An Assessment of the Health Status of Late 19th and Early 20th Century Khoesan

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Declaration

I, ... hereby declare that the work presented in this dissertation is based on my original work (except where acknowledgements indicate otherwise) and that neither the whole work nor any part of it has been or will be submitted for another degree to this or any other university.

Signature: ....

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Abstract

Since the arrival of the Dutch colonists in the Cape, Khoesan populations were subjected to severe political and economical marginalization and often fell prey to racial conflict and genocide. These circumstances persisted until the early 20th century, during which an astonishing number of Khoesan skeletons were transported from South Africa to various locations in Europe, as at the time, different institutions competed to obtain these valuable remains. Due to the above mentioned circumstances, Southern African Khoesan groups suffered from nutritional stress, as well as substandard living conditions. Such living conditions probably did not allow for health care and medical benefits at the time. It will therefore be interesting to evaluate the health status of this group through palaeopathological assessment. Skeletal remains housed in two different European institutions were studied. The sample comprises of 140 specimens from the Rudolf Pöch Skeletal Collection in Vienna, Austria and 15 specimens from the Museé de l'Homme in Paris, France. These individuals represent both sexes and were aged between newborn and 75 years, with 54 individual being younger than 20 years of age and 101 being adults. The aim was to analyse all skeletal lesions. Results indicated high levels of typical disease conditions associated with groups under stress, such as periostitis, cribra orbitalia and porotic hyperostosis. Treponemal disease, rickets, osteoarthritis and trauma were also encountered amongst other more specific indicators of health and disease. This study provided additional knowledge on the health status and lives of the Khoesan people during the turn of the 20th century, as well as focused new awareness on a group of severely mistreated individuals.

Keywords: health status, Khoesan, palaeopathology, southern Africa, skeletal remains

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Chapter 1: Introduction

1.1. Introduction

Palaeopathology focuses on diseases in historic or ancient populations as portrayed by skeletal remains and/or historic or ancient documentation (Ortner, 2003; White & Folkens, 2005). The study of palaeopathology has for many decades focused on specific subjects such as health, diet, nutrition, skeletal and dental pathology. Studies such as these often involve a certain population or group for which information pertaining to life expectancy, occurrence and frequency of stress indicators, changes in bone growth, occurrence of both specific and non-specific pathology, changes in stature and sexual dimorphism, as well as dental health and pathology are collected (Cohen, 1984). Morphology, histology and radiology of normal skeletal tissues provide the basis for interpreting abnormal conditions encountered in prehistoric and historic human skeletal remains. An understanding of the changes that take place within bone due to growth disturbances, nutritional deprivation and disease conditions is essential to the palaeopathologist to reconstruct the health status experienced in a specific population (Ortner, 2003).

Demographic data form the basis of any palaeopathological evaluation in archaeological samples. Some diseases are also associated with specific groups of people more than others (Ortner, 2003). Palaeopathological studies pertaining to specific groups have, often in the past, focused on the transition of hunter-gatherer lifestyles to agricultural ways of living. Two opposing arguments have come to light dealing with the influence of this transition on the health of the population concerned (Cohen, 1984). One such view is that the transition from hunter-gatherer to agricultural lifestyle had a positive influence on the health of populations. The main reasons for this theory are that, firstly, food supplies were overall more reliable, consistent and of a good quality and secondly, that the amount of labour performed to obtain food was much less (Bronson, 1975; Hayden, 1981). The second presumption dealing with this transition involved looking at the quality, as well as the variation of food available. Food obtained in a typical hunter-gatherer setting often provided a variety of plant and animal material of high quality, whereas agriculture was a strategy based on providing food to larger groups of people without necessarily paying attention to the amount of nutrition and quality of food (Lee & Devore, 1968; Lee, 1979).

Another factor to take into consideration when studying the difference in health between hunter-gatherers and agriculturalists is the exposure to acute and chronic epidemics affecting groups of people. Epidemiologists argue that the small hunter-gatherer groups probably did not experience the large pathogenic load caused by chronic infectious disease amongst larger, more crowded groups. The movement from area to area of hunter-gatherers almost certainly played a role in limiting disease, as mobility and low population density may have decreased the risk of infectious disease. Due to their general remoteness from other human groups and animals, they were often isolated from diseases carried by other human groups and animals. In contrast, high density population groups remaining in the same area or environment may be subject to acute diseases often recurring as living conditions remain unchanged (Silberbauer, 1965; Armelagos & Dewey, 1970; Tanaka, 1980). In general, there is a lack of good data from prehistoric times to support specific conclusions drawn from theories such as these, leaving much room for debate.

When taking all factors and studies into consideration, the general feeling persists that an overall decline in health is associated with the conversion from hunter-gatherer lifestyle to agricultural means of living. In addition, hunter-gatherers were fairly well adapted to their environment and survived for centuries amongst all odds.

As far as southern Africa is concerned, it is also important to note that colonial contact not only affected the lifestyle of hunters and gatherers, but also influenced pastoralism in the Cape Colony. With the onset of European contact (mid seventeenth century), two distinct groups were recognized as speaking dialects of the "click" language (Hausman, 1982), i.e. the San (small bodied hunter-gatherers) and the Khoikhoi (taller, more robust herders of sheep and cattle). In this sense, the terms "San" and "Khoikhoi" is used as biological names for these populations. As the colonial era progressed, San groups were driven further north, while Khoikhoi groups were divided and their land taken away. With the Dutch colonists' settlements in the Cape, herders could no longer utilize certain parts of the colony for pastoralism, as the farms of Dutch colonists were considered to be private property. Alternatively, they were offered positions as farm workers in exchange for food and living space on Dutch farms, ultimately altering their traditional way of life as they were absorbed into Dutch economic systems (Smith *et al.*, 2000; Penn, 2005). This caused smaller and divided groups of Khoikhoi and remaining groups of San in the Cape Colony to blend together and form new groups. As a result of this, cultural evolution took place that caused a biological, ethnohistorical and archaeological overlap between the San and Khoikhoi

(Hausman, 1982). After about two centuries of cultural evolution, many groups and/or individuals could simply be classified as being Khoesan (a biologically diverse group).

In 1959, Tobias classified the surviving Khoesan into five categories. These categories describe the transition state of the Khoesan as it most likely existed during the colonial contact phase until the early 20th century. Khoesan individuals included in the current study sample may thus be from either of the five categories, described as:

1. Those that have remained hunter-gatherers and have little or no contact with agricultural ways. Such groups/individuals are, however, very scarce and the remaining numbers are declining rapidly.
2. Individuals born in the veldt that come in contact with farms or boreholes to obtain food or water during the dry season, but primarily live in the veldt.
3. Some individuals born in the veldt have taken up residence on farms, although they often ventured back to the veldt to hunt and collect food.
4. Those that were born in the veldt, but now live and farms and never return to the veldt to obtain resources.
5. Lastly, the new generation of Khoesan that was born on farms and is not familiar with a lifestyle of hunting and gathering.

