. The individual was estimated to have been 15 to 18 years.

Teeth

Only four posterior teeth of the left maxilla were examined. They are all in good condition; small patches of dentine are exposed on the first molar.

Conclusion

The remains are of an older child aged between 15 and 18 years. The remains are incomplete and therefore assessment of pathology could not be carried out.

4.4 Bosutswe Burials

Bosutswe Burial 2001/1

Burial style

The burial was found approximately 180 cm below the surface in the center of the site. The skeleton indicated that the individual was in a flexed position with the head oriented to the west. Denbow excavated the burial in 2001 and no previous studies have been done on it.

Preservation

This is a complete and well-preserved skeleton.

Age

The crowns of the first incisors are not fully developed and the two halves of the mandible are not fused. The infant is estimated to have been between zero and six months old.

Bone pathology

The skeleton shows no signs of pathology.

Conclusion

This is a skeleton of an infant aged between zero and six months old.

Bosutswe Burial 3

Burial style

This burial was found on level 8, 70 - 80 cm below the surface of square 103W6N. The deposit that this burial came from was hard and compact unburned dung. The head was oriented to the west with the rest of the body to the east. The body was on its left side with the face looking towards the north and was tightly flexed at the hips, knees and elbows (Figure 4.3).

Three large stones were placed at different locations within the grave. One stone was placed behind the thoracic vertebrae; the other stone next to the elbows while the last one was at the feet. The skull was slightly out of position. A sharp curving of the thoracic vertebrae where one stone was placed appears to have disoriented the head as well as the neck. The atlas was located a few centimeters away from the foramen magnum. The mandible was located just next to the shoulder girdle and the thoracic vertebrae.

The left hand was complete and well articulated and spread out. On the other side of one of the stones, the right hand appeared clenched. The left radius underneath a stone was broken at the distal end and it seems to have been broken by pressure from this stone. The pelvis had collapsed and was slightly out of position. The tibia and fibula of the left leg crossed over their right counterparts at midshaft. Both feet were underneath a stone. The grave was excavated by the author in 2002.

Burial goods

Two rounded clay discs were found a few centimeters from the skull but their association to the burial was unclear. The presence of a mandible of a sheep/goat next to the pelvic outlet was also tentatively associated with the burial. No grave goods with direct association were found.

Preservation

The skeleton is well preserved and complete.

Age

Rib phase analysis indicates a phase 4. Cranial sutures are closed but not obliterated. The sphenooccipitalis synchondrosis is closed. The individual was an adult of 30 to 40 years old.

Sex

The sciatic notch is narrow and the sacrum is long and narrow. The acetabulum is large. On the cranium, the nuchal crest is well developed and the mastoids are large. The mandible is robust and the gonial angles are flared. These features are indicative of a male.

Stature

A combination of the physiological lengths of the femur and tibia was used to estimate the maximum living stature of this individual. He was approximately 170 ± 2.56 cm tall.

Bone pathology

The orbits are complete and show no signs of cribra orbitalia. One of the metatarsals of the right foot has evidence of a healed fracture. On the same foot, one phalange shows evidence for excessive usage.

Dental pathology

All permanent teeth were present. On the buccal surfaces of the maxillary second molar and its mandibular counterpart, small carious lesions were found. The lesions appear as thin bands at the cemento-enamel junctions (CEJs). Thin bands of calculus are present on the labial surfaces of maxillary and mandibular anterior teeth and on interproximal surfaces of all mandibular molars. All teeth are worn, ranging from small to large sized dentine exposed.

Conclusion

This was a burial of an adult male aged between 30 and 40 years. He was approximately 167 to 173 cm tall. The individual had suffered a broken metatarsal, which had healed prior to death. Small carious lesions have been identified on some teeth. Dental wear was noted on some teeth.

Bosutswe Burial 4

Burial style

This burial was found underneath feature 5, which was a collection of stones in excavation squares 105W2N and 105W3N. The head was oriented to the west with the rest of the body to the east. The body was tightly flexed, on its right side, facing south. A small stone had been placed between the head and the left ribs and thereby pushing the mandible downwards. The same stone had forced the sternal ends of the left and right ribs away from each other (Figure 4.4).

The left arm was slightly flexed at the elbow, folded over one of the stones. Bones of the right hand were visible from underneath the stone on the southern side of the burial. The left upper leg had been placed directly over the right upper leg but the lower legs were crossed over each other so that the distal ends of the left tibia and fibula were below instead of over their right counterparts. This grave was excavated by the author in 2002.

Preservation

The skeleton is well preserved and complete. However, placing stones on top of the body had resulted in breaking the mandible and the proximal end of the left humerus.

Age

Most deciduous teeth are in occlusion and so are the permanent first molars and permanent maxillary central incisors. Maxillary lateral incisors are below occlusion. Second molars (permanent) are all developed but not erupted. Age is estimated to be 8 ± 1 years.

Bone pathology

The skeleton shows no indications of pathology.

Teeth

A total of 24 teeth (16 deciduous, two maxillary permanent central incisors, two maxillary permanent lateral incisors and four permanent first molars) were assessed for dental pathology. There are no pathological conditions besides wearing of deciduous molars.

Conclusion

The grave was of a juvenile aged seven to nine years. There are no signs of pathology on this individual.

Bosutswe Burial 5

Burial style

Burial 5 was found in level 11, about 100 cm below surface, underneath dung deposits. The individual was buried in a tightly flexed horizontal position on its right side. The head was oriented to the north and the body to the south, facing west. The forearms were placed in between the thorax and the flexed legs, such that the hands rested on the knees (Figure 4.5). No stones were associated with this burial and a small fragment of Toutswe ceramic was recovered from the grave fill. This burial was found on the center of the site approximately 110 cm below the surface in square 101-6W, 1-6N.

Some rodent disturbance was evident at the feet, and a large chunk of corroded iron found near the feet could not be certainly associated with the burial. The author excavated this burial in 2002.

Preservation

The bones are well preserved but somewhat mineralized. They appeared rusty-brown in color. This may have been caused by chemicals precipitating down from the dung deposit just above. This is a well preserved and almost complete skeleton, though damage on some epiphyses of long bones was noted.

Age

All permanent teeth were in use. Third molars show no sings of dental wear. Epiphyses of the elbow are obliterated while on the hip, ankle and knee, fusion has occurred but lines are visible to obliterated. The wrist and shoulder epiphyses are semi-detached and the rest of the epiphyses are not fused. The remains are estimated to be of a 17 - 20 year old individual.

Sex

A narrow sciatic notch, a long and narrow sacrum and a large acetabulum suggest a male individual. Furthermore, the mandible has an angular corpus and its ramus is flexed. The nuchal crest is moderate and there is slight development of the brow ridge.

Bone pathology

Partial spina bifida occulta was identified on the fifth lumbar vertebra.

Teeth

All permanent teeth were present. More than half of the maxillary left first molar had been eroded by dental caries. Another carious lesion is present on the mandibular right premolar's mesial surface. Thick calculus deposits surround enamel on each mandibular tooth between the left central incisor and the right canine. Little dental wear is present. The left mandibular canine has an enamel hypoplastic line.

Conclusion

The individual was a male adolescent, aged between 17 and 20 years. The individual has evidence of partial spina bifida occulta. Carious lesions were identified on some of the teeth.

Bosutswe Burial 6

Burial style

This burial was found between 100 and 110 cm below the surface, just next to Burial 5, in a flexed position. The individual was oriented in a north-south direction with the head towards the north. The face was looking towards the west and was slightly elevated (Figure 4.6a). The hands were placed next to the chin, and like Burial 5, the bones were mineralized.

A stone was placed next to the hands, with another next to the lumbar vertebrae. The stone above the hands had crushed the right radius and ulna. Both feet were directly underneath a stone placed in the lumbar region, and the same stone had severely crushed most of the ribs and the vertebrae.

After removal of these stones, it was found that the neck had been twisted so much that the occipital bone was almost in contact with the ribs. The extent to which the vertebrae were twisted may indicate antemortem trauma, or burial practice, as it seemed unlikely that in situ movements during decomposition caused it (Figure 4.6b). The grave was excavated by the author in 2002.

Preservation

Several heavy stones were placed on top of this individual, resulting in damage to the some bones. The skeleton is, however, complete.

Age

Most deciduous teeth are in occlusion and so are the permanent first molars, maxillary central incisors and permanent canines are below occlusion. Permanent second molars and a maxillary left canine are below occlusion. A right maxillary first premolar is visible but not erupted. The juvenile is estimated to be seven to nine years old.

Bone pathology

The skeleton shows no indications for pathology.

Teeth

A total of 24 teeth were present. These included the 20 deciduous teeth and four permanent first molars. Dental caries was identified on a canine and a first molar (all deciduous) of the left maxilla, occurring as small lesions on interproximal surfaces. Calculus was found on some of the teeth. The maxillary incisors are not worn while the canines and molars have large dentine patches exposed but still surrounded by enamel. The same goes for mandibular teeth except for its canines, which have small dentine patches exposed. All permanent molars show little wear.

Conclusion

The skeletal remains are of a child aged between seven and nine years. There no signs of pathology found on the skeleton. There are, however, carious lesions on some of the individual's teeth.

Bosutswe Burial 7

Burial style

The burial was found at approximately 120 cm below surface in squares 102W1N and 102W2N on the western side of the site. The individual was an infant, buried with the head oriented in a northwest direction. It was horizontally flexed, laid on the right side facing southwest. The legs had been drawn up to the face and the knees were extended, bringing the feet close to the head. One stone had been placed next to the legs and two stones were on the pelvis. The author excavated this burial in 2002.

Burial goods

Numerous ostrich eggshell beads were recovered from around the neck and waist (Figure 4.7). These were remains of a necklace and waistband. Unfortunately the material used to put the beads together was not preserved.

Preservation

The skeleton is nearly complete but is in poor preservation condition. The bones are fragile and discoluored and the cranium is fragmented.

Age

The dentition is still deciduous. Mandibular canines are not yet in occlusion and all second molars were about to erupt, while the rest of the teeth were in use. The anterior fontanel is partially closed and the metopic suture is obliterated. The infant is estimated to have been between 18 and 24 months old.

Bone pathology

There are no lesions associated with pathology on this skeleton.

Teeth

A total of 14 teeth were available for assessment. Results showed no pathological conditions on any of the teeth.

Conclusion

This burial is of an infant of 18 to 24 months. There are no indications of pathology on the skeleton.

Bosutswe Burial 8

Burial style

The burial came from level 13 (120 - 130 cm below surface) in square 102W5N on the western side of the site. The cranium was in a southeast orientation, looking towards the northeast. The individual was in a flexed position on the right side (Figure 4.8). Some stones had been placed on top of the burial and they had collapsed into the grave. The neck had been twisted backwards. This burial was excavated by the author in 2002.

Burial goods

A complete clay beaker was found about 15 cm behind the cranium, with its mouth facing the west. It is a classic Toutswe type of beaker with no decoration, about 15 cm in height with a curved instead of flat base (Denbow: personal communication).

Preservation

Insect nests were present around the burial and the long bones of the lower body had been disturbed. Several bones of this burial were found out of what should have been their original position. Gnaw marks on the mandible and disturbed bones indicate that burrowing animals had, at some point in the past, accessed the burial but their nests were not visible at the time of excavation. Left ribs were missing and the cranium was crushed on the right side. The bones are fragile, especially the cranium, and are discolored.

Age

All deciduous teeth were in occlusion and the permanent first molars had not erupted. Moreover, the lateral parts of the occipital were not yet fused to the squama. These indicators suggest an age of three to five years.

Bone pathology

There are no indications for pathology on the skeleton.

Teeth

A total of 15 teeth (10 mandibular and five maxillary) were examined. Pitting enamel hypoplasia on mandibular canines are the only dental defects identified.

Conclusion

The skeleton is of a juvenile aged between three and five years. The individual has no signs of pathology.

Bosutswe Burial 9

Burial style

The burial was found on level 13 (120 - 130 cm below surface) in square 104W1N on the western side of the site. It was not possible to identify the orientation and manner in which the body had been placed in the grave, due to its destruction and incompleteness. The author excavated it in 2002.

Burial goods

The human remains were found mixed and close to a complete Toutswe type beaker. Due to disturbance of the grave it was not possible to identify the manner in which the beaker had been placed in relation to the body.

Preservation

Burrowing animals had disturbed the grave and the skeleton is incomplete and was poorly preserved. There are fragments of the cranial bones together with two complete femora and a fragment of the right tibia.

Age

On the basis of the length of the femur, the skeleton belongs to a newborn baby.

Bone pathology

There are no pathological lesions identified.

Conclusion

The remains are of a newborn/fetus.

Bosutswe Burial 11

Burial style

The burial was found in square 93W1N just east of a small semi-circular stonewall at about 70 cm below the surface on very fine, ashy soil. The individual had been horizontally flexed and the head was oriented to the west and looked to the south. It was on its right side (Figure 4.9). Both arms were tightly flexed and the hands were placed in front of the face. Several heavy stones had been placed on top of the burial. It was excavated in 2002 by the author.

Preservation

The cranium is damaged and facial bones including the maxilla are fragmented. Postcranial bones are generally well preserved but some show damage resulting from stones placed on the burial.

Burial goods

Several fragments of clay vessels were retrieved from the grave. Three of these were rim pieces and the others were body fragments. One of the rim pieces was from a straight vessel with no decoration and its measurements indicate that the vessel was at least 15 cm deep. The other two rim pieces were from a single vessel with a constricted neck. It had a single band of combstamping decoration bordered by single incision lines. The band was about half a centimeter thick and had been placed about half way between the root of the neck and the rim. The vessels are of a typical Toutswe tradition (Denbow 1983b).

Age

Maxillary deciduous second molars had not been shed and almost all permanent teeth are in occlusion except for maxillary first premolars and third molars. Epiphyses indicate that only the distal humerus and proximal femur were fused. Their fusion lines are still visible. The rest of the epiphyses are detached. On the basis of these, the individual's age is estimated to be 13 to 15 years.

Bone pathology

The sacrum has evidence of partial spina bifida occulta.

Teeth

A total of 14 maxillary and 14 mandibular teeth were available for analysis. The right maxillary lateral incisor is peg-shaped. A small amount of calculus is present on the labial surfaces of the mandibular incisors. There is little wear on all teeth, but the deciduous second molars are more worn than the rest of the teeth. A small lesion associated with dental abscessing on the mandibular left second premolar was found. A thin band of linear enamel hypoplasia occurs on anterior mandibular teeth including the first premolars. On the maxilla, enamel hypoplasia has been noted on the lateral incisors and left canine.

Conclusion

The remains are of an older child aged between 13 and 15 years. Evidence for spina bifida occulta was found on the sacrum. Teeth have calculus deposits as well as dental abscessing.

Bosutswe Burial 12

Burial style

The burial was discovered in square 91W, 3N, east of the semi-circular stonewall, between 70 and 80 cm below surface in a fine brownish soil deposit. The body had been horizontally flexed with the head oriented to the west lying on the right side (Figure 4.10). Five stones had been placed in a circular manner around the burial with the largest of them on top of the cranium. The tibiae and fibulae crossed over each other at midshaft. Both knees were located underneath one of the stones.

A circular floor surrounding Bosutswe Burial 12 clearly indicated that the grave had been dug onto a previous dwelling floor of some kind. The edges of the floor were elevated. On the northern side of the wall of the excavation unit, another piece of floor was discovered below the floor with Burial 12. It was tentatively concluded that two floors had been sequentially built on top of each other before the grave was subsequently dug through them. It was also evident that not much of the floors had been destroyed at the time of digging the grave. The burial shaft had been wide enough to fit the flexed body without leaving much space between the body and the wall of the grave. This grave was excavated in 2002 by the author.

Preservation

The skeleton is complete and well preserved.

Age

Cranial sutures are almost all obliterated and the teeth are severely worn. All epiphyseal lines are obliterated. The rib phase analysis indicates that the ribs were at phase 7 and therefore the individual was aged between 50 and 75 years.

Sex

The sciatic notch is narrow, the sacrum long and narrow and the acetabulum large. The mandible is robust with flaring gonial angles and large teeth. The individual had a well-pronounced nuchal crest, large mastoids and the brow ridge is fairly pronounced. In addition, the individual had robust bones. The features are indicative of a male.

Stature

Physiological lengths of the tibia and fibula were combined to estimate the living stature of this individual. He was approximately 170 ± 2.56 cm in height.

Bone Pathology

The individual had suffered from multiple defects some of which were due to degenerative conditions. For instance, there are osteophytes on many of the joint surfaces. The atlas and axis are fused to each other. The mandibular condyles are also affected. The sacrum had possibly fused to the os coxae and the fifth lumbar vertebrae had been sacralised. This individual had possibly suffered from DISH and is discussed in more detail in Chapter 6.

Teeth

All permanent teeth are present, except for the mandibular right first molar, which had been lost antemortem. Thin calculus deposits were present on the lingual and labial surfaces of all mandibular teeth as well as maxillary molars. All maxillary incisors are worn down to root level and the canines have small enamel remaining. Dental caries was identified on maxillary second and third molars on both sides of the maxilla. All lesions were located on interproximal surfaces and about a quarter of the surface had been affected in all cases. On the mandibular teeth, dental wear had affected all teeth, except third molars, exposing large patches of dentine but still surrounded by enamel. All third molars have small patches of dentine exposed. Dentine exposure on maxillary second premolars and second molars ranged between medium and large size patches.

Dental abscesses are present at the right mandibular first molar, between the first and second molars of the left side of the mandible and also on the maxillary left premolars. Dental abscess may have triggered loss of the right mandibular first molar. In addition to these, periodontal disease was identified on the mandibular incisors and canines. The condition may have been triggered by reduction in crown height of their maxillary counterparts.

Conclusion

The skeleton is of a male aged between 50 and 75 years, approximately 167 to 173 cm in height. The individual suffered from degenerative conditions affecting several joints on both the cranial and postcranial skeleton. He had poor dental health as indicated by dental abscessing and dental caries as well as antemoterm tooth loss.

Bosutswe Burial 13

Burial Style

Remains of Burial 13 were found in square 93W, 2N, east of the semi-circular stonewall, at about 100 cm below surface. The body had been slightly flexed and was oriented to the west, facing north. It was on its left side. Stones were placed in a circular manner around the burial, and unlike the other burials, the stones were next to the skeleton not on top of it (Figure 4.11). The left elbow was tightly flexed and the head rested on the left arm. The left leg had been brought slightly closer to the body than the right leg and the tibiae and fibulae crossed over each other at midshafts. The grave was excavated in 2002 by the author.

Burial goods

Several fragments of a single clay vessel were retrieved from the grave. The vessel was identified as being of the Toutswe type (Denbow 1983a).

Preservation

The cranium and mandible are well preserved. Even though some of the long bones are crushed and the os coxae are fragmented, this is a generally well-preserved and complete skeleton.

Age

Except for the third molars and maxillary second molars, all permanent teeth are in occlusion. On the distal humerus epiphyseal lines are nearly obliterated whereas those on the proximal ulnae are visible. The proximal femur is semi-detached. The rest of the epiphyses are detached. The individual's age is estimated to 13 ± 1 years.

Bone pathology

The skeleton has no evidence for pathology.

Teeth

A total of 28 (14 maxillary and 14 mandibular) teeth were examined. These excluded all third molars. The maxillary central incisors are shovel shaped. There is little calculus deposited in most of the teeth. Linear enamel hypoplasia is present on the anterior teeth of both the maxilla and the mandible.

Conclusion

The remains are of a child aged between 12 and 14 years. There are no indications of bone pathology on the skeleton. Teeth show little calculus deposits.

Figure 4.3 Bosutswe Burial 3 in situ. Note stones placed by the knees and feet.

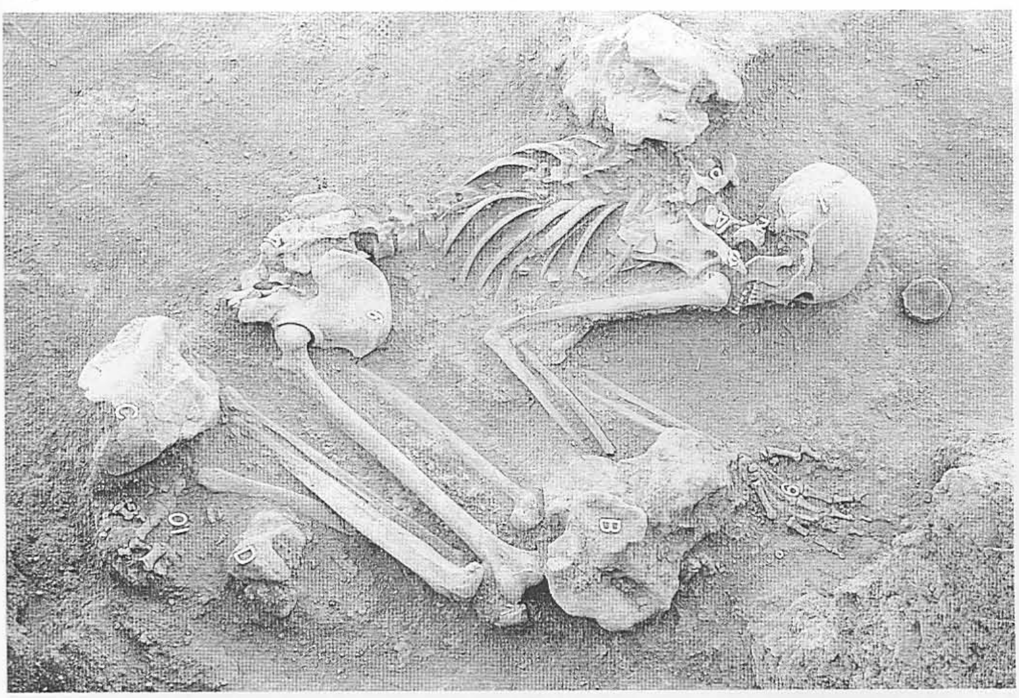


Figure 4.4 Bosutswe Burial 4 in situ

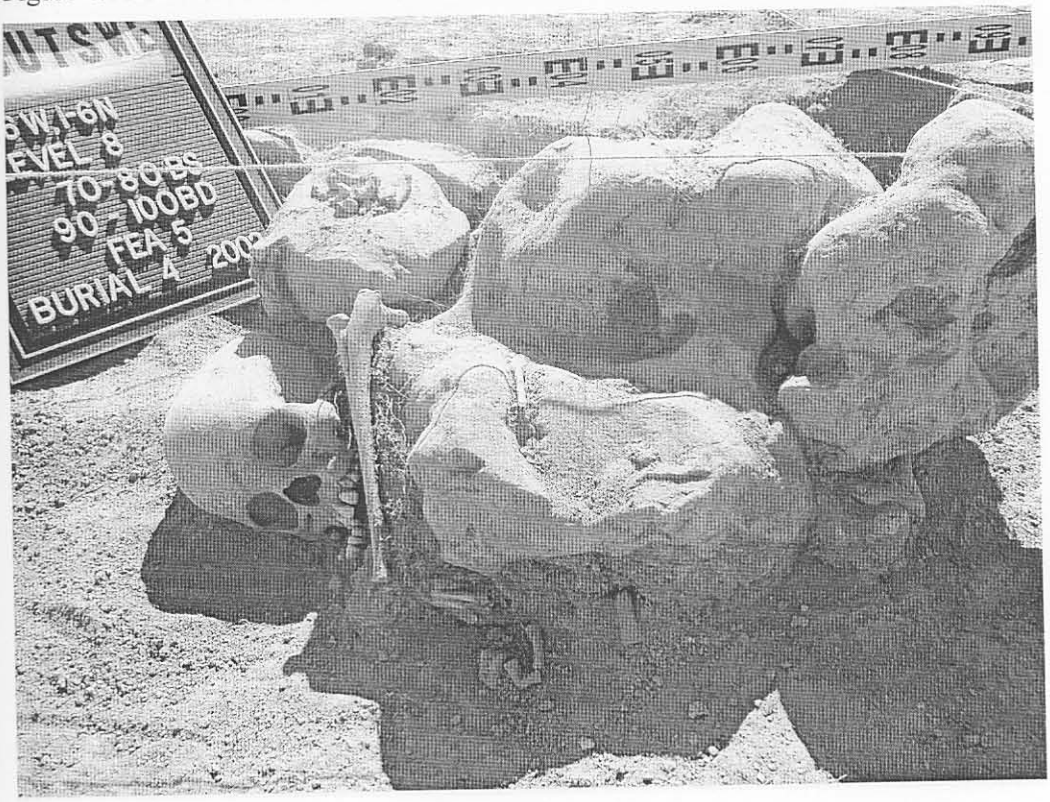


Figure 4.5 Bosutswe Burial 5 in situ

Figure 4.6a Bosutswe Burial 6 before stones were removed

Figure 4.6b Bosutswe Burial 6 after removal of stones. Note the twisted vertebral column

Figure 4.7 Close up view of ostrich eggshell necklace on Bosutswe Burial 7

Figure 4.8 Bosutswe Burial 8 in situ note a complete clay beaker next to the head

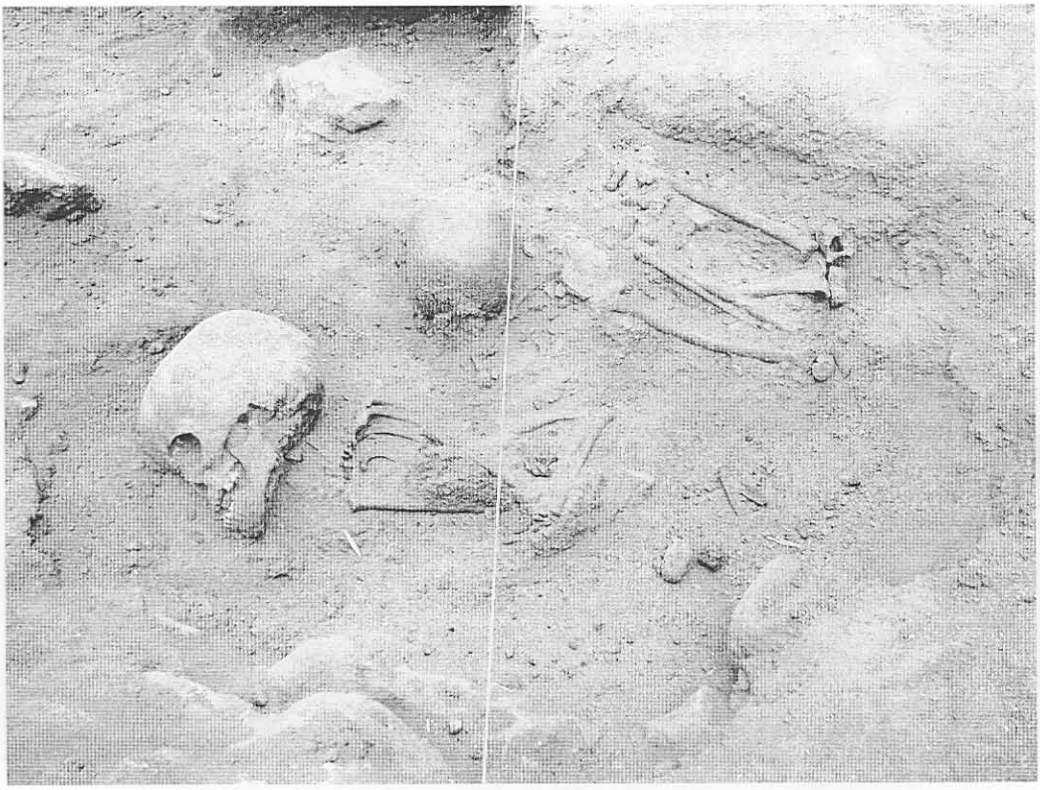


Figure 4.9 Bosutswe Burial 11 in situ

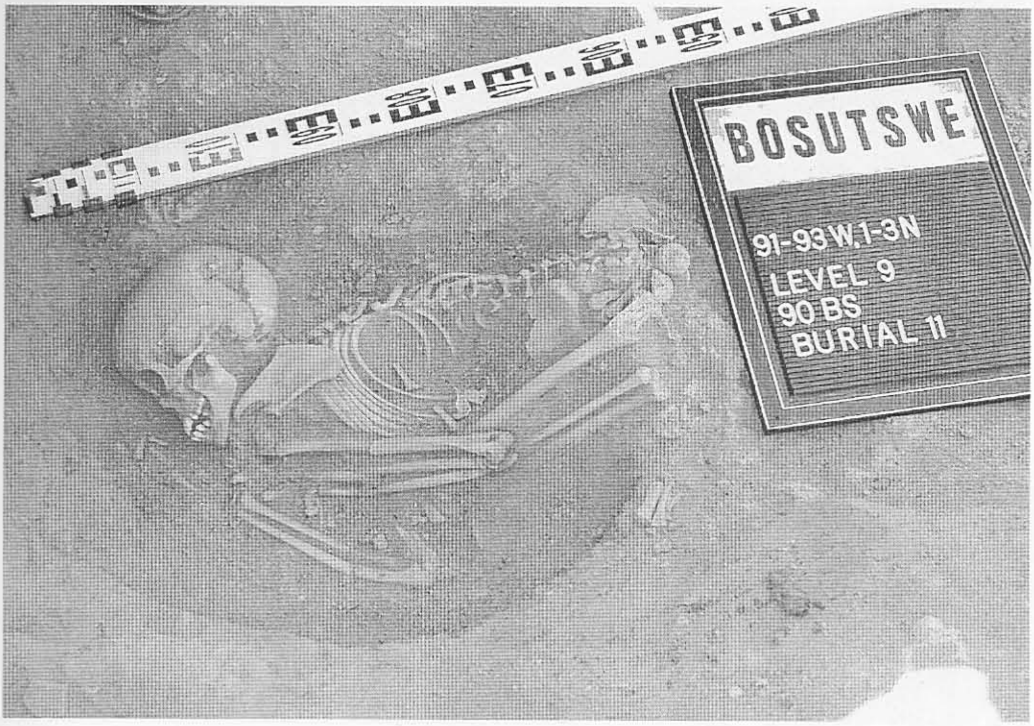


Figure 4.10 Bosutswe Burial 12 in situ

Figure 4.11 Bosutswe Burial 13 in situ

4.5 Thatswane Burials

Thatswane Burial 3

Burial Style

The body was in a horizontally flexed position with the head oriented to the west (Denbow 1979b). Denbow excavated it in 1979. The skeleton has not been examined before.

Preservation

The skeleton is poorly preserved and is incomplete. Most of the bones are fragmentary.

Age

All deciduous teeth are in occlusion and none of the permanent teeth had erupted. The basilar and lateral parts of the base of the occipital bone are not fused to each other or to the squama. On the basis of these, the individual's age was estimated to be three to five years.

Bone pathology

The skeleton shows no indications for pathology.

Teeth

A total of 15 teeth, six mandibular and nine maxillary, are present. Pitting enamel hypoplasia is present on the maxillary canines.

Conclusion

The skeletal remains are of an infant aged between three and five years old. The skeleton does not have any sings of bone pathology but has enamel hypoplasia.

Thatswane Burial 4

Burial style

The grave was found approximately 80 cm below the surface in unit 4 (Denbow 1979b). The individual had been placed in a tightly flexed position on the right side (Figure 4.12). It was excavated in 1979 by Denbow but has not been studied before.

Preservation

Grass roots had grown down to the level of the grave, thereby threatening the preservation of the bones. From the pictures provided by Denbow, the skeleton was complete at the time of excavation but the skull and mandible are currently missing. Bones present are in a fairly good state of preservation.

Age

Neural arches of the thoracic vertebrae are not fused to the centers. Long bone lengths were used to determine the age of this individual, which was estimated to have been between eight and 10 years.

Bone pathology

The skeleton shows no signs for pathology.

Conclusion

The remains are of a child aged between eight and 10 years. No pathological conditions were identified on the skeleton.

Thatswane Burial 5

Burial style

The body was in a flexed position, on the left side. It was found about 90 cm below the surface in unit 4. The head was oriented to the west (Figure 4.13). The grave was excavated in 1979 by Denbow (Denbow 1979b). The skeleton has not been studied before.

Figure 4.12 Thatswane Burial 4 in situ (Photo courtesy of JR Denbow)

Preservation

Vegetation close to the burial threatened the preservation of the bones. The cranium appears to have been complete but fragmentary. The skull and mandible are missing and bones present are fragmentary. The postcranial skeleton is incomplete.

Age

The individual was an adult, but unfortunately sternal ends of the ribs were not preserved and age was inferred from degenerative changes of the vertebral column. Arthritic changes and osteophytes developed on the vertebral column, suggest an adult of about 40 to 60 years old.

Sex

The sacrum is short and broad and a preauricular sulcus is present. The individual was probably a female.

Stature

This female's stature was estimated from a combination of the physiological lengths of the femur and tibia. She was about 168 ± 2.56 cm tall.

Bone pathology

There is evidence of arthritic disease on the patellae, proximal ends of the femora, the feet and on the vertebrae.

Conclusion

The skeleton has been identified as that of an adult female of between 40 and 60 years. Stature of this individual is estimated to be between 165 and 170 cm. Arthritic changes were observed on several bones.

Thatswane Burial 6

Burial style

The body had been placed in a horizontally flexed position (Denbow 1979b). The grave was found during excavations conducted by Denbow in 1979 and the skeleton has not been studied before.

Preservation

This skeleton is incomplete. The cranium is fragmentary and its right side is missing. Long bones are also damaged and most of them do not allow for maximum lengths to be measured. Porcupine gnaw marks were identified on the left femur and on the tibiae.

Age

Most of the teeth have been lost postmortem. Third molars are developed but not erupted. Epiphyses of long bones are not fused. Age was estimated to be 10 - 12 years.

Bone pathology

The skeleton does not have lesions associated with pathology.

Teeth

Ten maxillary and nine mandibular teeth were assessed. There are medium sized deposits of calculus on maxillary left first molar, right lateral incisor and on the mandibular central incisors. The maxillary right first molar has a much thinner deposit. In all incisors, calculus is present on the labial surfaces while on the molars it is buccal. Very thin enamel hypoplastic lines are present on the mandibular canines.

Conclusion

The skeleton is of a child aged between 10 and 12 years. There are no indications of bone pathology, but the teeth have enamel hypoplastic lesions and small calculus deposits.

Figure 4.13 Thatswane Burial 5 (Photo courtesy of JR Denbow)

4.6 Dikalate Burial

Dikalate Burial 1

Burial style

The head of this in individual was oriented to the west and the body was in a horizontally flexed position on the right side. The grave was situated in the middle of the site and was shallow (Reid 1999a). The grave was excavated by the author under supervision of Reid.

Preservation

The cranium and right side of the mandible are distorted but nearly complete and so is the postcranial skeleton. The skeleton was well preserved.

Age

The two halves of the mandible are not fused. Some tooth germs are present. Age of this individual is estimated to be between zero and six months old.

Bone pathology

The remains of this infant show no evidence for pathology.

Conclusion

The skeleton is of a newborn baby of between birth and six months old. There are no indications of pathology.

4.7 Mosu 3 Burial

Mosu 3 Burial 1

Burial style

The individual was found in a horizontally flexed position with the head oriented to the west and was laid on the right side (Figure 4.14). The legs were slightly flexed and the right arm was stretched but the left arm was flexed. The grave was found approximately 20 cm below surface in the fine ashy soil deposits. The burial was excavated by Reid in 1997.

Burial goods

Two large clay vessels were placed next to the individual, one behind the back and one in front between the flexed legs and the skull. Both vessels were found fragmented. A complete small clay beaker was located next to the knees. Remains of ostrich eggshell bead necklace were found around the cervical vertebrae.

Preservation

The skeleton is generally complete and in good condition. However, the cranium is fragmented, distorted and not complete. The mandible is fragmented but complete.

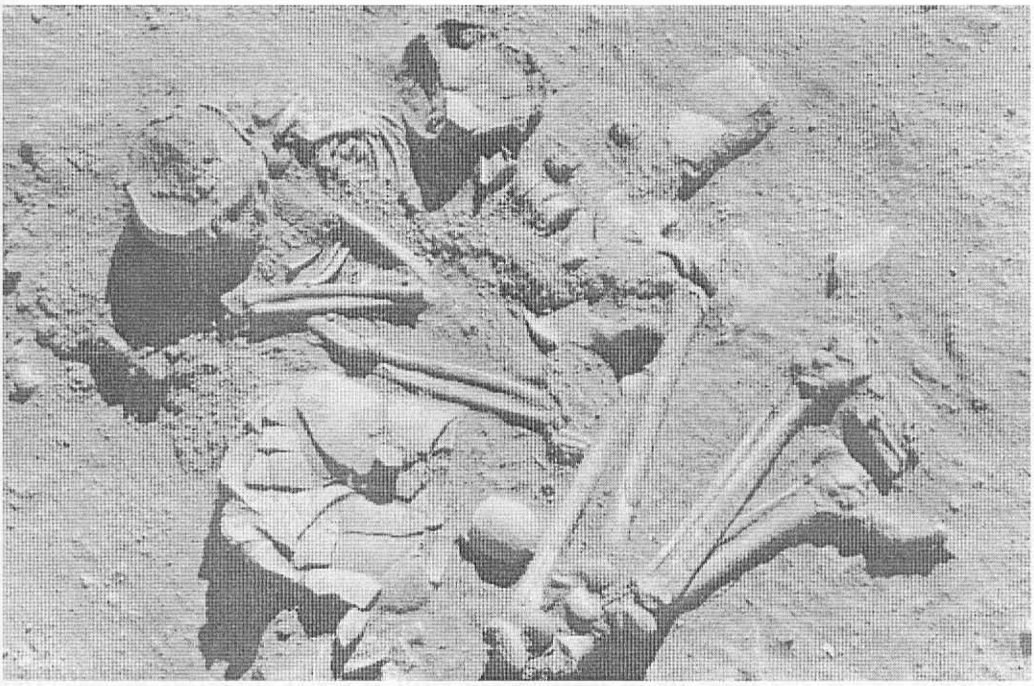
Age

Only the distal humerus is fused while all other epiphyses are detached. Permanent teeth are in occlusion except for the third molars, which are not yet erupted. Age is estimated to be 17 to 20 years.

Sex

The individual was immature but a narrow sciatic notch suggests a male.

Figure 4.14 Mosu 3 Burial 1 in situ (photo courtesy of A Reid)



Bone pathology

The skeleton does not have evidence for pathology.

Dental pathology

All maxillary and mandibular incisors have been lost postmortem and third molars had not erupted. There are no indications of dental pathology on all teeth.

Conclusion

The skeleton is of an adolescent aged between 17 and 20 years. Tentative results of sex determination are indicative of a male.

4.8 Thataganyane Burial

Thataganyane Burial 1

Burial style

The burial was excavated in 1992 and unfortunately there is no report regarding circumstances leading to its discovery, grave description, and provenance. There are no records accompanying the skeleton and the excavator is unknown. The bones have not been examined before.

Preservation

The skull and mandible are both fragmentary. A fragment of the right iliac bone is the only postcranial bone present.

Age

All permanent teeth are in occlusion and worn, including the third molars. The individual was aged between 20 and 40 years.

Sex

A narrow sciatic notch and an angular corpus of the mandible are indicative of a male.

Bone pathology

There is no evidence for pathology.

Teeth

The maxillary right second premolar and first molar have small carious lesions on their interproximal surfaces. There is little dental wear in all teeth but not on maxillary and mandibular second and third molars.

Conclusion

The remains are of a young adult male aged between 20 and 40 years old. There are no skeletal lesions on this individual and the teeth demonstrate small carious lesions.

4.9 Serowe Hill Burial

Serowe Hill Burial 1

Burial style

D. Schemers excavated the burial in 1978 above Thataganyane Hotel. There are no site records accompanying the bones and as a result there is no information regarding its burial style and provenance. The remains have not been studied before.

Preservation

The remains comprise of lumbar vertebrae, sacrum, and fragments of the iliac and pubic bones. The left and right ischial bones are complete.

Age

All epiphyses found are fused and obliterated. There are no pathological conditions found on the vertebrae and other joints. The individual is estimated to have been approximately 20 to 40 years old.

Sex

The remains are possibly of a female, as suggested by an incomplete but evidently wide sciatic notch.

Bone pathology

There are no signs of pathology.

Conclusion

The skeleton is too incomplete to allow for more accurate estimation of age but is estimated to have been 20 to 40 years old. The individual was possibly a female. There are no signs of pathology and stature could not be estimated, since no complete long bones were found.

4.10 Swaneng Hill Burial

Swaneng Hill Burial 1

Burial style

The burial was excavated in 1989 and currently its field records are not available. The excavator, provenance and burial style of this particular skeleton are unknown. The bones have not been studied before.