A transition from a hunting-gathering lifestyle to that of an agricultural way of life undoubtedly had an influence on the health, diet, physique and stature of the Khoesan. Tobias (1962) reported that there has been an increase in Khoesan stature over a period of a few decades. Statures of different Khoesan populations recorded were compared between three time periods. Mean statures before 1915 were shorter than those recorded from 1925 to 1935. Statures reported after 1950 proved to have the largest mean values. This suggests that improved environmental conditions and nutrition may have caused the Khoesan to grow taller than expected (Wells, 1960).

The Khoesan skeletons investigated in this study are known to have been collected during the early 20th century from various locations in southern Africa (Legassick & Rassool, 2000), which implies that they lived during the late 19th century and early 20th century and is thus a mixed group containing San, Khoikhoi and individuals of various admixtures. Also, the sample most likely contains individuals belonging to all five groups specified by Tobias (1959). It is expected that this group shows signs of less than optimal health, retarded growth and reduced statures as they form part of a group that had limited political power, restricted resources and divided social structures.

When dealing with groups such as the Khoesan that have been marginalized in the past, ethical issues often arise. There are also several issues that influence research on human skeletal remains, of which racial typology and repatriation are worth mentioning. Repatriation is an issue that affects all institutions that keep human remains today. The main problem regarding repatriation is whether descendant rights to rebury their ancestral remains supersede research being done by physical anthropologists (Bray, 1995). The means by which the skeletal remains were collected is most certainly a factor that should be taken into account. Grave robbery and trafficking of remains from specific "racial" groups, as portrayed by Legassick and Rassool (2000), are strongly condemned in modern times. However, such events did occur in the past and thus the question remains whether skeletal material affected by illegal practices in the past should be repatriated at present time.

During the last century great measures have been taken world-wide by bioarchaeologists and physical anthropologists towards establishing equality between all groups of which skeletal material are studied. Scientists are thus requested to adapt their means of investigation to consider the moral values of the descendants of people being studied (Walker, 2000). Numerous publications during the last few decades have focused on ethical and political issues regarding the collection and curation of skeletal remains (Ubelaker & Grant, 1989; Jones & Harris, 1998; Walker, 2000; Nienaber et al., 2008). Museums and educational institutions world-wide have, in modern times, raised their curation standards and guidelines for research by managing strict policies concerning the handling, storage and caretaking of human remains (e.g. ICRC 2004; Church of England 2005), whereas in the past such policies were much less seriously taken. It is thus the responsibility of the institution that houses the remains to ensure that all human material is treated with dignity and respect.

Human remains continue to be immensely valuable in the study of past populations and form the biological basis for studies of growth processes, health of specific groups and the influence of environmental change on people and may provide information that would not be otherwise obtainable. It is therefore hoped that negotiations between descendants and institutions keeping skeletal remains will initiate workable processes in which research can be performed whilst remains are being kept safe and treated with utmost respect.

1.1. Aims

Khoesan populations from the late 19th and early 20th century were subjected to high levels of stress due to economic and political marginalization. Skeletal remains of the Khoesan were, at that time, being collected by various museums as it had been regarded as extremely valuable material (Botha & Steyn, in print). Collection of Khoesan remains resulted in some of the skeletons being exported to various institutions across the world. Many of these skeletons remain largely unstudied. The remains held in the Rudolf Pöch (Vienna) and Museé de l'Homme (Paris) skeletal collections are some of the largest housed outside of South Africa and were selected for this study. Although they most probably do not represent a biological population as a whole, the individuals held here are representatives of a number of communities that were severely marginalized and under constant pressure. The broader scope of this study is expected to shed more light on the lifestyle of this group and the diseases that affected them as represented by these individuals. The Khoesan remains housed in these two institutions have never before been analysed for the purpose of health status studies.

The first objective of this study was to evaluate and interpret health status of the historic Khoesan as represented by the skeletons from the Vienna and Paris collections by assessing palaeopathological lesions, dental health and growth and stature. To achieve this goal, a general description regarding the age and sex of each skeleton was done. Specific attention was given to pathological lesions, including cribra orbitalia, porotic hyperostosis and periosteal bone growth. Dental health was assessed for all specimens, and specific reference was made to attrition, abscesses, caries and AMTL.

The second objective was to compare the results to similar studies performed on the Khoesan and other indigenous southern African groups from both the contact and pre-contact phases. This was achieved by comparing the results to data from, amongst others, Oakhurst, Toutswe, Riet River, Griqua, Kakamas, K2 and Mapungubwe areas.

Thirdly, it was aimed to obtain more information regarding the individuals housed in these collections, for example, where they came from and what the state of the collection is in order to inform future processes related to the remains.

Chapter 2: Literature Review

2.1. Introduction

2.1.1. General health and nutrition

Health and disease of past peoples have been investigated globally and information regarding the history of disease has been documented extensively. Human skeletal material is without a doubt the most useful source of information regarding disease of the past and by studying skeletal pathology, one can enhance the knowledge of how disease affect bone itself, as well as deepen one's understanding of the role of disease in human history and adaptation (Ortner, 2003). The presence of disease or ill-health is largely affected by human activity in correlation with natural forces, in other words, human behaviour as well as natural pathogens affect the health of an individual (Cohen, 1989). This shows that human health is balanced between disease causing organisms and environmental stresses. Cooperation between the fields of physiology, demography, anthropology, pathology and disease ecology enables scientists to conduct in depth studies on disease patterns in past peoples (Angel, 1981).

The health status of a population partly reflects on the reproductive success and mortality rate of the group. One can expect to find signs of disease even in overall successful populations. According to Wood *et al.* (1992) the presence of healed lesions in some of the individuals from a specific population indicates that enough time has passed to allow healing and thus infers on overall good health. However, to understand the health status of a population, numerous factors have to be taken into consideration. Health is affected not only by pathogens, but rather by a combination of factors such as genetic make-up, environmental factors, stress and nutrition. Environmental factors, stress and nutrition are in turn affected by social and economic status. These aetiological factors are closely linked together and may result in either an increase or decrease in population size (Passmore & Eastwood, 1986).

Another factor to be considered is the growth and development of subadults. When genetic factors such as those associated with dwarfism are set aside, long bone lengths may act as an indicator for the growth rate of an individual. The growth rate determines the eventual height of the individual, and if decreased during childhood, leads to a shortened stature and smaller body size in adulthood. Malnutrition or a decrease in the variety of plant and animal food in the diet can lead to growth retardation, immunodeficiency and infection (Larsen, 2000).

Assessment of health in skeletal material is done by investigating the nutritional status of the population, dental health and palaeopathology. Markers for nutritional surveys indicating malnutrition in bone specimens include the presence of craniotabes, frontal and parietal bossing, epiphyseal enlargement, beading of ribs, persistently open fontanelles and deformities of the thorax. These characteristics are considered to be of value when conducting nutritional investigation into past and present populations (Passmore & Eastwood, 1986; Ortner, 2003). The exact effect of nutrition on health in past populations is a complicated matter. A single source of information may be misleading when dealing with health status and it is recommended that both cultural and ecological variables be understood before interpreting stress markers on skeletal material (Cook, 1984.)

2.1.2. Stress and the skeleton

Larsen (1997) explains that 'stress' is the focus point in health studies of human societies. Stress and disease do not indicate the presence or absence of specific conditions, but rather provides a continuum with respect to both the population and individual. Increased stress levels can lead to functional impairment and decreased cognitive capabilities. Stress is often brought on by a number of factors working together which include limited resources, environmental stressors and culturally induced stressors. Stress caused by these factors gives way to physiological disruption that results in skeletal stress indicators and ultimately impacts the entire population. Decreased health, work capacity, reproductive capacity and socio-cultural disruption are indicators of stress in a population.

Rates of growth and development can reflect stress, or the absence thereof, in skeletal remains. Growth should be continuous from birth to adolescence under adequate nutritional circumstances. Children being raised in families suffering from poverty and inadequate nutrition generally show a smaller body size for a specific age, compared to European standards for upper class children (Smith, 1977; Rogol *et al*., 2000; Oldewage-Theron *et al*., 2006). Vitamins, minerals, amino acids, fiber and fatty acids all form part of the necessary nutrients the body needs to avoid nutritional stress. Human behaviour and social displacement largely influence adequate nutrition (Cohen, 1989). Malnutrition may cause pathological conditions or influence the growth and functioning of an individual, giving rise to a decreased health status (Malina, 1987).

Malnutrition, skeletal disorders, infection or genetic abnormalities may cause persistently open fontanelles, as in the case of an early 20th century rural population from the North West Province in South Africa. The discovery of four juvenile skeletal specimens presenting with unusually large open anterior fontanelles indicated to scientists that the population that occupied that area at the time were subjected to a high amounts of physiological stress. The possible presence of tuberculosis, syphilis and malnutrition in this community may account for the delay in skeletal maturation seen in these children (Steyn *et al*., 2002a).

2.2. The study of palaeopathology

2.2.1. Introduction

Palaeopathologists inspect skeletal remains to detect signs of disease, trauma and congenital defects. A disease condition may affect the bones directly (for example osteoarthritis) or indirectly (syphilis, tuberculosis, iron deficiency anaemia). Diseases that can be diagnosed specifically on skeletal remains include congenital defects, malignant conditions, infections (such as leprosy or treponemal infections), trauma, arthritis, vertebral osteophytes, gout and ankylosing spondylitis. Signs left by conditions such as these may display long-term effects on the body (Steinbock, 1976).

Pathologies that record physiological stress in bone include enamel hypoplasias, cortical bone loss, porotic hyperostosis, cribra orbitalia, periostitis and bone lesions caused by infection (Buikstra & Cook, 1981; Larsen, 1997). These lesions are referred to as generalized, non-specific signs of disease and often reflect on the socio-economic status and living conditions of past populations.

According to Stuart-Macadam (1989a), nutrition plays a vital role in the relationship between a population, its environment and diseases related to that specific group. Deficiency diseases such as scurvy, rickets and iron-deficiency anaemia are not only related to diet, but also to the more complex sociocultural context in which the population is found. “Faulty” nutrition may be to blame for deficiency diseases occurring, rather than undernutrition. Adequate nutrition thus plays a vital role in the health of a population.

There are several difficulties concerning the interpretation of palaeopathological analyses. Problems with the specimens itself include factors such as poor preservation and incomplete material. During the investigation of the material it is possible to oversee small lesions. Inexperience may also contribute to lesions being missed or not recognized. When examining specimens, it must be kept in mind that abnormal bone changes may not necessarily be due to disease, but that it may be due to postmortem damage or pseudopathology (Roberts & Manchester, 1995). It is also sometimes the case that there are insufficient criteria available to support a diagnosis. In cases where a diagnosis can be made, the amount of data may be insufficient to prove statistically significant (Tenney, 1991). Inferring health from historic skeletal samples is complex. Due to the fact that it is impossible to obtain accurate estimates of demographic and epidemiological data from prehistoric, and in some cases historic populations, it is difficult to derive precise data using standard methods (Waldron, 1994).

Wood and colleagues (1992) discuss certain theoretical problems associated with the interpretation of pathological conditions on skeletal material. An increase in a particular lesion or sign of disease may lead us to overestimate the prevalence of the condition within the population, since a skeletal sample consists only of individuals who actually died of the disease investigated and thus, no individuals who survived the disease are included in the study. Thus, the question should be asked whether the prevalence of pathological conditions observed in a skeletal sample is actually representative of the population.

A second problem involves the formation and healing of lesions on the skeleton. The individual needs to survive the manifestation of the condition, as well as live long enough to allow for the healing process to occur. This means that the individual with skeletal changes was most likely in good health and able to survive for a longer period of time. The immune system of such individuals was most likely strong enough to eliminate or suppress the disease (Wood *et al*., 1992; Larsen, 1997). However, individuals present in the skeletal sample that are seemingly in good health might have died of a disease that does not cause pathological changes in bone. It is also a possibility that the individual did not survive for a long enough time period to allow for skeletal changes to take place. This problem is commonly known as the “osteological paradox” (Wood *et al*., 1992).

There are many skeletal health indicators that are poorly understood and for which inadequate criteria are available for making diagnoses. It is thus recommended that multiple factors be taken into consideration for reconstruction of health in a population (Goodman & Martin, 2002).

2.2.2. Specific indicators of disease

2.2.2.1. Infectious disease

Infections are caused by pathogens belonging to one of four groups of micro-organisms, namely bacteria, viruses, fungi or parasites. Skeletal change due to infection usually surfaces in chronic conditions where the individual survives for a long enough time period which allows the development of specific bone lesions indicating a certain disease (Aufderheide & Rodríquez-Martín, 1998). Bacterial infections that often cause skeletal lesions include tuberculosis, leprosy, treponematosis, osteomyelitis and brucellosis. Bone infections caused by viruses (except rubella), fungi and parasites are extremely rare, although fungal infections may cause secondary bone infection. Infection caused by the *Rubivirus* is important in prenatal cases, as rubella causes skeletal changes in about 35% of foetuses carried by infected mothers. These changes often affect the metaphyses of long bones, ribs, vertebrae and cranium (Aegerter & Kirkpatrick, 1975; Ortner, 2003).

For the purpose of this study, tuberculosis, treponematosis and osteomyelitis will be discussed in further detail.