Preservation

This skeleton constitutes of a partially complete cranium, an incomplete mandible and incomplete cervical vertebrae only. The entire right side of the cranial vault is missing. The bone surrounding the missing part is whitened, probably due to long exposure to direct sun (Brothwell 1981).

Age

The third molar is in occlusion but the sphenooccipitalis synchondrosis is still open, thereby suggesting an individual of 20 to 30 years old.

Sex

The nuchal crest is well developed and the mastoids are large. The mandibular ramus is slightly flexed. The individual was probably a male.

Bone pathology

The diploe is thick, but there are no other indications of bone pathology.

Teeth

All maxillary teeth are present, and on the mandible the right canine, premolars and all three molars plus the left third molar are present. There are small calculus deposits on the maxillary left teeth.

Conclusion

The skull is of an adult male aged between 20 and 30 years. Stature could not be estimated as there are no long bones.

4.11 Kgaswe B-55 Burials

Kgaswe B-55 Burial 1

Burial style

The burial was found towards the northern area of the site. It was in a horizontally flexed position with the head oriented to the west (Denbow 1990). It was located just along the edge of the mound on the northern side of the site. The burial was excavated by Denbow in 1983 and has been analysed by Murphy (1996).

Preservation

Most of the skeleton is missing and available parts are fragmented. The skull is fragmented and distorted and the mandible is about half complete.

Age

Most of the teeth are missing but those present indicate that permanent teeth were in occlusion but third molars had not erupted. Age is estimated to have been about 15 to 20 years old.

Bone pathology

The skeleton has no evidence for pathology.

Teeth

A total of 23 permanent teeth were present. Two canines have linear enamel hypoplasia and one canine has pitting enamel hypoplasia.

Conclusion

The individual was an adolescent of 15 to 20 years old. There are no indications of bone pathology and three canines have enamel hypoplastic lesions.

Kgaswe B-55 Burial 2

Burial style

This burial was found along the northern most end of the midden close to a hut floor (Denbow 1990). It was a few meters from Burial 1. It was in a horizontally flexed position with the head oriented to the west. The burial was excavated in 1983 by Denbow and was included in the stable isotope analysis by Murphy (1996).

Burial goods

Numerous fragments of clay vessels were found and are associated with this individual. The fragments are from different vessels, none of which are complete.

Preservation

The cranium is well preserved but its right side has been partially destroyed, presumably during excavation because it had fresh breaks. The postcranial skeleton is nearly complete and well preserved.

Age

All permanent teeth are in occlusion and worn, but unfortunately fragments of ribs recovered do not have sternal ends. The vertebrae are not preserved. Based on cranial sutures, age of this individual is estimated to have been between 30 and 50 years.

Sex

The sciatic notch is fairly wide and the acetabulum is small. The mandible is slightly angular, and the mastoids are small. Thus the individual was diagnosed as female.

Stature

The living stature of this female is estimated to be 151 ± 2.56 cm. It was calculated on the basis of a combination of the physiological lengths of the femur and tibia.

Bone pathology

The skeleton has no evidence for pathology.

Teeth

Maxillary central incisors and a mandibular right central incisor and right canine are missing postmortem. Therefore a total of 28 permanent teeth were present. Thick deposits of tartar are present on the lingual surfaces of the mandibular anterior teeth. Other teeth have thinner calculus. Enamel hypoplastic lines are visible on the second and third molars of the left side only, on both the maxillary and mandibular teeth. Most teeth have advanced dental wear.

Conclusion

The remains are those of a female individual aged between 30 and 50 years. She was approximately 148 to 154 cm tall. No skeletal lesions were found. Calculus deposits and enamel hypoplastic lesions were present found on the teeth.

Kgaswe B-55 Burial 3

Burial style

Burial 3 was also on the northern side of the midden, but unlike Burials 1 and 2 it was not close to hut remains. It was found on the north central part of the site. It was in a horizontally flexed position with the head oriented to the west (Denbow 1990). Denbow excavated the burial in 1983 and the skeleton has been studied before by Murphy (1996).

Preservation

The skeleton is fragmented and incomplete.

Age

No teeth are present, and most of the bones are fragmented and epiphyses have been lost. However, the proximal radius is fused but not obliterated while the epiphyses of the proximal femur and proximal tibia are still detached. The individual was therefore an older child of about 12 to 14 years old.

Bone pathology

There are no indications for pathology.

Conclusion

This skeletal remains are of an older child aged 12 to 14 years with no indications of bone pathology.

Kgaswe B-55 Burial 4

Burial style

The grave was found within the central animal kraal in the center of the site. It was in horizontally flexed position with the head oriented to the northwest (Denbow 1990). The burial was situated next to the northeastern end of the central kraal, a few meters south of Burial 27. Denbow excavated it in 1983 and the bones have been studied before (Murphy 1996).

Preservation

The burial comprises only of a juvenile cranium with no facial bones and no postcranial skeleton.

Age

Based on cranial measurements, age of this individual is estimated to have been between five and 10 years.

Bone pathology

The skull of this individual has no indications for pathology.

Conclusion

The skull belongs to a juvenile of approximately five to 10 years old. No pathological lesions were found.

Kgaswe B-55 Burial 5(1)

Burial style

Two individuals, both labeled Burial 5, were found. This made it difficult to evaluate the burial style and provenance of the burial being discussed. Denbow excavated the skeleton in 1983 and it is possible that it was analysed by Murphy (1996) whose sample included one Burial 5.

Preservation

The cranium is complete but has been reconstructed from several fragments. The right side of the mandible is complete, but only 2 of its teeth have been preserved. The postcranial skeleton is partially complete.

Age

Third molars have no wear, thereby indicating that they had been in use for only a short time before death. Ribs are in phase 1, placing the individual at an age of between 18 and 22 years.

Sex

The sciatic notch is narrow and the sacrum is long and thin. The individual was a male.

Bone pathology

There are no indications for pathology.

Teeth

All maxillary incisors have been lost post mortem. In the mandible, the right canine, right first and second molars are the only teeth present. There are very feint enamel hypoplastic lines on both maxillary canines.

Conclusion

The individual was a male of about 18 to 22 years old. The skeleton has no signs of pathology.

Kgaswe B-55 Burial 5(2)

Burial style

These are remains of the second individual labeled burial 5. The burial style and provenance of this individual could not be determined from the report written by Denbow (1990) because of reasons mentioned above. It was excavated by Denbow.

Preservation

The skeleton comprises of a complete adult left femur and a fragment of a tibia only.

Age

The remains are of a middle-aged adult aged between 30 and 50 years as estimated from the basis of bone pathology.

Sex

The size of the head of the femur (45.7 mm) falls within the male range.

Stature

The individual's stature was estimated from the physiological length of the femur. He was about 173 ± 2.80 cm tall.

Bone pathology

The inferior articular surface of the femur has small osteophytes.

Conclusion

The remains are of an adult male of approximately 30 to 50 years old and was approximately 170 to 176 cm tall. The distal end of the femur has small osteophytes.

Kgaswe B-55 Burial 6

Burial style

The burial was located in the center of the midden not far from Burial 25. The grave was not close to any structure. It was in a flexed position with the head oriented to west (Denbow 1990). The skeleton has not been examined before. It was excavated in 1983 by Denbow and was assessed by Murphy (1996).

Burial goods

A fragmented but nearly complete clay bowl was found in association with this burial. It is shallow and flat-based bowl with a thick rim. The rim and the body are not decorated. Its exact location in relation to the skeleton is currently unknown. It is a Toutswe type vessel (Denbow 1983b).

Preservation

The bones are dark brown in color and much different from the other burials of the same site. The bones are, nevertheless, well preserved. The skull is fragmented and incomplete and the mandible is missing.

Age

The lengths of the ulna and femur both indicate an age range of six to eight years old.

Bone pathology

The skeleton has no evidence for pathology.

Conclusion

The skeleton is of a child six to eight years old with no observable pathological lesions.

Kgaswe B-55 Burial 7(1)

Burial style

The burial style of this individual could not be deduced from Denbow's report since two individuals were labeled Burial 7 in the laboratory, while the report mentions only one Burial 7. It is therefore not clear which one of these two is consistent with Denbow (1990). The remains discussed here are of the younger of the 2 individuals labeled burial 7 from the same site. The bones have not been studied before since Burial

7 used by Murphy is of an adult and therefore not consistent with the individual referred to as Burial 7(1). Denbow excavated the grave in 1983.

Preservation

The skull and mandible are fragmented, incomplete and distorted. The postcranial skeleton is incomplete. There are animal gnaw marks on some of the teeth.

Age

Third molars appear to have erupted not long before death since they are not worn. The individual was aged between 17 and 25 years.

Sex

Sex of this individual was not determined because relevant bones were missing.

Bone pathology

The skeleton shows no indications for pathology.

Teeth

The individual had no dental defects except for slight wear. A total of 24 teeth is present, some of which have enamel removed by burrowing animals as indicated by gnaw marks. They could thus not be assessed for pathology.

Conclusion

The individual was an adolescent of between 17 and 25 years. Bones used for sex determination were not present. No signs of bone pathology were found. Teeth are in good health condition although burrowing animals had destroyed some of them.

Kgaswe B-55 Burial 7(2)

Burial style

The skeleton is of the older individual labeled burial 7. Like burial 7(1), its burial style and provenance cannot be deduced from Denbow's report. The burial was excavated in 1983.

Preservation

The individual is represented by partially complete long bones.

Age

Epiphyses of the long bones are fused and obliterated. Small osteophytes on the distal end of the femur suggest that the remains are of an adult of about 30 to 50 years.

Sex

Based on the size of the head of the femur (44.8 mm) and the head of the humerus (40.9 mm) it is estimated that individual was a male.

Stature

The individual was about 169 ± 2.56 cm tall. The physiological lengths of the femur and tibia were used in combination to estimate the height of this individual.

Bone pathology

There are small osteophytes surrounding the inferior articular surfaces of the femora.

Conclusion

The skeleton is of a middle aged adult male of between 30 and 50 years. The individual was about 166 to 172 cm tall. Small osteophytes were found on the inferior articular surfaces of the femora.

Kgaswe B-55 Burial 8

Burial style

This burial was found along the eastern end of the midden in a horizontally flexed position with the head oriented to the west. The grave was discovered during excavations conducted by Denbow in 1983 and the skeleton has been studied previously by Murphy (1996).

Preservation

The skeleton is incomplete. A complete sacrum, left tibia and fragments of lower limbs are the only bones available.

Age

The elements of the sacrum of this individual were not fused. The remains are of a young child of six to eight years old. This estimate was based on a combination of the length of the tibia and the unfused sacrum.

Bone pathology

The remains found have no evidence for pathology.

Conclusion

The individual was a child between six and eight years old with no skeletal lesions.

Kgaswe B-55 Burial 9

Burial style

The body had been placed in a horizontally flexed position with the head oriented to the northwest. It was found in the midden in the southeastern area (Denbow 1990). The grave was discovered by Denbow in 1983 and the bones have been examined before by Murphy (1996).

Preservation

The skull is distorted and the mandible is incomplete. The postcranial skeleton is fragmentary and incomplete. The bones appear to have been well preserved in situ but destroyed either during excavation or storage.

Age

Epiphyses of all bones present are fused and obliterated. Permanent teeth are in occlusion and worn and were used to estimate an age range of 40 to 60 years for this individual.

Sex

The sciatic notch is incomplete but is evidently narrow. Tentative results indicate a male individual.

Stature

Stature of this individual was estimated from the physiological length of the tibia. The individual was about 161 ± 3.44 cm in height. .

Teeth

There are only 11 permanent teeth. Mandibular left second and third molars have thin calculus deposits and the maxillary left second premolar, second and third molars have small carious lesions on their interproximal surfaces. There is advanced dental wear on almost all teeth. The mandibular left canine has linear enamel hypoplasia.

Conclusion

The remains are of an adult aged 40 to 60 years old, possibly male of about 157 to 165 cm in stature.

Kgaswe B-55 Burial 11

Burial style

This burial was located on the southeastern area of the midden. The skeleton was found in horizontally flexed position with the head oriented to west (Denbow 1990). It was found in 1983 by Denbow and has been studied before (Murphy 1996).

Preservation

The skeleton constitutes of fragments of a scapula, humerus, tibia and fibula only. Burrowing animals had disturbed the grave.

Age

There are no pathological lesions associated with degenerative diseases and it is approximated that the individual was between 20 and 50 years.

Sex

None of the bones used for sex determination was present. The head of the humerus is fragmented and was not measurable.

Bone pathology

There is no evidence for pathology on the bones found.

Stature

Long bones present are incomplete and could not be used to estimate stature. Moreover, the sex of the individual was not determined and this would also hinder the calculation of stature.

Conclusion

The skeleton is too incomplete to allow for a more accurate estimation of age, while determination of sex and stature were not attempted. The bones are of a middle aged adult of between 20 and 50 years.

Kgaswe B-55 Burial 12

Burial style

The grave was found in the central area of the midden. It was in a horizontally flexed position with the head oriented to the west. The grave was discovered in 1983 when Denbow excavated the site (Denbow 1990). The bones have not been studied before, as they do not appear in Murphy's report.

Preservation

Similar to Burial 11, the remains of Burial 12 are incomplete and not very informative. They comprise of a complete frontal bone, fragments of long bones and other pieces. Burrowing animals had disturbed the burial.

Age

Cranial sutures are closed and partially obliterated. The individual was approximately 30 to 60 years old.

Sex

Sex could not be determined because none of the bones used for sex determination were present.

Bone pathology

The remains have no evidence for pathology.

Conclusion

The bones are of an adult aged between 30 and 60 years whose sex and stature could not be estimated. There are no pathological conditions identified.

Kgaswe B-55 Burial 13

Burial style

This burial was found in the central area of the midden, in a horizontally flexed position. The head was oriented to the west (Denbow 1990). The remains were found in 1983 by Denbow and were included in the sample analysed by Murphy (1996).

Preservation

An incomplete, fragmented and distorted adult skull with no postcranial remains represents Burial 13. The postcranial skeleton was present during excavation.

Age

Although cranial sutures were not complete, they indicate an age of between 30 and 60 years as they are fused.

Sex

It was not possible to determine the sex of this individual because the cranium is incomplete.

Bone pathology

Assessment for bone pathology revealed no lesions.

Conclusion

The skull is of an adult whose age was possibly between 30 and 60 years and its sex could not be determined. There were no long bones from which stature could be estimated.

Kgaswe B-55 Burial 14

Burial style

The burial was found on the southern area of the midden. Its head was oriented to the west and the body was in a flexed position (Denbow 1990). It was found in 1983 by Denbow. The skeleton was analysed by Murphy (1996).

Preservation

Most of the bones of this skeleton are present but fragmented. The skull is fragmented and the mandible is complete. There are chop marks on the right tibia.

Age

All epiphyses are fused and obliterated showing that the individual was an adult. Bone spurs found on the right patella and left calcaneus are associated with degenerative conditions and hence the individual is estimated to have been between 40 and 60 years old.

Sex

The sciatic notch is wide and the mandibular corpus is rounded. The individual was female.

Stature

The physiological length of the tibia indicates that the individual was about 156 ± 3.44 cm in height.

Bone pathology

Bone spurs had developed on the anterior surface of the right patella and on the posterior surface of the left calcaneus. The left patella and right calcaneus are both missing and the vertebral column is incomplete and has no indications of osteophytes.

Teeth

Maxillary central incisors are both worn down to the root level but other teeth have little or no wear at all. Mandibular first molars had both been lost antemortem and their sockets have closed. Severe carious lesions were identified on interproximal surfaces of two mandibular molars and smaller lesions were identified on maxillary first molars, a maxillary third molar and a premolar. All lesions are located on interproximal surfaces.

Conclusion

The remains are of an adult female aged between 40 and 60 years old. The female was about 152 to 160 cm tall. Lesions on the patella and calcaneus suggest that the individual had some degenerative disease. Some of the teeth have carious lesions.

Kgaswe B-55 Burial 15

Burial style

The grave was located on the southeastern area of the midden. The skeleton was in a horizontally flexed position with the head oriented to the west (Denbow 1990). It was excavated by Denbow in 1983 and has been studied before (Murphy 1996).

Preservation

The bones are well preserved, but incomplete. The cranium is fragmented and the mandible is missing.

Age

None of the epiphyses are attached and the elements of the sacrum are not fused. Maxillary permanent incisors, a canine and a premolar are in occlusion but the roots of the canine and premolar are not fully developed. The individual is estimated to have been 11 ± 1 years old.

Bone pathology

Cribra orbitalia is present in both orbits and the superior-posterior surface of the skull has small porotic hyperostosis.

Teeth

There are only four maxillary teeth and none them display any dental disease. The central incisor is shovel shaped.

Conclusion

The remains are of an older child of 10 to 12 years. Cribra orbitalia has been identified on both orbits.

Kgaswe B-55 Burial 16

Burial style

This burial was in the southwestern side of the midden. It was flexed with the head oriented to the west (Denbow 1990). Denbow excavated the grave in 1983 (Denbow 1990). Murphy (1996) had two individuals both labeled Burial 16 (one adult and one juvenile) but the current research identified one Burial 16. Murphy's individual was a female but the current analysis identified a male.

Preservation

This is a nearly complete but not very well preserved skeleton. The skull and some of the long bones were fragmented but were possible to reconstruct. The right femur has gnaw marks along the linear aspera indicating that burrowing animals had at some point found their way through to the burial.

Age

Using rib phase analysis, the age of this individual is estimated to have been 20 and 30 years old.

Sex

The sciatic notch is narrow and the mandibular ramus is flexed. The teeth are large and the brow ridges are pronounced. These features indicate a male

Stature

The physiological length of the femur indicates that this male was 167 ± 2.80 cm tall.

Bone pathology

There is evidence of healed trauma, possibly a fracture, on the distal end of the left fibula. The left tibia is very flat and its right counterpart is missing.

Teeth

All 32 permanent teeth are well preserved. There are small dentine patches exposed in all but the third molars. On the maxilla, thin calculus is located on the labial surfaces of all teeth from the left first premolar to the right first premolar and on the buccal surfaces of the right second premolar, first and second molars. In the mandible, teeth from the left canine to the right first molar are affected by calculus.

Conclusion

The remains are of an adult male aged between 20 and 30 years old. He was approximately 164 to 170 cm tall. The individual had suffered trauma on the left fibula, which had healed long before death.

Kgaswe B-55 Burial 17

Burial style

The burial was located in the central kraal not far from Burials 19 and 20. It was in the southern end of the kraal (Denbow 1990). The head was oriented to the west and the skeleton was in a horizontally flexed position. It was found during the 1983 excavation conducted by Denbow. The skeleton has been studied before (Murphy 1996).

Preservation

The skeleton is fragmented and incomplete. The cranium, mandible and long bones are missing.

Age

The ribs and cranium of this individual were nor preserved. Age was estimated on basis of pathological conditions associated with degenerative conditions on the vertebrae and pelvis. The individual is estimated to have been 50 to 75 years old

Sex

The sacrum is long and thin, and the sciatic notch very narrow. The individual was a male.

Bone pathology

Osteophytes had developed on all cervical vertebrae. The axis and C3 are fused to each other but not to the atlas. The right superior articular surface of the atlas and the right inferior articular surface of the axis are eroded indicating some form of arthritic disease. There are small osteophytes on the thoracic vertebrae. The articular surface of the body of S1 shows some possibility of fusion to L5.

Conclusion

The remains are of an adult male aged between 50 and 75 years old. The individual's stature was not calculated because there are no complete long bones. Osteophytes on the vertebrae and pelvis are a result of degenerative disease. The axis and C3 of this individual are fused o each other.

Kgaswe B-55 Burial 18

Burial style

Human skeletal remains were found within the daga structure associated with hut 17. The hut is along the southern end of the midden (Denbow 1990). A site label found with the skeleton indicates that the individual was buried in a pot. Unfortunately it is not possible to assess whether this was a primary or secondary burial. The orientation of the body is unknown. Denbow discovered the burial in 1983 (Denbow 1990). It was analysed by Murphy (1996).

Preservation

The skeleton is incomplete and bones are fragmented.

Age

The teeth and mandible are not well preserved. The tympanic bone is not fused to the squama of the temporal bone. Developmental stage of the temporal bone as well lengths of the ulna and radius are consistent with newborn/fetal age.

Bone pathology

The skeleton revealed no signs for pathology.

Conclusion

The skeleton is of a newborn/ fetus and has no indications of pathology.

Kgaswe B-55 Burial 19

Burial style

The grave was located just next to Burial 20 along the southern end of the central kraal (Denbow 1990). The skeleton was in a horizontally flexed position, head oriented to the west. It was excavated by Denbow in 1983 and was included in the sample studied by Murphy (1996).

Preservation

The remains comprise of a fragmented skull with no facial bones, and fragments of the lumbar vertebrae only.

Age

The skull is incomplete but cranial sutures are closed and partially obliterated. There are small osteophytes on the lumbar vertebrae. Age of this individual is estimated to have been 40 - 60 years.

Sex

A well-pronounced brow ridge suggests the individual was a male. This diagnosis is only tentative.

Bone pathology

Small vertebral osteophytosis were identified on the lumbar section.

Conclusion

Bones described here are of an adult, possibly male, aged between 40 and 60 years. There are no long bones and therefore stature could not be estimated. Small osteophytes were identified on the individual's lumbar vertebrae.

Kgaswe B-55 Burial 20

Burial style

Burial 20 was located along the southern border of the central kraal, very close to Burial 19. It was in a horizontally flexed position with the head oriented to the west (Denbow 1990). The grave was discovered during the 1983 excavations conducted by Denbow and the skeleton has been studied before (Murphy 1996).

Preservation

Despite an incomplete cranium, the skeleton of this individual is in good condition. However, teeth have been lost postmortem.

Age

None of the fontanelles is closed. The tympanic ring is not fused to the petrous part of the temporal bone. In addition, the greater wings of the sphenoid are not fused to the body. Lengths of the humerus and femur indicate that the remains are of a newborn/fetus.

Bone pathology

The skeleton has no evidence for pathology.

Conclusion

The remains are of a newborn/fetus with no pathological lesions.

Kgaswe B-55 Burial 21

Burial style

The grave was found underneath remains of hut 16 (Denbow 1990). It is difficult to tell if the grave had been dug through a pre-existing hut floor or whether the hut had been built over the grave. It was on the southern part of the midden. The orientation and placing of this burial are difficult to deduce from Denbow's report. The individual was not included in the sample studied by Murphy.

Preservation

The skeleton is fragmented and incomplete.

Age

The two haves of the mandible are not fused. Length of the femur places this skeleton within the newborn/fetal age range.

Bone pathology

There is no evidence for pathology on this skeleton.

Conclusion

The remains are of a newborn/fetus with no pathological conditions.

Kgaswe B-55 Burial 23

Burial style

The burial was located east of Burial 25, in the center of the midden. It was in a horizontally flexed position with the head oriented to the west (Denbow 1990). Denbow excavated the grave in 1983 and the remains have been studied before (Murphy 1996).

Preservation

The cranium is incomplete. The right ulna and partially complete tibiae are the only postcranial bones present.

Age

The length of the ulna suggests that the remains are of a newborn/fetus.

Bone pathology

The remains have no evidence for pathology.

Conclusion

The remains are of a newborn/fetus with no pathological lesions.

Kgaswe B-55 Burial 24

Burial style

This individual had been buried inside the central kraal, along its eastern edge (Denbow 1990). It was horizontally flexed with the head oriented to the west. The burial was discovered during the 1983 excavation conducted by Denbow. The skeleton has been studied before (Murphy 1996).

Preservation

The skeleton is incomplete but bones present are in good condition. The calvarium is nearly complete and the mandible is missing.

Age

Epiphyses of the elbow and hip are fused and obliterated; those at the ankle, knee and shoulder are fused but not obliterated. The acromion and iliac crest are not fused. Teeth were, unfortunately not preserved. The individual was aged between 15 and 20 years.

Bone pathology

The remains have no signs for pathology.

Conclusion

The individual was aged between 15 and 20 years. No attempts were made to determine its sex. There are no pathological conditions found on the bones.

Kgaswe B-55 Burial 25

Burial style

The burial was located within the central area of the midden, to the west of burial 23. A posthole was located just next to the head. The head was oriented to the west. It was in a horizontally flexed position (Denbow 1990). It was found in 1983 during excavations conducted by Denbow and the skeleton has been studied before (Murphy 1996).

Preservation

This is yet another incomplete skeleton. It constitutes of cranial fragments, an incomplete left femur and a fragment of the right iliac bone.

Age

Cranial sutures are partially obliterated and the individual was probably 30- 60 years old.

Sex

A narrow sciatic notch indicates that the individual was a male.

Stature

This individual's stature was not calculated because none of the long bones present are complete.

Bone pathology

The skeleton has no evidence for pathology.

Conclusion

The individual was a middle aged adult male of between 30 and 60 years old. There are no signs of pathology on the skeleton.

Kgaswe B-55 Burial 26

Burial style

The grave was located in the center of the site within the midden (Denbow 1990). The body had been placed in a horizontally flexed position with the head oriented to the west. Denbow excavated the grave in 1983 and the skeleton has been studied previously (Murphy 1996).

Preservation

The skull is fragmented and the mandible is missing. The axial skeleton and upper limbs are missing and the pelvic girdle and lower limbs are incomplete.

Age

The sphenooccipitalis is closed and there are no lesions commonly associated with degenerative conditions. Unfortunately no good age makers were preserved. The individual was an adult of 30 to 50 years old.

Sex

The sacrum is short and broad and the sciatic notch is wide, thus indicating a female.

Stature

Using a combination of the physiological lengths of the femur and tibia, the maximum living stature of this individual was estimated to be 158 ± 2.56 cm.

Bone pathology

There is no evidence for pathology on the skeleton.

Conclusion

The remains are of an adult female of about 30 to 50 years. She was approximately 155 to 161 cm in height. There are no indications of pathology on the skeleton.

Kgaswe B-55 Burial 27

Burial style

The grave was located within the central kraal, on the northern side. The individual was in a flexed position. The head was oriented to the west. The grave was unearthed in 1983 by Denbow (Denbow 1990) and the remains have been studied before (Murphy 1996).

Preservation

The postcranial skeleton of this individual was not found. The skull is fragmented and the face is missing. A nearly complete mandible is present

Age

A maxillary left second molar is below occlusion and third molars are not erupted. Anterior permanent teeth, premolars and the first molars were in occlusion at the time of death. The individual is estimated to have been 10 ± 1 years old.

Bone pathology

There are no pathological lesions identified on this individual.

Teeth

There are 19 teeth present and those missing have been lost postmortem. Six of the mandibular teeth (left premolars and the first and second molars and the right first and second molars) have feint linear enamel hypoplasia.

Conclusion

The remains are of a child aged between nine and 11 years. Its skeleton displays no signs of pathology. Enamel hypoplasia was identified on six mandibular teeth.

Tables 4.1, 4.2, 4.3 and 4.4 present brief summaries of the results obtained in the analysis of skeletons. The tables show individuals of 0-5 years, 5-10 years, 10-20 years 20+ years respectively. Distinctive notes include burial style (*italics)* where information was available and skeletal lesions found.

Table 4.1 Summary of individuals aged 0-5 years

No.	Age (years)	Preservation	Distinctive notes
	Toutswemogala		
1	Newborn	Complete	*Pot burial*
5	3-5	Incomplete	
7	3-5	Complete	*Associated with metal objects*
8	2-4	Incomplete	Porotic hyperostosis + bifid rooted canine
10	1-2	Partially complete	
11	0-0.5	Partially complete	
12	0-0.5	Incomplete	
18	3-5	Incomplete	
20	3-5	Incomplete	
21	1-1.5	Incomplete	
23	3-5	Partially complete	
24	3-5	Incomplete	
26	1-2	Incomplete	Enamel hypoplasia
27	0-0.5	Incomplete	
28	2-4	Incomplete	
	Taukome		
3	0-0.5	Complete	*Pot burial*
	Bosutswe		
01/1	0-0.5	Complete	*Flexed*
7	1.5-2	Complete	*Flexed*
8	3-5	Complete	*Flexed, grave stones, pot-* enamel hypoplasia
9	Newborn	Incomplete	
	Thatswane		
3	3-5	Incomplete	*Flexed-* enamel hypoplasia

Table 4.1 continued

No	Age	Preservation	Distinctive notes
	Dikalate		
1	0-0.5	Complete	*Flexed*
	Kgaswe B-55		
18	Newborn	Incomplete	
20	Newborn	Partially complete	
21	Newborn	Incomplete	
23	Newborn	Incomplete	

Table 4.2 Summary of individuals aged 5-10 years old

No.	Age (years)	Preservation	Distinctive notes
	Toutswemogala		
2	5-7	Complete	Cribra orbitalia + porotic hyperostosis
3	6-8	Incomplete	Cribra orbitalia + enamel hypoplasia
4	6-8	Incomplete	*Isolated skull burial*
6	9-11	Complete	*Pot-* Spina bifida occulta +enamel hypoplasia
9	7-9	Partially complete	
13	7-9	Partially complete	
14	5-7	Partially complete	Healed trauma on right femur
15	7-10	Partially complete	
29	6-10	Incomplete	Enamel hypoplasia
31	9-11	Incomplete	
	Taukome		
4	5-7	Incomplete	*Flexed*
	Bosutswe		
4	7-9	Complete	*Flexed, grave stones*
6	7-9	Complete	*Flexed, grave stones*- dental caries
	Thatswane		
4	8-10	Partially complete	*Flexed*

Table 4.2 continued

No	Age	Preservation	Distinctive notes
	Kgaswe B-55		
4	5-10	Incomplete	
6	6-8	Incomplete	*Flexed, clay pot*
8	6-8	Incomplete	
27	9-11	Incomplete	Enamel hypoplasia

Table 4.3 Summary of individuals aged 10 –20 years

No.	Age	Preservation	Distinctive notes
	Toutswemogala		
16	10-12	Incomplete	Dental modification + cribra orbitalia
17	10-12	Incomplete	
	Taukome		
6	15-18	Incomplete	*Maxilla exposed by animals*
	Bosutswe		
11	13-15	Complete	*Flexed, pots* -spina bifida occulta, enamel hypoplasia
13	12-14	Complete	*Flexed, pot*- enamel hypoplasia
	Thatswane		
6	10-12	Incomplete	*Flexed* – enamel hypoplasia
	Kgaswe B-55		
1	15-20	Incomplete	*Flexed*- enamel hypoplasia
3	12-14	Incomplete	*Flexed*
15	10-12	Incomplete	Cribra orbitalia
24	15-20	Incomplete	

Table 4.4 Summary of adults aged 17 years and over

No.	Age (y)	Sex	Stature	Preservation	Distinctive notes
	Toutswemogala				
19	40-60	M	-	Incomplete	Burnt, osteophytes
22	40-50	M	169-175	Partially complete	Osteophytes
25	30-50	F	167-173	Partially complete	*Flexed* - osteophytes
30	20-40	-	-	Incomplete	

Table 4.4 continued

No	Age	Sex	Stature	Preservation	Distinctive notes
	Taukome				
1	40-60	M	162-171	Incomplete	*Flexed*- osteophytes + dental caries and wear
2	40-60	F	-	Incomplete	*Flexed*- deformed mandible, caries, osteophytes
5	40-60	M	-	Incomplete	*Flexed*- osteophytes + calcified sternal rib ends
	Bosutswe				
3	30-40	M	167-173	Complete	*Flexed*- grave stones, fracture + dental caries
5	17-20	M	-	Complete	Spina bifida occulta, enamel hypoplasia, caries
12	50-75	M	167-173	Complete	*Flexed*- grave stones, DISH +dental caries
	Thatswane				
5	40-60	F	165-171	Incomplete	*Flexed*- osteophytes
	Mosu 3				
1	17-20	M	-	Complete	*Flexed, clay pots*
	Thataganyane				
1	20-40	M	165-171	Incomplete	
	Serowe Hill				
1	20-40	F	-	Incomplete	Dental caries
	Swaneng Hill				
1	20-30	M	-	Incomplete	
	Kgaswe B-55				
2	30-50	F	148-154	Partially complete	*Flexed, clay pots*
5(1)	18-22	M	-	Partially complete	Enamel hypoplasia
5(2)	30-50	M	170-176	Incomplete	Osteophytes + enamel hypoplasia
7(1)	17-25	-	-	Incomplete	
7(2)	30-50	M	166-172	Incomplete	Osteophytes
9	40-60	M	158-164	Incomplete	Dental caries + enamel hypoplasia
11	20-50	-	-	Incomplete	
12	30-60	-	-	Incomplete	
13	30-60	-	-	Incomplete	
14	40-60	F	153-159	Incomplete	Bone spurs + dental caries
16	20-60	M	164-170	Partially complete	Healed fracture
17	50-75	M	-	Incomplete	Osteophytes, axis and C3 fused
19	40-60	M	-	Incomplete	Osteophytes
25	30-60	M	-	Incomplete	
26	30-50	F	155-161	Incomplete	

5. PALAEODEMOGRAPHY

5.1 Introduction

In its broadest terms, palaeodemography encompasses the reconstruction and study of prehistoric population stabilities and dynamics (Buikstra and Konigsberg 1985). These population dynamics are studied with the aim to provide us with a better understanding of the relationship between man and his environment and the role of culture as an intermediary between man and the environment. Many authors see the development of agriculture and subsequent sedentary life as the major turning point in the evolution of human demography (Angel 1969; Ascadi and Nemeskeri 1970; Ward and Weiss 1976; Cohen and Armelagos 1984; Buikstra et al. 1986).

During the past several decades, there have been many publications based on palaeodemographic studies. Numerous publications made can be divided into broad categories that are not necessarily mutually exclusive. A set of literature dealing with the methods and techniques for primary data collection for palaeodemographic construction has been established (e.g., Angel 1969; Ascadi and Nemeskeri 1970; Henneberg 1976; Ward and Weiss 1976; Howell 1976; Coale and Demeney 1983; Gage 1988; Konigsberg and Frakenberg 1992; 2002; Paine and Harpending 1996). Problems, limitations and criticisms towards the use of skeletal data to project prehistoric population demography have been discussed (Bocquet-Appel and Masset 1982; 1996; Buikstra and Konigsberg 1985). Despite problems with materials and methods used, case studies based on archaeological populations have attracted attention from all over the world, e.g., Ubelaker (1989a), Patrick (1989), Mensforth (1990), Storey (1992) and Henneberg and Steyn (1994; 1995).

Palaeodemographers interested in the Demographic Transition theory use skeletal populations to evaluate the demographic stages that communities are experiencing. According to this theory, world societies go through three demographic stages. In the first stage, there is high fertility and high mortality rates. This pattern is usually associated with prehistoric and pre-industrialized populations (Ascadi and Nemeskeri 1970). In the second stage there is high fertility but low mortality, which is the primary factor behind accelerated modern population growths. Stage 3, often associated with modern industrialized countries, is characterized by low fertility and low mortality rates (Storey 1992).

Palaeodemographic studies usually focus on population dynamics to the exclusion of population size mainly because estimating population size requires ideal situations often not provided by both the archaeologist and the archaeological record (Ubelaker 1989a). Such ideal conditions include total site excavation and very excellent preservation to allow for maximum skeletal recovery. It is inappropriate to excavate entire sites without preservation of some of its parts. In southern Africa, complete site excavations often occur as part of mitigation procedures on sites that are earmarked for development purposes. Even then archaeologists are often under time pressure to give way to the developer and would often resort to quick but very destructive excavation procedures such as the use of heavy machinery (e.g. at Kgaswe B-55). This, in turn, compromises the chances of total recovery. Alternatively, sites with elaborate structures such the architecture of Teotihuacan (Storey 1992) may be completely excavated for research purposes. These sites often have ideal preservation conditions and can allow total skeletal 'harvest' to grant population size estimation (Storey 1992). There were no formal graveyards in southern African prehistory (Steyn 2003) and this makes it difficult to evaluate the representativeness of a sample. Individuals were buried in different areas depending on their sex, age and social status. Archaeological burials recovered in southern Africa are very often chance discoveries since no permanent grave makers were used.

5.2 Problems and limitations

Konigsberg and Frakenberg (1992) have discussed, in detail, the 'stumbling blocks' that are commonly experienced in palaeodemographic studies. The first of these is that population growth rate, i.e. the ratio of birth and death rates of skeletal populations, is never known. The second stumbling block is that it is often not clear whether or not the skeletal samples are representative of the actual populations. The representativeness of the skeletal sample is usually assumed rather than being known. The third stumbling block emanates from the fact that ages of individuals are estimated, not known (Konigsberg and Frakenberg 1992). The accuracy of age estimates is influenced by several factors such as the completeness of a skeleton, the accuracy of the method being used and biases by the assessor. The possibility of secular trends ought to be checked especially when the reference and target samples are thousands of years apart. Secular trends may influence the age at which changes in bone take place and hence blur the accuracy of aging techniques (Bocquet-Appel and Masset 1982).

In the reconstruction of a life table of ancient populations, data are derived from censuses of the dead whereas in conventional demography, the primary data source is the census of the living (Angel 1969; Ward and Weiss 1976; Buikstra and Konigsberg 1985; Ubelaker 1989a). In the absence of written records of the archaeological populations, age and sex are determined from the bones. It is therefore important that the best and most highly accurate techniques be used to determine age and sex since the results obtained will influence the palaeodemographic characteristics being studied (Bocquet-Appel and Masset 1996). Age and sex determinations are influenced, to a large extent, by the availability of relevant bones or features used in such determinations.

Konigsberg and Frakensberg (1992) and Bocquet-Appel and Masset (1996) outline different methods for age determination to assist in reconstruction of demographic profiles of skeletal populations. The Bayesian method and the interactive proportional fitting procedure (IPFP) reveal that individuals within the same age interval have varying chances of being at different stages of the same age indicator (Konigsberg and Frakensberg 1992; Bocquet-Appel and Masset 1996). As a result an individual being observed is divided into the number of age intervals into which the stage of the indicator has possibilities of falling within.

It is important to bear in mind the extent to which the skeletal sample is representative of the actual population (Ubelaker 1989a; Williams 1992; Storey 1992; Henneberg and Steyn 1994). The representativeness of the skeletal sample is in itself, influenced by the sampling strategies used in excavations of sites, the differential or age specific burial practices of the communities under study, and the preservation conditions prevailing on the sites (Ubelaker 1989a; Storey 1992; Henneberg and Steyn 1994).

Isolated, fragmentary and commingled remains complicate the evaluation of the representativeness of the sample. These are absolute indicators of the presence of other burials but may not yield information on sex and age of the individuals. It is therefore natural for researchers to focus on more complete skeletons and exclude incomplete and fragmentary individuals (Storey 1992). Much as this is inevitable, it does obviously compromise the representativeness of the sample.

Storey (1992) brings to the forth one of the most important conditions that must be met in order to make sound demographic inferences. This, she says, is the definition of a population. Defining an archaeological population in a demographic study calls for strict limitations on both the spatial and temporal contexts of the skeletons included in the sample. This calls for caution on the use of skeletons from sites that were occupied repeatedly over centuries e.g., Bosutswe. One needs to be careful of the stratigraphic context of each burial from such sites as to have an idea of which skeletons belong to the same period of occupation. An archaeological population can be defined by time, geographic distribution or cultural characteristics.

In order to understand the growth rate of a skeletal population, estimates of fertility (Weiss 1973; Henneberg 1976; Buikstra et al. 1986; Paine and Harpending 1996) can be made and compared to mortality rates. Population fertility can be estimated in various ways. 1) by dividing the reproductive period by the length of interval between successive children. The reproductive period (from menarche to menopause) is on average 30 years and the generally accepted birth interval is 30 months. Biologically, birth interval is influenced by the length of the lactation period, which suppresses the onset of ovulation following a successful pregnancy and delivery (Howell 1976). 2) Based on reconstructed age distribution of females and assumed age specific fertility rates. However, various cultural and socioeconomic factors governing fertility levels of females in prehistoric societies are so specific and binding that it becomes difficult to make generalizations on age specific fertility (Henneberg 1976). Despite numerous attempts to develop and perfect already existing methods for estimating fertility rates in skeletal populations (Weiss 1973; Ward and Weiss 1976; Henneberg 1976; Buikstra et al. 1986; Paine and Harpending 1996), there are still problems encountered. The most lamented problem is the accuracy of applying mathematical equations to skeletal data.