Treponematosis

Although commonly known as syphilis, this infection is caused by a microscopic spiral-shaped bacterium (spirochete) of the genus *Treponema* and can cause four disease patterns depending on geographical and clinical variation. These four disease groups are named yaws (*Treponema pertenue*), pinta (*Treponema carateum*), nonvenereal or endemic syphilis (*Treponema pallidum*) and venereal syphilis, which can be transferred from the mother to the foetus causing congenital syphilis (*Treponema pallidum*). Each of these four types varies in skeletal expression, but may be difficult to diagnose as bone responds in a similar manner to all four species of the bacterium responsible for the infection (Steinbock, 1976; Ortner, 2003; Mann & Hunt, 2005).

Yaws, also known as frambesia, mostly affects people living in tropical areas under poor hygienic conditions. It is classified as a non-venereal form of the disease that is transmitted through close personal contact (Steinbock, 1976; Mann & Hunt, 2005). The formation of skin and bone lesions is characteristic of this form of infection and it is more common amongst the children and adolescents of the population. The lesions can frequently be seen in the tibia and may cause a bended appearance of the bone which is similar to saber shin seen in congenital syphilis (Ortner, 2003). The initial stages of infection may involve periostitis in different areas of the skeleton which is usually bilateral. More advanced stages of the disease involve the long bones, as well as the bones of the hands and feet. Skull and joint involvement is uncommon in yaws, although in some cases the joints and para-articular regions show destruction of bone tissue with subsequent bone healing (Aufderheide & Rodríquez-Martín, 1998).

Pinta is also classified as a non-venereal form of the disease and is the least destructive of the four types. This form is localized to the American tropical areas including central and south America, as well as Mexico. It is marked by depigmentated spots on the skin commonly found in the facial skin, upper and lower extremities. The disease is spread through physical interaction and usually found in adolescents and young adults, with the highest incidence occurring between 15 and 30 years of age (Aufderheide & Rodríquez-Martín, 1998; Mann & Hunt, 2005).

Endemic syphilis, also referred to as non-venereal syphilis, bejel and treponarid, is localized to warm, arid and semiarid areas of Africa, the Mediterranean and Asia. It occurs in populations living in poor hygienic conditions; often those of low socioeconomic status. The disease is transmitted through physical contact such as kissing or sharing cutlery. Bejel shows skeletal lesions similar to that of yaws. Periodic recurrence is observed with the later stages often causing destruction of the nasal bone and soft tissue. Saber shin of the tibia is also often present and may be the one of the first manifestations of the disease (Aufderheide & Rodríquez-Martín, 1998; Mann & Hunt, 2005).

Venereal syphilis (acquired) is spread through sexual contact and has no geographical or climate restrictions. Initially the skin is affected, but as progression of the infection continues, the skeleton, liver, heart and brain also become affected. Skeletal involvement usually ranges from 10 to 20% (Steinbock, 1976). Gummatous lesions of the skull are common and present in the tertiary phase of the infection. When the bones of the cranium are destroyed by these bone gummas the phenomenon is termed *caries sicca*. Bones mostly affected are the tibia, frontal bone, parietal bones, nasal and palatal areas, sternum, clavicle, vertebrae and other long bones of the extremities. These bones usually display periostitis when affected. This form of treponematosis may be fatal if no treatment is given (Aufderheide & Rodríquez-Martín, 1998; Ortner, 2003; Mann & Hunt, 2005). This form of treponematosis can be transferred to the foetus of the infected mother (congenital syphilis) and may eventually cause the development of Hutchinson's teeth, mulberry molars and osteochondritis in the child. Differential diagnosis of early congenital syphilis includes rickets and scurvy, whereas periostitis, gummatous osteomyelitis, joint pathology and dental pathology may indicate later stages of the infection (Aufderheide & Rodríquez-Martín, 1998). Children with congenital syphilis may also acquire skeletal deformities such as a "saddle-nose" and bossing of the frontal bone. The dental stigmata of children found in archaeological contexts are often used for diagnosing this condition and features such as tooth size, notching, wear and colour are assessed (Hillson *et al*., 1998).

Osteomyelitis

Osteomyelitis is the infection of bone by pyogenic bacteria causing inflammation of the bone and marrow cavity. This condition is often the result of surgical or traumatic wounds that become infected with either *Staphylococcus aureus* (about 90% of cases) or *Streptococcus* species and subsequently spread to the bone. This means that osteomyelitis might be secondary to either open wounds or fractures that get infected. The mode of infection may be either directly through means of an open wound or haematogenous (Steinbock, 1976; Ortner, 2003). There are several factors that may predispose an individual to developing haematogenous osteomyelitis, which include trauma, skin infections, burns, complications of pregnancy and delivery, sickle cell anaemia, respiratory infections, as well as gastrointestinal and urinary tract infections (Vigorita, 2008).

Osteomyelitis may be acute, subacute or chronic. Acute haematogenous osteomyelitis is more common than acute osteomyelitis caused by direct infection, and is mostly seen in children (about 80% of all haematogenous cases occur in children). The bones involved show signs of bone destruction, reactive bone repair and may be accompanied by necrotic bone areas. The bones are often deformed and enlarged. Acute haematogenous osteomyelitis is usually distributed along the metaphyses of the long bones of the skeleton and then spread to the diaphysis, causing detachment of the periosteum. Although any bone may be involved in this type of osteomyelitis, the lower limbs seem to be affected most frequently (Steinbock, 1976; Aufderheide & Rodríquez-Martín, 1998).

Skeletal pathology seen in acute osteomyelitis caused by direct infection (i.e. an open wound) is observed more frequently in adults, but may occur at any age. The pathological changes are similar to that of acute hematogenous osteomyelitis, but the presence of fractures may indicate the initial location of infection (Aufderheide & Rodríquez-Martín, 1998).

Acute osteomyelitis may become chronic for various reasons, but often develops if an acute infection fails to heal. Chronic pyogenic osteomyelitis is often found in the long bones and may be characterized by new bone formation around the complete infected area, as well as by the formation of honeycomb cavities or cloacae. A sequestrum may be present, however, this is not always the case (Steinbock, 1976; Aufderheide & Rodríquez-Martín, 1998).

Tuberculosis

Tuberculosis results due to the body being infected by the bacterium *Mycobacterium tuberculosis* or *Mycobacterium bovis*. These two microorganisms are almost identical on a DNA level and it is thus unclear whether the organisms are really two different bacteria, or merely two mutations of the same microorganism. In most cases, *M. tuberculosis* is labelled as the cause of the disease. This bacterium is a gram-positive bacillus and account for millions of deaths each year worldwide (Madigan *et al*., 2003).

Human infection usually occurs through contact between individuals and starts as a lung infection after inhalation of the microorganism. Two phases are recognized in the event of infection: primary and secondary (reactivation) phase (Aufderheide & Rodríquez-Martín, 1998). The primary phase is labelled as the first time that the body comes in contact with the bacterium when the bacilli settle in the lungs and start to grow. An immune response is subsequently launched, preventing the occurrence of an acute infection. However, in individuals with low resistance, the body is not able to effectively delay the growth of the bacilli and this allows for an acute infection to take place (Madigan *et al*., 2003). One may become infected again after primary exposure to the bacterium and when this occurs it is known as secondary infection. Secondary infection may occur in one of two ways. Dormant bacilli that have been contained in the body during primary infection may be released and reactivated, initiating the secondary phase of infection. The host may also be exposed to large quantities of the bacterium on a second occasion during his/her lifetime, leading to repeated infection. However, upon secondary infection the body's immune system is able to activate an immune response to the infection, resulting in inflammation of the bronchial tissues (Aufderheide & Rodríquez-Martín, 1998). Secondary contamination usually results in chronic infection that may cause destruction of the lung tissue and ultimately calcification at the sites which undergo partial healing (Madigan *et al*., 2003). Poor hygiene and crowded living spaces increase the risk of getting infected. Poor nutrition also contributes to increased risk of infection as it jeopardizes the immune system. Therefore, a high number of cases is associated with people living in poor economical circumstances (Wescott, 1997; Roberts & Buikstra, 2003).

The manifestation of skeletal lesions occurs after the development of soft tissue involvement. Skeletal involvement has been reported to range from 3 to 5% in cases of tuberculosis (Resnick & Niwayama, 1995; Vigorita, 2008). It has been reported that in modern times the frequency of skeletal lesions have increased in the post-antibiotic era. Also, the distribution of skeletal lesions were found to have changed during the 20th century in a South African sample, with rib lesions becoming more frequent, while the occurrence of spinal lesions seemed to decrease (Steyn *et al*., 2013).

The most common sites for skeletal manifestation of lesion are the spine, bones of the hands and feet, ribs, tibia, fibula, radius, ulna, pelvis and temporal bone. The femur, humerus and sternum may also be affected, but are encountered in a lesser amount of cases. Joints that are commonly affected include the knee, hip and elbow. The ankle, shoulder and wrist joint are less commonly affected. Skeletal areas that are least likely to be affected include the scapula, clavicle, patella, occipital bone, parietal bone, frontal bone, mandible, maxilla and sacrum (Ortner, 2003). Tuberculous lesions located in the spine account for about 40% of skeletal lesions caused by tuberculosis infection. The thoracic and lumbar vertebrae are the most frequent locations for the occurrence of lesions. The development of vertebral infection initially affects the intervertebral disc, from which it may spread to the vertebral body, causing abscessing. This renders the vertebra incapable of supporting the weight placed on the vertebral column and vertebral collapse occurs. The deformity caused by these events is known as Pott’s disease (Aufderheide & Rodríquez-Martín, 1998; Roberts & Buikstra, 2003). Also, several publications have reported on the involvement of rib lesions in pulmonary tuberculosis (Santos & Roberts, 2001 & 2006; Matos & Santos, 2006; Steyn *et al.* 2013).

Tuberculosis has been reported in archaeological and modern skeletal populations, as well as for many populations world-wide, including Egypt (Vandier, 1964; Morse *et al*., 1964), south-eastern Europe (Haas *et al*., 2000; Fletcher *et al*., 2003; Roberts & Buikstra, 2003), South America (Salo *et al*., 1994; Arriaza *et al*., 1995), North America (Ritchie, 1952; Morse, 1961), Britain (Stirlanda & Waldron, 1990; Anderson, 2001; Mays & Taylor, 2003) and southern Africa (Steyn *et al*., 2002b; Steyn, 2003; Van der Merwe, 2006). Evidence from these populations suggests that tuberculosis is a noteworthy cause of death in past and present times. In Europe and the USA morbidity increased from the medieval period to the middle 19th century, from when a decline in the number of deaths due to tuberculosis infection was seen. However, reasons for this pattern of morbidity are unclear and it is suspected that natural selection and its impact on disease might have played a role (Aufderheide & Rodríquez-Martín, 1998).

2.2.2.2. Metabolic and nutritional disorders

Metabolic diseases result when a specific nutritional element is consumed either excessively or inadequately, but may also manifest if there is a physiological defect causing the nutrient to be absorbed poorly or not at all. It is thus important to understand the biological processes taking place in the absorption of vitamins and minerals (Ortner, 2003). Skeletal manifestation of metabolic disease is seen, amongst others, in vitamin C deficiency (scurvy), iron-deficiency anaemia, vitamin D deficiency (rickets), hypophosphatasia, starvation, fluorosis and osteopenia. These conditions are caused by inadequate osteoid production, inadequate osteoid mineralization or extreme deossification of normal bone tissue. Evidence suggests that both malnutrition and a possible endocrine disorder may be the cause of nutritional disorders. Therefore, it is important to understand and document the condition at hand, regardless of specific classification systems used for malnutritional and endocrine disorders (Steinbock, 1976; Ortner, 2003).

For the purpose of this study, rickets and scurvy will be discussed in further detail.

Rickets (vitamin D deficiency)

Vitamin D deficiency is the most common, although not the only, cause of rickets (manifestation in early childhood) and osteomalacia (manifestation during adulthood). Vitamin D is essential for the absorption of calcium and phosphorus, which are crucial elements in the formation of cartilage and osteoid matrixes. The absence of this vitamin prevents bone mineralization from taking place, resulting in deformation of bone by biomechanical forces exerted on the bone. The onset of rickets almost always occurs between the ages of 6 months and two years which is a period rapid bone growth, with only a few cases developing after this age range (Steinbock, 1976; Ortner, 2003).

Skeletal pathology may be observed in the long bones, skull, thorax, spine and pelvis. Long bones often appear as being “bowed” due to the bone yielding under the weight of the body. This is a result of the bone being poorly mineralized and often affects the long bones of the lower extremities, although severe cases also involve the bones of the upper extremities. A persistently open anterior fontanelle and widening of the cranial sutures may indicate rickets due to extensive endochondrial resorption and poor mineralization. Another common observation in children suffering from rickets is frontal bossing, giving the skull a square appearance. The spine and pelvis are affected only in severe cases of vitamin D deficiency and involves thoracic kyphosis, sometimes coupled with scoliosis. Lordosis may also be evident, in which case it pushes the sacral promontory forward, changing the position of the pelvis (Aufderheide & Rodríquez-Martín, 1998).

Rickets and osteomalacia are much less frequently found in ancient hunter-gatherer remains than in skeletons from north-eastern European origin. This can be explained by the fact that sunshine aids the production of vitamin D in the body (Aufderheide & Rodríquez-Martín, 1998). Food contains both vitamin D and precursors of the vitamin, although precursor amounts are sometimes higher than the actual vitamin and need to be converted to vitamin D. A light-catalyzed reaction (light provided by sunshine) in the skin is responsible for converting the precursor into a physiological form of the vitamin that can further be metabolized by the liver (Brody, 1999). It is likely that hunter-gatherers avoided the manifestation of rickets due to their intake of fresh fish and exposure to more sun, such as in the case of hunter-gatherer groups from Africa (Froment, 2001). A study performed by Mays and colleagues (2006) showed that 21 immature skeletons (12.8%) out of a total of 164 immature skeletons studied in a 19th century urban population from Birmingham, England were subjected to rickets. It is thus not uncommon to see higher frequencies of the disease among ancient or historical populations living in areas subjected to less sunshine and colder climatic conditions.