A more recently popularized method for estimating growth rate of skeletal populations is where model life tables are fitted into the skeletal data to project the fertility rates (Coale and Demeney 1983; Gage 1988; Paine 1989; Paine and Harpending 1996). The Coale and Demeney (1983) 'West' model is the one best suited for prehistoric and pre-industrial societies (Howell 1976; Paine 1989). Model life tables provide a pattern of age specific mortality to be used where the skeletal data is not workable e.g. in the case of K2/Mapungubwe (Henneberg and Steyn 1994; 1995). Mathematical models of establishing mortality patterns are a slight variation of model life tables and can be used in palaeodemography where there is insufficient primary data provided by the skeletal sample (Gage 1988).

A fundamental problem with the use of biological parameters in estimating fertility rates is that social and cultural dictates are ignored. According to some authors, e.g. Henneberg (1976), cultural and social factors responsible for limiting the number of children per female are of an insignificant magnitude and therefore can be ignored. Contrary to this, all non-Malthusian societies develop cultural mechanisms that regulate population growth rate once the critical threshold between man and his environment has been reached. For instance, among the !Kung hunter-gatherers in Botswana, South Africa and Namibia, socio-economic and cultural constraints extend the birth interval to an average of 36 months (Howell 1976) and thereby limiting the total fertility rate (TRF) to about five children per female.

Controversies, concerns and critiques raised about palaeodemography around the mid 1980s to the early 1990s (Buikstra and Konigsberg 1985; Konigsberg and Frakenberg 1992) appear to have now been partially answered and corrected. One of the main concerns at the time was the use of poor aging techniques especially on adults (Buikstra and Konigsberg 1985; Bocquet-Appel and Masset 1996). At the time, the pubic symphysis and cranial sutures were the most highly relied upon methods despite the fact that they had low accuracy and could only provide broad age ranges (Angel 1969; Bocquet-Appel and Masset 1982; Buikstra and Konigsberg 1985; Ubelaker 1989a; Konigsberg and Frakenberg 1992; Loth and İşcan 1994). At this point in the evolution of anthropological aging techniques, it is tempting to argue that this concern is being dealt with by developing more reliable and more accurate methods such as the rib phase analysis (e.g., Loth and İşcan 1994; 2000a; Oettlé and Steyn 2000). This method has produced satisfactory results for different purposes. Other age estimation techniques such as the Bayesian method and the IPFP are being reviewed to assist in aging adult skeletons more accurately (Konigsberg and Frakenberg 1992; Bocquet-Appel and Masset 1996). Although sex and population specificity are still a concern in skeletal aging, more and more reference collections are being established in order to bridge the spatial differences between reference samples and study samples. Archaeological as well forensic skeletons are now aged using reference samples closer to them than was the case in the past. For instance, the Department of Anatomy, University of Pretoria has developed a rib phase model for South African blacks (Oettlé and Steyn 2000) and this was used to age the Toutswe skeletons in the current study.

5.3 Other similar studies

In sub-Saharan Africa, palaeodemographic studies are not common due to the fact that it is difficult to obtain skeletal samples from the same site or sites of the same period that are large enough to warrant such studies. In southern Africa, one of the best case studies of palaeodemography has been done on skeletons from Mapungubwe and K2 sites (Henneberg and Steyn 1994; 1995).

From these sites, 109 skeletons were excavated, 97 from K2 and 12 from Mapungubwe, a sample large enough to allow for reconstruction of the life table. Two life tables were calculated, one for K2 only and another one for the K2/Mapungubwe combination (Henneberg and Steyn 1994; 1995). The stable population results showed a very low life expectancy of about 12 years at birth, which could not be compared with any prehistoric or modern Malthusian populations (Henneberg and Steyn 1994; 1995). An annual increase in population of 2.5% was then used to adjust the demographic situation and the life expectancy at birth rose to at least 18 years, providing a more workable life table (Henneberg and Steyn 1994; 1995). The K2/Mapungubwe results are used in this study for comparison with the Toutswe results.

Another case study of the reconstruction of palaeodemography in southern Africa was done on skeletal remains from Oakhurst, a rock shelter situated along the southern coast of South Africa (Patrick 1989). The Oakhurst study is important in that it is one of the first paleodemographic studies done in southern Africa, however some problems exist. The main problem is that the Oakhurst sample spans a period of approximately 10 000 years, but there are not enough skeletons to indicate demographic transition throughout the centuries. The sample of 42 individual skeletons is too small to argue that it is representative of the population of a 10 000 year period. Therefore, a comparison between Oakhurst demography and that of any other skeletal population has to be done with caution.

In North America and other parts of the world, numerous case studies have been published, e.g., Ubelaker (1989a), Mensforth (1990), Storey (1992). Teotihuacan is an ancient Mesoamerican city located on the northeastern side of the Valley of Mexico, not far from Mexico City, dated between 150 BC and AD 750 (Storey 1992). A life table for this population was calculated from a sample of 206 individuals. The results are that nearly 30% of infants died before the end of their first year. The area had high infant mortality and life expectancy at the end of the first year was about 20 years.

Another example comes from Kentucky in the northeastern side of the United States of America. Here different authors (e.g., Mensforth 1990) have reported a late archaic skeletal population of 430 individuals from Carlson Annis (Bt-5). The demographic study of this population included 354 individuals. The resulting life table shows a life expectancy of 22.4 years at birth, which raised by five years once an infant, completed the first year of its life (Mensforth 1990). Like other archaeological examples, this community was characterized by high infant mortality. Of the 354 individuals, 98 are between seven lunar months and four years. Only 70.3% of the babies born survived to reach five years. At least 19.5% of the original population survived to 40 years (Mensforth 1990).

The skeletons from Ossuary II in Maryland were used to construct a life table of the community (Ubelaker 1989a). The life table showed that at birth life expectancy was 23 years but once an individual survived the first five years of life, then that individual could expect to live an additional 27 years to reach the age of 42. Despite the relatively high life expectancy at birth by comparison to other cases, the sample indicated a relatively high infant mortality rate and low adolescence mortality (Ubelaker 1989a).

5.4 Analysis of survival times

The main aim of palaeodemography is the analysis of survival times. Survival time refers to the time from a fixed starting point to the death of an individual (Altman 1991; Hosmer and Lemeshow 1999). In clinical trials, the starting point can be the time of when treatment was applied to the subject. In palaeodemography the starting point is the time of birth so that the survival time is between birth and death. The statistical analysis of survival time is referred to as survival analysis (Altman 1991; Hosmer and Lemeshow 1999). Survival analysis can be carried out in different ways such as; (1) a life table, (2) a survivorship curve and (3) a Kaplan-Meier curve. There are different kinds of life tables designed for different kinds of data (Angel 1969; Ubelaker 1989a; Altman 1991; Williams 1992; Hosmer and Lemeshow 1999). In palaeodemography, a life table encompasses an estimation of life expectancy. A life table presents tabulated data while the survivorship curve and the Kaplan-Meier curve present data graphically (Altman 1991; Hosmer and Lemeshow 1999).

A total of 84 skeletons were used to for survival analysis of the Toutswe population. Of these, 52 are infants and juveniles younger than 15 years while the remaining 32 are adults aged between 15 and 75 years.

5.4.1 Life table

A life table is, in essence, a brief summary of mortality rates and demographic characteristics of a population, or an indication of varying chances of death due to age or a mortality schedule (Weiss 1973; Coale and Demeney 1983; Ubelaker 1989a; Storey 1992). An advantage of using a life table is that it allows for the estimation of life expectancy, which can not be estimated from either a survivorship or a Kaplan-Meier curve.

The birth and death rates of the Toutswe population are unknown and hence a stationary population assumption was used to reconstruct a life table by means of Halley's method (Acsadi and Nemeskeri 1970). A stationary population is defined by equal birth and death rates, zero migration and a relatively constant age distribution (Ascadi and Nemeskeri 1970; Weiss 1973;Coale and Demeney 1983; Williams 1992; Storey 1992). The stable population theory assumes that unchanging birth and death rates for a hundred years would yield unchanging age structures of that population within that one hundred-year period.

The Toutswe skeletons come from several sites, but none of the sites produced a sufficient sample size to warrant isolated life table construction. All skeletons were therefore combined to construct a single life table with the assumption that the entire sample was representative of the actual population. An adult sex distribution was also evaluated.

Methods

Five-year age intervals were used to establish the age distribution. The age interval is based on an idealized concept of a cohort in which a group of people born within the same age interval experience similar probabilities of death as a function of age during their lives (Williams 1992). An age interval has two qualities, an entry age and the width of the interval. Deciding on these qualities is influenced by the age resolution obtained from the skeletons. Estimation of age from skeletons cannot provide resolutions for one-year intervals, especially after the first year of life (Williams 1992). Ubelaker (1989a) advises that five-year intervals be used because they are broad enough to encompass possible errors incurred in estimating age, but at the same time short enough to depict mortality patterns more easily and clearly. The last interval can be left open ended to include all individuals much older than its entry age (Williams 1992).

For skeletons whose ages fell across two or more age intervals, such skeletons were distributed by fractioning them into equal values which were then placed into relevant age intervals (Henneberg and Steyn 1994; 1995). For instance, a skeleton aged between 30 and 50 years was divided into four parts, each being 0.25 and each five -year interval between 30 and 50 was allocated a 0.25 value. The life table was calculated using the Halley's method as follows:

The number of all skeletons whose ages fell within an age interval (x) was summed to determine the number of deaths (Dx) per age interval. The percentage of deaths for each interval (dx) was calculated by expressing the number of deaths (Dx) as a percentage of the total sample. The percentage of survivors of each interval (lx) is the percentage of the original sample that survived into the beginning of that interval. It is calculated by subtracting the percentage of deaths (dx) of a previous interval from the percentage of survivors (lx) in the same interval. The probability of death (qx) was calculated by dividing the percentage of deaths (dx) by the number of survivors present at the beginning of the interval for which the probability of death (qx) is calculated. The total number of years lived by all individuals within the same interval (Lx) was calculated by adding the number of survivors in an interval (lx) to the number of survivors entering the next interval (lo). The sum was then multiplied by 5 (length of age interval) and the result divided by 2 to get the answer i.e. $Lx = 5 (lx + lo) / 2$. The total number of years remaining in the lifetimes of all individuals entering each age interval (Tx) is the sum of

Lx values of that interval and all those after it. Life expectancy (ex) at each interval was obtained by dividing the Tx value by the lx value in that age interval (x). It represents the number of years an individual within a particular age interval (x) can be expected to live (Ubelaker 1989a). The life table was computed using a spreadsheet developed in Excel.

Results

The results indicate a high infant mortality rate (Table 5.1). The zero to four-year age interval has the highest representation, with about 30% of the individuals belonging in this group. The life expectancy at birth was about 17 years, but once a child survived the first five years of its life it could expect to live another 18.45 years to become approximately 24 years. Fifty-three of the 84 individuals (nearly two-thirds) died before reaching the age of 15 years. Thus, only one-third of the original sample survived beyond 15 years. A sharp decline in the number of deaths is seen between the ages of 10 and 19 years, where 12 individuals had died at the end of 14 years but only five dying at the end of 19 years. Only five individuals lived to be between 50 and 75 years old. One of the features of this population is that many of individuals died prematurely but those who did survive adolescence lived for a relatively long period. The large number of infants and juveniles could be a result of high rate of reproduction as has been implicated in the K2/Mapugubwe study (Henneberg and Steyn 1994), or may be a function of differential disposal of the dead.

5.4.2 Survivorship curve

A survivorship curve is a graph used to depict the percentage of the original sample alive at the end of each age category (Ubelaker 1989a; Altman 1991; Hosmer and Lemeshow 1999). The total sample is theoretically taken as 100 percent of the actual population.

The survivorship curve (Figure 5.1) shows four distinct features reflected by changes in the steepness of the slope at roughly four phases. First it shows a steep slope in survivorship between the ages of five and 15 years. The 50% mark of the curve is at approximately 15 years. This phase is a result of high mortality rates during the early years of life. The second phase is approximately between the ages of 15 and 35 years where the slope is fairly gentle. The gentleness of the slope is due to the relatively low mortality. The percentage of individuals alive from one age category to the other drops by small amounts from 15-35 years and hence a gentle slope in the survivorship curve. Between the ages of 35–55 the curve becomes fairly steep marking the third phase of the survivorship curve. This indicates a fairly rapid decline in the percentage of survivors during early adulthood. In the last phase starting at 60 years, there are very small chances of survival and after the age of 75 there are no survivors.

Table 5.1 Life table of the Toutswe population.

Age	Dx	dx	lx	qx	Lx	Tx	ex
0- 4	26	30.95	100.00	0.31	422.62	1723.214	17.23
5 - 9	16.5	19.64	69.05	0.28	296.13	1300.595	18.84
10 - 14	10.5	12.50	49.40	0.25	215.77	1004.464	20.33
15 - 19	5.5	6.55	36.90	0.18	168.15	788.690	21.37
20 - 24	1.5	1.79	30.36	0.06	147.32	620.536	20.44
25 - 29	2	2.38	28.57	0.08	136.90	473.214	16.56
30 - 34	5	5.95	26.19	0.23	116.07	336.310	12.84
35 - 39	5	5.95	20.24	0.29	86.31	220.238	10.88
40 - 44	4.2	5.00	14.29	0.35	58.93	133.929	9.38
45 - 49	3.7	4.40	9.29	0.47	35.42	75.000	8.08
50 - 54	1.65	1.96	4.88	0.40	19.49	39.583	8.11
55 - 59	1.15	1.37	2.92	0.47	11.16	20.089	6.89
60 - 64	0.65	0.77	1.55	0.50	5.80	8.929	5.77
65 - 69	0.45	0.54	0.77	0.69	2.53	3.125	4.04
70 -74	0.2	0.24	0.24	1.00	0.60	0.595	2.50
Total	**84**						

Dx- number of deaths

dx- percentage of deaths

lx- percentage of survivors at the beginning of an age category

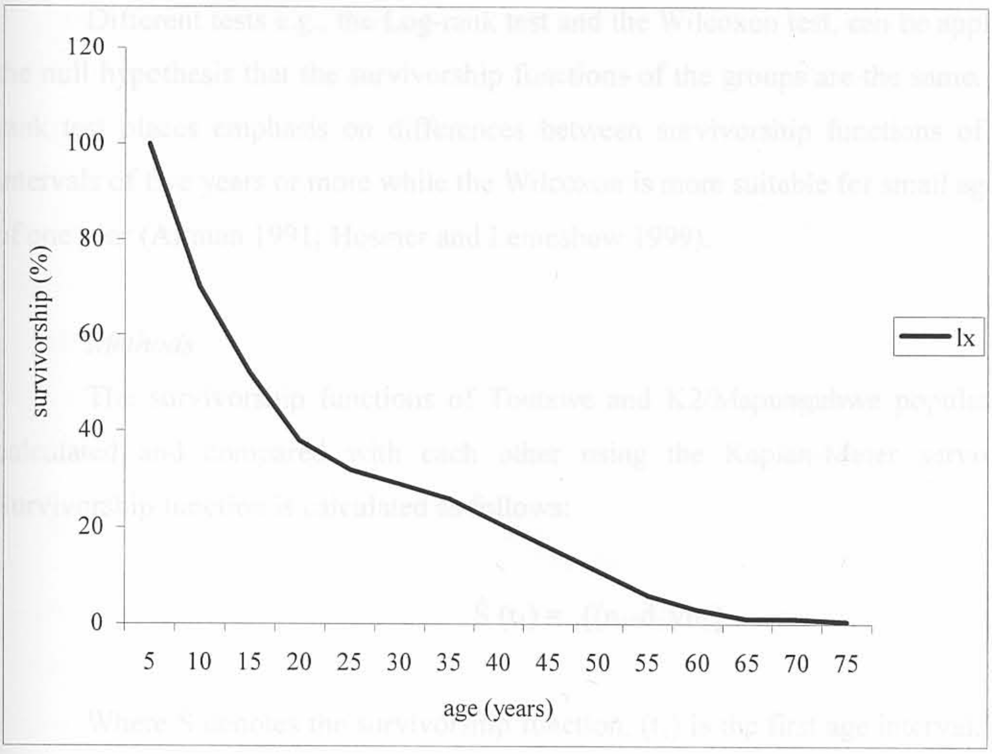
qx- probability of death

Lx- total number of years lived by all individuals

Tx- total number of years remaining in the life times of all individuals

ex- life expectancy

Figure 5.1 Survivorship curve of the Toutswe people



5.4.3 Kaplan-Meier survival estimates

Kaplan-Meier survival curve is a graphic presentation of survivorship functions. The survivorship function is defined as the probability of observing a survival time exceeding, that which has been stipulated. For example, in a palaeodemographic analysis with age intervals of five years, the survivorship function of the first age category is the possibility of survival after the first five years (Altman 1991; Hosmer and Lemeshow 1999). Kaplan-Meier survival estimate is one of the most commonly used survival analysis.

The Kaplan-Meier survival estimate is an effective means of comparing survivorship functions at each age category in two or more groups of data. The groups being compared are usually defined by some key factors that they both possess. For instance, the Toutswe and K2/Mapungubwe populations are both Iron Age inhabitants of the Shashe-Limpopo basin. The main reason for comparing groups of data using the

Kaplan-Meier survival estimate is to quantify the differences between the groups at different points in time.

Different tests e.g., the Log-rank test and the Wilcoxon test, can be applied to test the null hypothesis that the survivorship functions of the groups are the same. The Log–rank test places emphasis on differences between survivorship functions of large age intervals of five years or more while the Wilcoxon is more suitable for small age intervals of one year (Altman 1991; Hosmer and Lemeshow 1999).

Methods

The survivorship functions of Toutswe and K2/Mapungubwe populations were calculated and compared with each other using the Kaplan-Meier survival curve. Survivorship function is calculated as follows:

$$\hat{S}\,(t_1) = \{(n_1\text{-}d_1)/n_1\}$$

Where $\hat{S}$ denotes the survivorship function, (t_1) is the first age interval, (n_1) is the number individuals alive at the beginning of the first age category and (d_1) is the number of deaths that occurred during the first age category (Altman 1991; Hosmer and Lemeshow 1999). For the second age category the formula is the same and the result is multiplied by the survivorship function of the first age category i.e.,

$$\hat{S}\,(t_2) = \{(n_1\text{-}d_1)/n_1\} \text{ x } \{(n_2\text{-}d_2)/n_2\}$$

Where (t_2) is the second age category (n_2), is the number of people alive at beginning of the second age category and (d_2) is the number of individuals who died during the second age category. The third age category is multiplied by the first and the second age category (Altman 1991; Hosmer and Lemeshow 1999):

$$\hat{S}\,(t_3) = \{(n_1\text{-}d_1)/n_1\} \text{ x } \{(n_2\text{-}d_2)/n_2\} \text{ x } \{(n_3\text{-}d_3)/n_3\}$$

The Log-rank test was then calculated to test the null hypothesis that the survivorship functions of the two groups are the same.

Results

The survivorship functions of Toutswe and K2/ Mapungubwe are given in Table 5.2. The Table indicates that at the beginning, the sample from Toutswe was 84 individuals and K2/Mapungubwe was 109 individuals. At the end on the first five years of life, Toutswe had lost 26 individuals resulting in a survivorship function of 0.6905 while K2/Mapungubwe had lost 50 of its members and hence a survivorship function of 0.5413. The total number of individuals alive at the end of five years is 58 and 59 for Toutswe and K2/Mapungubwe respectively. Between zero and 50 years, the survivorship function of Toutswe exceeds that of K2/Mapungubwe and the two almost equal each other at the end of 55 years. This means that during the first 50-year period, Toutswe lost a smaller percentage of its original size every five years than K2/Mapungubwe. The two groups had lost nearly the same percentages of their original sizes at the end of 55 years.

A Log-rank test was used to test for statistical differences between the survivorship functions of K2/Mapungubwe and Toutswe at various age categories. The survivorship functions of the two groups do not differ significantly as indicated by the Log-rank test. The chi square test of 0.4155 also indicates that these populations were not statistically different. From the Kaplan-Meier survival estimate by group (Figure 5.2), the two groups started at a survival probability of 100% each and declined every five years. The rate of decline was highest at K2/Mapungubwe. Between the end of the first five years and 60 years, the Toutswe curve is higher that the K2/Mapungubwe curve indicating that Toutswe had a higher percentage of survivors during this period.

5.5 Adult sex distribution

The adult sample is made of 30 individuals aged between 17 and 75 years (Table 5.3). Of these, 17 were males (57%), seven were females (23%) and the remaining 6 (20%) are indeterminate. Most of the adults died between the ages of twenty and sixty years (80%) and only a percentage (7%) of them are old aged. The adult sample found in this study is too small to make more statistical inferences from.

Table 5.2 Survivorship functions of Toutswe and K2/Mapungubwe samples

Age (Years)	Toutswe Beginning Total (n)	Fail (Dx)	Survivor Function	K2 and Mapungubwe Beginning total (n)	Fail (Dx)	Survivor Function
< 5	84	26	0.6905	109	50	0.5413
<10	58	16.5	0.4940	59	18	0.3761
< 15	41.5	10.5	0.3690	41	13	0.2569
< 20	31	5.5	0.3036	28	4	0.2202
< 25	25.5	1.5	0.2857	24	5.50	0.1697
< 30	24	2	0.2619	18.50	7.75	0.0986
< 35	22	5	0.2024	10.75	2	0.0803
< 40	17	5	0.1429	8.75	2.50	0.0573
< 45	12	4.2	0.0929	6.25	1.70	0.0417
< 50	7.8	3.7	0.0488	4.55	0.95	0.0330
< 55	4.1	1.65	0.0292	3.60	0.70	0.0266
< 60	2.45	1.15	0.0155	2.90	0.70	0.0202
< 65	1.3	0.65	0.0077	2.20	1.20	0.0092
< 70	0.65	0.45	0.0024	1	1	0.0000
< 75	0.2	0.2	0.0000			

Beginning total- number of individuals alive at the beginning of an age category

Fail- number of individuals who failed to succeed to the next age interval

Figure 5.2 Comparisons of survival curves using Kaplan-Meier survival estimates

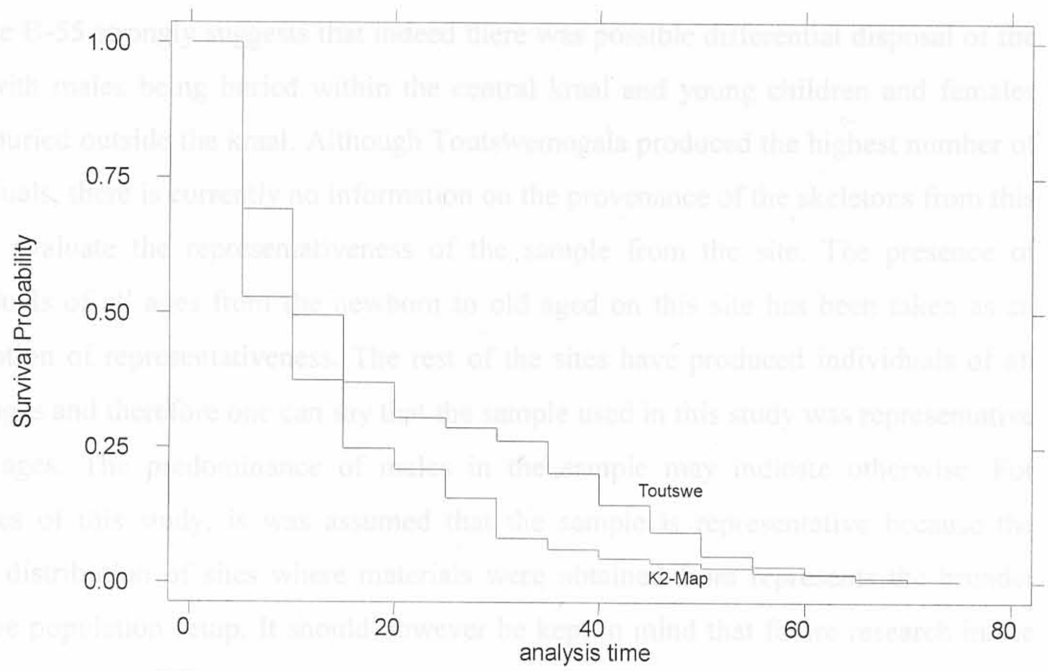


Table 5.3 Adult sex and age distribution

Age (years)	Male	Female	Indeterminate	Total
17-25	3	0	1	4
20-50	5	4	3	12
30-60	7	3	2	12
50-75	2	0	0	2
Total	**17**	**7**	**6**	**30**

5.6 Discussion

The presence of fetal and old aged individuals in the sample was taken on a superficial level to imply non-differential disposal of the dead from all sites. However, Kgaswe B-55 strongly suggests that indeed there was possible differential disposal of the dead with males being buried within the central kraal and young children and females being buried outside the kraal. Although Toutswemogala produced the highest number of individuals, there is currently no information on the provenance of the skeletons from this site to evaluate the representativeness of the sample from the site. The presence of individuals of all ages from the newborn to old aged on this site has been taken as an assumption of representativeness. The rest of the sites have produced individuals of all age ranges and therefore one can say that the sample used in this study was representative of all ages. The predominance of males in the sample may indicate otherwise. For purposes of this study, is was assumed that the sample is representative because the spatial distribution of sites where materials were obtained from represents the broader Toutswe population setup. It should however be kept in mind that future research in the Toutswe area may differ.

Although splitting the total sample into individual sites distorts the broader picture, it is worth mentioning separately the Toutswemogala and Kgaswe B-55 skeletons. Only four of the 31 Toutswemogala skeletons are adults aged between 20 and 50 years. These include two males, one female and one indeterminate individual. This site demonstrates a very distinct pattern of very little representation of adults. This may raise questions regarding the representativeness of individuals from this site but answers to such questions would not be attempted in this report. Contrary to Toutswemogala, Kgaswe B-55 has 16 adults out of a total of 27 skeletons. Thus nearly 56% of the Kgaswe B-55 skeletons are adults aged between 15 and 75 years old. Of these, eight are males, three are females and the remaining five are indeterminates.

The Toutswe and K2/Mapungubwe palaeodemographic results show some similarities. In these samples, infants and juveniles younger than 15 years are the most highly represented, 63.1% for Toutswe and 74.3% for K2/Mapungubwe. The figures for K2/Mapungubwe were corrected for growth (Henneberg and Steyn 1994). High infant mortality rates, little representation of adolescents and few adults characterize these two prehistoric population groups.

At Kgaswe B-55 graders stripped the entire site during a developmental project. Although the entire site has been excavated, the skeletal sample obtained is not sufficient to allow for sound population size estimation. Only 27 individuals were found and some have been badly destroyed during excavation. All other sites included in this study have only been partially excavated and consequently no attempts were made to estimate the population size of the Toutswe people.

The Oakhurst sample is similar to the Toutswe sample in that they are both characterised by high infant mortality. From the Oakhurst sample it was found that only 27% of newborn babies had chances of fully participating in reproduction (Patrick 1989). Although the Oakhurst sample is small, it indicates a slightly lower life expectancy at birth. An individual at 20 years could expect to live an additional 13 years to be 33 years old at Oakhurst. At the age of 20 years, an individual at Toutswe could expect to live an additional 20 years. It is possible that differences resources of subsistence and diseases may be the reason for a lower life expectancy at Oakhurst than at Toutswe and K2/Mapungubwe but sample size differences can not be ruled out as being responsible for the mortality patterns seen between these three groups.

6. HEALTH AND TRAUMA

6.1 Introduction

In order to understand the general health of a population, one needs to evaluate multiple factors that are crucial to the health status of individuals. These factors may be related to the environment, diseases, nutrition and social constraints or limitations. Usually only those factors that leave traces on the human skeleton, e.g. chronic diseases and nutrition, are available for evaluation of health of archaeological populations. Even these are not always sufficiently and accurately reflected on the human skeleton and therefore scientific assumptions and theories become inevitable.

The study of the health of prehistoric communities based on the presence or absence of diseases in skeletal populations has become increasingly important (e.g., Mensforth et al 1978; Ortner and Putschar 1981; Stuart-Macadam 1989; Ortner and Aufderheide 1991; Wood et al. 1992; Steyn 1995; Roberts and Manchester 1995; Kent and Dunn 1996). This approach has become known as the study of palaeopathology (Steinbock 1976). Palaeopathology is a broad field of study in which the evolution and progress of diseases are examined in conjunction with the evolution and progress of human populations. Description and classification of lesions on human tissue are the first steps in conducting a palaeopathological study (Ortner and Aufderheide 1991). The second step is to interpret that which has been described and classified and the ultimate step is to make a general statement on the health status of the individual or population being studied (Buikstra and Cook 1980; Ortner and Aufderheide 1991; Roberts and Manchester 1995).

It is through the study of palaeopathology that anthropologists and other researchers are familiarised with the manner in which past populations adapted, both culturally and biologically, to environmental and biological factors (Angel 1966; Steinbock 1976; Mensforth et al. 1978; Manchester and Roberts 1995). An indirect way of studying the health of archaeological populations is to study the environment within which communities lived. Studies of palaeoenvironments are a good source of information of the kinds of food resources, pathogen populations and physical constraints of a community in the past.

Numerous studies of both humans and animals have shown that it takes a long time for any disease to manifest itself in the skeleton. For the osteological manifestation of any disease to occur, such a disease has to be chronic in nature (Steinbock 1976; Ortner and Putschar 1981; Krogman and İşcan 1986; Roberts and Manchester 1995; Steyn and İşcan 2000) and the individual affected has to survive long enough for skeletal lesions to be established. The study of palaeopathology, based on human skeletal remains, therefore gives just a glimpse of the multitudes of diseases that would have affected prehistoric populations. There are countless acute and chronic soft tissue diseases that can not be accounted for in palaeopathology based on skeletal remains (Roberts and Manchester 1995). It must, therefore, be borne in mind that the absence of skeletal lesions does not, in any way, equate to the absence of diseases (Buikstra and Cook 1980; Ortner and Putschar 1981; Roberts and Manchester 1995; Aufderheide and Rodriguez-Martin 1998). Wood and co-authors (1992) also bring to the forth the fact that sometimes the disease may be so severe that those affected die quickly before skeletal involvement is elicited. Therefore those who survive to show lesions may actually represent the stronger members of a community in that they did not succumb to death as a result of a disease.

Different diseases leave skeletal lesions that require different techniques for identification. Some lesions can be noted by simple macroscopic observation of dry bone, e.g., degenerative disease that cause the development of osteophytes on the vertebral column, while some lesions require the use of radiographic techniques to identify e.g. Harris lines on long bones. Chemical analysis of dry bone may also be used to identify possible changes in bone due to diseases or diet, e.g., stable isotope analysis can be used to determine the types of food that were predominant in a prehistoric community. DNA can now be extracted from archaeological remains and has proved to be very informative regarding a number of diseases (Ortner and Aufderheide 1991).

Roberts and Manchester (1995) differentiate two main sources of evidence of diseases that affected archaeological populations: human remains and art/documents. Human remains provide the primary or direct evidence of the presence of diseases and nutritional problems. Secondary evidence comes from ancient written documents and art. For instance some of the earliest evidence of Pott's disease comes from ancient drawings and text (Stuart-Macadam 1992; Roberts and Manchester 1995).

6.2 Problems and limitations

Skeletal remains have been used extensively in palaeopathological studies as the main source of information on the health status of prehistoric populations. Unfortunately, skeletons alone can not inform us of all aspects and dynamics of general health of the dead (Buikstra and Cook 1980; Wood et al. 1992). Such aspects as mental health, environmental hardships, level of exposure to life threatening conditions etc, can not be inferred from the skeleton. Not only are skeletons limited in the amount of information available, they have also been found to be a lot more difficult and complicated to interpret because a lot of factors need to be taken into account before making inferences (Wood et al. 1992).

One of the limitations emanates from the often incompleteness of archaeological remains. Depending on the aetiology and pathogenesis of any disease, skeletal lesions resulting thereof tend to 'favour' certain parts of the skeleton. The implication is, therefore, that sound results are dependent on how much of a skeleton has been found. Unfortunately, archaeological skeletons are not always complete. This is more problematic when dealing with diseases that affect the small bones of hands and feet (e.g., rheumatoid arthritis). Preservation and recovery of such small bones is limited by numerous factors and therefore such bones may not always be available for analysis (Brothwell 1981; Ubelaker 1989a; Roberts and Manchester 1995).

Another problem is that most skeletal lesions are ambiguous (Buikstra and Cook 1980; Ortner and Putschar 1981; Roberts and Manchester 1995). Bone tissue has a limited number of ways in which it can respond to stress and hence it tends to produce ambiguous lesions (Buikstra and Cook 1980). Such lesions become difficult to attribute to a specific disease especially when the skeleton is incomplete. Despite similarities in the appearance of some lesions, many diseases tend to have a very specific characteristic that can only be identified on a specific bone or set of bones. Such a feature can be used in differential diagnosis to identify the most possible diseases responsible for lesions found in the skeleton.

Differential diagnosis itself requires knowledge and understanding of numerous diseases that affect the skeleton. It is only successful provided key features that differentiate diseases with similar skeletal lesions have been identified (Buikstra and Cook 1980). An example is that of psoriatic arthritis and rheumatoid arthritis, both of which affect joints of the upper and lower extremities (i.e. hands and feet). The key difference between these two diseases is that while psoriatic arthritis is asymmetrical, rheumatoid arthritis affects the body symmetrically (Ariaza 1993). Ambiguous lesions can only be attributed to specific diseases on the basis of differential diagnosis, provided bones needed for the procedure are present.

Some skeletal lesions produced during developmental years, e.g. Harris' lines and porotic hyperostosis, tend to disappear or become obliterated in adulthood (Buikstra and Cook 1980; Ortner and Putschar 1981; Martin et al. 1985; Aufderheide and Rodriguez-Martin 1998). This means that the risk of exposure to stress during early years would remain unknown once an individual recovers and survives to adulthood (Wood et al. 1992). In this regard, skeletal pathology provides information on the number of individuals who died during stress exposure or during the healing process, not the total number of individuals who were exposed to stressors (Wood et al. 1992).

Diagnosis of diseases from skeletal remains relies on clinical criteria and this presents a multifaceted problem in palaeopathology (Ortner 1991; Wood et al. 1992). Firstly, observations made on clinical orthopaedic cases are superimposed on palaeopathological cases despite the fact that many palaeopathological cases have no direct correlation to clinical medicine. Just like humans, pathogens evolve through random and non-random processes (Buikstra and Cook 1980; Ortner and Aufderheide 1991). Using clinical cases to interpret palaeopathological cases implies that the evolutionary processes that pathogens have gone through are not taken into account. Knowing the evolutionary status of pathogens responsible for diseases in ancient times is important in that it can help explain any deviations in expected lesions of known diseases (Buikstra and Cook 1980).

Palaeopathology is based mainly on skeletons, which may demonstrate lesions that may not be fully known in clinical medicine (Ortner and Utermohle 1981; Ortner and Putschar 1981; Rodgers 1982; Ortner 1991; Ariaza 1993; Aufderheide and Rodriguez-Martin 1998). For instance, Ortner and Utermohle (1981) reported on a case of rheumatoid arthritis from a pre-Columbian skeleton in Alaska. Although the individual suffered from rheumatoid arthritis, the skeleton shows severe destruction of the sacroiliac joint and the lumbar vertebrae. These lesions are not clinically associated with rheumatoid arthritis and even on the basis of differential diagnosis there was no evidence to suggest the occurrence of any other disease on this individual. They note the fact that radiological imaging may have failed to recognize the involvement of the sacroiliac joint in rheumatoid arthritis in some clinical cases. Since their discovery, several similar cases were reviewed from clinical patients and cadavers and revealed some cases of sacroiliac involvement in rheumatoid arthritis (Ortner and Utermohle 1981). The implication of such a case is that numerous palaeopathological rheumatoid arthritic lesions of the spine and the sacroiliac joint may have been misdiagnosed.

Congenital abnormalities are problematic because there is no clear differentiation between malformations resulting from simple deviation from normal development without clinical significance i.e. anatomical variants and those with clinical significance to such an extent that survivability and reproductive success may be compromised i.e. physiological variants (Turkel 1989). Quite often these are lumped together in palaeopathology and consequently, anatomical variants alter the true results of the health status of the skeletal sample under study. For instance, it has been found that posterior neural arches of the vertebral column may fuse much later than expected in some individuals and this can be misinterpreted as spina bifida occulta (Ferembach 1963; Turkel 1989; Aufderheide and Rodriguez-Martin 1998).

The traditional approach in interpreting skeletal lesions in palaeopathology has been to make estimations on the prevalence of diseases in populations. This approach has been influenced by the idea that the presence of skeletal lesions implies a healthy or an unhealthy population depending on the quantity of lesions found. However, it has been found that the occurrence of skeletal lesions has a more complex relationship with the health of a skeletal population than initially thought (Buikstra and Cook 1982; Wood et al. 1992). The absence of lesions can be attributed to low or no exposure or very high exposure to risks. High exposure can lead to death within a short time before bony response is evoked. The presence of lesions, on other hand, can be a result of moderate exposure to stress that allows time for osteological manifestation to occur. This implies that a population with less skeletal lesions than the other is not necessarily the healthier one. With no information on the levels of risks exposure, comparing the health statuses of two or more populations is complicated (Ortner and Aufderheide 1991; Wood et al. 1992). According to Wood et al. (1992), a comparison of distribution of lesions should not be equated to a comparison of health.

One of the problems within the theoretical field of palaeopathology involves understanding that which ought to be classified as disease and that which is a 'dysfunctional biomedical response' (Ortner and Aufderheide 1991). A disease would be any physical, psychological, emotional or other abnormality or dysfunction that makes the individual unhealthy and therefore increases the chances of death or reproductive failure (Buikstra and Cook 1980). A dysfunctional biomedical response, on the other hand, is similar to disease in terms of the side effect but has positive effects of increasing survivorship and reproductive possibilities. It is therefore crucial to differentiate between these when inferring the health of a past population on the basis of skeletal material because when dysfunctional biomedical responses are viewed as health hazards they give incorrect results (Wood et al. 1992). For instance, sickle cell anaemia (heterozygote) in a malaria infested area could be viewed as a dysfunctional biomedical response or adaptation to the environment (Angel 1966; Ortner and Putschar 1991; Wood et al. 1992). The totality of causes of death in a given skeletal population is never known. At any given point in time, individuals or populations are exposed to different factors that can result directly or indirectly in their death (Wood et al. 1992). This means that the total number of deaths is made up of fractions of different causes of death which, unfortunately, can not be estimated from skeletal remains only.

One of the factors that needs to be taken into account is that skeletal remains can not give any clues of individuals' resistance to diseases and stress. Individual differences in response or susceptibility to diseases and stress, also known as frailty, can be influenced by a variety of factors (Wood et al. 1992). Influential factors include, among others, genetic makeup, access to food and other resources, economic and social status.

The prevalence of malformed individuals in skeletal samples may be influenced to some extent by the cultural beliefs of the population being represented. Differential burial practices associated with 'out of the normal births' and stigmatised diseases interfere with the recovery and consequently evaluation of congenital and other stigmatised diseases in prehistoric time (Turkel 1989; Buikstra and Cook 1980). Preservation of individual bones is affected by soil conditions, depth of graves, burrowing animals, burial practices etc (Brothwell 1981; Ubelaker 1989a).

A prior knowledge of bone changes resulting from taphonomic processes is essential when studying palaeopathology (Buikstra and Cook 1980; Ortner and Putschar

1981; Brothwell 1981; Roberts and Manchester 1995). Some post-depositional processes can alter the appearance of bones in such a way that differentiating between them and pathology becomes obscured. The condition where post depositional damage resembles pathology is referred to as pseudopathology. Small bones of fetuses and newborn babies are at high risk since they have very limited resistance to taphonomic processes. Erosion of outer or inner tables of cranial bones would present limitations when examining lesions such as porotic hyperostosis on infants.

6.3 Specific diseases found in the Toutswe population

Some skeletal lesions can be associated with specific diseases. Such diseases can, for example, be congenital, degenerative, infectious or metabolic (Steinbock 1976; Ortner and Putschar 1981; Roberts and Manchester 1995; Aufderheide and Rodriguez-Martin 1998). The following sections examine the presence and prevalence of specific diseases as reflected by skeletal lesions on various individuals.

6.3.1 Spina bifida occulta

Introduction

Spina bifida is a developmental neurulation defect. Failure of the neural arches to fuse means that a vertebral arch develops abnormally, resulting in a cleft (Barnes 1994). Depending on the size of the cleft created, the neural tube may be displaced outside the vertebral column if the cleft is large, whereas if the cleft is small, a lipoma (an extra layer of fat) may develop in place of the missing bone to protect the neural tube. Sometimes the cleft is small and the neural tube remains unthreatened (Barnes 1994; Roberts and Manchester 1995). In severe cases, cranioarachischis may develop resulting in death during embryonic or early life (Barnes 1994; Roberts and Manchester 1995; Aufderheide and Rodriguez-Martin 1998).