Scurvy (vitamin C deficiency)

Scurvy results due to inadequate intake of vitamin C over a prolonged period of time. A deficiency of this vitamin causes defective collagen synthesis in the body which results in skeletal growth retardation and bleeding. Scurvy is common in areas where fresh fruit and vegetables are in short supply, such as high latitude areas. Tropical areas seldom report cases of scurvy as fruit is abundantly available. The most pronounced symptom associated with scurvy is the tendency to haemorrhage. It is important to note that haemorrhagic patterns are usually symmetrical (Aufderheide & Rodríquez-Martín, 1998; Ortner, 2003).

Haemorrhaging is often observed as being more pronounced in infants and children than in adults, due to the periosteum being thinner and more easily separated from the cortex in subadults than in adults. Also, signs of haemorrhaging in adults tend to be located predominantly in the diaphyseal areas (Jaffe, 1972; Aufderheide & Rodríquez-Martín, 1998). A study by Brickley and Ives (2006) revealed that long-term scurvy in infants presented as multiple lesions found in several skeletal locations, including the maxilla, mandible, scapulae, cranial bones and orbits. The presence of many lesions provided a good foundation for a diagnosis of scurvy. However, it is recommended that a differential diagnosis should be made in cases of infantile scurvy where few lesions are present in the skeleton.

Historical reports of scurvy are plentiful, with some of the earliest encounters of scurvy recorded at about 400BC. Several events that took place during the last 500 years lead to the recognition and description of scurvy, including possible preventions and cures (Aufderheide & Rodríquez-Martín, 1998). However, the first palaeopathological description of the condition was made by Maat (1982). The presence of black stains at the epiphyseal plate and teeth roots (confirmed to be due to haemorrhaging), together with micro-fractures and subperiosteal haematomas provided palaeopathological evidence of scurvy in the study of 50 bodies belonging to Dutch whalers buried at Spitzbergen.

Possible adult scurvy has also been reported in the 19th century mining community from Kimberley in South Africa. Sixteen adults presented with healed lesions that were indicative of bilateral ossified haematomas, periostitis and periodontal disease (Van der Merwe *et al*., 2009). Several other factors were also believed to have contributed to the mine workers experiencing scurvy, such as high alcohol consumption (Seftel *et al*., 1966) and poor diet (Van der Merwe *et al*., 2009).

Care must be taken not to confuse scurvy with other conditions such as rickets, as there are several similarities between the two conditions. Widened metaphyses of long bones and distorted costochondral rib junctions may appear in a person suffering from either scurvy or rickets (Aufderheide & Rodríquez-Martín, 1998). It is thus important to understand the mechanisms by which a nutritional disorder is produced.

2.2.2.3. Degenerative joint disease and joint pathology

Degenerative joint disease (DJD) is a chronic condition that progresses with age. It results due to the loss of cartilage in the joint that promotes direct interaction between the two bones involved. This process is marked by the formation of new bone, with or without eburnation. DJD is almost always a primary condition, but may also be caused by trauma, congenital hip dislocation, metabolic disease, rheumatoid arthritis, obesity or occupational stress. The joints most commonly affected by DJD include the knee, hip, ankle, sacroiliac, spine, shoulder, elbow and wrist, but may also be seen in the bones of the hand, temporomandibular joint, acromioclavicular joint and pubic symphysis (Aufderheide & Rodríquez-Martín, 1998).

Degenerative joint pathology is important in archaeological specimens as it is the most frequently found pathological condition in dry bones (Aufderheide & Rodríquez-Martín, 1998). A study performed by Bridges (1991), for example, focused on degenerative joint disease in hunter-gatherers (6000-1000 BC) and agriculturalists (1200-1500 AD) from the southeastern USA. Results indicated that the shoulder, elbow and knee were the most common site for osteoarthritic changes to take place, while the least common sites included the hip and ankle. Hunter-gatherers and agriculturalists displayed similar patterns of DJD, suggesting that subsistence economy may not be the only factor influencing the development of DJD since their lifestyles were significantly different from one another. These results support the notion that osteoarthritis is caused by a variety of factors, including age, sex, occupation, body build, trauma and disease (Engel & Burch, 1966; Roberts & Burch, 1966; Ortner, 2003).

Steinbock (1976) classified arthritis into seven disorders, namely osteoarthritis, vertebral osteophytosis, traumatic arthritis, rheumatoid arthritis, ankylosing spondylitis, infectious arthritis and gout. Ortner (2003), however, classified arthritic conditions into two main groups. The first group involved osteoarthritis and diffuse idiopathic skeletal hyperostosis (DISH), while the second group included erosive anthropathies, enthesopathies and miscellaneous conditions of joints. There are two processes that mark the development of all above mentioned conditions: new bone formation (osteoblastic activity) and the destruction of bone, of which only one or both of the processes may be present in an individual. Arthritic conditions have been present for several thousands of years, as both archaeological and modern bone specimens portray signs of the condition (Roberts & Manchester, 1995).

Osteoarthritis

Osteoarthritis is the most frequently encountered form of arthritis and may develop at any stage after the fourth decade of life, depending on the population studied. It often affects the joints that are subjected to a high degree of weight-bearing, i.e. the knee, bones of the feet, patella and hip joint. Long-term friction between the bones substituting the joint causes the articular surfaces to appear polished and sometimes grooved, which is known as eburnation. Although the eburnated bone appears hard and dense, it is thinned with weakened underlying bone due to the pressure exerted on the joint (Steinbock, 1976). However, if eburnation is not present on the joint surface, osteophytes and a porous joint surface may possibly indicate the presence of osteoarthritis (Waldron & Rogers, 1991).

The development of this condition may be associated with the normal process of biological ageing, but may also be linked to obesity, genetic factors, increased physical activity during life, occupation, environmental factors such as climate and hormonal changes and thus may be primary or secondary (Roberts & Manchester, 1995; Larsen, 1997). Osteoarthritis may also be associated with other conditions that affect the joints, for example, Paget's disease and osteoporosis. It has been suggested that osteoarthritis develops due to conditions such as the above mentioned, but that the exact relationship between osteoarthritis and other diseases is still poorly understood (Waldron, 2009).

Many studies have been done to prove that there is a link between functional activity due to a specific occupation and osteoarthritis, for example the onset of degenerative changes in the feet and ankles of soccer players and ballet dancers (Brodelius, 1961). It is, however, important to take note that not all joints are equally subject to degenerative changes and that arthritic changes due to occupational stress varies in terms of the type and duration of activity performed (Jurmain, 1991).

Recording osteoarthritis may be problematic as an individual may experience osteoarthritis during his lifetime, but the joint may not always portray evidence regarding this condition. A study by Waldron and Rogers (1991) tested the accuracy in recording the presence or absence of osteoarthritis where people with different degrees of expertise recorded the presence or absence of eburnation, osteophytes, new bone formation, pitting and deformation of the joint. The presence or absence of osteoarthritis was scored consistently between candidates, but there were some disagreement regarding the severity of the condition. All specimens scored had osteoarthritis, although experts concluded that only three had the condition without doubt. This reflects a severe underscoring of the condition in the specimens given and suggests that the basic data recorded should be accurate, as this affects the outcome of the research performed.

Vertebral osteophytosis

Osteophytes of the vertebral column develop under different conditions, which may be pathological or part of the normal aging process (Nathan, 1962). The condition is one of the most frequently found degenerative changes in skeletal material and is present in almost all individuals over the age of 60 years, but may be present as early as the age of 30 years. Osteophytes may affect any portion of the vertebral column, but is most commonly seen in the lumbar and lower thoracic regions (Steinbock, 1976).

The degree of development of osteophytes may be classified into four stages. First degree osteophytes are characterized by the presence of isolated points of initial hyperostosis. Second degree osteophytes are bony protrusions projecting more or less horizontally from the vertebra. As soon as these protrusions start curving in the direction of the vertebral disc, third degree osteophytosis is evident. The fourth and last degree is characterized by the fusion of the osteophytes of two adjacent vertebrae, forming a bridge across the intervertebral disc and causing immobilization of the joint. The incidence of osteophytes was found to be greater on the anterior aspect of the vertebrae than on the posterior aspect and osteophytes were found to develop in the concavities of the vertebral column (Nathan, 1962). It should be kept in mind that the fusion of two adjacent vertebrae as seen in the fourth degree, however, may also be indicative of the presence of another condition or disease, such as DISH, kyphosis or a spinal tumour (Rogers *et al*., 1985; Herkowitz *et al*., 2006; Van der Merwe *et al*., 2006).

Van der Merwe *et al*. (2006) studied the pattern of vertebral osteophyte development in a South African black population containing both male and female individuals. They found that the thoracic region had the least amount of osteophytic development. A possible explanation for this occurrence is that the thoracic area is supported by the ribs and is less mobile, whereas the cervical vertebrae support the weight of the head and are more mobile due to the movement of the neck. The lumbar region, on the other hand, carries more weight than either the cervical or thoracic vertebrae and thus display the highest degree and frequency of osteophytes. Also, males showed more severe osteophytic growth than females, with the primary site of differentiation being the cervical region.

Temporomandibular osteoarthritis

Degenerative changes that may take place in the temporomandibular joint include porosity, eburnation and hypertrophy. Osteophyte formation, however, is not common (Ortner, 2003). Arthritis of this joint may typically be caused by developmental defects, endocrine disorders, birth injuries, infection, primary inflammation of the joint caused by rheumatoid arthritis, trauma and metastatic malignancies. Conditions such as these that cause changes in the temporomandibular joint usually occur at an early age, but are quite rare. The occurrence of degenerative changes associated with this joint in older individuals is most likely caused by the collapse of the masticatory system. This breakdown starts with antemortem tooth loss and progresses to more severe dental malfunction, such as loss of the dental arch integrity that interferes with the occlusal position of the teeth and mandible. This may lead to excessive stress being placed on the mandible that subsequently causes osteoarthritis of the joint. This means that dental function, apart from aging, have an influence on the development of temporomandibular osteoarthritis (Hodges, 1991; Aufderheide & Rodríquez-Martín, 1998).

Temporomandibular osteoarthritis is a common finding in many populations (Blackwood, 1963; L'Abbé & Steyn, 2007), with the right condyle and glenoid fossa often showing more severe signs of osteoarthritis than the left (Ortner, 2003). This condition is found more frequently in females than in males (Alexiou *et al*., 2009) and might possibly be attributed to higher frequencies of caries, antemortem tooth loss and abscesses observed in females than in males (Hodges, 1991; Lukacs & Largaespada, 2006).

Rheumatoid arthritis

This form of erosive arthropathy is commonly seen in various parts of the world, although a higher prevalence is present in some populations than in others. The exact cause of rheumatoid arthritis is not clear, but it is believed that individuals with a genetic predisposition may develop the condition through exposure to some type of environmental infectious agent, creating an autoimmune response that acts on the joints (Ortner, 2003).

It is difficult to diagnose rheumatoid arthritis from skeletal remains and the topic remains controversial (Rogers & Dieppe, 1990). Rogers and colleagues (1987) state that this condition is often symmetrical and usually affects the metacarpophalangeal and metatarsophalangeal joints, as well as the proximal interphalangeal joints of the hand. Also, the bone around the affected joint will be porotic. Fusion of the affected bones, however, is uncommon and if encountered, should be regarded as an extremely late manifestation of the condition. Waldron (2009) gives a set of features that are characteristic of rheumatoid arthritis, which includes cortical destruction, exposed trabeculae, sharp or scalloped ridges, minimal new bone formation, absence of spinal fusion, symmetrical erosions of hand and/or foot joints and sparing of the sacro-iliac joints. It is, however, essential that the hand and/or foot bones are present before a diagnosis can be made with certainty.

Females are affected more often than males, with some population ratios of affected females being up to four times that of affected males (Firestein, 2001). Although there exists no specific age range for the development of rheumatoid arthritis, the typical age range for onset of the disease occurs between the ages of 25 and 55 years (Resnick & Niwayama, 1995). The joints of the hands are usually the first of many joints to be affected. Temporomandibular arthritis may also be an indication of rheumatoid arthritis. The joints of the feet, knee, wrist, elbow and shoulder are also commonly affected, with affected areas usually being symmetrical. The joints of the hip and axial skeleton are less commonly affected (Ortner, 2003; Resnick & Niwayama, 1995).

Several archaeological cases of possible rheumatoid arthritis have been reported, of which the earliest is dated between 2500 and 1900BC (Leden *et al*., 1988). Archaeological cases of this condition often involve signs of arthritis in the appendicular skeleton, specifically the hands the feet. The skeletal remains may also appear to be osteoporotic. Although osteoporosis is not typical of rheumatoid arthritis, the possibility exists that osteoarthritis may develop secondary to rheumatoid arthritis, especially in older individuals (Ortner, 2003).

2.2.3. Trauma

2.2.3.1. Introduction

Trauma may be defined as any injury or wound of the body, but the palaeopathologist is interested specifically in trauma that affects the bones of the body, such as fractures, abnormal displacement of bone and events that cause deliberate deformation of bone (Ortner & Putschar, 1981). The type of trauma observed in a population group may reflect something about their lifestyle, for example living environment, economic status (such as hunter-gatherer vs. agricultural) and interpersonal violence. For example, healed trauma may be indicative of medical care and compassion.