Diagnosis of severe spina bifida, associated with anencephaly and meningomyelocele, is very difficult in palaeopathology given the fact that individuals with this condition died prematurely (Barnes 1994; Roberts and Manchester 1995; Aufderheide and Rodriguez-Martin 1998). However, it may be easy to identify this defect in mummified rather than skeletal remains. The less severe condition usually referred to as spina bifida occulta (Ortner and Putschar 1981; Barnes 1994; Roberts and Manchester

1995), can be found in archaeological skeletons of older children and adults since the condition is not life threatening. Spina bifida occulta varies depending on the size of the cleft created. It can occur with clinical symptoms such as severe pain, impaired motor function and impaired sphincter control when the neural tube is affected (Barnes 1994; Roberts and Manchester 1995). Spina bifida occulta without neural tube defects is more common than that with neural tube defects (Barnes 1994; Aufderheide and Rodriguez-Martin 1998).

Spina bifida occulta affects individuals of both sexes equally. It is one of the most commonly reported spinal defects in archaeological human remains (Ferembach 1976; Ortner and Putschar 1981; Roberts and Manchester 1995). Within the first year of life, neural arches remain unfused (Black and Scheuere 2000) and so it is difficult to differentiate between normal unfused neural arches and pathologically unfused neural arches when dealing with skeletal material only. Although commonly found on the sacrum, spina bifida occulta also affects other types of the vertebrae.

In the early 1960s, there were concerns regarding the description of that which constitutes sacral defects. Ferembach's concern was based on the identification of incompletely developed neural arches that were not necessarily due to spina bifida occulta (Ferembach 1963). Aufderheide and Rodriguez-Martin (1998) point out that sometimes neural arches may not fuse until later than the expected age of fusion and this makes it difficult to distinguish between pathologically induced lesions and simple deviation from the normal anatomical situation. The implication here is that the prevalence of spina bifida occulta in a skeletal population tends to decrease with age, indicating that delayed fusion of the vertebrae in young individuals is being mistaken for spina bifida occulta.

Methods

Evidence for spina bifida occulta was examined, through simple visual observation, in all individuals whose vertebral arches had fused. No attempts were made to examine infants and young children since it is difficult to differentiate between normal and pathologically unfused neural arches of young infants. Unfortunately not all older children and adults could be included because of poor preservation leading to loss of vertebrae.

Results

From the Toutswe sample, three individuals have evidence for partial spina bifida occulta involving the cervical, lumbar and sacrum. On Bosutswe Burial 5, a male of 17 - 20 years old, the fifth lumbar was involved while on Bosutswe Burial 11, a 12 - 15 year old child of unknown sex, the lesion is on the first sacral vertebra. Lesion on the axis was identified on Toutswemogala Burial 6, a child aged between nine and 11 years old. In all three cases, the other vertebrae were normal and therefore delayed fusion was excluded as a cause. However, the defects appear to have been asymptomatic because the lack of contact between the neural arches left very small fissures. Therefore the lives and reproductive capabilities of those affected were not in endangered in anyway. From this result, it is apparent that spina bifida occulta was not a common problem for this population. The incidence of spina bifida occulta in the Toutswe is low and the lesions found are small fissures. Numerous individuals from Toutswe sites have fragmented or missing parts, and some even have no vertebrae present. Therefore, the anomaly could not be assessed on the whole population. Statistical analysis of the prevalence of this condition on the study sample in thus limited.

The prevalence of the defect is often reported for other archaeological populations e.g. Morris (1984) Steyn and Henneberg (1995a). On the K2/Mapungubwe sample, three adults aged between 17 and 30 years had spina bifida occulta (Steyn and Henneberg 1995a) and in all cases the anomalies were not serious. Morris (1984) identified six individuals with this defect and one of them was a 3- year old child with a more severe spina bifida. The lesion was associated with an under developed spinous process.

In both Toutswe and K2/Mapungubwe skeletons, the incidence of this defect is below five percent of the total skeletal sample. However, the incidence may be slightly higher if expressed on the basis of only those individuals with complete or nearly complete vertebrae. No cases have been reported on the Oakhurst sample (Patrick 1989).

6.3.2 Arthritic and degenerative diseases

Introduction

Arthritic disease is a general term used to refer to diseases that affect joints. They may be infectious, metabolic, genetic or degenerative (Steinbock 1976; Aufderheide and

Rodriguez-Martin 1998). Degenerative and arthritic diseases are non-inflammatory, chronic and progressive. Although the etiology differs, the most common predisposing factor has been found to be the development of lesions on cartilage that separates bones in joint and thereby exposing bone surfaces. These conditions are characterized by new bone formation, usually visible by the age of 40 years (Aufderheide and Rodriguez-Martin 1998).

Methods

Macroscopic visual observations for gross morphological alterations associated with arthritic diseases were made. Each lesion found was recorded in terms of its size and location on the bone. The assessment included vertebral segments and peripheral joints.

Results

Lesions associated with degenerative and arthritic diseases were osteophytes on the vertebrae and around articular facets of major weight bearing joints. Those affected were aged between 30 and 75 years old. One male (Bosutswe Burial 12) will be discussed in more detail since differential diagnosis produced significant results. In two cases, Taukome Burials 1 and 5, both males and both aged between 40 and 60 years old, osteophytes were identified on the vertebrae only, as long bones were either incomplete or missing. Some of the lumbar vertebral segments had fused to each other on Taukome Burial 5 (Figure 6.1). Unfortunately the hip and knee joints of this individual were not preserved. The sacrum of Taukome Burial 2 shows signs of involvement. Taukome Burial 2 had osteophytosis on the cervical region as well as bone growth on the lesser tubercle of the left humerus where the subscapularis inserts (Figure 6.2). On Kgaswe B-55 Burial 17, a 50 - 75 year old male, most of the cervical and thoracic vertebrae had been involved but unfortunately none of the long bones was present. The axis had fused to the third cervical vertebra and the lateral articular facets between the atlas and the axis are partially eroded. The lumbar vertebrae are missing but lesions on S1 suggest possible fusion to L5. On two individuals the vertebrae were present but not involved while the hip and knee joints had lesions. One individual is about 30 - 50 years old (Toutswemogala Burial 25), and one is about 40 - 60 years old (Thatswane Burial 5) and they were both females. Toutswemogala Burial 25 had lesions around the distal articular surface of the right femur but not on the proximal articular surface of the right tibia. The left femur and tibia are both missing. Thatswane Burial 5 has lesions on the vertebrae, distal femur, patellae and some bones of the feet i.e. Toutswemogala Burial 25 and Thatswane Burial 5.

Kgaswe B-55 Burials 5(2) and 7(2), both males of 30 - 50 years old, have osteophytes surrounding the distal articular surfaces of their femora. Unfortunately, both individuals are represented by incomplete long bones only. Thus peripheral joints of the three adults (Taukome Burials 1 and 5) with vertebral osteophytosis were not preserved and the one individual (Taukome Burial 2) with other joints showed involvement of the shoulder joint. Two individuals (Kgaswe B-55 Burials 5(2) and 7(2)) both show involvement of the knee joints but their vertebrae were not preserved.

Table 6.1 shows the distribution of arthritic lesions on the sample. Bosutswe Burial 12 has been excluded from the table since it presents a more different condition. The elbow has also been excluded in the table since none of the individuals indicated involvement of this joint. Of all individuals included in the table, only Toutswemogala Burial 25 and Thatswane Burial 5 have all joints assessed. Lesions on different parts of the vertebrae are pooled because of small sample size. The most commonly affected site is the vertebra (eight cases) followed by the knee (five cases). The feet are the least affected. Thatswane Burial 5 shows the most affected joints which include the hip and feet. Osteoarthritis is the most probable cause of lesions found on the skeletons.

Vertebral osteophytosis associated with osteoarthritis are common in archaeological and historical skeletons. They have been reported at K2/Mapungubwe (Steyn 1994; Steyn and Henneberg 1995a), Oakhurst (Patrick 1989), Riet River and Kakamas (Morris 1984) and historical skeletons from South Africa (Peckmann 2002). The skeletons from 18th and 19th century Griqua, Colesberg and Wolmaransstad show relatively higher incidences of osteoarthritis by comparison to earlier ones from Toutswe, K2/Mapungubwe, Riet River and Kakamas.

Lesions found are located on the vertebrae and bones of the feet and hands. The distribution of lesions on the vertebrae is associated with the three primary curves of the vertebral column. Individuals with osteophytosis on the K2/Mapungubwe skeletons are mostly middle aged and old adults (Steyn 1994) and thereby similar to what was found at Toutswe. It is possible that degeneration of vertebrae at Oakhurst was linked to daily activities because the individuals are mostly young whereas at K2/Mapungubwe and Toutswe individuals affected are older and therefore expected to show such lesions.

Other degenerative conditions found include a deformed mandible of Taukome Burial 2 as a result of dental wear and antemortem tooth loss and calcification of sternal ends of first ribs on Taukome Burial 5, which are normally cartilage. Kgaswe B-55 Burial 14, a 40-60 year old female has bone exostosis on the patella and calcaneus.

Table 6.1 Distribution of arthritic lesions on adults

Burial	Age	Sex	Vertebrae	Shoulder	Hip	Knee	Feet
Toutswemogala 19	40-60	M	Present	-	-	-	-
Toutswemogala 22	40-50	M	Present	-	-	Preset	-
Toutswemogala 25	30-50	F	-	-	Present	Present	-
Taukome 1	40-60	M	Present	-	-	-	-
Taukome 2	40-60	F	Present	Present	-	-	-
Taukome 5	40-60	M	Present	Present	-	-	-
Thatswane 5	40-60	F	Present	-	Present	Present	Present
Kgaswe B-55 5(2)	30-50	M	-	-	-	Present	-
Kgaswe B-55 7(2)	30-50	M	-	-	-	Present	-
Kgaswe B-55 17	50-75	M	Present	-	-	-	-
Kgaswe B-55 19	40-60	M	Present	-	-	-	-

Figure 6.1 Fused lumbar vertebrae on Taukome Burial 5

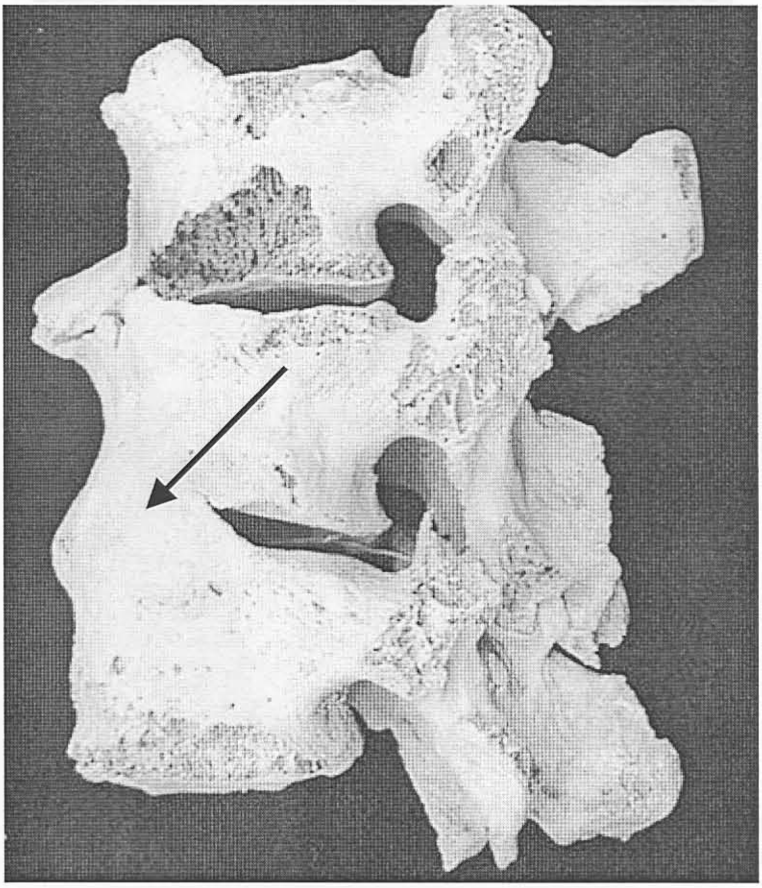
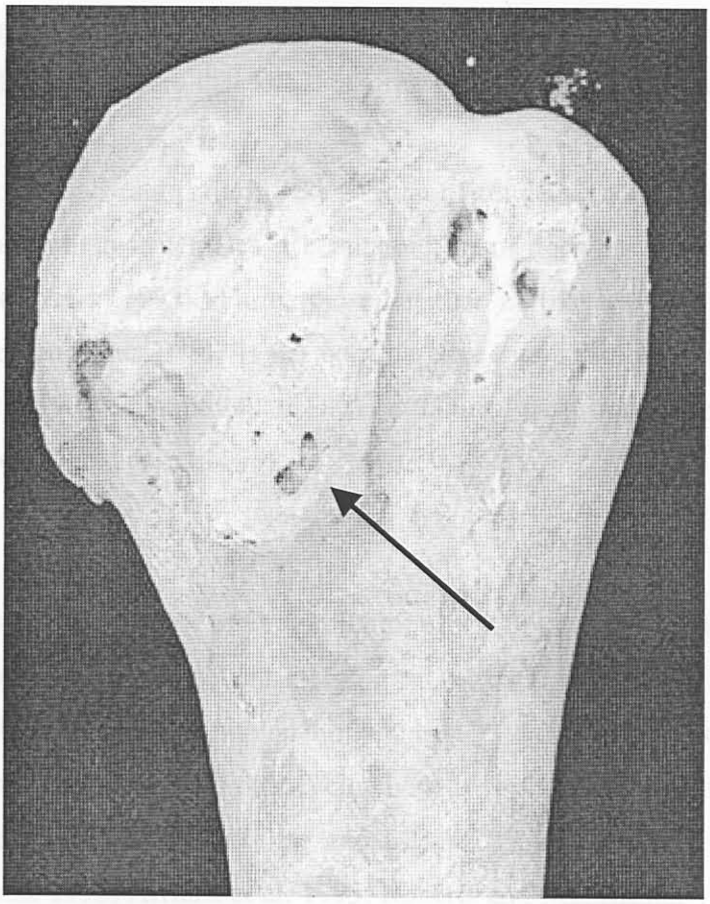


Figure 6.2 Bone growth on the left distal humerus, Taukome Burial 2



6.3.3 Possible case of Diffuse Idiopathic Skeletal Hyperostosis (DISH)

Introduction

Reports on Diffuse Idiopathic Skeletal Hyperostosis (DISH) also known as Forestier's disease, date as far back as the 1950s (Rodgers 1982; Crubezy and Trinkaus 1992; Arriaza 1993; Arriaza et al. 1993; Roberts and Manchester 1995; Maat et al. 1995; Aufderheide and Rodriguez-Martin 1998; Reale et al. 1999; Jankauskas 2003). This is a degenerative condition occurring in both archaeological and modern populations. The etiology of this condition is not fully known (Rodgers 1982; Crubezy and Trinkaus 1992; Arriaza 1993; Arriaza et al. 1993; Roberts and Manchester 1995; Maat et al. 1995; Aufderheide and Rodriguez-Martin 1998; Reale et al. 1999; Jankauskas 2003). It is, however, commonly associated with diabetes and obesity. In clinical cases it has been demonstrated that obese patience with type II diabetes have impaired insulin function. The insulin impairment increases levels of serum growth hormones that in turn evoke bone growth. It has been suggested that DISH is a result of metabolic disorders caused by high calorie intake (Jankauskas 2003).

The condition usually starts during the fourth or fifth decade of life and is slightly more common in males than in females. Rheumatoid factor does not play a role in the etiology of DISH (Arriaza 1993). Furthermore, neither cartilage (intervertebral) nor synovium is involved and thus DISH is not considered a true arthropathy (Aufderheide and Rodriguez-Martin 1998). Symptoms of DISH in clinical cases include back stiffness and reduced movement (Jankauskas 2003).

Skeletal manifestations of DISH

DISH causes fusion of the vertebral column, especially on the thoracic vertebrae through the development and subsequent merging of vertebral osteophytosis. However, spaces for intervertebral disks are maintained. In addition to vertebral lesions, extra spinal manifestations of this condition include development of osteophytes on major weight bearing joints and exostosis on the patellae and calcanei (Rodgers 1982; Crubezy and Trinkaus 1992; Arriaza 1993; Arriaza et al. 1993; Roberts and Manchester 1995; Maat et al. 1995; Aufderheide and Rodriguez-Martin 1998). One of the key diagnostic features of this condition is the development of osteophytes on the sternum where the first ribs articulate (Rodgers 1982; Arriaza 1993; Arriaza et al. 1993; Reale et al. 1999; Jankauskas 2003). The sacroiliac joint may be fixed by bony bridges, but not by intra-articular bony ankylosis, which is the case in ankylosing spondylitis (Aufderheide and Rodriguez-Martin 1998; Jankauskas 2003).

Results

A possible case of DISH has been found on an adult male aged between 50 and 75 years (Bosutswe Burial 12). This individual has osteophytes on the cervical (Figure 6.3), thoracic and lumbar vertebrae (Figure 6.4), and had caused partial fusion of the vertebral column at the time of death. Articular surfaces of vertebral bodies show no signs of involvement, therefore strongly suggesting lack of intervertebral disk involvement.

However, the axis and C3 had fused to each other (Figure 6.5). On the sternum, articular surfaces of the first ribs had been involved (Figure 6.6). Lesions on the mandibular condyles suggest that the temporomandibular joints were fusing (Figure 6.7). Other extra spinal lesions found include exostosis on the posterior aspect of the olecranon of the ulnae, where the triceps brachii muscles insert, the anterior surfaces of the patellae (Figure 6.8) at the insertion of the quadriceps femoris muscles, and posterior surfaces of the calcanei at the insertion of the Achilles tendon (Figure 6.9). On the same individual, the sacroiliac joint has some lesions. Bones of the hands and feet of Bosutswe Burial 12 are complete and have no lesions.

Figure 6.3 Vertebral osteophytosis on the cervical region of Bosutswe Burial 12

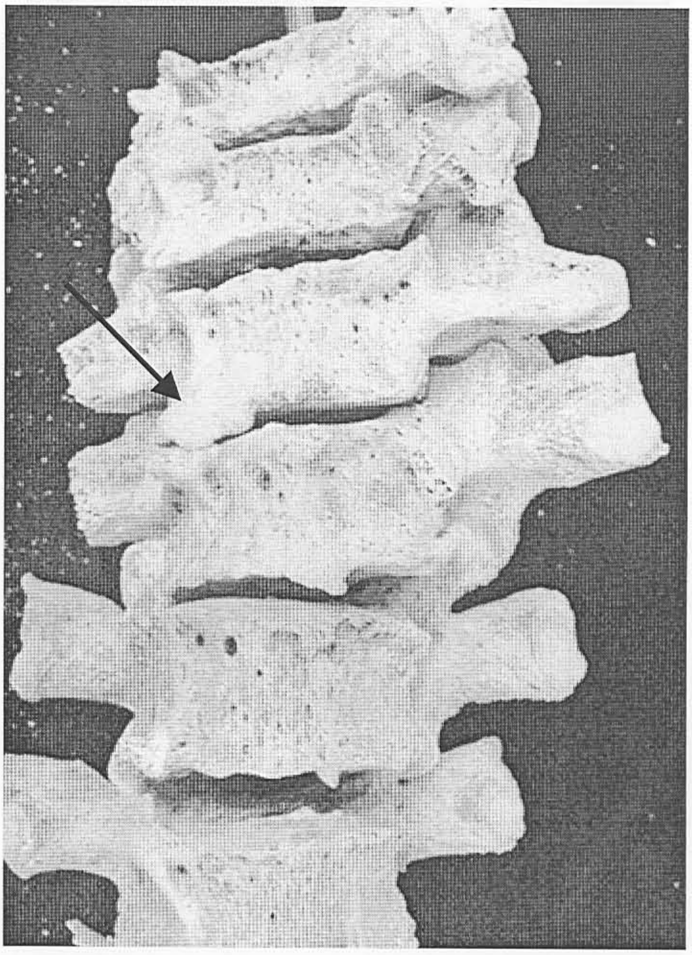


Figure 6.4 Vertebral osteophytosis on the thoracic and lumbar regions Bosutswe Burial 12.

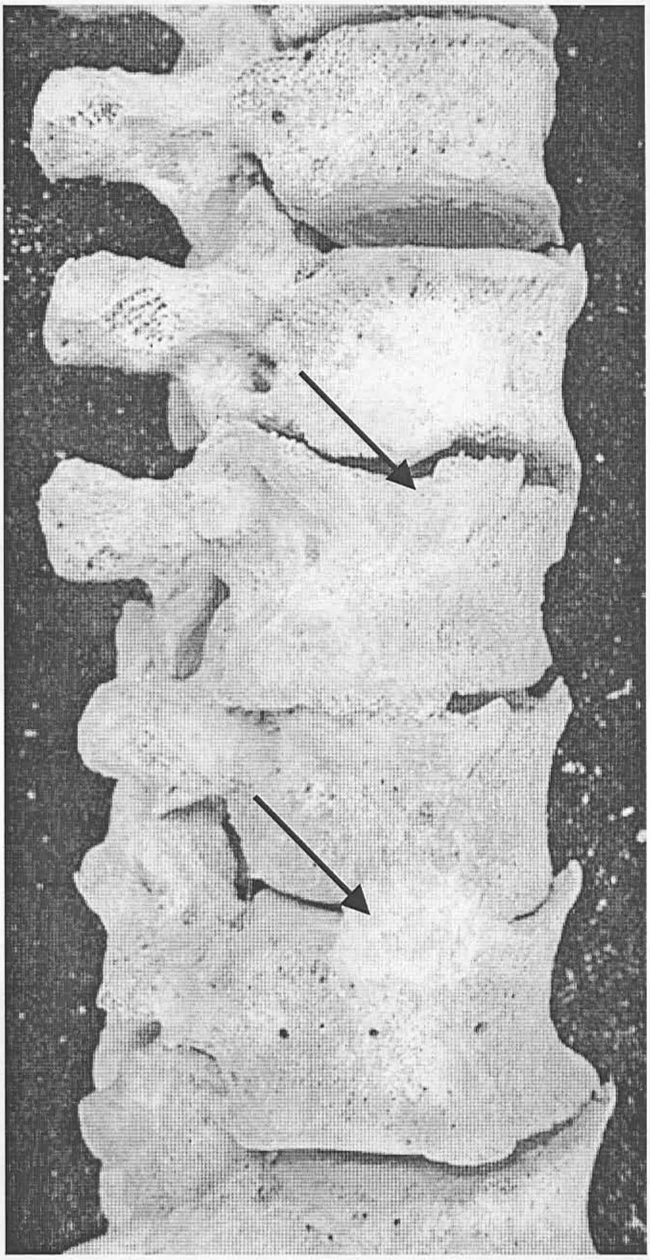


Figure 6.5 Fused axis and C3, Bosutswe Burial 12

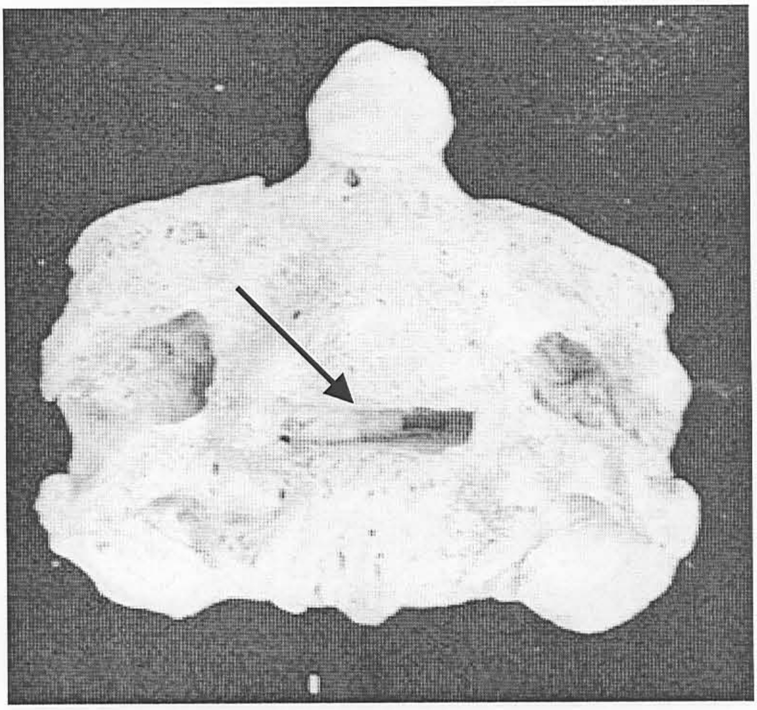


Figure 6.6 Osteophytes on the manubrium where first ribs articulate, Bosutswe Burial 12

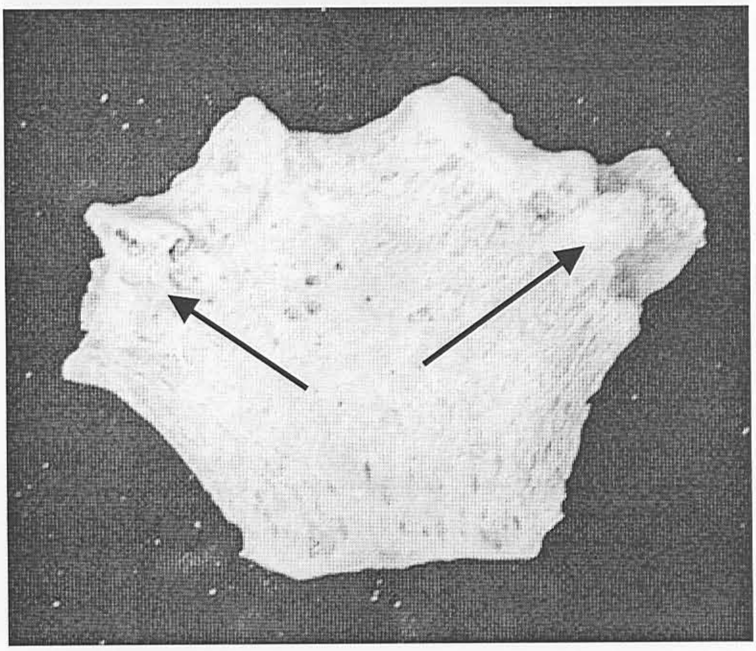


Figure 6.7 Lesion on the right mandibular condyle, Bosutswe Burial 12

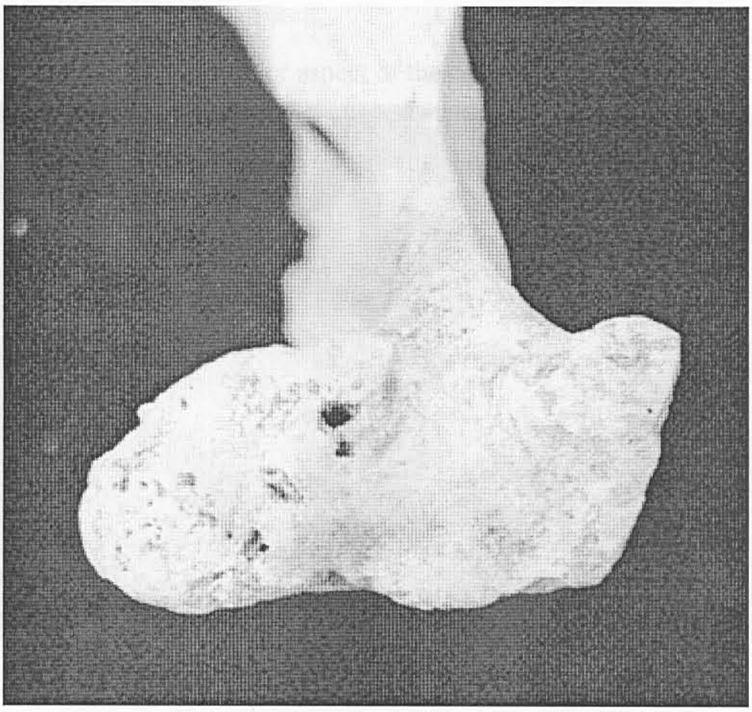


Figure 6.8 Exostosis on the patella, Bosutswe Burial 12

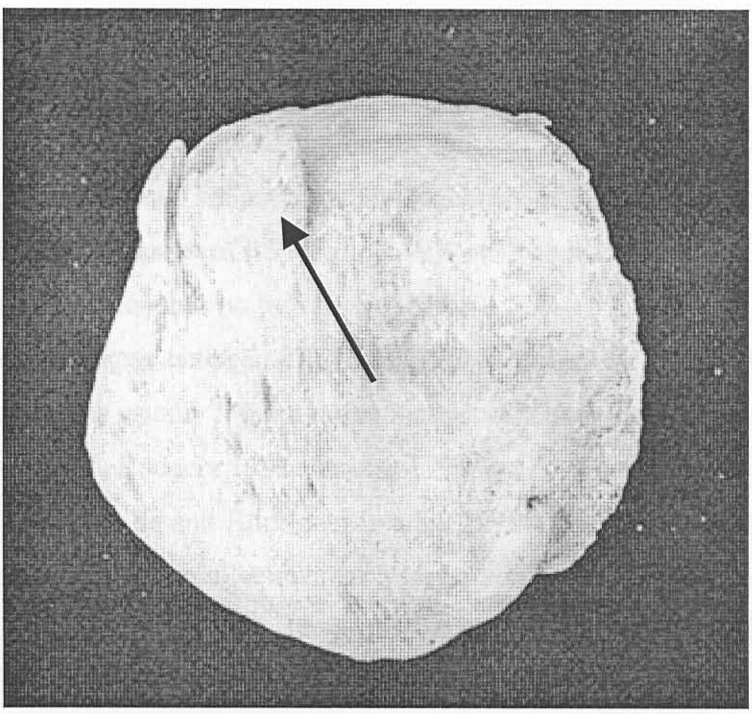
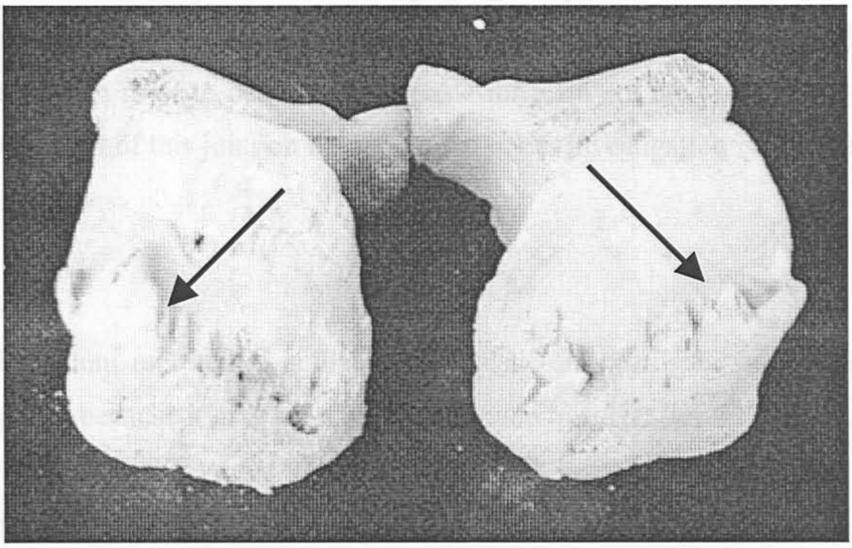


Figure 6.9 Exostosis on the posterior aspect of the calcanei, Bosutswe Burial 12



Differential diagnosis

Other diseases that may have caused the lesions found on this individual include ankylosing spondylytis (AS), rheumatoid arthritis (RA), psoriatic arthritis (PA), Reiter's syndrome (RS) and osteoarthritis (Rodgers 1982; Arriaza 1993; Arriaza et al 1993; Rodgers and Manchester 1995; Jankauskas 2003). RA and PA can probably be excluded, since in both conditions small bones of the hands and feet are the main affected areas whereas in DISH the small joints are not affected. Phalanges of the big toes are one of the main sites of involvement in cases of RS (Arriaza 1993) and as previously mentioned, the individual being discussed here has no lesions on his feet.

One of the differences between DISH and AS is that while DISH affects other parts of the skeleton, AS is usually limited to the lumbar vertebrae and the sacroiliac joint (Ortner and Pustchar 1981; Rodgers 1982; Arriaza 1993; Arriaza et al. 1993; Rodgers and Manchester 1995; Aufderheide and Rodriguez-Martin 1998; Jankauskas 2003). The case under study shows no signs of involvement of intervertebral disks or spaces and this is typical of DISH. AS would have most probably shown signs of involvement of intervertebral disks by lesions on the articular surfaces of the affected vertebral bodies. Post depositional damage makes it difficult to determine whether the sacroiliac lesions on this individual are characteristic of DISH or AS defined by Aufderheide and Rodriguez-Martin (1998) and Jankauskas 2003. Degeneration of the temporomandibular joint is usually associated with severe dental wear, especially on posterior teeth, and excessive antemortem loss of teeth (Richards and Brown 1981; Richards 1990). Bosutswe Burial 12 has lost only one tooth prior to death and the posterior teeth are not worn down to root level. The involvement of this joint on the individual under investigation is assumed to be one of the DISH lesions.

Discussion

DISH is seldom reported in archaeological skeletons, partly because it is a rare condition and partly because it may have previously been mistaken for other diseases like AS (Rodgers 1982; Crubezy and Trinkaus 1992; Roberts and Manchester 1995; Aufderheide and Rodriguez-Martin 1998; Jankauskas 2003). One of the earliest known cases is of a Neanderthal male aged between 35 and 40 years old from Iraq (Crubezy and Trinkaus 1992). Rogers (1982) diagnosed this condition on a 79-year old female from Europe. In Africa cases of this nature have been reported from a site associated with Meroitic Nubians at Semma South in Sudan (Arriaza 1993). From a total of 134 adults, DISH was identified in 13.4% of the sample and most of the individuals affected were males. To the best of the author's knowledge, no cases of DISH have been reported from southern African Iron Age sites yet. A recent study by Jankauskas (2003) on the skeletons from Lithuania indicates a correlation between socio-economic statuses and the prevalence of DISH. The condition was found to be most prevalent on individuals from higher social classes who had more access to foods rich in calories, which are some of the predisposing factors to DISH.

Cases reported by Rodgers (1982), Crubezy and Trinkaus (1992) and Reale and co-authors (1999) demonstrate lesions similar in morphology and distributions to those found on Bosutswe Burial 12. Vertebral osteophytes, bone spurs on the olecranon, patellae, calcanei and other lesions have been found in all cases including the individual under study. However, there are differences in the magnitude of bone involvement with previously reported cases as many of them had complete fusion of the vertebral column while Bosutswe Burial 12 did not. Bearing in mind all factors mentioned, it is proposed that individual suffered from Diffuse Idiopathic Skeletal Hyperostosis.

6.4 Trauma

Introduction

Traumatic lesions are commonly encountered on skeletal remains in archaeological samples (Ortner and Putschar 1981; Brothwell 1981; Roberts and Manchester 1995; Aufderheide and Rodriguez-Martin 1998). There are several kinds of trauma including fractures, dislocations, deformations, burning, mutilations and trephination (Ortner and Putschar 1981; Brothwell 1981; Roberts and Manchester 1995). Very often mutilations and trephination are restricted to specific cultural groups, whereas the other kinds of trauma occur across cultures. Trauma on bone can be sudden and intense or it can result from long mild stress applied continuously to bone.

Lesions associated with trauma can provide information on the occupation or lifestyles of those affected (i.e. occupational trauma) and can also indicate the social and political status of a study population. For instance, a community characterised by violence would demonstrate a high incidence of trauma, especially fractures. Size and location of trauma can help hypothesise on the cause of death particularly when there is no evidence of healing (Roberts and Manchester 1995). Fractures result from any event that leads to the partial or complete breaking of bone (Roberts and Manchester 1995). Fractures occurring shortly before death, whether they resulted in death or not, are difficult to differentiate from post depositional damage. As a result, the most commonly reported fractures in palaeopathology are those that were in the process of or completely healed at the time of death (Roberts and Manchester 1995).

Methods

Macroscopic visual observation of bone was used to identify any morphological changes associated with trauma. Where such changes were observed, they were described in terms of the bone(s) affected, location on the bone and the gross appearance of the affected area. The bones were subsequently photographed. No x-rays were used in this study.

Results

One individual, Bosutswe Burial 3, a 30 - 40 years old male, shows evidence of a fracture on a left metatarsal (Figure 6.10) and another individual, Kgaswe B-55 Burial 16, a male aged between 20 and 30 years, had a fracture on the left fibula. In both cases the fractures had healed long before death. The metatarsal had been fractured on the middle one-third of the diaphysis whereas on the fibula the fracture was close to the distal end. Another healed traumatic lesion was found on the diaphysis of the left femur of Toutswemogala Burial 14. The individual was a child of five to seven years old.

Two juveniles, both from Toutswemogala (Burials 4 and 6), had possible traumatic lesions on their skulls. Burial 4 is a child of between six and eight years old and Burial 6 is between nine and eleven years. Each of them has a hole with sharp exterior margins and internal beveling. In both cases the holes are situated on the left parietal bones. Figure 6.11 shows the small, round lesion on the cranium of Toutswemogala Burial 4. On Toutswemogala Burial 6 the hole is oval in shape. Unfortunately there is no evidence of healing in both of them meaning that if indeed the holes were traumatic, the trauma would have occurred around the times of their deaths. In the absence of substantial evidence for trauma, the possibility of these lesions having resulted from post depositional processes cannot be ruled out. Thus skeletal changes mentioned above could be simply pseudotrauma.

The bones of an adult male aged between 40 and 60 years (Toutswemogala Burial 19) have evidence of burning. Shafts of the femora and tibiae are charred. The head of the right femur, the fragments of the pelvis as well as the distal ends of the ulnae are whitened. Several of this individual's phalanges are charred. The cranium and vertebrae, although incomplete, appear not to have been affected by the burning. The skeleton itself was mixed with animal bones, which have also been burnt. Prolonged exposure of bones to fire after burial is not ruled out as a possible cause of this burning. Unfortunately the provenance and context of the grave are not known and no sound conclusions can be made at this point.

Figure 6.10 Healed fracture on a left foot metatarsal of Bosutswe Burial 3

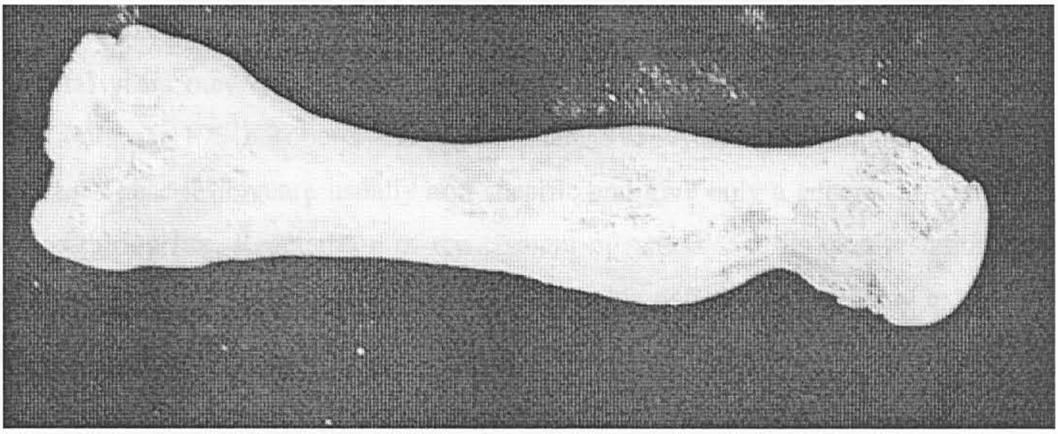
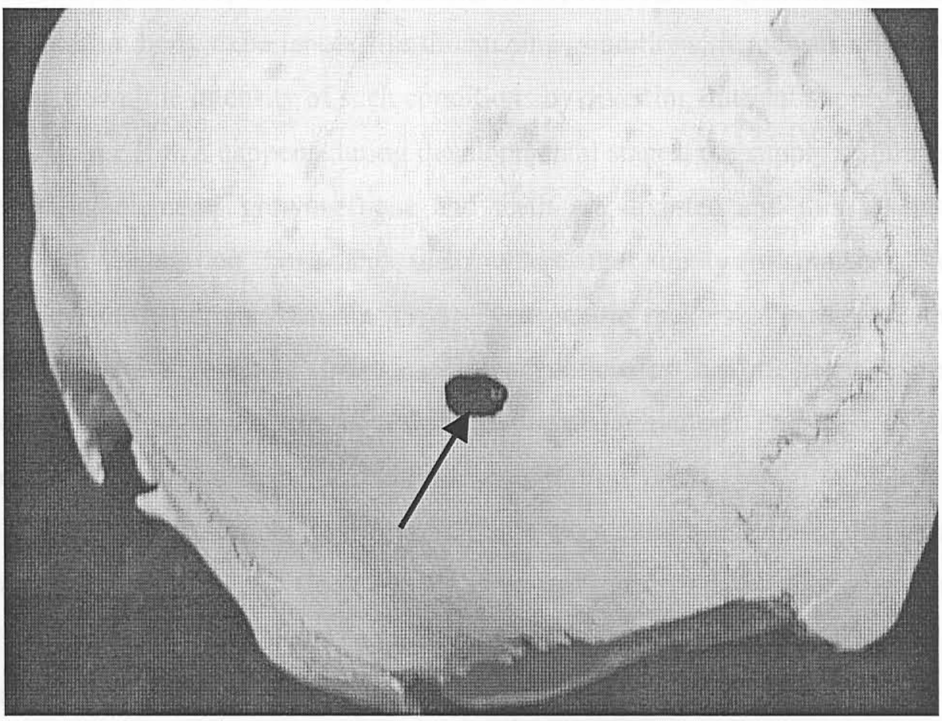


Figure 6.11 A round hole on the skull of Toutswemogala Burial 4



6.5 Nonspecific lesions

Stress due to nutritional deficiency and pathogen invasion experienced during developmental years may leave marks on bone (Selye 1973; Buikstra and Cook 1980; Ortner and Putschar 1981; Roberts and Manchester 1995; Aufderheide and Rodriguez-Martin 1998). These lesions are usually non-specific and give only a general impression of hardships during life. Recognition of the concept of 'stress' and its manifestation on bones dates as far back as the 1950s (Selye 1973). Selye defines stress as any extrinsic condition or set of conditions that impact on an organism, at a magnitude that provokes that organism's biological and physiological reaction. Such extrinsic factors include, among others, severe nutritional deficiency and microbial invasion (Steinbock 1976; Buikstra and Cook 1980; Ortner and Putschar 1981; Roberts and Manchester 1995). Stress can be acute or chronic and depending on intensity can have short-term asymptomatic lesions or can result in retarded growth with life term consequences. Nonspecific skeletal lesions do not have a one-to-one relationship with stressors (Buikstra and Cook 1980; Ortner and Putschar 1981; Roberts and Manchester 1995).

When the body experiences life threatening conditions, it focuses on eliminating or lowering down the intensity of such conditions by diverting nutrient supply and energy to affected areas. If this happens during developmental stages, the supply of nutrients and other essential elements growing bone and teeth are diverted and this results in the formation of lesions on bone and teeth where the supply of nutrients was cut (Aufderheide and Rodriguez-Martin 1998). Nonspecific makers of stress are therefore indicative of stress resulting from nutritional deficiency or infections experienced elsewhere in the body not where the lesions are located (Goodman and Rose 1980; 1990; Goodman et al. 1980; Aufderheide and Rodriguez-Martin 1998).

Nonspecific indicators of stress fall into two categories: dental indicators and bone indicators (Buikstra and Cook 1980; Ortner and Putschar 1981; Goodman and Rose 1980; Martin et al. 1985). Dental indicators of stress are macroscopically visible enamel hypoplasias. Enamel hypoplasias are pits or grooves resulting from arrested enamel growth whereas discoloration of enamel may result from water chemicals and poor nutrition (Buikstra and Cook 1980). Nonspecific indicators of stress on bone can also be macroscopically visible (e.g. cribra orbitalia, porotic hyperostosis and periostis) or radiologically visible e.g. Harris lines. From the demographic point of view, high infant mortality rate is seen as a nonspecific indicator of stress (Buikstra and Cook 1980; Wood et al. 1992). Frequencies of any of these nonspecific stress indicators within a population are often calculated to assess the extent to which a population survived or succumbed to environmental insults (Buikstra and Cook 1980; Ortner and Putschar 1981; Roberts and Manchester 1995; Aufderheide and Rodriguez-Martin 1998). Harris lines were not included in this study because of the difficulties with obtaining x-rays for these bones.

6.5.1 Cribra orbitalia and porotic hyperostosis

Cribra orbitalia and porotic hyperostosis are generally accepted to result from anaemia. However, this anaemia may be due to iron deficiency, but is more likely to be a reflection of the occurrence and severity of infectious diseases. By definition, anaemia refers to a condition in which there is a reduction in the concentration of haemoglobin and/or red blood cells below the quantities required for normal body function (Mensforth et al. 1978; Stuart-Macadam1989; 1991; 1992; Ascenzi et al. 1991). The body stores its own iron supply in the liver and spleen, but continuously absorbs iron from food to maintain certain levels of iron stores. This iron is needed in the formation of haemoglobin in new red blood cells developing in the bone marrow (Stuart-Macadam 1989; 1992; Ascenzi et al. 1991; Kent et al. 1994; Roberts and Manchester 1995). When there is shortage of iron for new haemoglobin, the red blood cells become pale and often die within half the time of their normal life span. There are different kinds of anaemia and therefore the etiology differs from one type of anaemia to the other (Stuart-Macadam 1989; 1992; Ascenzi et al. 1991; Kent et al. 1994; Roberts and Manchester 1995).

Anaemia can be acquired (e.g. resulting from infections, parasitic and bacterial invasion, trauma with excessive blood loss) or it can be congenital, as in sickle cell anaemia and thalassemia (Mensforth et al. 1978; Stuart-Macadam 1989; 1992; Ascenzi et al. 1991; Kent et al. 1994). Genetic anaemia, particularly sickle cell anaemia (homozygotes), is not compatible with life and therefore lack of appropriate medical intervention in prehistoric times would have resulted in premature death of those affected (Stuart-Macadam 1989; Kent et al. 1994; Roberts and Manchester 1995). Individuals with sickle cell trait (heterozygotes) may live long and successfully. An assumption is that lesions found in older children and adults in archaeological skeletons are a result of acquired iron deficiency anaemia (Stuart-Macadam 1992; Roberts and Manchester 1995).

The aetiology of iron deficiency anaemia depends on many factors. Predisposing factors include a cereal-based diet, severe blood loss, accelerated demands during pregnancy and growth (Mensforth et al. 1978; Stuart-Macadam1989; 1992; Roberts and Manchester 1995) and pathogen invasion. Red meat, legumes and fish have high quantities of iron that can be made available to the body through absorption by intestinal mucosa. On the other hand, cereals, especially maize, have compounds called phytates that inhibit the absorption of iron (Mensforth et al. 1978; Stuart-Macadam 1989; 1992; Roberts and Manchester 1995). Phytates, phosphates and carbonates bind iron to insoluble macromolecules, which the body cannot synthesize (Mensforth et al. 1978). Moreover, cereals themselves have poor iron content.

Many bacterial and viral pathogens that invade the human body require serum iron for replications but do not have their own iron supply. Such pathogens are able to compete with their host for iron to maintain their growth and reproduction. In order to prevent replication of microorganisms, the human body reduces the amount of serum iron and also reduces the absorption of iron from food. Thus the body produces a hypoferric (iron deficiency) state to deprive pathogens of essential iron supply. This physiological response is termed 'nutritional immunity' (Mensforth et al. 1978; Stuart-Macadam 1992; Kent et al. 1994). In infants and young children both mild and severe infections can result in much lowered hemoglobin levels. Adults can resist infections much better than children without producing anaemic lesions. Rather than dietary shortcomings, Stuart-Macadam proposed that chronic disease and infection are the major forces behind the etiology of acquired anaemia especially in modern populations (Stuart-Macadam 1989; 1992; Kent et al. 1994).

Morphological alterations of the skeleton, commonly known as porotic hyperostosis and cribra orbitalia, result from red marrow proliferation with anaemic stimulus as a predisposing factor (Mensforth et al. 1978). It is often not easy to identify the nature of anaemia an individual suffered from on the basis of dry bone only. However, severe haemoglobin disorders like thalassemia can be distinguished on the basis of the involvement of the postcranial skeleton (Ortner and Putschar 1981). Thalassemia can cause joint necrosis, deformation of the vertebral column and coarse trabaculation of long bones (Palkovich 1987).

The most notable skeletal feature of anaemic condition is the involvement of skull where lesions develop on the frontal bone, orbits, the parietal bones, the mastoids, diploe and on the occipital bone (Ortner and Putschar 1981; Stuart-Macadam 1992; Roberts and Manchester 1995). It is common for orbital lesions and calvarial lesions to co-exist on the same skull and when they do, they appear separate from each other (Ortner and Putschar 1981). Lesions associated with anaemia are more pronounced in young individuals and they often disappear in adulthood as a result of bone resorption and remodeling. In adulthood haemopoietic bone marrow can be doubled without altering the bone and thereby reducing chances of forming lesions (Mensforth et al. 1978; Ascenzi et al. 1991).

6.5.1.1 Cribra orbitalia

Cribra orbitalia occurs as multiple pores within a confined locality on the roof of the orbits. The outer table of the orbits is destroyed and thereby pores of cancellous bone of the diploe are exposed. The involvement of the orbits in anaemia is usually symmetrical (Nathan and Haas 1966; Mensforth et al. 1978; Stuart–Macadam 1991).

Methods

Each individual was examined for orbital lesions. Based on the knowledge that cribra orbitalia is usually symmetrical (Mensforth et al. 1978; Stuart-Macadam 1991) where only one orbit was present the scoring was taken to be reflective of the missing orbit. For instance, an individual with only the left orbit and with that orbit having no cribra orbitalia was concluded to have been unaffected. Only those individuals with one or both orbits observable were included in the analysis. Individuals whose orbits were missing or severely damaged were not included.

Mensforth et al. (1978) devised a criterion in which anaemic lesions could be classified on the basis of whether or not the disease was active or healed at the time of death. Remodeled or inactive lesions are those associated with earlier episodes of anaemia, in which case the lesions were in the process of healing at the time of death. Unmodeled lesions are those associated with active disease in which case the individual would have been suffering from anaemia around the time of his or her death (Mensforth et al. 1978). Due to the problematic nature of this classification, no attempts were made to classify anaemic lesions from the sample being studied. In addition, the affected sample itself is too small to allow for meaningful subdivisions.

Results

Of the 84 individuals included in this study, 49 were not observable and thus only 35 individuals had one or both orbits. Out of these 35 individuals, eight had one orbit each (five with right orbits and three with left orbits) and 27 had both orbits. Twenty-nine of the 35 observed individuals had no cribra orbitalia and only six had lesions. These included five individuals from Toutswemogala Burial 2 (five to seven years), Burial 3 (seven to eleven years), Burial 9 (seven to nine years), Burial 13 (seven to nine years) and Burial 16 (10 to 12 years). One individual was from Kgaswe B-55 (Burial 15 aged between eight and 12 years old). At least five of the affected individuals had both orbits. The lesions ranged between small, shallow pores covering a very small area to large deeper pores covering a wider area on the roofs of both orbits. The sex distribution of affected individuals was not assessed since the individuals themselves were immature and no attempts had been made to determine their sex. The most severe or well-developed cribra orbitalia was noted on Toutswemogala Burial 16 (Figure 6.12), an older child aged between 10 and 12 years. The individual had large, deep pores covering a relatively large area on the roofs of both orbits.

A comparison of cribra orbitalia between Toutswe and K2/Mapungubwe samples was carried out. A total of 38 individuals from the K2/Mapungubwe had orbits (Steyn and Henneberg 1995a) while 35 individuals from Toutswe sites had orbits. Fifteen of the 38 individuals with orbits at K2/Mapungubwe were found with cribra orbitalia while on the Toutswe sample only six of the 35 individuals demonstrated these lesions.

Table 6.2 shows a summary of the age distribution of individuals affected by cribra orbitalia from the study sample. The table includes data from only two sites where individuals with cribra orbitalia were identified. None of the individuals with this defect was below five years or above 15 years. Table 6.3 summaries the comparison with other South African skeletal populations. The result indicates that there was less cribra orbitalia on the Toutswe skeletons than at K2/Mapungubwe. Thirty-eight skulls from K2/Mapungubwe were examined and 15 of them had cribra orbitalia. The number of affected individuals on the Toutswe sample is less than half the number affected at

K2/Mapungubwe and Oakhurst. In both samples, the lesions are generally mild. From Oakhurst, 11 individuals out of 18 were affected. The incidence of these lesions at Oakhurst appears to be much higher than at Toutswe and K2/Mapungubwe. It should however be kept in mind that the Oakhurst sample is small. The more recent skeletons from Riet River and Kakamas much less incidences of cribra orbitalia.

At K2/Mapungubwe, the presence of cribra orbitalia was evaluated in the following age categories; younger than two years, 2 -13 years, 13 - 20 years and older than 20 years. Each of these age categories have at least one or more individuals with cribra orbitalia (Steyn and Henneberg 1995a). Thus not only are cribra orbitalia lesions higher in the K2/Mapungubwe skeletons by comparison to Toutswe skeletons, it is also distributed across a broad spectrum of age categories at K2/Mapungwe as opposed to Toutswe. None of the Toutswe infants below two years were found with lesions but one child of below two years was found with lesions on the K2/Mapungubwe skeletons. At Oakhurst, one individual of approximately six months old had cribra orbitalia. There were also seven juveniles, two adult females and adult two males. They are aged between zero and 40 years old (Patrick 1989).

The differences in the prevalence of cribra orbitalia on the various samples are not fully understood but subsistence strategies and pathogen invasions are possible reasons. Riet River and Kakamas are pastoral groups with possibly less reliance on cereals than the Toutswe and K2/Mapungubwe farmers and herders. The Oakhurst community on the other hand is a pre-pastoral group and the sample size could be a reason for the high prevalence of cribra orbitalia seen. It thus seems that the incidence of cribra orbitalia is much lower at Toutswe, as compared to Iron Age sites at K2 and Mapungubwe, and is also only present in juveniles. This probably indicates that the stressors causing these lesions were less at the Toutswe group of sites.

Figure 6.12 Cribra orbitalia on Toutswemogala Burial 16.

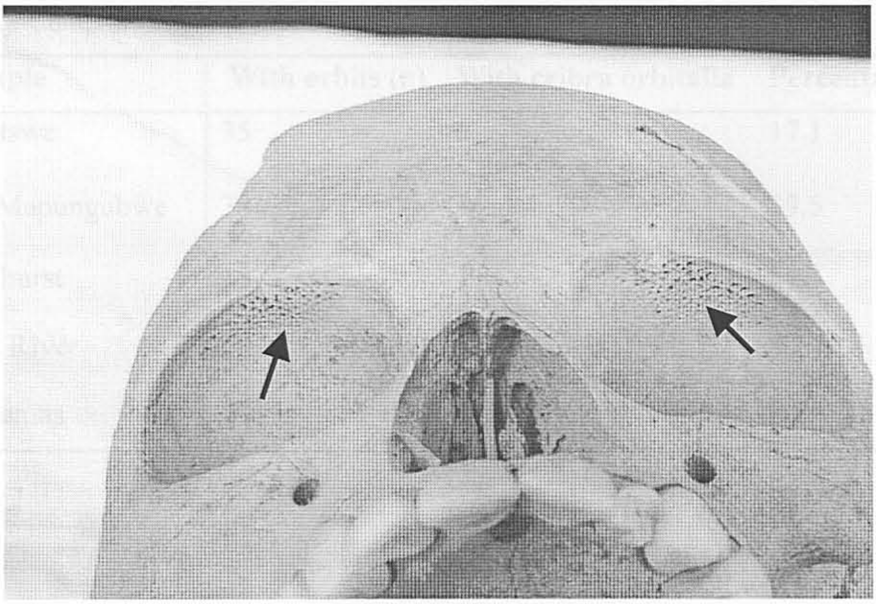


Table 6.2 Summary of age distribution of cribra orbitalia

Site	<5y	5-10y	10-15y	Total
Toutswemogala	0	4	1	5
Kgaswe B-55	0	0	1	1
Total	**0**	**4**	**2**	**6**

Table 6.3 Comparison of the prevalence of cribra orbitalia on different samples

Sample	With orbits (n)	With cribra orbitalia	Percentage
Toutswe	35	6	17.1
K2/Mapungubwe	38	15	39.5
Oakhurst	18	11	61.1
Riet River	74	7	9.5
Kakamas	53	2	3.8

6.5.1.2 Porotic hyperostosis

Porotic hyperostosis has been studied as far back as the late nineteenth century but at the time was thought to be of different causes, such as carrying water jugs on the head and geographic location (Angel 1964; 1966; Stuart-Macadam 1989). The geographic location as a predisposing factor to porotic hyperostosis was partly based on the distribution of areas infested with *falciparum* malaria (Angel 1966; Ortner and Putschar 1981). The main interest at the time was to describe the lesions and hypothesize on their etiology. Porotic hyperostosis was viewed as a direct evidence for nutritional stress and this led to a general misconception that those archaeological populations with high incidence of porotic hyperostosis were nutritionally disadvantaged (Angel 1964; 1966; Hengen 1971; Mensforth et al. 1978; Stuart-Macadam 1991; 1992; Kent et al. 1994). It was not until the late 1920s that a breakthrough in the understanding of the aetiology of porotic hyperostosis was made. Radiographic similarities between the lesions in clinical cases and archaeological cases were identified. Since the clinical cases were mostly of individuals with iron deficiency anaemia, the archaeological cases were readily interpreted as having resulted from anaemia (El-Najjar and Robertson 1976; Stuart-Macadam 1991; 1992).

Porotic hyperostosis is a generic term used to describe skeletal lesions resulting from a decrease in bone density (Ortner and Putschar 1981; Ascenzi et al. 1991). It has the same aetiology as cribra orbitalia. Bone density decreases in response to increased haemopoietic bone marrow. The lesions appear as small pores on the cranial vault, especially on the temporal, parietal and occipital bones. They range in size and appearance between small holes on a small or localised area to large openings on a larger area (Ascenzi et al. 1991; Stuart-Macadam 1991; 1992). The lesions are frequently found around the mastoids, around the bregma and on the posterior surface of the skull. Porotic hyperostosis is less common but almost always found in association with cribra orbitalia (Mensforth et al. 1978).

Individuals with anaemia may display thicker diploe than normal (Mensforth et al. 1978; Ortner and Putschar 1981; Stuart-Macadam 1991; 1992). In thalassemia cases, the diploe expands leading to a reduction in the number of the trabeculae. The external table is eroded and new subperiosteal bone developing creates a 'hair on end' appearance (Ortner and Putschar 1981).

Methods

All cranial bones present were observed regardless of whether the skull was complete or not. Where only a few cranial fragments were present and were included. Therefore the analysis included all individuals with complete and incomplete skulls. Individuals of all ages were included in this analysis.

Results

Five individuals with porotic hyperostosis were identified on five individuals and the lesions are distributed on the temporal, frontal and occipital bones with little evidence on the parietal bones. Cribra orbitalia was found in association with porotic hyperostosis in two cases, Kgaswe B-55 Burial 15 (10-12 years) and Toutswemogala Burial 2 (five to seven years old). Two individuals had no cribra orbitalia and they are Swaneng Hill Burial 1, an adult male aged between 20 and 30 years, and Toutswemogala Burial 8, a child of five to seven years. One individual, Thatswane 3, aged between three and five years, had no orbits.

On the K2/Mapungubwe sample, only one individual had porotic hyperostosis. The individual was aged approximately eight years (Steyn and Henneberg 1995a). No cases of this condition were reported on the Oakhurst sample. Peckmann (2002) also found a few cases. Thus the incidence of porotic hyperostosis on Toutswe exceeds K2/Mapungubwe, but cribra orbitalia shows a higher incidence K2/Mapungubwe than Toutswe. In all samples the numbers of individuals affected are too small to make statistical inferences from. It therefore appears that the Toutswe results are within ranges previously quoted for southern Africa.

6.6 Enamel hypoplasia

Enamel hypoplasias are bands or pits marking levels where enamel is thin (Goodman et al. 1980; 1984a; 1984b; 1987; Lukacs 1989; Goodman and Rose 1990; 1991; Hillson 1996; Aufderheide and Rodriguez-Martin 1998) as a result of the cessation of ameloblast activity during developmental stages of a tooth. During the secretion phase of amelogenesis, stress resulting from nutritional deficiency or other factors, e.g. major acute bacterial invasion, retards or withholds the growth of enamel. Once the stress is relieved, enamel growth starts again. When growth restarts, a band or pit of thin enamel is left marking the cessation of growth (Goodman et al. 1980; 1984a; 1984b; 1987; Goodman and Rose 1990; 1991; Aufderheide and Rodriguez-Martin 1998). Enamel hypoplasia occurs only during developmental ages and therefore any stress experienced after the completion of amelogenesis does not produce lesions on teeth. Two broad categories of stress that causes enamel defects are malnutrition and diseases (Skinner and Goodman 1992). In malnourished children, the material needed for matrix formation or mineralisation are supplied in quantities below normal requirements or are not supplied at all. A disease, on the other hand, impairs normal cellular function.

The ability of developmental defects of enamel to progress to stages where they are observable depends on two factors. First they depend on the susceptibility of an affected individual or group to environmental insults and secondly, on the susceptibility of the dental tissue to allow for a reactive response and thereby creating a record of the stress (Skinner and Goodman 1992; Wood et al. 1992). Enamel hypoplasia is only an indicator of strenuous episodes during developmental years (approximately five months in utero to about seven years) when amelogenisis of deciduous and permanent teeth is at its highest. It may also be detected at the ages of 10 to 16 years when third molar amelogenisis is occurring (Anderson et al. 1976; Goodman et al. 1980; Goodman and Rose 1990; 1991; Skinner and Goodman 1992). In many of case studies (e.g. Goodman et al. 1980; 1984a; 1984b; 1987; Lanphear 1990; Steyn and Henneberg 1995a), it has been found that enamel hypoplasia occurs mainly between two and four years which is the period corresponding to the hype of ameloblast activity.

Unlike bone, enamel cannot remodel once formed. Therefore, lesions produced during the early years remain permanently unless other diseases or post depositional damage (Goodman and Rose 1980; Goodman et al. 1984; Aufderheide and Rodriguez-Martin 1998) destroys affected teeth. Previous studies have shown that mandibular permanent canines and maxillary central incisors are the most prone to enamel hypoplasia. These teeth have a relatively longer developmental period and therefore their ameloblast activities have more chances of being disrupted (Goodman et al. 1980). By measuring the distance between the cemento-enamel junction and enamel hypoplasia, the age at which enamel hypoplasia occurred can be estimated.

Methods

Enamel hypoplasia was recorded as present or absent where the enamel was observable. All teeth were analysed, regardless of the side from which they came. In cases where the enamel had been destroyed by either pathology or post-depositional processes, enamel hypoplasia was recorded as unobservable. All deciduous and permanent teeth present were examined. From the literature surveyed, there is no clearly defined criterion to score the severity of enamel hypoplastic lesions. Without proper guidelines, no attempts were made to differentiate the severity of lesions found. However, if a lesion appeared to be more pronounced than the others, such a case was noted. A distinction between pits and linear lesions was made.

All lesions recorded were measured from the cemento-enamel junction to the nearest millimeter using a digital sliding caliper. The distances were used to estimate ages at which enamel hypolasitic lesions occurred and only permanent teeth were included. Regression equations for estimating age at which enamel hypoplastic lesions formed on permanent teeth is detailed in a publication by Goodman and Rose (1991). The distances measures were fit into relevant regression equations to estimates ages of formation. A total of 50 lesions from 44 teeth were included in the estimation of age at which lesions formed.

Results

Due to either pathological and/or post-depositional damage, 20 permanent teeth were excluded from the analysis. None of the deciduous teeth were excluded. A total of 53 out of 784 teeth from 16 individuals had been affected by this developmental defect. The teeth affected include eight central incisors, five lateral incisors, twenty-two canines, five first premolars, two second premolars, two first molars, five second molars (all permanent) and three deciduous canines. Table 6.4a shows the distribution of permanent teeth affected by enamel hypoplasia and Table 6.4b summarises data on deciduous teeth. The number of each tooth type affected is expressed as a percentage of the total number of teeth affected. Table 6.3a shows that the most commonly affected permanent tooth is the canine (26.83%).

A comparison between permanent maxillary and mandibular teeth indicates that mandibular teeth were more affected than maxillary teeth. Of the 50 permanent teeth affected, 40 are mandibular and 10 maxillary. In both the maxilla and mandible, the most commonly affected tooth is the canine, followed by the lateral incisor of the maxilla and central incisor of the mandible.

Out of 46 individuals examined, 14 had enamel hypoplasia i.e. 30.4% of the individuals. The number of teeth involved per individual ranged between one tooth (e.g. Bosutswe Burials 5 and 6) and nine teeth (Bosutswe Burials 9 and 13). Of the 53 teeth involved, 11 had pitting enamel hypoplasias and the remaining 42 had horizontal linear enamel hypoplasias. Only one individual had both types of lesions (Toutswemogala Burial 6), but on different teeth. None of the teeth displayed multiple pitting enamel hypoplastic lesions but multiple horizontal linear lesions per tooth were noted on four individuals. Most of the recurring lesions occurred on mandibular canines.

The ages at which enamel hypoplastic lesions were formed is presented in Table 6.5. The ages were estimated on permanent teeth only. The data used in the table was pooled from mandibular and maxillary teeth, because a small number of lesions were identified. The earliest age at which enamel hypoplastic lesions were formed was at 0.8 years. This age was recorded on a mandibular central incisor of Toutswemogala Burial 6. At time of death this individual was approximately 9-11 years old. The oldest age of lesion formation was at six and a half years, estimated on a mandibular second molar of Kgaswe B-55 Burial 2. The individual had survived to be 30-50 years old. On the same tooth an earlier episode of stress had occurred at approximately four and a half years. In Toutswemogala Burial 29 (6-10 years) the episodes were experienced at one and half, two and a half and four years on the right mandibular canine. A left mandibular canine of Bosutswe Burial 5 (17-20 years) had three lesions formed at two and half, three and nearly five years respectively. The average age of occurrence of hypoplastic lesions was 3.7 years.

Table 6.4a Distribution of enamel hypoplastic lesions on permanent teeth.

Tooth	n	Affected	Percentage
I1	62	8	12.9
I2	68	6	8.82
C	82	22	26.83
PM1	78	5	6.41
PM2	75	2	2.67
M1	104	2	1.92
M2	76	5	6.58
M3	46	0	0
Total	591	50	8.46

Table 6.4b Distribution of enamel hypoplastic lesions on deciduous teeth

Tooth	n	Affected	Percentage
i1	27	0	0
i2	30	0	0
c	35	3	8.57
m1	50	0	0
m2	51	0	0
Total	**193**	**3**	**8.57**

Table 6.5 Ages at which enamel hypoplastic lesions were formed on permanent teeth

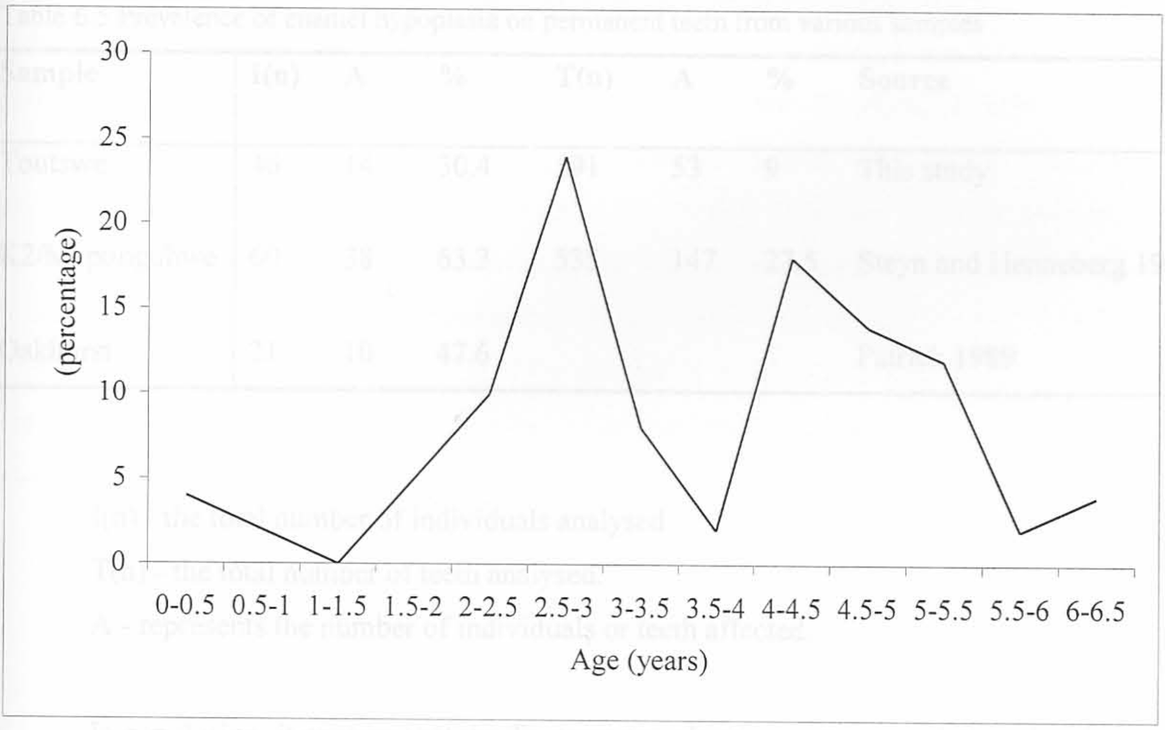
Age (years)	I1	I2	C	PM1	PM2	M1	M2	Total
0-0.5								0
0.5-1.0	2							2
1.0-1.5			1					1
1.5-2.0								0
2.0-2.5	2	2	1	2		1		8
2.5-3.0	4	2	3			1		10
3.0-3.5		2	1					3
3.5-4.0			1	1				2
4.0-4.5			8	1				9
4.5-5.0			5		1		1	7
5.0-5.5			2	1	1		2	6
5.5-6.0							1	1
6.0-6.5							1	1
Total	**8**	**6**	**22**	**5**	**2**	**2**	**5**	**50**

The chronology of formation of enamel hypoplasia on permanent teeth (Figure 6.13) shows a bimodal curve indicating that there were generally two phases during which children were exposed to stress. The figure shows that stress was minimal during the first year of life where less than five percent of the total hypoplastic lesions were formed. After one and half years, there is a rapid increase in the formation of lesions until two and a half to three years and the period that follows is characterised by a decline in the formation of enamel hypoplasia. The age of around three to four and half years is marked by the second phase of accelerated formation of hypoplastic lesions. The age at which the most number of lesions was recorded is between two and half and three years where approximately 25% of the total number of lesions was formed.

It is difficult to make sound comparisons of the distribution of teeth with enamel hypoplastic lesions between the Toutswe and K2/Mapungubwe samples. The K2/Mapungubwe sample is more than twice the Toutswe sample with 147 lesions (Steyn 1994; Steyn and Henneberg 1995a) while the Toutswe sample has only 53 lesions. However some similarities can be identified despite the sample size differences. For instance, the most commonly affected mandibular tooth in both samples is the canine. On the K2/Mapungubwe sample, the age of lesion formation raged between 1.1 to 6.5 years with an average occurrence of 3.7 years. The Toutswe sample shows an age range of lesion formation of 0.8-6.5 years with a mean of 3.7 years.

The distribution of ages at which lesions formed on the Toutswe population differs from that recorded on a modern sample from Chicago (Goodman and Rose 1990). The Chicago sample has a single peak during which most enamel hypoplastic lesions were formed. This peak was at approximately the end of the first year of life where more than 70% of the lesions were recorded. No lesions were recorded after the age of four on the Chicago sample whereas at Toutswe the last lesions were formed at about the age of six and a half years. The chronology of formation of hypoplastic lesions on an archaeological sample at Dickson Mounds distributed between the ages of six months to six and a half years similar to Toutswe. However the Dickson Mounds curve is unimodal with the peak occurring at approximately three years. About 30% of the total lesions were formed at three years (Goodman Rose 1990). The samples from America were selected as outliers whose subsistence and health are well understood. The bimodal curve displayed by the Toutswe sample may be a function of sample size. Other possibilities include pathogen invasion at the time of weaning as well malnutrition when breast milk is stopped at the time of weaning.

Figure 6.13 Chronology of formation of enamel hypoplasia on the Toutswe population



The prevalence of enamel hypoplasia of three archaeological populations including the current sample is presented in Table 6.5. The table compares two important variables, the total number of individuals observed and the percentage of those affected and the total number of teeth analysed and the percentage of those affected. The data included comprises of pooled maxillary and mandibular teeth from all individuals. The K2 and Mapungubwe results have also been pooled.

The percentage of affected individuals at K2/Mapungubwe is more than twice the percentage affected at Toutswe. The Oakhurst sample is much smaller than the other two, but shows that nearly 50% of the individuals analysed were affected. The total number of permanent teeth analysed on the Toutswe sample is 591 while on K2/Mapungubwe it is

535. In contrast the number of teeth with lesions on the K2/Mapungubwe sample exceeds the number of teeth with lesions on the Toutswe sample by 94 (i.e. 147 versus 53).

Table 6.5 Prevalence of enamel hypoplasia on permanent teeth from various samples

Sample	I(n)	A	%	T(n)	A	%	Source
Toutswe	46	14	30.4	591	53	9	This study
K2/Mapungubwe	60	38	63.3	535	147	27.5	Steyn and Henneberg 1995a
Oakhurst	21	10	47.6				Patrick 1989

I(n) - the total number of individuals analysed

T(n) - the total number of teeth analysed.

A - represents the number of individuals or teeth affected.

In conclusion, it appears that the Toutswe sample represents a population showing relatively low levels of stress. The incidences of nonspecific makers of stress are low compared to K2/Mapungubwe. However, more recent individuals from historical sites (Morris 1984; Peckmann 2002) seem to have been healthier than the Toutswe people and other earlier populations. It therefore seems as if there is trend towards better health from earlier to modern groups.

7. DENTAL HEALTH AND CHARACTERISTICS

7.1 Introduction

Dental anthropology is a broad field of study that encompasses the study of the development, anatomy, morphology, and diseases affecting teeth (Hillson 1986; 1996; Lukacs 1995; Roberts and Manchester 1995; Aufderheide and Rodriguez-Martin 1998). Because of the complex organic and inorganic structure of teeth, they tend to preserve and last much longer in archaeological deposits than bones. There are abundant amounts of information that can be derived from teeth such as oral health, diet, as well as nutritional and bacterial stress experienced during early developmental ages (Lukacs 1995; Roberts and Manchester 1995). This chapter is divided into four main sections namely, dental pathology, dental wear, odontometric characteristics and dental modification.

7.2 Dental pathology

The study of dental palaeopathology is a specialized field focused on ancient dental diseases (Lukacs 1989; Goodman and Rose 1990; 1991; Larsen et al. 1991; Roberts and Manchester 1995; Aufderheide and Rodriguez-Martin 1998). Dental palaeopathology has become increasingly important over the years (Ortner and Putschar 1981; Roberts and Manchester 1995; Lukacs 1995), owing to the fact that it provides data on both diet and dental health of skeletal populations. A strong relationship between diet and dental health has long been recognised (Lukacs 1989; Walker and Hewlett 1990; Larsen et al. 1991; Goodman and Rose 1991; Erdal and Duyal 1999) and used to further our knowledge of the lifestyles of ancient populations. For instance, severe nutritional deficiencies during the early years of life cause disturbances on amelogenesis and result in enamel hypoplasia (Ortner and Putschar 1981; Goodman and Rose 1990; 1991; Roberts and Manchester 1995), while dental caries is triggered by high carbohydrate and sugar content in food (Lukacs 1989; 1995 Larsen at al. 1991; Hillson 1991; 1996; 2001). Calculus is known to trap food microscopic elements such as plant phytoliths, which can be used to reveal the most dominant type of food an individual, or group of individuals, had regular access to (Buikstra and Ubelaker 1994). Indicators of oral health are thus used as parameters from which general diet and lifestyles of archaeological skeletal populations can be inferred (Erdal and Duyal 1999).

The role of diet on the prevalence of dental diseases has been studied using skeletal populations of different subsistence strategies and time periods, e.g., Goodman et al. (1980), Walker and Hewlett 1990 and Larsen et al. (1991). A general trend in the results of these various works is that there is a high prevalence of dental caries on populations dependant on agriculture for subsistence, and much dental attrition in hunter-gatherers whose subsistence is based on unrefined foods. Enamel hypoplasias are most common in communities whose food resources are seasonal rather than annual.

Like all other studies based on human skeletal remains, dental palaeopathology is fraught with problems and limitations. Although teeth tend to survive much longer in the archaeological record than bones, they are easily removed from their sockets and can be lost. Postmortem tooth loss and tooth damage are common problems in archaeological cases. Anterior teeth are the most susceptible to destructive post-depositional processes (Ortner and Putschar 1981; Buikstra and Ubelakar 1994; Roberts and Manchester 1995) because their single root structure does not offer resistance to processes acting upon them. Posterior teeth have multiple roots whose morphology makes it difficult for them to be dislodged. Both postmortem and antemortem tooth losses are problematic because they lead to loss of information regarding the pathological status of lost teeth.

Antemortem tooth loss may be pathologically or culturally induced (Ortner and Putschar 1981; Lukacs 1989) but unfortunately it is not always easy to differentiate between the possible reasons for antemortem tooth loss when dealing with archaeological skeletons.

Another problem is that dental disease can result in very large lesions or total crown destruction, thereby erasing any evidence of earlier lesions caused by other diseases. For instance, severe dental wear or attrition, especially common in archaeological remains, erases evidence of other dental pathologies that could have been recognised from the eroded enamel such as dental caries, calculus and enamel hypoplasia. Both dental wear and dental caries can result in total crown destruction in which only the root remains. At this point it becomes difficult to differentiate between these diseases especially when only macroscopic visual observation is the only method used.

7.2.1 Dental caries

Dental caries, also known as dental decay, is a pathological process in which the hard outer tissues of teeth are destroyed (Ortner and Putschar 1981; Lukacs 1989; Henneberg 1991; Roberts and Manchester 1995; Aufderheide and Rodriguez-Martin 1998). The process through which a tooth decays depends on a variety of external factors such as oral hygiene and diet as well as the morphology of the tooth itself. For instance, it has been noted by various anthropologists that anterior teeth have less prevalence of dental caries than posterior teeth (Buikstra and Ubelakar 1994; Erdal and Duyar 1999; Hillson 2001). This is because posterior teeth have fissures and crevices within which bacteria and its associated chemicals can easily attach to the tooth. Dental caries is a progressive infectious disease caused by bacterial organisms (Lukacs 1989; Aufderheide and Rodriguez-Martin 1998). Some authors have suggested a genetic predisposition to dental caries.

Different theories have been proposed with regard to conditions necessary to trigger the development of dental caries. Chemicals, parasitic bacteria and acids in the oral cavity have been found to be the most dominant predisposing factors (Ortner and Putschar 1981; Lukacs 1989; Henneberg 1991; Hillson 1996; Aufderheide and Rodriguez-Martin 1998). Sucrose and acidogenic bacteria combine and cause the dissolution of the inorganic matrix through decalcification and demineralization. This is followed by the disintegration of the organic matrix. The end result is cavitation of the tooth (Lukacs 1989; Henneberg 1991; Hillson 1996). Dental caries are differentiated on the basis of the tooth area affected, for example, crown caries and root caries (Ortner and Putschar 1981; Hillson 1996; 2001; Aufderheide and Rodriguez-Martin 1998). Crown caries are common across all ages, while root caries tends to be associated with older individuals with a history of periodontitis.

Dental caries have been reported in all parts of the world and throughout all time periods (Ortner and Putschar 1981; Roberts and Manchester 1995; Aufderheide and Rodriguez-Martin 1998). It affects individuals of all races, sexes, ages and social levels. Several authors (e.g., Lukacs 1989; 1996; Henneberg 1991; Larsen et al. 1991) have attributed the marked increased in the prevalence of dental caries during the last several centuries to the development of agriculture. The increase in carbohydrate and sucrose content in diet increased the chances of dental caries. Larsen and coworkers (1991) studied four population groups in the southeast Atlantic coast of the USA. The groups were differentiated on the basis of their mode of subsistence and the results indicate a general increase in the incidence of dental caries with the development of agriculture and early contact with Europeans (Larsen et al. 1991). Dental caries rates provide valuable information regarding the adaptation of past populations to the physical and cultural environment (Erdal and Duyar 1999).

The observed caries rate (the percentage of teeth with caries) is regarded as less accurate indicator because it does not account for antemortem tooth loss which may have been a result of dental caries. In order to eliminate this shortcoming, correction procedures for calculating dental caries are employed (Lukacs 1992; 1995; 1996; Erdal and Duyar 1999). One such procedure is the decayed-and-missing teeth index. The decayed-and-missing teeth index assumes that all teeth missing antemortem are a result of dental caries. Although the method overrules other factors as being responsible for antemortem tooth loss especially in archaeological skeletons, it may not necessarily lead to critical inaccuracies in results obtained particularly where the prevalence on antemortem tooth loss is low. Erdal and Duyar (1999) have proposed a slightly different correction procedure for calibrating dental caries. Their procedure involves the separation of anterior teeth (incisors and canines) from posterior teeth (premolars and molars) so as to calculate dental caries rates on the basis of the ratio of anterior to posterior teeth. Posterior teeth are more prone to dental caries than anterior teeth and the method proposed by Erdal and Duyar (1999) takes this factor into account.

Methods

Visual observation was done on all surfaces of each tooth. Carious lesions were recorded in terms of their location on the tooth and a scoring system was used for the size of lesions found. The lesions were divided into small, moderate and large. Small lesions were mostly small pits and moderate lesions were those affecting approximately one-fourth of the tooth surface. Large lesions included those in which at least half of the crown height had been destroyed and thereby creating deeper cavity.

Two different caries rates were calculated, the 'observed caries rate' and the 'decayed-and–missing index' (Lukacs 1995; 1996; Erdal and Duyar 1999). The 'observed caries rate', also known as caries intensity, is the number of teeth with caries expressed as a percentage of the total number of teeth observed. The corrected caries rate, using the decayed-and-missing teeth index, is the sum of teeth with carious lesions and teeth missing antemortem expressed as a percentage of the sum of teeth observed and those teeth lost antemortem (Lukacs 1996). Caries frequencies were calculated for deciduous, permanent and combined samples. Caries frequency shows the percentage of individuals with carious lesions on one or more teeth. Assessment for dental caries included 587 permanent teeth and 193 deciduous teeth. Twenty-four permanent teeth were excluded because of post depositional damage, which had made them unobservable.

Results

Dental caries was identified on 23 teeth; 20 permanent and three deciduous. Permanent teeth affected include two central incisors, one first premolar, one second premolar, three first molars, seven second molars and four third molars and the two unidentified molars. Table 7.2a and Table 7.2b show the distribution of dental caries on various permanent and deciduous teeth respectively. The 20 permanent teeth with carious lesions came from eight individuals (Thataganyane Hill Burial 1, Taukome Burials 1 and 2, Bosutswe Burials 3, 5 and 12; Toutswemogala Burial 16 and Kgaswe B-55 Burial 14).

In the case of deciduous teeth, a canine, a first molar and a second molar were affected. The teeth are from Bosutswe Burial 6 and Toutswemogala Burial 6. The individuals affected ranged between about six years (Bosutswe Burial 6) and 75 years (Bosutswe Burial 12).

Table 7.1a shows that on permanent teeth, dental caries occurred more frequently on posterior teeth than on anterior teeth. Two premolars and 16 molars had been involved while only two central incisors show small carious lesions. Posterior teeth are more susceptible to dental caries because of their surface morphology allows for bacteria to attach to them easily.

Carious lesions found ranged in size between small pits to large cavities, which had eroded most of the tooth crown (e.g., the lower right second molar of Taukome Burial 2 and the upper right second molar of Bosutswe Burial 5). The number of teeth involved per individual ranged between one tooth (e.g., Taukome Burials 1 and 2 and Toutswemogala Burial 6) and six teeth (e.g., Kgaswe B-55 Burial 14).

Observed caries rates or caries intensity of permanent teeth as well as deciduous teeth were calculated (Lukacs 1995; Erdal and Duyar 1999). The same calculation was also performed on pooled deciduous and permanent teeth and the results are shown in Table 7.2. Caries intensity is greatest on permanent teeth by comparison to deciduous and combined samples of permanent and deciduous teeth. Deciduous teeth show the least caries intensity.

Table 7.1a Distribution of dental caries on permanent teeth.

Tooth	**Number of teeth**	**Affected**	**Percentage**
I1	59	2	3.39
I2	69	0	0
C	81	0	0
PM1	78	1	1.28
PM2	74	1	1.35
M1	104	3	2.88
M2	76	7	9.21
M3	44	4	9.09
Unidentified	2	2	100
Total	587	20	

Table 7.1b Distribution of dental caries on deciduous teeth

Tooth	**Number of teeth (n)**	**Carious**	**Percentage**
i1	27	0	0
i2	30	0	0
c	35	1	2.86
m1	50	1	2.00
m2	51	1	1.96
Total	**193**	**3**	

Table 7.2 Summary of caries intensities of Toutswe sample

	Number of teeth (n)	Carious	Intensity (%)
Deciduous	193	3	1.55
Permanent	587	20	3.41
Pooled	780	23	2.95

Seven permanent teeth (five first molars, a second molar and a third molar) from four individuals had been lost antemortem. All of these individuals had carious lesions on some of their remaining teeth. Taukome Burial 2 had lost three mandibular molars Unfortunately the maxilla and its teeth had not been preserved. Kgaswe B-55 Burial 14 had lost both lower first molars and was the most affected by dental caries with six teeth involved. Taukome Burial 1 and Bosutswe Burial 12 had each lost a first molar.

The seven teeth lost antemortem were used to calculate a decayed-and-missing index. Although the true underlying factors responsible for these losses are unknown, an assumption that they were lost due to dental caries was made on the premise that all of them had been lost on individuals with carious lesions on some of their preserved teeth. A corrected dental caries rate or intensity based on the decayed-and-missing index of permanent teeth was calculated as follows:

Decayed-and-missing index = (20+7)/ (587+7) × 100 = <u>4.55%</u>

The decayed and missing index still shows a low corrected caries rate of only four and half percent. Subsequently, the caries frequency was calculated. The total number of individuals assessed was 46 and 10 of then had carious lesions. The caries frequency was therefore 21.74%.

Caries frequency = 10/46 x 100 = <u>21.74%</u>

A comparison of both caries intensity and caries frequency between Toutswe and other skeletal populations is shown in Table 7.3. The data used in this table is for permanent teeth only. Comparison of caries incidence should ideally be done at the caries frequency level where the comparison is based on number of individuals affected. This is because caries intensity is biased in the sense that the number of carious teeth varies from one individual to the other. Unfortunately it is not always possible to find the number of individuals included in the sample, as some authors are more interested in caries intensity than caries frequency. The Toutswe sample included in this table consists of 26 adults with one or more permanent teeth. They are aged between 20 and 75 years old.

The samples included in the comparison come from both archaeological and modern populations. These included K2/Mapungubwe, Oakhurst, Kakamas and Riet River, Kalahari San and Aka. The Aka people are a modern agriculturalist population in central Africa (Walker and Hewlett 1990). They have been selected as an outlier from a different geographical area and with a different subsistence. Oakhurst is a pre-pastoral group, Kakamas, and Riet River samples represent pastoral communities (Morris 1984; 1992; Patrick 1989; Sealey et al. 1992). The Kalahari San are a modern population dependent mostly on hunted and gathered terrestrial resources (Van Reenen 1964c). Historic communities at Griqua, Colesberg and Wolmaransstad show relatively low caries intensities (Peckmann 2002). The historic communities were included in this comparison as outliers from a more recent time period.

Table 7.3 shows a very high caries intensity and frequency in the Oakhurst sample (17.7% and 84.6% respectfully) by comparison to others. The Oakhurst people were dependent on marine and terrestrial food. Although diet plays a role, the high incidence of dental caries in the Oakhurst sample has been attributed to extremely low fluoride content in the underground water and diet (Patrick 1989; Sealy et al. 1992). The Kalahari San, on the other hand, have a low caries intensity and frequency attributed to sufficient fluoride content in water (Van Reenen 1964c; Sealy et al. 1992). Fluoride is a halogen compound that protects teeth from invading bacteria. Another factor for the low caries rates on the Kalahari San is their diet, which has high fiber content and is thus less cariogenic (Van Reenen 1964c).

The Toutswe people are the third least affected by dental caries, with an intensity of 3.41% and frequency of 21.74%. By comparison to both archaeological and modern agriculturalist samples, i.e. K2/Mapungubwe and Aka, the Toutswe sample is the least affected by dental caries. When compared to all archaeological samples regardless of the mode of subsistence, they are the second least affected. Unfortunately, not much is known about fluoride content of underground water surrounding the Toutswe area. The sites themselves are distributed over a vast area and therefore the fluoride content may have varied from one place to other. Evidence in the form of carbonized sorghum grains and millet (Denbow 1982; 1983a; Reid 1998) gives an indication of some of the cereals exploited by these people.

Table 7.3 Caries intensities and frequencies on permanent teeth from various populations

Sample	Caries intensity			Caries frequency			Source
	teeth (n)	carious teeth	I (%)	individuals (n)	affected individuals	F (%)	
Toutswe	587	20	3.41	46	10	21.74	This study
K2/Mapungubwe	306		18.3		56	54.5	Steyn 1994
Oakhurst	192	34	17.7	13	11	84.62	Sealy et al. 1992
Kakamas	989		1.3	42.5		18.8	Morris 1992
Riet River	1061		4.3	46.5		41.7	Morris 1992
Kalahari San*	11521	79	0.69	406	37	9.11	Van Reenen 1964c
Aka*	3099	163	5.17	110			Walker & Hewlett 1990
Griqua!	1101	32	2.9				Peckmann 2002
Colesberg!	1067	41	3.8				Peckmann 2002
Wolmaransstad!	522	29	5.6				Peckmann 2002

* Modern community

! Historic community

I (%) caries intensity

F (%) caries frequency

7.2.2 Calculus

Calculus, also commonly known as tartar, is mineralised plaque (Ortner and Putschar 1981; Hillson 1986; 1996; Roberts and Manchester 1995). Dental plaque, which contains microorganisms, accumulates in the mouth and attaches to enamel. If not removed regularly, crystallites are deposited on top of living plaque to form what is eventually found as hard calculus (Roberts and Manchester 1995; Hillson 1996). Teeth surfaces closest to the salivary glands are the most susceptible to calculus formation. Such surfaces are lingual surfaces of anterior teeth and buccal surfaces of molars (Lukacs 1989; Roberts and Manchester 1995; Hillson 1996). Calculus is associated with infection of the gingivae on areas where deposits are made (Van Reenen 1964c).

There are two types of calculus, supragingival and subgingival. Supragingival calculus attaches to the enamel or above the gums. This type of calculus is usually thicker with a rough surface and is cream or brownish in colour. Subgingival calculus is deposited on the root surface of the tooth, thinner but harder than supragingival calculus and lighter in colour (Hillson 1996). The most commonly found calculus in archaeological skeletons is supragingival. It may be easily lost after deposition or during analysis if not treated with caution.

Deposits of calculus may give a reflection of oral hygiene since they result from oral debris that is not cleaned off. Calculus has been used in reconstructing diets of prehistoric skeletons. Microscopic food elements such as plant phytoliths can get trapped and embedded into calculus and thus provide information on individuals and population diets (Roberts and Manchester 1995).

Methods

Deposits of calculus or tartar were recorded as present or absent. A fine, small painting brush was used to brush teeth slightly to check if deposits found were actually hard calculus or fine ash and soil attached to teeth after deposition. Post depositional dirt in the form of ash and soil came off easily using fine strokes on teeth. Hard and well-attached calculus, on the other hand, did not fall of teeth when brushing them finely. True calculus was not cleaned off but scored and left in situ.

Calculus deposits were scored on a scale of one to three. On the least side of the scale were teeth with thin calculus deposits and on the other extreme end were thick deposits covering up to about half the tooth size in some cases. The surfaces where such deposits were found were also recorded. The system used has been borrowed from Brothwell (1981) and has been recommended by numerous authors (e.g., Lukacs 1989; Buikstra and Ubelaker 1994; Roberts and Manchester 1995). In some cases of thick calculus deposits, it was not possible to make an observation of enamel hypoplasia.

Results

A total of 12 individuals had some degree of calculus deposits on some their teeth (Bosutswe Burials 3, 5, 6, 11, 12, 13, Toutswemogala Burial 16, Kgaswe B-55 Burials 2, 9, 16, Swaneng Hill Burial 1 and Thatswane Burial 6). The amount of calculus ranged from thin bands on the labial surfaces only to thick bands covering labial and lingual surfaces. Interproximal calculus deposits were also noted in a few cases. Anterior and posterior teeth were affected almost equally. Three adults and one child had thick deposits on some of their teeth. One child with deciduous dentition had been affected. Although calculus takes time to accumulate, during which deciduous teeth maybe shed, poor oral hygiene and diet may facilitate its rapid buildup even on deciduous teeth. Figure 7.1 shows moderate calculus deposits on mandibular teeth of Bosutswe Burial 12.

Reports of calculus on archaeological skeletons and modern populations are common in all parts of the world. While diet oral chemical have influence on the rate and amount of calculus being deposited, it is possible that calculus in archaeological skeletons may be largely influenced by poor oral hygiene.

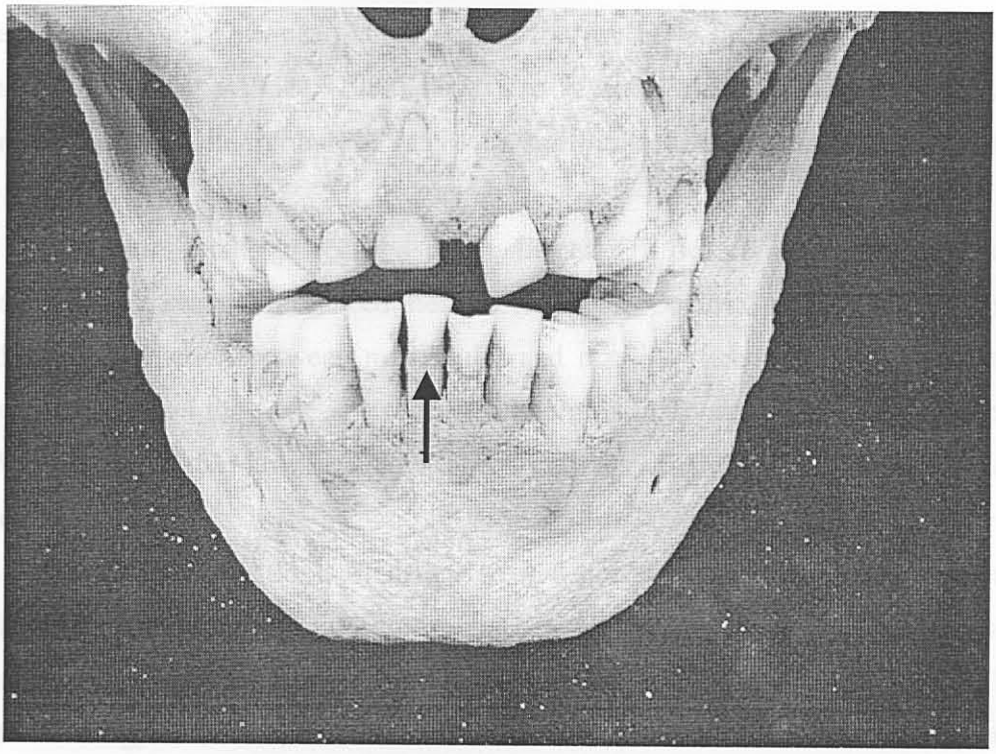
7.3 Dental wear

Introduction

Dental wear is a general term used to refer to any of the progressive conditions that destroys tooth enamel (Molnar 1971; Hinton 1981; Van Reenen 1982; Powel 1985; Roberts and Manchester 1995; Aufderheide and Rodriguez-Martin 1998). There are three such processes, mainly dental attrition, dental abrasion and dental erosion. Dental attrition is the wearing away of tooth enamel as a result of tooth-to-tooth contact during mastication. It is a physiological process associated with age. This process is not pathological but can expose structures underneath the enamel to risks of diseases (Ortner and Putschar 1981; Powell 1985; Roberts and Manchester 1995; Aufderheide and

Rodriguez-Martin 1998). Severe dental attrition can lead to the degeneration of the temporomandibular joints (Brothwell 1981; Richards and Brown 1981; Richards 1990) and, occasionally, the development of tori (Roberts and Manchester 1995). In cases of severe dental attrition, the mandible may be displaced anteriorly thereby resulting in edge-to edge occlusion of incisors (Richards and Brown 1981).

Figure 7.1 Bosutswe Burial 12 with moderate calculus on mandibular teeth



Dental abrasion occurs as a result of friction between the enamel and foreign material introduced to the oral cavity. Abrasive material can be from food or other materials placed regularly in the mouth (Ortner and Putschar 1981; Powell 1985; Roberts and Manchester 1995; Aufderheide and Rodriguez-Martin 1998). Dental erosion is a process in which chemicals introduced into the oral cavity erode the enamel, without bacterial activity.

Numerous studies (e.g., Molnar 1971; Brothwell 1981 Ortner and Putschar 1981; Powell 1985; Roberts and Manchester 1995; Aufderheide and Rodriguez-Martin 1998) have shown that dental wear can be used as an age indicator in adult skeletal remains within a population, once factors affecting the rate of wear in that population have been assessed. Furthermore, dental wear has been shown to be a good indicator of differences in food acquisition procedures between males and females within a population and also across populations. For example, Hinton's (1981) study of numerous dentitions from four aborigine groups has revealed differences in dental wear between sexes and populations as a result of cultural practices, which govern the use of teeth. Other studies by Van Reenen (1964a; 1964b; 1964c; 1982) have also revealed the role played by cultural division of labour in determining the rate, type and form of dental wear on the Kalahari San.

Dental wear results in reduced crown height if it occurs on occlusal surfaces. Interproximal wear results in reduced mesiodistal length. Occlusal wear is often a result of tooth-to-tooth friction between mandibular and maxillary teeth. During mastication movement of teeth on the same jaw results in interproximal wear (Ortner and Putschar 1981; Van Reenen 1982; Powell 1985; Roberts and Manchester 1995; Aufderheide and Rodriguez-Martin 1998).

The magnitude and form of dental wear depends on a variety of intrinsic and extrinsic factors (Hinton 1981; Van Reenen 1982). Intrinsic factors include the size, shape, form and quality of enamel as well the position of the tooth on the mouth. The amount of energy used for mastication can also influence the rate of dental wear. Previous studies have shown that incisors are the least resistant to attrition because of their small occlusal surface (Van Reenen 1982). Extrinsic factors include the quantity of abrasives in food, as well as the use of teeth as tools. The habitual use of teeth plays a major role in determining form of tooth wear (Molnar 1971; Hinton 1981). Secondary dentine is formed to replace that which had been destroyed by attrition and abrasion. However, the rate of dentine destruction may be much faster than the rate for secondary dentine formation and in such cases the pulp space is exposed (Van Reenen 1982; Roberts and Manchester 1995; Aufderheide and Rodriguez-Martin 1998).

Dental wear is one of the most commonly reported dental defects in archaeological skeletons from all parts of the world (Molnar 1971; Roberts and

Manchester 1995; Aufderheide and Rodriguez-Martin 1998). It has been found that prehistoric populations suffered more dental wear than modern populations presumably due to high quantity of abrasives in food, use of teeth for other purposes besides chewing, as well as tough food requiring more energy for mastication (Molnar 1971; Van Reenen 1982; Roberts and Manchester 1995; Aufderheide and Rodriguez-Martin 1998). Morphological alterations of teeth as a result of dental attrition, abrasion or erosion are macroscopically similar. However, dental abrasion can be identified by the presence of microscopic groves or pits on enamel whereas dental attrition produces smoothly worn surfaces (Roberts and Manchester 1995).

One of the most commonly identified forms of tooth wear in archaeological skeletons is 'cupped wear' or a concave surface in which the dentine level recedes below the enamel level (Molnar 1971; Hinton 1981). This occurs because dentine is softer and wears much faster than enamel. Wear type is the angle formed on the occlusal surface as result of attrition (Molnar 1971).

Methods

Dental wear was recorded on all deciduous and permanent teeth with preserved crowns. The scoring was divided on a scale of zero to seven (Brothwell 1981). A score of one was allocated to teeth whose occlusal surfaces showed no signs of attrition, while a score of two was for surfaces showing slight polishing but with occlusal surfaces still showing all of its morphological features. Teeth were allocated a score of three if small or medium sized dentine was exposed. A score of four was allocated to teeth with large dentine exposure, but still surrounded by enamel. Teeth with enamel eroded on occlusal surfaces as well as other surfaces were given a score of five. Those with little or no enamel remaining and those with only roots present were scored six and seven respectively (Brothwell 1981).

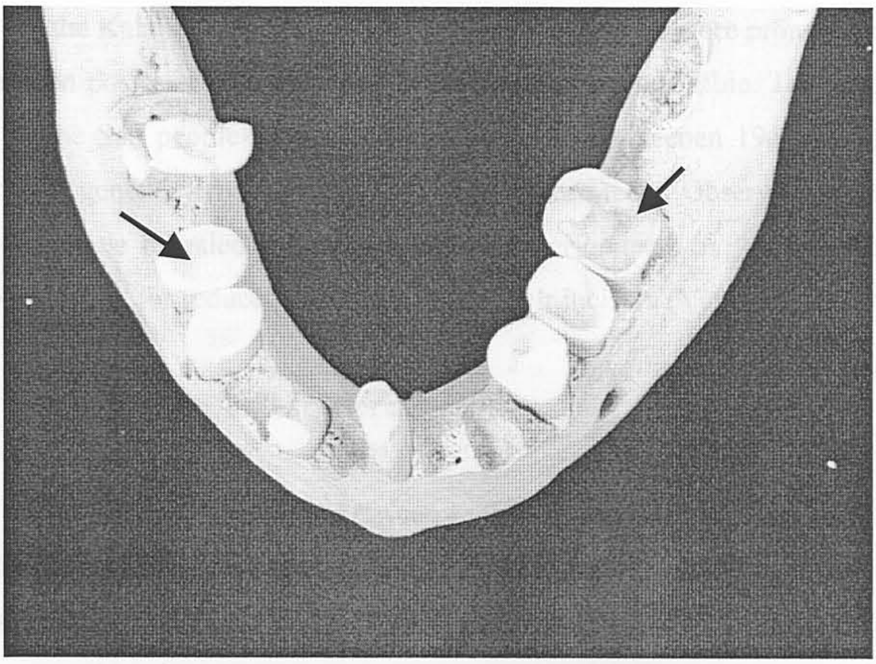
A macroscopic observation of teeth is usually the only technique used for analysis. Therefore, no attempts were made to determine whether tooth wear found was a result of dental attrition, abrasion or erosion. The results obtained are therefore inclusive of all dental wear processes. The direction and form of tooth wear was not examined on the study sample.

Results

The sample of permanent teeth included in this analysis is made up of 52 central incisors, 60 lateral incisors, 72 canines, 77 first premolars, 67 second premolars, 80 first molars, 58 second molars and 42 third molars, thus totaling 508. Deciduous teeth were also included in the analysis.

Most of the teeth are clustered between scores of one and two, with a smaller number of teeth showing severe dental wear. Severe dental wear tends to be most common on posterior teeth. However, in some individuals both anterior and posterior teeth were affected almost equally, for example, Taukome Burial 2 is characterised by advanced dental wear of all mandibular teeth (Figure 7.2). Enamel still surrounds dentine in some of the teeth but on the left first molar it has been eroded on the buccal surface.

Figure 7.2 Mandibular teeth of Taukome Burial 2 showing advanced wear



A summary of the degree of wear on various permanent teeth is shown in Table 7.4. The Table indicates that maxillary teeth were generally less worn than mandibular teeth. The scores of advanced tooth wear are more common on posterior teeth than on anterior teeth. For example, 16 teeth have been allocated a score of four. Of these teeth, there is one canine, three are first premolars, two are second premolars, six are first molars, three are second molars and one is a third molar. Thus 15 of the 16 teeth with advanced wear are posterior teeth.

Dental wear rates on both the study sample and K2/Mapungubwe are similar to that for hunter-gatherers, but both populations were agriculturalists (Denbow 1982; Steyn 1994). Two possible explanations for this is that their food may have had high abrasives content or they may have regularly used their teeth as tools. Using anterior teeth as tools commonly results in them being worn rounded (Morris 1984). Thus the absence of rounded incisors at K2/ Mapungubwe suggests that this was not a common practice. A few individuals with rounded maxillary incisors were identified among the Toutswe skeletons e.g. Bosutswe Burial 12.

On the Kalahari San, dental attrition was found to be more pronounced on anterior teeth than on posterior teeth in both the maxilla and the mandible. The second and third molars of the San people were the least affected (Van Reenen 1964c; 1982). This had resulted in a generally reduced crown height of these teeth. Observations of the modern San people have revealed that they use their anterior teeth as tools and therefore this could be a reason for reduced crown height on their incisors (Van Reenen 1964c; 1982).

7.4 Odontometric Characteristics

Introduction

Divergence or 'distance' between individuals or populations was first calculated using the 'coefficient of racial likeness' (CRL) developed by Pearson in the 1920s (Penrose 1954; De Villiers 1968b). Divergence between individuals was estimated through a combination of numerous measurements of different characteristics. CRL was subsequently replaced by size and shape distances following the realization that it did not account for intercorrelation between anthropological characteristics.

Table 7.4 Summary of scores of dental wear on permanent teeth.

				Maxillary teeth				
S	**I1 (n)**	**I2 (n)**	**C (n)**	**P1 (n)**	**P2 (n)**	**M1 (n)**	**M2 (n)**	**M3 (n)**
0	1	6	9	13	9	11	12	8
1		4	6	8	7	8	11	8
2	12	8	13	8	9	15	11	6
3	4	2	5	4	6	5		
4		1		3	2	4		
5	2	5	2	2				
6	2	2						
7								
				Mandibular teeth				
0	**I1 (n)**	**I2 (n)**	**C (n)**	**P1 (n)**	**P2 (n)**	**M1 (n)**	**M2 (n)**	**M3 (n)**
1	7	7	9	12	9	13	8	6
2		3	5	6	7	6	8	6
3	17	16	17	14	8	6	9	5
4	7	6	6	6	10	10	7	2
5						2	3	1
6								
7				1				

S- score

(n)- number of teeth

By the mid 1950s Penrose had developed a statistical method for calculating size and shape distance between similar variables across two or more sets of data (Penrose 1954, De Villiers 1968b). Shape or morphological differences between individuals or groups enable anthropologists to assign such individuals or groups into particular population groups (Penrose 1954). It compares sets of data obtained from three or more individuals or groups and indicates the closest similarity between any two sets from the numerous sets of data included in the study. For example, a comparison between groups A, B, C and D would produce shape distances between A and B, A and C, A and D, B and C, B and D and between C and D. The smallest distance between any of these combinations would mean that the two individuals/groups are closest to each other (Penrose 1954; De Villiers 1968b). It has been established that size difference does not play a significant role in determining population affinities of individuals unless such size differences are of great magnitude. Therefore distances using this method are usually expressed as shape distances.

Both metric and non-metric (i.e. size and morphology) features of a tooth have been found to be good indicators of racial affinity since they are under strong influence of genetic rather than environmental factors (Portin and Alvesalo 1974). Therefore, studies of dental characteristics of an individual or populations are an important and reliable tool of estimating the population affinity of an individual or population under investigation (Jacobson 1982). Studies of this nature have been done on both archaeological and modern populations in southern Africa (Steyn and Henneberg 1997b). Data derived from modern populations (e.g., Van Reenen 1982; Jacobson 1982) was used to establish possible relationships between archaeological populations and present day communities (Steyn and Henneberg 1997b). A study by Steyn and Henneberg (1997b) has established matrices of Penrose shape distances for maxillary and mandibular teeth based on various skeletal collections. The current study is therefore adding a new set of data to an already existing body of information.

The Penrose size and shape distances can be used to determine population affinity on the basis of both dental and cranial measurements. The cranial data set of the sample is too small to warrant further analysis cranial measurements can be seen in Appendix 1

Methods

The measurements used to calculate shape distance was buccolingual and mesiodistal diameters of permanent teeth. Buccolingual distance was taken as the maximum interproximal distance for any tooth and mesiodistal diameter was measured perpendicular to the buccolingual distance (Van Reenen 1982; Jacobson 1982; Hillson 1986; 1996). Males and females were pooled because of small sample size. Table 7.5 summaries the mean buccolingual and mean mesiodistal diameters and standard deviations of maxillary and mandibular left permanent teeth. There are 144 maxillary permanent teeth and 157 mandibular permanent teeth. The mean values of the buccolingual and mesiodistal diameters of permanent teeth measured were calculated. Standard deviations were also computed for the measurements (Table 7.5). The data included was derived from permanent teeth of the left side. Teeth of the right side were only used when their left counterparts were not measurable. Teeth that did not allow for measurement of one of the characteristics were excluded. Those teeth that were loose from the alveoli and unidentifiable were excluded. Crown height was not measured because its dimensions are influenced to a large degree by occlusal wear, which varies from individual to individual. Teeth showing advanced dental wear were excluded

The shape distance is performed in four steps (Penrose 1954; De Villiers 1968b). The first step is to establish common standard deviations for all samples included in the matrix. In the second step, for every two populations being compared, the differences between standardised means for each variable were summed (d^2) and divided by the total number of variables (n) to come up with the mean square distance. Thus mean square distance (CH) was calculated using the formula below.

$$C^2_H = (\sum d^2)/n$$

The third step is to establish size distance (CQ), which is the sum, squared d (Σd^2) values divided by the total number of variables. Thus:

$$C^2_Q = [\,(\sum d^2)\,/n]^2$$

In the final step, shape distance is calculated by subtracting the size distance from the mean square distance i.e.

$$C^2_P = C^2_H - C^2_Q$$

The calculations were tabulated on an excel worksheet. For further clarification regarding these calculations, the reader is referred to Penrose (1954) and De Villiers (1968b).

The matrixes of Penrose shape distances were tabulated for maxillary (Table 7.6a) and mandibular teeth (Table 7.6b). The data was pooled from males and females. Data from five sample populations was used for comparison and the samples included are Mapungubwe, K2, South African blacks, Kalahari San and the Australian aborigines (Van Reenen 1982, Jacobson 1982, Kieser 1990; Steyn and Henneberg 1997b). The K2 and Mapungubwe data were not pooled in this analysis. The term 'Negro' used in previous studies has been replaced by 'black' in the current study but the original data from the sample population remains unchanged. The samples included for comparison were selected for various reasons. Mapungubwe and K2 skeletons have been used continuously in the current study as a reference population. South African blacks and the Kalahari San are modern populations who have been studied before (Jacobson 1982, Van Reenen 1982) and therefore their odontometric data was easily accessible. The Australian aborigines (Kieser 1990) were selected as an outlier to show contrast with the southern African populations. All these samples have been compared with each other before and with the Australian aborigines (Kieser 1990; Steyn and Henneberg 1997b).

Results

Results of the matrix of Penrose shape distances of the maxillary teeth indicate that Toutswe people had a closer affinity with the South African blacks than with other groups. In the case of both the maxillary and mandibular teeth, the shortest distance between Toutswe any other group is with the South African blacks followed by the Australian aborigines and K2. It is not surprising that the South African blacks demonstrate close associations with the Toutswe people given that the former are generally believed to be descendants of southern African Iron Age communities, which include the Toutswe people. Given that the Australian aborigines come from a completely different geographic area, they were expected to be one the furthest from Toutswe in terms of shape distance. The reason for this apparent closeness between Toutswe and Australian aborigines is not clear.

The furthest distance is between Toutswe and Mapungubwe and the San people. This is not surprising given that the San are known to have smaller teeth than other South African populations (Van Reenen 1964a; 1982), and they are expected to be distant from the Toutswe people. The Mapungubwe people have the largest teeth known from southern African archaeological populations (Steyn and Henneberg 1997b). It can be concluded that the Toutswe people form part of the broader ancestral southern African black population group.

7.5 Dental modification and miscellaneous characteristics

Introduction

Dental mutilation is a fairly common practice on southern African prehistoric and modern populations (Van Reenen 1978a; 1978b; 1977; Steyn 1994; Morris 1998). In fact some of the earliest inhabitants of southern Africa from are known to have practiced some forms of dental mutilations. However the practice seems to have lost popularity with time (Morris 1998). Most dental mutilations appear to have been associated with personal beautification or initiation at the onset of puberty (Van Reenen 1977; 1978a) and in recent times they may be symbols of youth gangs (Morris 1998). Studies have shown that the Herero people in Namibia and North West Botswana and the Kalahari hunter-gatherers are some of the few modern communities practicing dental modification in Southern Africa.

Different kinds of dental modifications have been reported from various parts of the world (Buikstra and Ubelaker 1994). The forms range from extraction of anterior teeth or chipping crowns to a blunt point (Van Reenen 1977; 1978b; Morris 1998) to making incisions without extraction (Van Reenen 1977; 1978a; 1978b; Buikstra and Ubelaker 1994; Morris 1998). Incisions may be made on occlusal surfaces or on labial surfaces. While in some populations dental mutilations are restricted to maxillary teeth, in some they may include mandibular teeth. The v-shaped incision between maxillary central incisors is a commonly found form dental mutilation in southern Africa (Van

Reenen 1977; 1978a; 1978b; Steyn 1994) and has been reported in both archaeological and modern populations. Swallowtail form of dental mutilation has been reported from teeth found at Broederstroom, an Early Iron Age site dated circa 500 AD in South Africa (Van Reenen 1977).

Table 7.5 Mean and standard deviations of permanent teeth

	Tooth	**n**	**Mean Buccolingual**	**SD**	**Mean Mesiodistal**	**SD**
Maxillary	M3	11	10.80	1.63	8.95	1.36
	M2	19	11.30	1.53	9.86	0.95
	M1	26	11.29	0.77	10.32	1.11
	PM2	18	9.63	0.70	6.68	0.88
	PM1	20	9.65	0.75	7.08	0.93
	C	20	8.74	0.87	7.65	0.83
	I2	17	6.99	1.43	6.71	1.24
	I1	13	7.33	0.68	8.67	1.52
	Total	**144**				
Mandibular	M3	10	10.16	0.83	10.80	1.05
	M2	20	10.51	0.59	10.79	0.76
	M1	27	10.85	0.53	11.31	0.74
	PM2	19	8.45	0.76	7.30	0.56
	PM1	21	8.24	0.60	7.25	0.65
	C	21	10.54	14.63	7.08	0.47
	I2	19	6.31	0.30	5.82	0.65
	I1	20	5.85	0.29	4.97	0.78
	Total	**157**				

Table 7.6a Matrix of Penrose shape distances (maxilla)

	Toutswe	Mapungubwe	K2	SA black	San	Australian aborigine
Toutswe	-	0.265	0.159	0.077	0.769	0.127
Mapungubwe	-	-	0.423	0.453	0.750	0.398
K2	-	-	-	0.189	0.196	0.285
SA black	-	-	-	-	0.190	0.117
San	-	-	-	-	-	0.373
Australian aborigine	-	-	-	-	-	-

Table7.6b Matrix of Penrose shape distances (mandible)

	Toutswe	Mapungubwe	K2	SA black	San	Australian aborigine
Toutswe	-	0.459	0.275	0.18	0.447	0.174
Mapungubwe	-	-	0.369	0.382	0.521	0.695
K2	-	-	-	0.216	0.783	0.590
SA black	-	-	-	-	0.708	0.248
San	-	-	-	-	-	0.586
Australian aborigine	-	-	-	-	-	-

Methods

All anterior permanent teeth with complete crowns were analysed for dental modifications of any kind. Miscellaneous dental characteristics such as peg and shovel shaped teeth were noted where identified.

Results

One individual appears to have performed dental modification. The individual found was a child of 10 to 12 years old (Toutswemogala Burial 16). An inverted v-shape incision produced between maxillary central (Figure 7.3) does not go all the way to the alveolar, as is the case in some Herero communities (Van Reenen 1978a; 1978b). This modification is obtained by filling corners of mesial ends of central maxillary incisors. The skull of this individual was found buried in isolation (Lepionka 1971; 1978; De Villiers 1976) possibly for ritual purposes. The form of dental modification identified on this individual is common among the San hunter-gatherers of North West Botswana and adjacent parts of Namibia (Van Reenen 1978a; 1978b) as well as on the K2/Mapungubwe peoples (Steyn 1994). The same individual had alveolar prognathism (Figure 7.4) that had resulted in malocclusion of anterior teeth.

Other morphological characteristics identified include a bifid rooted deciduous left mandibular canine of Toutswemogala Burial 9, a child of approximately six to eight years old (De Villiers 1976). This is normal variation of the canine (Brothwell 1981; Van Beek 1983). Unfortunately the maxillary dentition of this individual is missing and the right canine is in situ and no x-rays were taken on this tooth and therefore its root was not observable. Peg-shaped incisors were noted on two individuals, Toutswemogala Burial 17 and Bosutswe Burial 12. In both cases the incisors are lateral and permanent. In the case of Toutswemogala Burial 17 both lateral incisors show this feature while on Bosutswe Burial 12 only the right incisor has this shape. Bosutswe Burial 13 demonstrates shovel-shaped maxillary central incisors. Kgaswe B-55 Burial 15 has shovel shaped maxillary central incisors. These characteristic features occur in small number and not much can be inferred from them.

Figure 7.3 V-shape dental modification of maxillary central incisors on Toutswemogala Burial 16

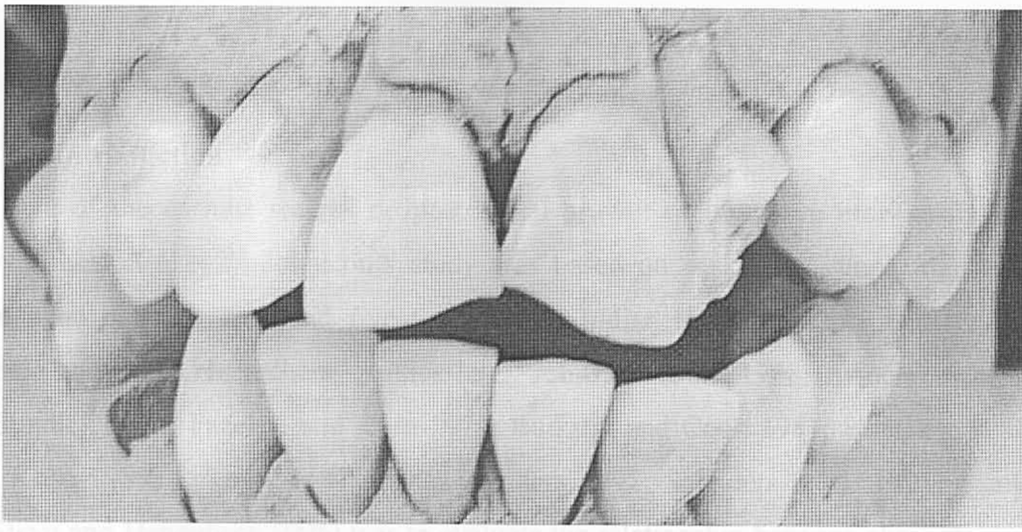
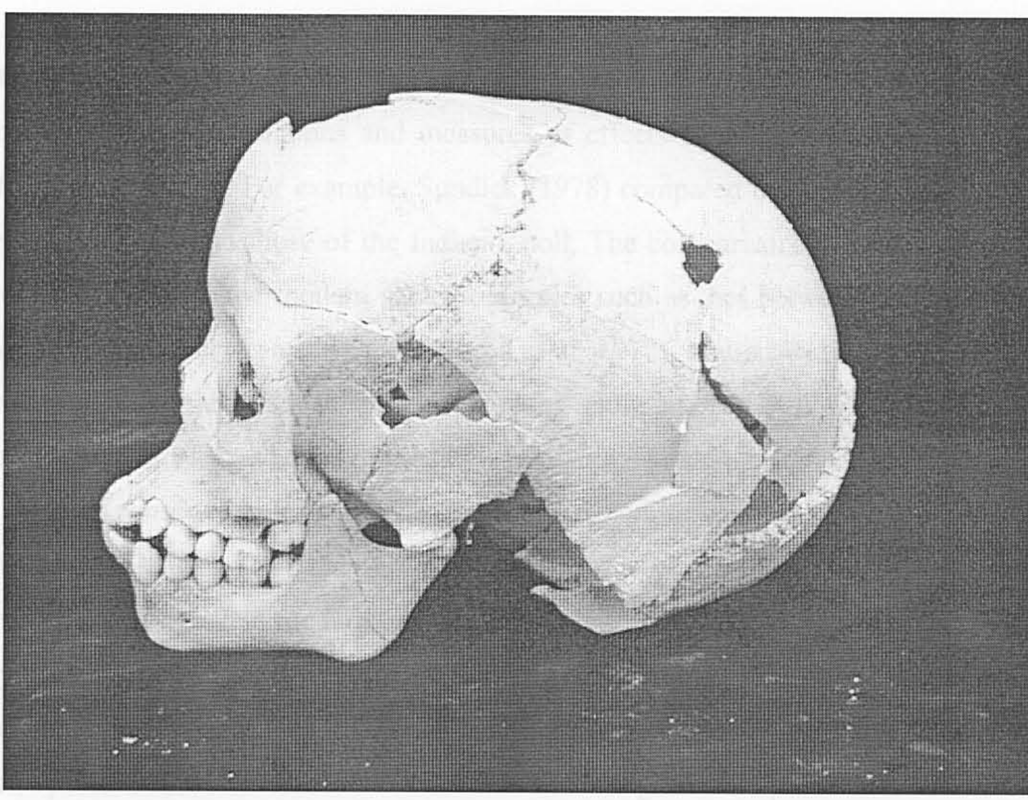


Figure 7.4 Lateral view of Toutswemogala Burial 16 skull showing prognathism of anterior teeth.



8. SKELETAL GROWTH

8.1 Introduction

One of the earliest studies on postcranial growth of immature individuals was done by Johnston (1962). Johnston's study was based on a skeletal sample of young children aged between zero and five years old at Indian Knoll. The main interest in Johnston's and other researchers' studies (e.g., Johnston 1962; 1968; Armelagos et al. 1972; Sundick 1978; Fazekas and Kosa 1978; Buikstra and Cook 1981; Ubelaker 1987; 1989b; Kosa 1989; Lovejoy et al. 1990; Saunders 1992; Saunders et al. 1993; Sciulli 1994; Steyn and Henneberg 1996) was to evaluate the relationship between chronological age and long bone lengths with the aim of assessing skeletal growth rates of subadults. In a more recent study, lengths of long bones have been used to evaluate the extent to which climatic conditions affect growth rates of the upper and lower limbs (Holliday and Ruff 2001).

Comparisons of bone growths between populations are often carried out to assess population variations in skeletal growths (Buikstra and Cook 1981). Descriptive comparisons between populations and measures of effects of environmental insults on populations are essential. For example, Sundick (1978) compared the growth rates of the Alternerding subadults to those of the Indian Knoll. The comparisons can also be made between archaeological and modern skeletal samples such as that between the Sudanese Nubians and white American boys (Armelagos et al. 1972), while Lovejoy et al. (1990) compared the Denver and Libben subadult growths. Holliday and Ruff (2001) evaluated variations in lengths of long bones of the limbs on various modern populations.

Comparisons of skeletal growth rates are useful indicators of possible stress exposure on populations. Most archaeological skeletons have been found to be shorter for their chronological age than modern populations (Johnston 1962; Armelagos et al. 1972; Lovejoy et al. 1990; Saunders 1992). A possible explanation for this observation has been that archaeological populations had less access to a variety of nutritious foods than modern populations, which would have resulted in slow growth in prehistoric times. On the other hand, abundance of food resources in modern times could have resulted in accelerated growth rates. Diseases in the past may have also contributed towards slowed or even retarded growth (Johnston 1962) of prehistoric children. Lesions such as Harris lines are a clear indication of arrested growth during developmental years and are commonly found on archaeological human skeletons. However, the extent to which growth was retarded is often unclear.

Effects of genetic change on growth are slow and can only be seen over successive generations while environmental effects such as nutritional deficiency and pathogen invasion on growth are recognisable within short periods (Saunders 1992). Abrupt changes in skeletal growth can therefore be attributed to sudden environmental changes or influx of a new population with different physical characteristics (Saunders 1992). Such intra population changes in skeletal growth rates need large samples of subadults derived from successive time periods or socioeconomic classes in order to be elicited (Johnston 1968).

For environmental stressors to have an effect on bone lengths, they have to be severe and chronic (Saunders 1992). More rapidly growing bones of the lower limb i.e. femur, tibia and fibula are the most susceptible to unfavourable environmental conditions (Sciulli 1994). Lovejoy et al. (1990) argue that, although the skeletal sample of children represents those individuals who did not survive diseases or other causes of death, they are nonetheless a true reflection of the growth status of the populations from which they were obtained. This is because most infant and children deaths are associated with acute rather than chronic diseases, which means that such individuals would have died before a bony response to stress or diseases was evoked.

8.2 Problems and limitations

Skeletal remains of immature individuals do not always preserve well by comparison to adult skeletons in the archaeological record. For instance, tooth germs of fetuses and newborn babies are easily lost thereby making dental aging difficult. Furthermore, archaeological samples are often not recovered in sufficient in sizes, which makes it difficult to assess any changes in growth rates at different ages (Johnston 1968; Sundick 1978; Ubelaker 1989a; 1989b; Lovejoy et al. 1990; Saunders et al. 1993; Steyn and Henneberg 1996).

Notwithstanding the fact that growth rates differ between boys and girls, most studies based on archaeological skeletal samples tend to pool the data between males and females (Armelagos et al. 1972; Sundick 1978; Lovejoy et al. 1990; Saunders 1992; Saunders et al. 1993; Steyn and Henneberg 1996). The main reason is that methods used to determine sex on immature skeletal remains are not justified and are problematic and usually not attempted. Therefore variations between male and female growth rates are not always possible to evaluate on archaeological samples.

The relationship between long bone lengths and age is dependent on the accuracy of aging techniques. The more accurate the aging technique the more accurate is the growth rate observed in a population. Dental eruption and development are the most accurate methods of estimating age from immature individuals (Massler et al. 1941; Ubelaker 1987; 1989b; El-Nofely and İşcan 1989; Johnston and Zimmer 1989) and in growth studies, only those individuals whose ages were estimated from teeth were included (Armelagos et al. 1972; Sundick 1978; Lovejoy et al 1990; Saunders 1992; Saunders et al. 1993; Steyn and Henneberg 1996). Therefore a substantial number of individuals are usually excluded from growth related studies if teeth of such individuals are not preserved.

Population variations in skeletal growth are of great importance in growth studies. Unfortunately different authors use different age categories, thus making comparisons difficult. Some use age categories of one-year intervals (e.g., Sundick 1978; Lovejoy et al. 1990; Saunders et al. 1993; Steyn and Henneberg 1996) while in some publications age intervals vary in length (e.g., Armelagos et al. 1972). Moreover, the samples themselves vary in size and thus caution needs to be practiced when making inferences on skeletal growth rates of various populations. Moreover, some studies focus on very specific age groups and exclude other subadult individuals. For example, Johnston's (1962) study of the Indian Knoll children focused on children aged between zero and five years only while Armelagos et al. (1972) studied Nubian individuals of zero to 31 years old. Therefore comparison of growth dynamics between these two reports can only be restricted to the first five years of life.

Mortality rates during late childhood and adolescence are usually low which means that the samples available for these age categories are often small. Inter-individual variations in skeletal growth are large and when samples are small the variation effect becomes a compounding problem. Thus for each age category, the sample has to be large so that the mean length of any bone is derived from a wider representation encompassing many individuals of different lengths but from the same age category.

8.3 Materials and methods

Infants and children whose age could be determined from dental development were used to evaluate growth of the Toutswe children. A great emphasis is placed on the use of dental age to establish skeletal growth (Armelagos et al. 1972; Ubelaker 1987; Lovejoy et al. 1990; Saunders 1992; Steyn and Henneberg 1996) but because of the small number of individuals whose age was determined from dental development, other age indicators were considered for inclusion. For example, some infants had only a few germs available to establish dental age (e.g., Dikalate Burial 1). In such cases age indicators like fusion of the temporal bone (Scheuer and Black 2000) were used to improve the accuracy of results from dental development. In order to avoid circular reasoning (Johnston and Zimmer 1989; Saunders 1992), those individuals whose age could only be determined from long bone lengths were excluded.

Maximum diaphyseal lengths of long bones of fetuses and newborn babies were measured to the nearest millimeter using a digital caliper. Bones whose maximum diaphyseal lengths exceeded caliper capacity were measured with a standard osteometric board. Landmarks used in measuring bones have been defined by various authors (e.g. Krogman and İşcan 1986; Ubelaker 1989a; Fazekas and Kosa 1989; Buikstra and Ubelaker 1994; Moore-Jansen et al. 1994). Bones of the left side were used but substituted with their right counterparts if missing or fragmented. Individuals whose long bone lengths were not measurable were excluded. Bones whose epiphyses were attached were also excluded, i.e. only maximum diaphyseal lengths were used for this investigation

Having considered the above parameters for inclusion and exclusion, 25 immature individuals were selected for the study. They ranged from approximately eight months in utero to 16 years old. This sample is made up of 20 humeri, 20 radii, 19 ulnae, 15 femora, 15 tibiae and eight fibulae. No attempts were made to determine sexes of immature individuals and therefore the data used for this analysis is pooled.

Long bones lengths of the Toutswe children were compared to other skeletal samples from southern Africa (Steyn and Henneberg 1996) and other parts of the world.

These included the Libben sample and Denver from Colorado (Lovejoy et al. 1990), Alternerding, in Germany and Indian Knoll in USA (Sundick 1978). The St Thomas Church sample is from Canada (Saunders et al. 1993). Reference was also made to the sample from Nubian cemeteries in Sudan (Armelagos et al. 1972). The samples used represent different geographic areas as well as time periods.

8.4 Results

The samples of bones per age category are very small and in some age groups there were no individuals. This makes it difficult to make statistically sound conclusions about the growth of the Toutswe children. Table 8.1 shows the mean lengths of different long bones with increase in age. There is a general increase in lengths of all bones from one age category to the next at relatively constant rate. Any decrease in length from one age to the other can only be explained as a result of small samples used. There is a small number of individuals with evidence of cribra orbitalia and porotic hyperostosis. The lesions are small in all cases and therefore it is suggested that there may have been no significant stunted growth on individuals involved.

By comparison to other samples, the Toutswe children appear to have had relatively longer humeri, but were shorter than the St Thomas's Church individuals in this regard (Figure 8.1). The St Thomas's Church children had longer humeri than the rest of the populations throughout all age categories. However, the Toutswe measurements of the humeri exceed the St Thomas's Church measurements by a minimal margin at approximately nine years. Between one and three years, the Toutswe show relatively shorter humeri by comparison to other samples. Between six and 11 years, the Toutswe lie generally between the St Thomas' Church sample and other samples. By comparison to K2 children, the Toutswe had a slightly shorter humeri in early years (between one and five years old). After five years, the Toutswe show a tendency of longer humeri than the K2 children.

While the Toutswe and other samples show a tendency to increase humeri lengths at varying rates for each age category, the Libben sample shows a constant increase throughout the years (Lovejoy et al. 1990). For instance the Toutswe sample shows the lowest value at approximately three years but remains in between the others from four years onwards approaching the Libben values with increase in age. In the earlier years, they appeared to have been shorter (Toutswe), but later they were at par and even larger than some of the children.

The radii lengths are clustered around each other for the first few years of life (Figure 8.2). At approximately three years, the Toutswe children had the shortest radii lengths but they grew relatively faster that some of the children because at approximately 12 years, the Toutswe children had the longest radii lengths.

Table 8.1 Long bones lengths of subadults

	Humerus		Radius		Ulna		Femur		Tibia		Fibula	
Age	n	mean	n	mean	n	mean	n	mean	n	mean	n	mean
Newborn/fetal	1	64.5	1	54.0	1	60.0	1	79.0				
0-0.5	3	69.4	2	62.6	2	55.2	3	79.0	2	69.2		
0.5-1.5												
1.5-2.5	1	104.0	1	82.0	1	92.0	1	132.0	1	111	1	107.0
2.5-3.5												
3.5-4.5	4	133.6	3	110.1	3	124.2	2	209.5	2	170	2	167.5
4.5-5.5												
5.5-6.5	2	160.6	2	133.5	2	146.5	2	230.1	2	194.3	2	193.0
6.5-7.5	3	190.3	3	148.9	3	162.7	2	263.0	2	221.0	1	241.0
7.5-8.5	2	200.0	2	160.0	2	177.0	1	278.0	1	234.0	1	224.0
8.5-9.5												
9.5-10.5	1	220.9	1	190.8	1	210.0	1	320.0	1	270.0		
10.5-11.5	2	233.0	2	177.8	2	191.5			1	287.0		
11.5-12.5												
12.5-13.5	1	220.7	1	180.2								
13.5-14.5	1	234.0	1	186.0	1	205.0	1	331.0	1	264.0	1	242.0

Figure 8.1 Growth curves of humeri of Toutswe children and other populations

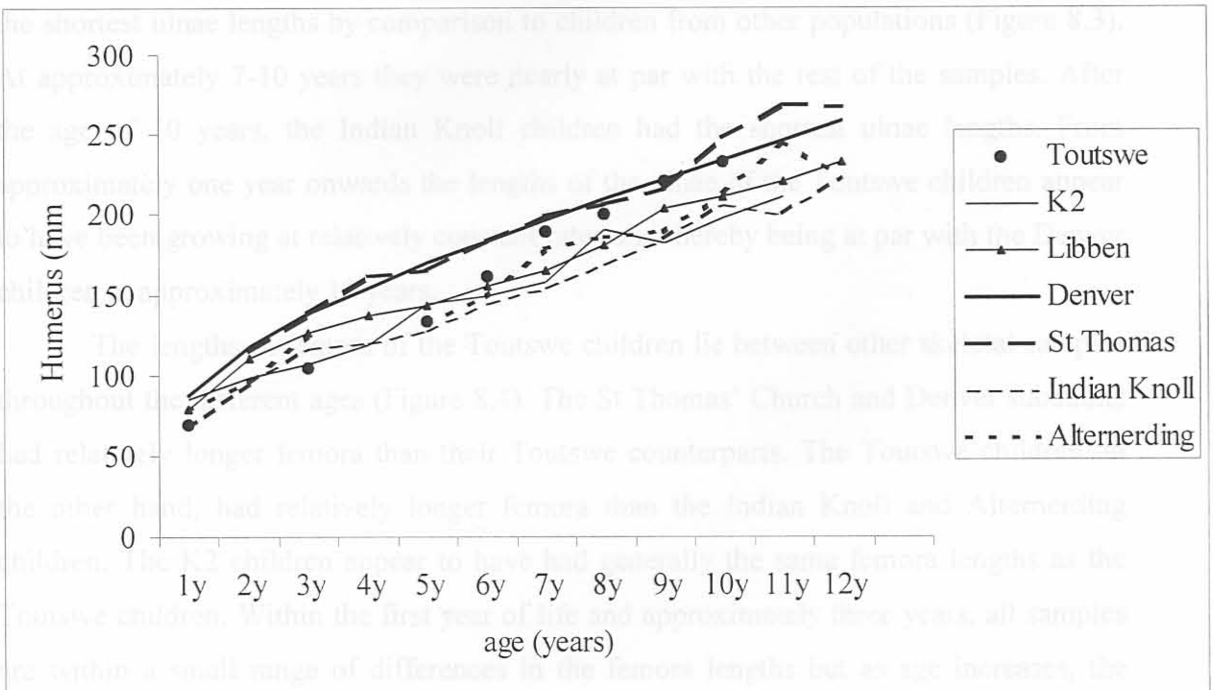
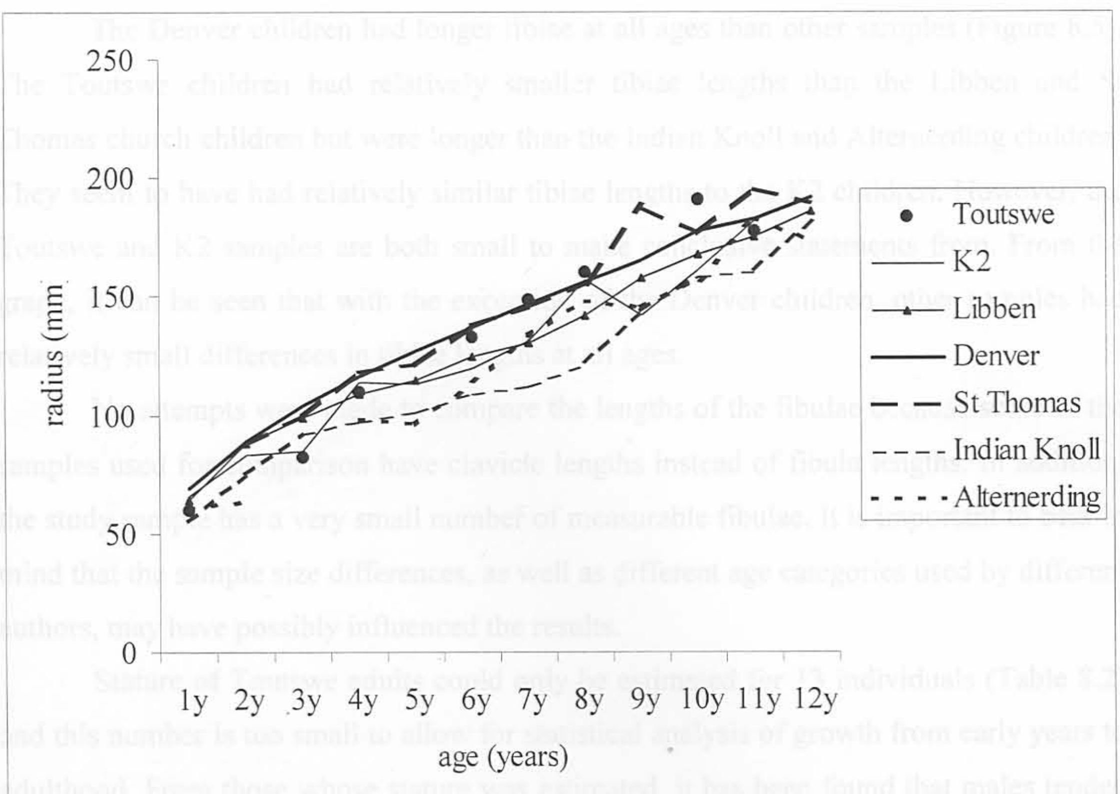


Figure 8.2 Growth curves of radii of Toutswe children and other populations



During the early years, i.e., between one and six years, the Toutswe children had the shortest ulnae lengths by comparison to children from other populations (Figure 8.3). At approximately 7-10 years they were nearly at par with the rest of the samples. After the age of 10 years, the Indian Knoll children had the shortest ulnae lengths. From approximately one year onwards the lengths of the ulnae of the Toutswe children appear to have been growing at relatively constant rates and thereby being at par with the Denver children at approximately 12 years.

The lengths of femora of the Toutswe children lie between other skeletal samples throughout the different ages (Figure 8.4). The St Thomas' Church and Denver subadults had relatively longer femora than their Toutswe counterparts. The Toutswe children on the other hand, had relatively longer femora than the Indian Knoll and Alternerding children. The K2 children appear to have had generally the same femora lengths as the Toutswe children. Within the first year of life and approximately three years, all samples are within a small range of differences in the femora lengths but as age increases, the differences in lengths between samples also increase. Thus the rate of femur growth varies with increase in age.

The Denver children had longer tibiae at all ages than other samples (Figure 8.5). The Toutswe children had relatively smaller tibiae lengths than the Libben and St Thomas church children but were longer than the Indian Knoll and Alternerding children. They seem to have had relatively similar tibiae lengths to the K2 children. However, the Toutswe and K2 samples are both small to make conclusive statements from. From the graph, it can be seen that with the exception of the Denver children, other samples had relatively small differences in tibiae lengths at all ages.

No attempts were made to compare the lengths of the fibulae because some of the samples used for comparison have clavicle lengths instead of fibula lengths. In addition, the study sample has a very small number of measurable fibulae. It is important to bear in mind that the sample size differences, as well as different age categories used by different authors, may have possibly influenced the results.

Stature of Toutswe adults could only be estimated for 13 individuals (Table 8.2) and this number is too small to allow for statistical analysis of growth from early years to adulthood. From those whose stature was estimated, it has been found that males tended to have been relatively taller than females.

Figure 8.3 Growth curves of ulnae of Toutswe children and other populations

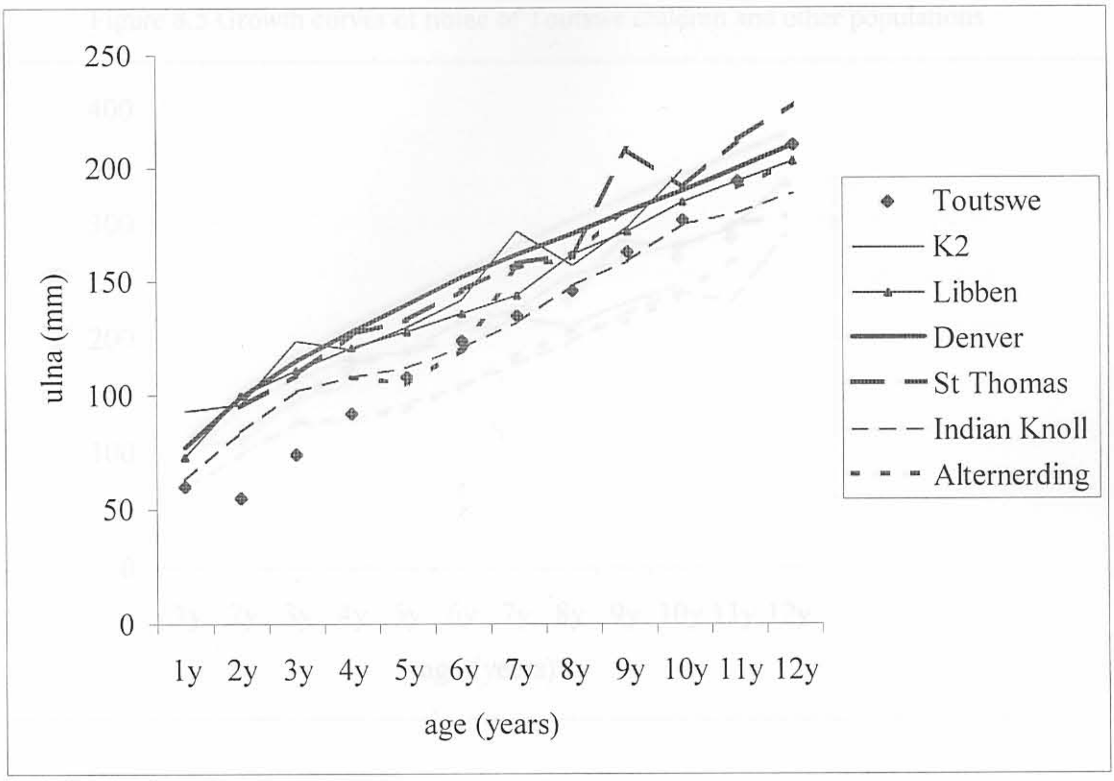


Figure 8.4 Growth curves of femora of Toutswe children and other populations

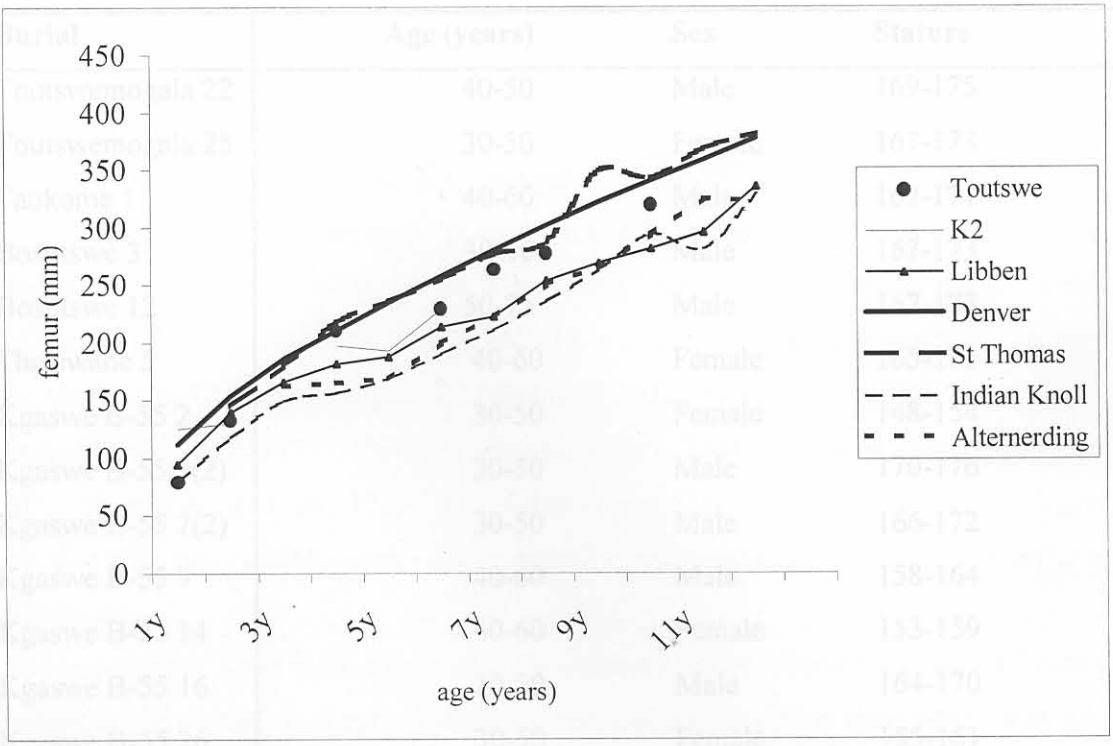


Figure 8.5 Growth curves of tibiae of Toutswe children and other populations

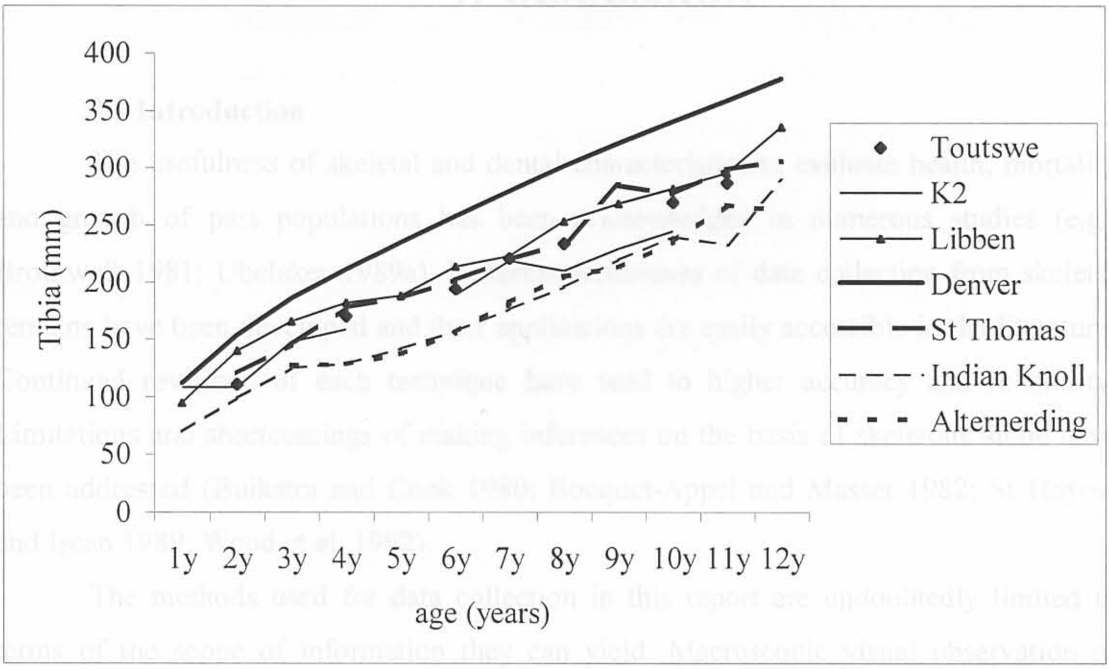


Table 8.2 Estimated statures of adults

Burial	**Age (years)**	**Sex**	**Stature**
Toutswemogala 22	40-50	Male	169-175
Toutswemogala 25	30-50	Female	167-173
Taukome 1	40-60	Male	162-171
Bosutswe 3	30-40	Male	167-173
Bosutswe 12	50-75	Male	167-173
Thatswane 5	40-60	Female	165-171
Kgaswe B-55 2	30-50	Female	148-154
Kgaswe B-55 5(2)	30-50	Male	170-176
Kgaswe B-55 7(2)	30-50	Male	166-172
Kgaswe B-55 9	40-60	Male	158-164
Kgaswe B-55 14	40-60	Female	153-159
Kgaswe B-55 16	20-30	Male	164-170
Kgaswe B-55 26	30-50	Female	155-161

9. DISCUSSION

9.1 Introduction

The usefulness of skeletal and dental characteristics to evaluate health, mortality and growth of past populations has been acknowledged in numerous studies (e.g., Brothwell 1981; Ubelaker 1989a). Different techniques of data collection from skeletal remains have been developed and their applications are easily accessible in the literature. Continued revisions of each technique have lead to higher accuracy and reliability. Limitations and shortcomings of making inferences on the basis of skeletons alone have been addressed (Buikstra and Cook 1980; Bocquet-Appel and Masset 1982; St Hoyme and İşcan 1989; Wood et al. 1992).

The methods used for data collection in this report are undoubtedly limited in terms of the scope of information they can yield. Macroscopic visual observation of bones for estimating age, sex and stature, assessment of bone pathology, dental pathology and biological distances, has left out some crucial information on the growth and health of the study sample. Lack of specialised methods like x-rays, stable isotope analysis etc. means that some of the skeletal characteristics of the study sample would remain unknown until such time that more methods are used. Not withstanding these limitations, viable inferences can still be made on the basis of the current results. Most importantly, an avenue for future research has been opened.

The main area of interest in population studies in Botswana has been on the living hunter-gatherer groups living in the desert (e.g., Van Reenen 1964a; 1964b; 1964c; 1978a; 1978b 1982; Kent and Dunn 1996). Like other case studies from various parts of the world e.g., Mapungubwe and K2 (Galloway 1937; 1959; Steyn 1994), Orange River sites (Morris 1984; 1992), Oakhurst (Patrick 1989), Sudanese Nubia (Armelagos et al. 1972; Martin et al. 1984; 1985; Ariaza 1993) and Teotihuacan (Storey 1992), human remains have been used to assess the biological characteristics of the Toutswe prehistoric population.

Attempts were made to establish the impact of environmental insults on Toutswe inhabitants from their skeletons. Once incidences of diseases were established, they were compared to data from K2 and Mapungubwe and other archaeological sites in South

Africa. The K2/Mapungubwe skeletons were used for comparison, firstly because they represent the best understood Iron Age skeletal population in the region and secondly because Toutswe, K2 and Mapungubwe peoples are known to have interacted with each other at some point in the past (Denbow 1983a; 1999; Huffman 1986; Reid 1998; Segobye 1998). However, K2 and Mapungubwe occupation postdate the rise and fall of the Toutswe communities.

The cultural homogeneity of the Toutswe communities, based on ceramic typologies, has been elucidated by archaeologists (Denbow 1982; 1983a; 1984a; 1986; Segobye 1987; Kiyaga-Mulindwa 1993; Reid and Segobwe 1997; Reid 1998). The spatial distribution of the Toutswe sites clearly suggests that they had differential access to food resources and possibly different modes of subsistence within their environs (Denbow 1982; 1983a; 1984a; 1984b; 1986; 1990; Kiyaga-Mulindwa 1993; Plug 1996; Reid and Segobye 1997; Reid 1998). For example, the northern frontiers of the Toutswe complex include sites like Mosu 1, 2 and 3 and Kaitshe, all of which are scattered along the edges of a saltpan (Reid and Segobye 1997; Reid 1998). The faunal and floral populations of these environs were different to those from Toutswemogala Hill. Pooling skeletal remains from these different sites was justified by small sample sizes and cultural homogeneity and therefore results obtained are an average of various subsistence modes and environmental insults. The distribution of pathogens may have also varied from place to place and time to time.

The analyses of faunal and floral remains from some sites indicate that the Toutswe people explored a variety of resources from far and near them (Denbow 1984a; 1984b; 1999; Denbow and Wilmsen 1986; Plug 1996; Reid 1998). Cattle, sheep and goats were the main source of protein through all the phases of occupation. The samples of domestic animal bones and cow dung deposits from various sites indicate, without doubt, that like other southern African prehistoric populations, the Toutswe communities were self-sustained. The protein from domesticated animals was supplemented with meat of wild animals as well as seasonal water resources (Welbourne 1975; Denbow 1983a; 1984a; 1984b; Thy et al. 1995; Plug 1996; Reid 1998). There is strong evidence that the people traded with inhabitants of the far west as indicated by the presence of species of animals that were exploited in the west. Floral remains do not preserve well in the archaeological record and therefore it has been difficult to assess the plants and vegetables used by the Toutswe people. However, scanty evidence recovered from sites like Thatswane where carbonised beans and sorghum grains were found are a testimony of some of the plant foods utilised (Denbow 1982; Reid 1998).

The description of burial styles was deemed important enough to be included in the current study. Burial practices of prehistoric populations in Botswana are a neglected aspect in archaeological texts (Segobye 1998). Occasionally, general statements are made about specific burials but there has never been a specific publication that describes past burial practices. The ritualistic interpretations of burial styles are beyond the scope of this report and therefore would not be attempted.

9.2 Problems and limitations of the study

Without consistent and detailed reference data on the burials on which to base the current research, the study was limited in many ways. Theoretical and methodological problems and limitations have been described in detail at all specific areas of skeletal analysis. To avoid repetition such problems would not be discussed in this chapter. Only those problems specific to the current sample are discussed here.

Fundamental to any skeletal study is the identification of individual skeletons. Mixing of bones at sites and during storage hindered identification of some individual skeletons. The most affected of these were the skeletons from Toutswemogala, excavated by Lepionka in the 1970s. Most of them had been stored together in the same boxes without separating one individual from the other. In some cases skulls of different individuals had been put together with mandibles mixed in other boxes. Attempts were made to identify as many of them as possible, using the scanty descriptions given by De Villiers (1976) and Lepionka (1977; 1978). The following captions from Lepionka (1978) demonstrate how the material was treated.

> 'It was usually necessary, for lack of space, to divide up each skeleton among two or more containers, each appropriately labeled – most often with the skull separate from the rest of the skeleton' (Lepionka 1978: p 372)

'All human bones and any other macroscopic objects within the outline of the burial pit at the level of the skeleton were then collected, being packed into whatever quantity of containers necessary. The skull, if whole, was usually packed separately' (Lepionka 1978: p 373-374).

Pitifully the labels attached to the skeletons were written on paper and stuck with tape, which after sometime fell from the bones and were consequently useless. In any case it is evident that only skulls were labeled while postcranial bones were not. None of the skulls had an attached site label. Unfortunately the total number of individuals from Toutswemogala and the number of isolated remains is unknown. Lepionka (1978) described 28 burials from the site but the author would like to propose that the total number of burials might have been more than reported on the following basis:

- ❖ When the remains were sent to De Villiers for analysis several years after excavation, there were more than 28 skeletons (De Villiers 1976). In some instances De Villiers identified more than one individual with the same label attached.
- ❖ Lepionka's report is based on skeletons analysed by De Villiers without reference to the actual number of burials he excavated, i.e. nowhere does he mention the total sample found.
- ❖ When Lepionka left Botswana he left behind one of his field assistants to excavate the west side of the site (Lepionka 1978: p 374) on his behalf, he did not account for the number of burials found at the time. This may possibly explain why Lepionka (1978) expressed some doubt on the sample when he realised that De Villiers (1976) had analysed two burials of isolated skulls. Lepionka had excavated only one such burial and it is possible that the second case was excavated in his absence.
- ❖ Welbourne identified some partially complete human skeletons (Welbourne 1975; Lepionka 1978) from the faunal assemblage sent to him for identification and analysis.

- ❖ Lepionka insists that there were only two adult burials found but the current study identified an adult female and two adult males and there is no doubt that they are all from Toutswemogala.
- ❖ What may have been regarded as incomplete burials not worth mentioning in the Lepionka's (1978) report may have been counted as individuals in the current study.

A minimum number of individuals from Toutswemogala were established on the basis of the mandibles and maxillae, since they allowed for a more precise age determination. The remaining commingled bones are listed in Appendix 3.

The BNMMAG and UB, where the skeletons were obtained for the study, currently do not have catalogues or even proper storage facilities for human remains and consequently some skeletons end up misplaced or commingled. Even labeling of boxes with skeletons is not proper at both institutions. To the best of the author's knowledge there should have been more individuals from sites like Kaitshe, Lechana, Maipetwane, Mosu 1, Phate Hill and possibly others but attempts to locate them were futile. Other skeletons reported from Thatswane (Denbow 1979b) are also missing. Only four of the original six skeletons excavated at Thatswane were available for this study. Therefore it is expected that future investigations would reveal other skeletons that were supposed to be included in the current sample. Having identified the problems associated with the skeletal collections stored at the BNMMAG and UB, the author has made recommendations (Appendix 4) geared towards minimising problems in future.

The sample used was pooled from various sites as none of the sites produced a sufficient sample size on its own. The sites are known to have been of different socioeconomic statuses (Denbow 1983a) and therefore pooling the data meant that comparisons between sites were not possible. Moreover, it was not possible to evaluate any differences in the health problems encountered at different phases of occupation. Pooling of sexes meant that intra-population differences in life expectancy, skeletal growth and health could not be assessed. No attempts were made to determine sex of immature individuals who make up more than 50% of the sample and the adult sample of 30 individuals is too small to depict sex differences in the distribution of lesions.

Differential diagnosis of diseases on some of the members of the sample was not possible. This was because individual skeletons affected were incomplete and therefore distribution of lesions, which is often useful in differential diagnosis, was unknown.

Preservation of individual skeletons varies within sites and across sites. Animal disturbance was evident at places like Kgaswe B-55, Taukome and Thatswane. For example, Taukome Burial 6 comprises of a nearly complete left side of the maxilla that was found on the surface next to an animal burrow pit. The shaft of the right humerus of Kgaswe B-55 Burial 16, the left femur and both tibiae of Thatswane Burial 6 and the mandible of Bosutswe Burial 8 all have animal gnaw marks. On Kgaswe B-55 Burial 7(1) teeth crowns have marks of possible animal gnawing.

Soil chemicals were also involved in the preservation, or lack thereof, of some bones. At Bosutswe all bones coming from below the cow dung deposits had turned dark brown. Some of these bones had become brittle, possibly as a consequence of chemicals acting on them (Denbow: personal communication). Bone discolouration had hindered assessment of some dental pathology on individuals affected. Bones affected by soil chemicals were not only restricted to Bosutswe as a few others were observed at Toutswemogala.

The skull of Swaneng Hill Burial 1 may have been exposed to direct sun, as suggested by whitening of the bone surrounding the fragmented part of the skull. If indeed the skull had been exposed, then it is possible that the grave was shallow or that rapid erosion on the site had removed soil from the grave. Erosion at Mosu 3 had almost resulted in exposure of the burial. The skeleton was found approximately 20 cm below the surface. Individual skeletons represented vary from mandibles only to complete skeletons in good condition.

Excavations at Kgaswe B-55 were also destructive. The site was excavated by plant machinery (Denbow: personal communication) and resulted in destruction of some of the burials.

9.3 Burial practices

Prehistoric burials in southern Africa are usually accidental discoveries as no formal graveyards were established, e.g., at K2 and Mapungubwe (Galloway 1937; 1959; Inskeep 1986; Meyer 1998; Steyn 2003) and from the areas of the current study

(Lepionka 1971; 1977; 1978; Denbow 1979b; 1983a; Reid 1998). Once excavation units are dug, concentrations of stones found underneath the surface may indicate the presence of a burial, as was the case with some burials at Bosutswe. Features like hut floors and cattle kraals may also be associated with burials and therefore need to be excavated with caution. Kgaswe B-55 burials were distributed by sex and age in relation to the central kraal and huts surrounding the central kraal (Denbow 1986).

While lack of information on burial styles and provenance of some skeletons has been lamented in chapter four, a substantial portion of the sample has adequate information to make inferences from. Attempts by some archaeologists to describe burial styles needs to be appreciated as they became very useful sources of information. In most cases the descriptions are not well detailed but nevertheless contain essential information from which to make inferences. For example, a detailed plan of the features excavated at Kgaswe B-55 (Denbow 1986) was a useful indicator of the distribution of burials as well as burial styles.

The most commonly identified burial position was that in which individuals were laid in horizontally flexed positions (e.g., Kgaswe B-55 burials, Toutswemogala Burials 6 and 25, Bosutswe Burials 3, 5, 7 and 12). Some were laid on the left side while some were on the right side (Lepionka 1978; Denbow 1986). The sides on which the dead were laid are represented almost equally (Lepionka 1978; Denbow 1979b; 1983a). It appears that the sides on which individuals were laid were not restricted by either age or sex.

It seems that orientation of the head to the west as well as horizontal flexing had some ritual connotations as most of the burials were in this orientation. It appears that age had no role in determining the orientation of the head of the dead as individuals of all age groups were in this position. This is a fairly common burial practice in southern African archaeological populations (Inskeep 1986; Patrick 1989; Morris 1992; Steyn 1994; 1998) of different time periods.

A horizontally flexed position is noted from various parts of the study area, but there is one case where the head of the individual had been twisted backwards (Bosutswe Burial 6). There is no indication of animal disturbance to suggest that the vertebrae may have been moved after deposition. Upon inspection of the skeleton, no pathological lesions on the vertebrae were found.

Addition of burial goods is a common practice in both prehistoric and modern populations in different parts of the world (Lepionka 1978; Inskeep 1986; Patrick 1989; Morris 1992; Steyn 1994; 1998; Meyer 1998) and therefore findings of this nature were not a surprise. Burial goods included clay vessels as well as body ornaments in the form of ostrich eggshell bead necklaces and waistbands. Numerous burials with complete or fragmented clay vessels were found from various Toutswe sites. At Toutswemogala, seven burials were found with complete clay vessels (Lepionka 1978; p398). The actual burials with goods are currently unknown because Lepionka's (1978) labeling system is yet to be decoded. At Bosutswe Burials 8 and 13 had vessels and at Mosu 3 the individual was buried with three clay vessels. One infant from Toutswemogala was found in association with a vessel containing hematite (Lepionka 1977; 1977).

Individuals buried with ostrich eggshell ornaments were found at different sites, but the best preserved of these were found on Mosu 3 Burial 1 (Reid and Segobye 1997; 2000) (17-20 year old male) and Bosutswe Burial 7 (1.5-2 years old). While scatters of ostrich eggshells were recovered on some graves, it is evident that these two individuals were definitely wearing the ornaments at the time of deposition. Toutswemogala Burials 7 and 9 were found with metal objects. The individuals are aged 3-5 and 7-9 years respectively. The objects are not reported in the literature and their relationships to the burials are currently unknown. They were found from the same boxes from which the skeletons had been kept. They are unfortunately rusted and fragmented and reconstruction was not possible. It is possible that these were iron bracelets or anklets or even totally different objects. A complete copper bead was identified on Toutswemogala Burial 9. The iron bracelet described by Lepionka (1978) was found in association with an adult but the individuals being referred to here are both immature. Four dark blue cane glass beads were retrieved from the grave fill of Taukome Burial 2, a 40-60 year old male.

Some possible ritual burials were excavated by Lepionka at Toutswemogala (Lepionka 1971; 1977; 1978; De Villiers 1976). These are Burials 4 and 16 in the current study. Toutswemogala Burial 4 is a young child of between six and eight years, while Toutswemogala Burial 16 is a slightly older child of 10 to 12 years old. In both cases the individuals are represented by skulls, which were found buried in isolation. No such burials have been reported on other Toutswe sites. Similar cases were reported from the

Mapungubwe complex of sites (Steyn 1995; Steyn et al. 1998). The contextual information of these burials is not fully known.

Infants buried inside clay pots were found at Toutswemogala (Burial 1 and incomplete burial 11), Kgaswe B-55 (Burial 18) and at Taukome (Burial 3). One newborn baby at Toutswemogala was found inside a pot on top of a pile of stones. A complete clay vessel containing hematite was found next to the burial pot (Lepionka1977; 1978). Unfortunately, it is not clear which of the two pot burials has been labeled Toutswemogala Burial 1 in the current study. Taukome Burial 3 and Kgaswe B-55 Burial 18 are aged between zero and six months old and Toutswemogala Burial 1 is a newborn/fetus. Skeletal remains of humans have been found in clay vessels on other sites (Inskeep 1986; Steyn 1995) and therefore are not unique to the Toutswe sites. In the case of infants, complete skeletons may be found inside vessels while adults may be represented by selected parts of the skeleton (Meyer 1998; Steyn 1995; 1998; Steyn et al. 1998) or teeth (Van Reenen 1978).

At Bosutswe, some of the burials were found with stones placed directly above or surrounding the skeletons. The number of burials with stones, seven out of 13, was enough to suggest that this was a fairly common practice amongst the Bosutswe inhabitants. At least one burial each from Taukome and Toutswemogala were also found with gravestones (Lepionka 1978; 1977; Denbow 1979b; 1983a).

During the excavation of Bosutswe Burial 12 it was noted that the edges of undamaged compact floor material were very close to the remains. Evidently the burial pit had been dug through a pre-existing house floor. This burial gives the impression that some, if not all of the graves, were dug only big enough to fit the body without much space between the body and the grave wall.

Further investigations from the point of cultural archaeology and anthropology are needed to address the aspect of burial practices of the Toutswe people focusing on issues like significance and implications of burial positions, goods location etc. The present brief assessments has revealed that burial practices of the Toutswe people are similar to those practiced by Iron Age inhabitants of southern Africa.

9.4 Health and adaptation

The sample used in this study is small and has been pooled from several sites. It is proposed that the sample is representative of a once living population as individuals of all age groups are represented. However, it has been noted that at sites like Toutswemogala (Lepionka 1971; 1978) and Bosutswe the number of infants and juveniles exceeded the adult samples by significant margins. Of the 31 individuals from Toutswemogala, only three are adults while the remaining 28 are infants, juveniles and adolescents. Differential disposal of individuals of different ages may be the reason for this (Lepionka 1978). Fertility and growth rates of this population were not estimated but are expected to have been relatively high as has been observed in most prehistoric agricultural populations (Henneberg 1976; Bocquet-Appel and Masset 1982; Buikstra et al. 1986)

The demographic profile of the Toutswe people shows characteristics similar to many other archaeological samples for example, Oakhurst (Patrick 1989), Ossuary II in Maryland (Ubelaker 1989a) and K2/Mapungubwe (Henneberg and Steyn 1994). There is high infant mortality with approximately 50% of the total individuals dying before the age of 15 years. Life expectancy at birth was approximating 20 years but once an individual survived to adolescence, he/she could expect to live to be over 60 years. The expectancy of life at birth was low and thereby suggesting that many newborn babies died before participating in child-bearing processes.

Death rates during adolescence were low, suggesting that during the first few years of life individuals were more prone to diseases and environmental hardships. This is consistent with the evaluation of ages of formation of enamel hypoplasias. Most hypoplastic lesions were formed between two and half and four years, a period associated with weaning (Ward and Weiss 1976; Goodman et al. 1980; 1984a; 1984b; Martin et al. 1985; Goodman and Rose 1990; 1991; Lanphear 1990).

There are 30 adults aged between 17 and 75 years old. Of the 30 adults found, 17 are males, seven are females and in the remaining six, sex could not be determined. While the sample is small, it shows a male dominant population. Males and females are almost equally represented in the old age categories, i.e. between 60 and 75 years old.

The high infant mortality rate could be associated with acute childhood diseases, which resulted in death before bony reaction was elicited. However, further studies involving x-rays and other techniques as well as increase in sample size are needed to detect arrested growth during developmental years and to further elucidate the current hypothesis.

The health of an individual or a population depends on a combination of intrinsic and extrinsic factors. The physical, mental, nutritional and environmental factors all contribute to the general health status of the members of a population. The presence or absence of diseases as reflected by skeletal lesions is only a component of the health status of a population. Through palaeopathology, attempts are made to identify diseases and their prompting environmental insults as well as pathogens (Brothwell and Sandison 1967; Steinbock 1976; Ortner and Putschar 1981; Haneveld and Perizonius 1982; Cohen and Armelagos 1984; Ortner and Aufderheide 1991; Roberts and Manchester 1995; Aufderheide and Rodriguez-Martin 1998).

Infectious diseases are known to have been fairly common in prehistoric populations from all parts of the world (Brothwell and Sandison 1967; Steinbock 1976; Ortner and Putschar 1981; Haneveld and Perizonius 1982; Ortner and Aufderheide 1991; Ortner 1991; Roberts and Manchester 1995; Aufderheide and Rodriguez-Martin 1998). For example, Steyn and Henneberg (1995b) reported a possible case of treponemal disease at K2. From their study area they also identified several individuals with subperiosteal bone growth, associated with infectious diseases (Steyn and Henneberg 1995a). From the analysis of Toutswe skeletons, no lesions associated with specific infectious diseases were found. Bearing in mind the arguments raised by Buikstra and Cook (1980) and Wood et al. (1992), caution needs to be taken in interpreting this. Lack of specific infectious lesions does not necessarily equate to a population free of infections. It is possible that affected individuals may not have been found during excavations or that pathogens involved may have been virulent and thereby causing death prior to bony response. Although no specific infectious diseases were identified, the presence of cribra orbitalia and porotic hyperostosis (albeit low) could be linked to chronic infection.

Vertebral osteophytes are some of the common degenerative lesions in prehistoric and modern populations and are commonly associated with osteoarthritis (Roberts and Manchester 1995; Aufderheide and Rodriguez-Martin 1998). Several individuals had suffered from vertebral osteophytosis and major weight bearing joints were involved in some individuals. The knee and hip were the most commonly affected and the one individual showed involvement of the foot. These individuals were aged between 35 and 75 years old. Bone spurs are fairly common on the patellae and calcanei.

While Bosutswe Burial 12 presents the first possible case of DISH in the southern African Iron Age, not much can be inferred from it unless other individuals with the same condition are found. DISH is a condition of old age which, when found occurring on a substantial number of individuals of the same population, may be an indication of high life expectancy of that population (Ariaza et al. 1993; Jankauskas 2003). DISH has been reported from other parts of the world (Rodgers 1982; Ariaza et al. 1993; Jankauskas 2003). From a sample of skeletons from Lithuania representing different socioeconomic classes, it was found that DISH occurred most frequently on the wealthy members of the community who had access to foods rich in calories (Jankauskas 2003).

Three cases of congenital defects were found. In all individuals, partial spina bifida occulta was identified, two on the sacra (Bosutswe Burials 5 and 11) and one on the axis (Toutswemogala Burial 6). The frequency of these defects is within limits of quoted figures for most prehistoric populations (Ferembach 1963; Roberts and Manchester 1995; Aufderheide and Rodriguez-Martin 1998). The defects are minimal and would not have caused any problems to the individuals involved (Ortner and Putschar 1981; Barnes 1994; Roberts and Manchester 1995).

In so far as trauma is concerned, types and distribution of lesions identified demonstrate a peaceful population. No individual has signs of violent death. Although one adult male aged between 35 and 45 years (Toutswemogala 19) had been burnt, it is not clear whether or not he was burnt at the time of or after death. The presence of animal bones in association with this skeleton is difficult to interpret. It has been suggested that it could have resulted from bush fires after deposition. The results are generally similar to those from K2/Mapungubwe where no indications of violent death were recorded.

There are six cases of cribra orbitalia. Two individuals with cribra orbitalia also had porotic hyperostosis while three had porotic hyperostosis only, bringing the total in the population to nine. Of the nine individuals with these nonspecific lesions, three of them had no teeth preserved (Kgaswe B-55 Burial 15, Toutswemogala Burials 8 and 13) and of the six with teeth, three had enamel hypoplasia and three had no hypoplastic lesions. A total of 14 individuals had enamel hypoplastic lesions and two of them also had cribra orbitalia (Toutswemogala Burials 3 and 9) and one had porotic hyperostosis (Thatswane Burial 3). Thatswane Burial 3 had porotic hyperostosis and no enamel hypoplasia and orbits of this individual were not preserved. In summary, nonspecific markers of stress on teeth and bone were identified on 15 of the 84 (17.9%) individuals in the study. The lesions are generally mild to moderate and therefore it can be argued that environmental hardships experienced were not severe enough to cause drastic health effects.

Ages of formation of enamel hypoplastic lesions in the 14 individuals affected vary from just below one year (0.88) to six and a half (6.5) years old. On average the lesions were created between the end of the third year and beginning of the fourth year. The averages for pooled teeth (3.7) and canines (3.9) are only slightly different. On rare instances multiple lesions on the same tooth were found indicating recurrences of environmental insults and diseases affecting the same individual. A mandibular left canine of Bosutswe Burial 5 shows formation of lesions at approximately two and half years, about three years and approximately five years.

An analysis of skeletal growth indicates a population whose subadults grew normally. The results obtained for each of the long bones included in the study of skeletal growth are consistent with other prehistoric results e.g., Sudanese Nubia (Armelagos et al. 1972), Indian Knoll (Sundick 1978) and the Libben sample (Lovejoy et al. 1990), K2 (Steyn and Henneberg 1996). Growth of immature individuals appears to have been normal. This was an expected result for two main reasons, (1) because there are no indications of subperiosteal bone reaction indicating chronic infections and (2) the incidences of enamel hypoplasis, cribra orbitalia and porotic hyperostosis are low.

9.5 Dental health and diet

From a total of 84 individuals, dental health and characteristics could be examined on 46 individuals only. Of the 38 individuals who could not be examined, 30 had lost all their teeth postmortem and seven were newborn babies with poorly preserved incomplete crowns (Toutswemogala Burials 6, 23, 27, Taukome Burial 3, Kgaswe B-55 Burial 20, Bosutswe Burial 2001/1 and Dikalate Burial 1). An additional one older child's teeth (Toutswemogala Burial 30) had been broken into small fragments and were also excluded. At least 26 of the 84 individuals are aged between 20 and 75 years and are expected to have had complete permanent dentition at the time of death. Of these, only 12 had either complete or partially complete sets of teeth. Kgaswe Burial 16, Thataganyane Hill Burial 1, Bosutswe Burials 3 and 5 all had 32 permanent teeth. Kgaswe Burial 2, Bosutswe Burials 11, 12 and 13, Taukome Burial 1, Mosu 3 Burial 1, Toutswemogala Burials 14, 16, 25 and 30 had teeth ranging in number between 25 and 31. Although the sample itself is not very large, it is sufficient to give us a glimpse of the possible general dental health of the Toutswe people.

The 46 individuals included here were aged between six months and 75 years. Twenty-two individuals had permanent teeth only, five had deciduous teeth only and the remaining 19 had mixed dentition. A total of 804 teeth was examined, 611 permanent and 193 deciduous. Seven permanent teeth had been lost antemortem, these included five first molars, one second molar and one third molar. The number of teeth recovered per individual ranged between four teeth (e.g. Kgaswe B-55 Burial 15 and Taukome Burial 6) to a complete set (e.g. Bosutswe Burials 3 and 5).

The dental caries frequency of 21.7% appears to be relatively low for this population. A caries intensity of 3.4% (20 out of 587 permanent teeth affected) is also low by comparison to other archaeological populations in southern Africa. An adjustment for antemortem tooth loss does not increase the caries incidence by any significant amount. The assumption can be made that dental caries was not a regular pathological condition in this group. In most cases identified, the lesions are small to moderate with only a very small number at advanced levels. Calculus deposits are small to moderate and only 12 individuals are affected. None of the deposits were large enough to have been a health problem. It can be concluded on the basis of dental pathology that the diet of the Toutswe people was generally non-cariogenic and unrefined causing small caries intensities and a fair amount of dental wear. It appears also that underwater fluoride content was within normal limits as reflected by the general state of dental health.

9.6 Biological distance

Teeth were used to determine biological distances between the study population and other prehistoric and modern populations from different places by way of a matrix of Penrose shape distances. Crania were not used for this purpose because only a small number of adult crania were measurable. The results indicate that in archaeological populations, the Toutswe were biologically closer to K2 occupants than they were to Mapungubwe. This was an expected result given the fact that the teeth of the Mapungubwe people have been shown to be very different from other archaeological groups in Africa (Steyn and Henneberg 1997b). Among modern populations, the Toutswe people show closest relationship with South African blacks, followed by the Australian aborigines and the Kalahari San. On both maxillary and mandibular teeth, the Toutswe people are closest to the South African blacks, Australian aborigines and K2 people respectively. The Mapungubwe people are closer to the Toutswe people than the San are when using maxillary teeth but when using the mandubilar teeth, the San are closer than the Mapungubwe are to the Toutswe people.

Given the geographic distance between the Australian aborigines and the Toutswe communities it was thought that the two would show the largest biological distance through dental measurements. Surprisingly the Australian aborigines are the second closest to the Toutswe following the South African blacks. This can not be explained but it is possible that differences in sample size between these two populations may have had an effect on the results.

Archaeologists have argued on the basis of cultural artifacts that there were economic and social interactions between the Toutswe communities and K2/Mapungubwe people and also with the San hunter-gatherers (Denbow 1982; 1999; Maggs 1984; Huffman 1986; Hall 1987). These groups exchanged ideas, goods, and most possibly had some level of interbreeding. It is therefore possible that the results obtained in this study are a reflection of the gene exchange that may have taken place during the Iron Age in the Shashe-Limpopo area. It is important to note that this interpretation is suggestive but not conclusive and more studies would be required to test the validity of this idea.

9.7 Conclusion

A plethora of skeletal and dental lesions has been identified and described from a sample of 84 individuals. These are in essence residues of diseases experienced at some point during life (Rothschild 1992) and were used to make inferences on the health of the Toutswe people. However, some of the lesions identified are of no clinical significance and therefore are not ideal indicators of health of the individuals (Buikstra and Cook

1980; Wood et al. 1992). Lesions associated with partial spina bifida occulta are an example.

The Toutswe people appear to have been fairly healthy. There are no indications of chronic infectious diseases and degenerative diseases found are within normal incidences reported in other archaeological populations (Morris 1992; Steyn and Henneberg 1995b; Steyn 2003). Skeletal lesions resulting from nonspecific environmental insults are generally low. Similar to other prehistoric population, the Toutswe palaeodemography depicts a high infant mortality but once an individual survived the first 15 years of life, he could expect to live a fairly long life.

In general, life expectancy, frequency of skeletal and dental lesions and skeletal growth rates are similar to what has been reported from other sites. However, it is possible that selective burial practices may have influenced the results. Signs of stress and diseases were few, e.g., cribra orbitalia and enamel hypoplasia were much lower than at other sites and in addition there is was no subperiosteal bone growth on the Toutswe people. Therefore, it can be concluded that those who died within the first few years of life probably died of acute diseases (e.g., pneumonia and diarrhea). Chronic diseases would have resulted in more specific and nonspecific skeletal lesions. Therefore this population was probably not plagued by many chronic diseases, for example there are no signs of treponemal diseases.

A high incidence of cribra orbitalia, enamel hypoplasia and other nonspecific lesions, may be, to some extent, reflective of social change and disruptions with development of social complexity. At Toutswe sites, however, the social environment may have been more stable, as reflected by the low indices of these indicators. The stratigraphic contexts of these sites indicate long occupation, except at small sites (Denbow 1982; 1983a; 1999) where the length of occupation was less than a hundred years. Traumatic lesions found on the Toutswe people do not in anyway suggest that communities were violent.

Although more is known about the health of the K2 and Mapungubwe people than is known of the Toutswe people, the current results tend to favour the idea that the Toutswe people may have been healthier than the K2 and Mapungubwe people. The inclusion of radiological techniques in the analysis of the K2 and Mapungubwe skeletons has enabled researchers to reach a much more informed conclusion on the health status of these people (Steyn and Henneberg 1995a; 1995b). It is hoped that future research on the Toutswe skeletons would employ specialised techniques for data collection so as to make a more holistic rather than limited comparison between these two population samples.

Appendix 1.a Cranial measurements

The following are cranial measurements taken from children and adults. Newborn babies and infants are excluded. Only those individuals with some measurements taken of the cranium are included in this appendix.

	Toutswemogala						
Measurements	2	3	4	6	7	9	14
g-op	160.6	185	160.6	187	181	173	170
eu-eu	120		120.4		123	127	
zy-zy				111			
ba-b	110.8		110.9	151	130	125	136
ba-n	80.6		80.1	145	130		124
ba-pr	84.1		76.6	143	109.5		128.3
ecm-ecm	51	63.1	51.1	59.4			59.5
pr-alv		41.4	34.5	43			39.2
ALB	97.1			103.9		103.7	103.6
n-pr	52.5	57	43.3	56.6			50.3
ft-ft	86.5		82	93.5	81.9	90.3	91.1
fmt-fmt	90.6		90.9	102	94.2		
n-ns	36.6	39.8	31.6	42.3	32.7		37
al-al	20	24.4	22	24.5	18.8		18.43
d-ec	34.7	*37.5	32	38			
OBH	33.5	*34.4	33	35.5			38.5
ec-ec	84.2		78.6	91.3	84.5		
d-d	21.4	23.8	20.1	26.8			23.37
n-b	96.5	112.8	96.8	114.6	104.8		102.8
b-l	104.5	115.8	105.2	115.8	105.4	109.8	100.1
l-o	89	97.1	95	87.2	88.9	92.6	38.3
ba-o	38.3		34.8	42.9			28.9
FOB	30.6		23.5	31.6	23.5	30.7	
MDH			11.1	15.4	13.5	9.5	

* Measurements taken from the right side

Appendix 1.a Continued

	Toutswemogala continued				Bosutswe		
Measurements	16	17	20	25	3	4	5
g-op	180.2		166	182	190.1	182	189
eu-eu			116	127	130.4	129	133
zy-zy				129	140.1	112	139
ba-b			115	130	130.8	140	145
ba-n			80.6	104	100.5	99	143
ba-pr				98	100.8	91	146
ecm-ecm	55.9	55.9		57.1	67	59.7	67.8
pr-alv	45.1			50.4		46.1	56.2
ALB	102.7		85.7	120.5	122.4	103.8	119.6
n-pr	51.3	51.8		71	72.2	55.5	70.8
ft-ft				98.2	97.5	91	102.2
fmt-fmt				106.5		103	107.2
n-ns	42.8	37.5		55.1	53.1	40.3	50.6
al-al	22.8	22.4		24.5	23.8	21.8	29.2
d-ec	35	33.9*		42.5	41.2	34.7	36.7
OBH	33.3	39.3*		39.2	34	33.6	38.1
ec-ec	83			101.9	95.7	82.2	104
d-d	20			26.3	22.2	19.2	32.1
n-b			89.6	116.4	112.6	111	110
b-l		109.5	111	109.3	107.7	116	105
l-o		126.8	89.5	83.8	99.7	98	106
ba-o		94.9	35.4	36.8	43	37.2	39.7
FOB			21.5	30.7	31	28.1	31.4
MDH	23.8	16		24	33.4	25.4	30.2

*Measurements taken from the right side

Appendix 1.a Continued

	Bosutswe continued				Kgaswe B-55	
Measurements	6	11	12	13	2	16
g-op	191	169	181	184	180	185
eu-eu	123	128	125	127		120
zy-zy	114					
ba-b	148		148	141		138
ba-n	133		142	141		105
ba-pr	126		136	135		105
ecm-ecm	59.5		65.7	63.5	59.7	61
pr-alv	43.9		50.8	45.2		
ALB	106.8		122.7	109.7		113.5
n-pr	57		72.3	102.8	58.5	73.7
ft-ft	97.7		96.2	94.4	93.6	95.3
fmt-fmt	109.5		107.7	100.3	100.2	103.2
n-ns	43.2		52.1	53	58.9	48.4
al-al	23.6		23.1	24.7	27	25.8
d-ec	33.9		40.1	36	37.9	
OBH	33.5		40.1	33.7	29.6	
ec-ec	92		101.9	96.5	100.7	
d-d	22.9		29.6	28.1	26.9	
n-b	111.5		109.3	117.4	108.2	106.8
b-l	117		101.3	112.8	110.8	116.8
l-o	106		109.3	96.2	93.4	
ba-o	40			36.3		
FOB	27.5			26.4		
MDH	22.4		24.7	30.7	*26	*34

* Measurements taken from the right side

Appendix 1.b Mandibular measurements

	Toutswemogala									
Measurements	2	3	5	6	7	9	14	16	17	20
C H	23.3	28	22.6	26.8	21.1	25.6	22.7	25.8	29.6	21.7
BHMF	19.7	25.8*	17.4*	25.7	18	24.8	22.7	22.2	27	18.1
BTMF	10.8	12.5*		12	10.2	12.2	12.5	12	12.1	8.78
BD	69.1			73	70.1	75.4	84.4	77.8	79.4	66.7
BB	89					96.3	103.3	97.6	93.2	82.7
Min RB	26.5	30.7*	23.2*	33.7*	27.1	30.4	33.9	33.6	32.6	24.4
Max RB	31.6	34.1*	30*	38.6*	31.8	37	39.5	40.6	34.8	34.5
Max RH	31*	36*	27	41	34	37	41	30.9	39	32.5
ML	61	69*	55	77	64	67	70		78	53
MA°	133	133*	141	123	139	135	127	123	130	130

Appendix 1.b Continued

	Toutswe continued	Taukome		Bosutswe						
Measurements	25	1	2	3	4	5	6	7	8	11
C H	36.1	34.3	33.5	33	27.3	34.4	27.7	19.4	23.3	26.8
BHMF	31.1	27.6	34.8	33.9	25.8	31.2	25.4	15.3	19.7	16.7
BTMF	10.3	12.6	11.9	10.3	11.9	13.2	10.9	8.6	8	12.8
BD	89.5	104.5	90.9	110.2	83.8		80.3	56.6		82.7
BB	121.9	124.5	118.8	122.1	97.1	122.8	108.2			106
Min RB	33.6	42.5	34	36.1	30.3	40.4	32.6	20.3		32.8
Max RB	44.7	53.6	48	44.7	38.5	46.8	38.2*		30.7	38.8
Max RH	58.5	62.	47	61*	43.5	60*	41*		38	39
ML	81	91	86	86.5*	66	91*	73.5*		61	71
MA°	120	109	131	136*	135	127*	127*		136	123.5

Appendix 1.b Continued

	Bosutswe continued		Thatswane	Kgaswe B-55	
Measurements	12	13	3	2	16
C H	35.2	34.6	20.2	31.9	41.4
BHMF	29.3	29.6	17.4	29.8	37.2
BTMF	12.5	11	9.8	9.7	12.8
BD	105.4	91.8		79.7	81.7
BB	124.8	112.4		108.5	
Min RB	35.2	35.5	25.6*	36.2	32.2
Max RB	42.5	41.7	28.1*	43.3	42.1
Max RH	52	46.5	27.4	50.2	61
ML	79	86	60.1	80.3	82
MA°	126	121	136	119	121

CH- Chin height

BHMF- Body height at mental foramina

BTMF- Body thickness at mental foramina

BD- Bigonial diameter

BB- bicondylar breath

Min RB- Minimum ramus breath

Max RB- Maximum ramus breath

Max RH- Maximum ramus height

ML- mandibular lengths

MA°- Mandibular angle

* Measurement from the right side

Appendix 2 Postcranial measurements –clavicle and scapula

Burial	Max length midshaft (clavicle)	Sagittal diameter midshaft (clavicle)	Vertical diameter midshaft (clavicle)	Scapula height	Scapula breath
Toutswemogala					
2	70.3	7.6	4.2	67.9	53.5
3	95.3*	8*	5.7*	95*	63.7*
6	110.1	8.2	8.4		
7	73.1	5.2	3.8		
9				78.5	58.6
13	92.4	606	5.2	84.4	60.8
14	95.4	7.7	5.5		61.7
15	90.3	8.6	5.1		
17	101.4*	9.4*	8.6*		
22				125.9	106.9
Taukome					
1	165	14.3	10.7		
2	154	11.9	8.4		105.3
Thatswane					
3	60.1	5.8	3.3		
4	100.2	7.5	5.7	100.2	68.9
Mosu 3					
1	120	8.7	6		

Appendix 2 continued, Humerus

Burial	Max length	Epicondylar breath	Max diameter head	Max diameter midshaft	Min diameter midshaft
Toutswemogala					
2	*140.2	*20.8		*11.5	*9.3
3	*198	*40.3		*14.4	*12
5	*116.1	*25.7		*10.5	*9.5
6	220.9	40.2		14.4	11.9
7	*151	*30.6		*10.3	*8.3
8	161			10.8	9.2
9	163	32.1		13.3	10.8
13	194.8	*36.1		*13.4	*9.9
14	181	35.3		12.9	11.7
15	200.8	30.6		14	10.3
17	245	42.3		18.5	13.4
22	328	61	44.7	20.9	16.7
24	*147	*28.5		*11.7	*9.7
Taukome					
1	330	70	48.9	22.9	18.7
2	319	62	40.3	25.3	18.2
Thatswane					
3	110.2	20.6		10.5	8.8
4	*200.5	*40		*14	*10.6
Mosu 3					
1	276	49.5		16.6	14.6
Kgaswe B-55					
1	200.7			14.7	13.5
2	294	50.1	37.7	19.9	14.7
5(1)	320.1	60	42.8	20.1	15.2
7(2)	320.1	50.7	40.8	20.7	15.6
15	220.1			13.5	11.5
16	*314	*57.5	*42.1	*20.6	*16.4
24	330.8	50.9	44.2	23.3	18.1

Appendix 2 continued- Radius and Ulna

Burial	Max length radius	Sagittal diameter midshaft radius	Transverse diameter midshaft radius	Max length ulna	Dorso-volar diameter ulna	Transverse diameter ulna	Physiological length ulna	Min circumference ulna
Toutswemogala								
2	111	5.7	7.7	124.9	9.5	8.8	108.5	18
3	157	7	10.7	175	14	10.4	153	27
5	91.2	5.3	6.6	104.6	9.5	7.5	92.9	
6	190.8	8.4	10.1	210.3	12.2	8.8	190.4	20.4
7	*119	*5.3	*7.3	134	10.6	9	121	21
8	120.2	5.5	7.1	126.5	10.6	9.6	111.5	
9	130.8	6.9	9.7	145.1	13.3	10.3	128	10
13	160	7.5	8.2	176	11.3	10	158	24
14	155	7.6	9.9	168	11.8	9.9	149	23
15	160.2	8.4	10.4	170.7	11.2	10.5	160.2	23
17	185	9.9	12.7	202	15.9	11.8	182	24
22	*267	*11.1	*14.9	*285	*15.1	*13.6	256	27
25	*263	*12	*15	*281	*15.7	*15	*255	
Taukome								
1	262	13	14.9	284	18.4	14.4	245	39
2				*295	*17.8	*15.6	*268	33
Thatswane								
4	160.2	7.5	8.6	180.2	13.3	14.3	160.7	27
5	260	11	15.9	277	19.4	14.8	243	36
Mosu 3								
1	209	9.7	11.4	235	14.7	12	205	
Kgaswe B-55								
1	180.2	10.6	8.8					
2	220	10.8	13					
5(1)				280.6	15.6	14.4	25.4	
6				162	11.5	11	149	
7(2)	250.6	11.8	15.1					
15	170.6	9.6	8.7	180.9	12.8	10.2	175	22
16	254	12.4	15	*266	*15.3	*15.8	*240	
24	*280.9	*12.6	*17	*310	*14.4	*18.5	*280	39

Appendix 2 continued, Femur

Burial	Max len	Bicondy len	Epicondy len	Max diam head	A-P subtroc	Trans subtroch diam	A-P diame midsh	Trans diam midsh	Cirmfe midsh
Toutswemogala									
2	190.2	190.1	30.7		12.6	15.8	12.6	13.5	40.4
6	320		40.9		18.1	23.7	17.7	17.6	50.7
7	200	198	40.5		13.5	16.5	12.9	11.5	40
8	217	214	42.2		12.3	16.4	13.2	12.2	42
9	235	233	47.4		17.7	20.4	15.5	15.5	52
14	270	268	52.3		19.6	20.9	17.8	14.3	54
15	281	280			17.3	22.3	19	12.3	50.6
22	486	483	78	46.3	27	32	28.8	29.8	
25	485	479	81	44.5	26.2	36.1	28.3	28.7	
Taukome									
2	449			41.5	23.8	33.8	28.5	28.6	88
Thatswane									
4	281				19.3	22	16.7	16.6	50
5	485	480	72	41.3	23.9	29.3	27.5	23	80
Mosu 3									
1	390	388	62		21.1	26.2	21.1	22.1	
Kgaswe B-55									
2	415	406	69	38	21.8	27	23	25	76
5(1)	470	469	80	43.2	23.9	29.2	29.1	26.6	90.3
5(2)	495	493		45.7					
6	252				15.5	18.6	15.6	15.5	48.5
7(2)	481	478	70.9	44.8	20.8	28.4	30	24.9	80.7
16		480	74		23.7	28.7	27.6	24.5	
24	481	443	70.7	43.8	24	31.1	38.2	28.8	100
26	448			43.3	23.1	28.1	27.5	25.6	

Appendix 2 continued, Tibia

Burial	Condylo-malleola length	Max proximal epiphyseal breath	Max distal epiphyseal breath	Max diameter nutrient foramen	Transeverse diameter nutrient foramen	Circumference nutrient foramen
Toutswemogala						
2	160.5	30.5	20.2	16.2	14.8	49
3		50.9		22.8	16.3	65
6	70	40.6		22.3	17.2	60.5
7				15.6	13	45
8				15.2	12.2	46
9	192			18.6	17	58
13				19.5	16.3	58
14	228		30.9	20.9	16.7	58
15	*231	*40.6	*30	* 20.8	*16.7	*60
17	287	35.8	27.8	22.8	80	
22	*411	*77	*51	*35.2	*22.6	*95
25	*411	*79	*49	*39.6	*21.9	
Taukome						
1			50.6	36.8	24.4	60
2			43.4	35.5	22.6	60
Thatswane						
4	240.2			21.6	16.3	84
5	396	73.5	49	31.9	21.7	75
Mosu3						
1	327	52	39	28.5	20.6	
Kgaswe B-55						
2	47		42	27	21.2	
5(1)	96	70.6	50.1	38.2	24.8	
24	20	70.3	50.1	39.6	26.7	

Appendix 2 continued- Innomate

Burial	Height	Iliac breath	Pubis length	Ischium length
Toutswemogala				
2			47.2	41.4
6		90.6	51.2	61.6
8			44.4	50.5
9			48	47.8
Taukome				
1	214	163	81.9	89.6
2		147	88.9	75
Mosu 3				
1	*172	*120	*65.2	*73.6
Kgaswe B-55				
2	*181		72.5	75.6

Appendix 3. Incomplete and commingled bones from Toutswemogala and Taukome

The following remains are too incomplete to yield much useful information. They have not been included in the demographic analysis. It is difficult to account for each package of these incomplete remains in terms of whether they were found as isolated remains or whether they were separated from the main bags during storage. Consequently, there is no information regarding their provenance and burial styles. Lepionka unearthed all of them. Reference is made to those described by De Villiers as isolated human remains (De Villiers 1976).

Toutswemogala incomplete skeletons

Bag 1 (10R3 [10R01] burial sub level 1)

The remains comprise of a nearly complete scapula, complete clavicles, and a fragment of a humerus, a radius and an incomplete femur. The bones appear to belong to one infant. They have been examined by De Villiers (1976) in the past.

Bag 2 (10R135 second half level 2)

Fragment of an adult molar, as well as an infant femora, tibiae and right ulna. The remains were excavated by Lepionka (1977) and examined by De Villiers (1976). The bag also includes a fragmented animal tooth.

Bag 3

The remains comprise of a manubrium, partially complete radius, humerus, femur, tibiae, patella and calcaneus and bones of the hands and feet of a subadult (De Villiers 1976).

Bag 4 (10 R135 First half level 1)

Fragment of an infant occipital bone, vertebrae, phalanges and ribs. The remains were excavated by Lepionka (1977) and examined by De Villiers (1976).

Bag 5 (10R 135 burial)

Incomplete radius, complete left calcaneus, talus and other tarsal and metatarsal bones, phalanges of an immature individual.

Bag 6

Two partially complete right scapulae, both from immature individuals but different in size and hence belonging to separate individuals. A permanent maxillary molar, a third molar and a mandibular incisor were also found. The remains were excavated by Lepionka (1976) but it is not clear whether they were sent to De Villiers for examination.

Bag 7 (5 R135 first half burial level 4)

The bag contains a fragment of the maxilla with two deciduous molars. The molars had been held in place by compacted soil. De Villiers (1976) had identified the fragment as that of a mandible.

Bag 8 (ORO level 4)

Fragments of an infant femur and vertebra are included in this bag. The remains have been examined by De Villiers (1976).

Bag 9 (5 R135 first half level 3)

There is a deciduous canine, fragments of the vertebrae and radius (De Villiers 1976). The vertebrae appear to be of an individual possibly older than the individual whose radius was included in this bag.

Bag 10 (5 R135 first half level 2)

The bag contains fragments of the vertebrae, ribs and axis. The remains are of an infant (De Villiers 1976)

Bag 11 (10R3 [10R01] level 4) Pot burial Beaker

Fragments of the left temporal bone and some vertebrae are put together in this bag. The remains are of infant.

Bag 12

The bag has no site label. It contains partially complete femora of possibly the same individual.

Bag 13(10R135 Burial S)

This bag contains bones isolated from the same bag as Burial 20. They comprise of a nearly complete vertebral column, a complete sacrum, a complete radius, a rib fragment, head of humerus, epicondyles of both femora, proximal ends of tibiae, complete calcanei and taluses as well as some phalanges. The remains are of an immature individual but who was older than Toutswemogala Burial 20.

Bag 14 (10R135 Burial S)

The bag contains a complete clavicle of an adult individual. The clavicle was placed in the same bag as Toutswemogala Burial 20 possibly as part of Lepionka's way mechanism to save space (Lepionka 1978).

Bag 15

The bag has no site record and it contains a partially complete right side of the cranium (temporal and frontal bones). The individual was immature as indicated by cranial sutures.

Bag 16

A permanent maxillary and medial incisor as well as some phalanges and metatarsal bones are included in this bag. They are of an immature individual. The site record label is missing.

Bag 17(5R 155 first half burial bedrock)

Some vertebral centras and a single phalanx are in this bag. The bones are of an immature individual.

Bag 18

The bag contains the following remains of a possible newborn or infant, neural arches, tibia, humerus and calcaneus. In addition there are fragments of the sacrum, neural arches and a radius of an immature individual but their size indicate that the individual was older than the one described before. A fragment of the sphenoid bone and thoracic vertebrae of mature individual indicate the presence of a third individual in this bag. A permanent incisor is also present. There is no site label.

Bag 19 (5R 135 second half level 2)

The bag contains several fragments of possibly different individuals. There is an incomplete adult mandibular ramus, rib fragments, a nearly complete set of adult phalanges and an incomplete clay figurine. There is also a proximal end of a tibia and fragments of different skulls.

Taukome incomplete remains

Bag 1

A fragment of a right femur of an adult was found in a rodent burrow on the western end of unit 1 (Denbow 1979b).

Bag 2

In unit 5 level 6 (between 40 and 60 cm below surface), in the light brown silt soil, a cranial fragment was found (Denbow 1979b). The fragment came from the southeastern side of the unit and was in a rodent burrow. The skull is represented by articulated parietals and a frontal bone. The left orbit is complete and has no signs of pathology while the right orbit is missing.

Bag 3

Fragments of a parietal and a pelvic bone which had been dug out by rodents in unit 6, level 5, 60 - 75 cm below surface (Denbow 1979b).

Appendix 4 Recommendations to BNMMAG for scientific handling and storage of human tissue

The author proposes the following recommendations or guidelines for proper cataloguing, storing and handling of archaeological skeletons.

- That the archaeology laboratory personnel be given basic training in identifying, handling and storing human skeletal remains.
- That each skeleton be labeled with proper ink upon arrival at the institution. The process should also include the current collections but a trained anthropologist should be employed to help identify individual skeletons where possible from the boxes with more than one individual.
- That a section be established within the storerooms or laboratories for the sole purpose of storing human skeletal remains and their associated grave goods.
- That a cataloguing system for human remains be established with coded burial numbers. The codes should indicate the site from where the burial was found, the date (year) of excavation and the burial number.
- That once the catalogue is established on the basis of the current collections, the BNMMAG should control the numbering of new burials found at sites where previous excavations produced burials e.g., one burial was found at Bosutswe in 2001, which should be burial 1 for that site so that those found in 2002 should start at burial 2, or alternatively indicate the date of excavation
- Boxes of proper sizes should be used to store individual skeletons so that each individual is placed in one box. The boxes should be labeled properly indicating the burial number and site from where the burial was recovered.
- That the BNMMAG establish a body of rules for archaeologists submitting human skeletal remains for storage. The rules should emphasize that skeletons should be accompanied by field notes and photographs, indicating the date of excavation, the principal excavator and team members, provenance, burial style and any other essential information.

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