Trauma, together with dental and joint disease, is one of the most commonly found palaeopathological findings in human skeletal material (Steinbock, 1976; Ortner, 2003). As all life forms are susceptible to trauma, the location, severity and precise characteristics of trauma may give clues regarding the clinical state of the injury and shed light on the lifestyle of the individual affected. An individual may suffer trauma due to an accident or due to intensional harm being caused to the person by him/herself or another individual. Roberts & Manchester (1995) state that trauma is regarded as an unforeseen event, making both young and old individuals equally susceptible to it. However, one should take into consideration that older people are more prone to osteoporosis and falling (accidental trauma) than younger individuals, and that this may contribute to trauma being seen more frequently as age increases in population.

Trauma to bone may be caused by force exerted through a blunt object, force exerted through a sharp object, gun shots or fire. Such traumatic events investigated on dry bone may be classified as antemortem, perimortem or postmortem. It is often difficult to distinguish between peri- and postmortem trauma, and due to uncertainty perimortem trauma is often regarded as postmortem events, causing perimortem trauma to be underestimated (Ortner, 2003).

Factors such as sex, culture, occupation and environment may affect the prevalence and location of trauma present in a population. However, the frequency of traumatic events in a population may also be influenced by physiological conditions such as senile osteoporosis and mental disorders (Lovell, 1997; Ortner, 2003).

Several studies performed on South African groups (Venda, Maroelabult, Koffiefontein, K2 and Mapungubwe) have reported the incidence of trauma to be relatively low in comparison to other groups outside of South Africa (Steyn, 1994; Steyn *et al*., 2002b; L'Abbé *et al*., 2003; L'Abbé, 2005). However, the Gladstone populations from Kimberley (Van der Merwe, 2006) had a high incidence of trauma that was attributed to mining activities which placed them at high risk of obtaining work-related fractures. Interpersonal violence was also suspected as living conditions were poor and resources limited.

2.2.3.2. Fractures

The term “fracture” refers to any traumatic event that results in complete or incomplete discontinuity of a bone and there are many ways in which a fracture may occur. Different types of stress on bone may lead to the occurrence of a fracture: tension, compression, twisting, bending or shearing. When a fracture occurs, a process of healing will be initiated involving new bone growth. There are, however, several factors that influence the rate at which healing occurs. The location in the skeleton, the type of bone and specific conditions pertaining to the fracture are all significant. Skull fractures, for example, heal more slowly than long bone fractures. The age of the individual also plays a role, as fractures heal more rapidly in children than in adults (Ortner, 2003).

Fractures may be either open or closed, meaning that if the skin is damaged or torn due to the fracture, it is open. Depending on whether the fracture is open or closed, several complications may arise, such as infection, tissue necrosis, inadequate fusion of the fracture, bone deformity, traumatic arthritis, joint fusion and traumatic myositis ossificans. Infection may cause serious complications, due to bacteria invading the fracture site. If left untreated by antibiotics, the infection may spread to other parts of the body and possibly result in death of the individual (Roberts & Manchester, 1995; Ortner, 2003). This is important as people of past populations did not have the benefit of antibiotics and medical treatment. Thus, individuals that did survive infection might have suffered from chronic osteomyelitis or other disabilities brought on by the fracture.

Fractures in dry bone are classified as antemortem, perimortem or postmortem. Antemortem fractures are usually easily distinguished from peri- or postmortem fractures on evidence of healing (Sauer, 1998). Within days of a fracture occurring, evidence that suggests healing may be observed. Healed bone often shows callus formation where the fracture took place if healed properly. There are, however, several problems that may cause fractures to heal incompletely and create a healed state that may easily fracture again. These problems include delayed healing, pseudoarthrosis, poor alignment, bone shortening, osteomyelitis, avascular necrosis of bone, neuropathy and articular changes (Aufderheide & Rodríquez-Martín, 1998). Whether the fractured bone undergoes any of these problems or heal completely, it can be easily distinguished from bone that had been damaged peri- or postmortem due to osteoblastic activity observed the bone.

It is often difficult to distinguish between peri- and postmortem fractures as neither display new bone formation. Perimortem fractures usually show no colour differences between the bone area where the fracture occurred and the area surrounding the fracture, i.e. the bone appears as one colour on the fracture edges, surface and surrounding bone (Ubelaker & Adams, 1995). Also, fresh bone is more likely to splinter, instead of breaking into small pieces. This occurs due to the collagen in fresh bone that increases the bone's tensile strength. Dry bone, on the other hand, tends to break into a few smaller pieces as it is much more brittle than fresh bone (Sauer, 1998).

Fractures resulting from intensional violence include, amongst others, fractures of the forearm (due to the individual defending him/herself), various skull traumas, fractures resulting from sword wounds, projectile points situated in the bone causing fractures, as well as judicial hanging. Burial context may also provide clues as to whether interpersonal violence occurred. An atypical burial displaying no calculated means of body placement, in conjuction with perimortem skeletal trauma suggesting fatal or defence fractures, may indicate that interpersonal violence possibly occurred (Martin & Frayer, 1997; Walker, 2001; Ortner, 2003).

Fractures of cervical vertebrae, specifically the axis, may be indicative of judicial hanging. Hanging as a form of execution has been practised for many centuries world-wide and if carried out correctly, should cause almost instantaneous death (James & Nasmyth-Jones, 1992). A Hangman's fracture is defined as a fracture-dislocation at the second to third cervical vertebrae, with the fracture occurring in both pedicles of the axis and ending in the vertebral body. This may be accompanied by subluxation of C2 on C3, however, this is not always the case. Hanging causes forcible hyperextension of the head, giving rise to this type of fracture (Segen, 2005). James and Nasmyth-Jones (1992) performed a study in which they examined the cervical spines of convicted murderers executed by means of hanging between 1882 and 1945 at three different prisons. They found that fractures exclusively occurred in the second and third cervical vertebrae and that six out of the seven fractures were present in C2. However, not all deaths occurred due to cervical fracture, dislocation or a combination of these two factors. Some of the deaths were caused by possible asphyxia or strangulation and did not show any signs of trauma to C2 and C3.

2.2.3.3. Spondylolysis

Spondylolysis is a defect of the vertebrae where a fracture occurs through the pars interarticularis. Usually the fracture occurs bilaterally, resulting in the complete neural arch being separated from the vertebral body, but may also be unilateral or incomplete. This condition is most commonly found in the fifth lumbar vertebra, but may also be seen in the third and fourth lumbar vertebrae, as well as in the thoracic area (Waldron, 1993; Mann & Hunt, 2005).

The aetiology of this condition is not fully understood, although it is believed that genetic and congenital factors may play a role in its development. Stress and trauma to the lower back is thought to be the most common contributing factor, as repeated stress to the lower back have been associated with the occurrence of fractures in the vertebrae (Kono *et al*., 1975; Mann & Hunt, 2005).

Spondylolysis has been strongly associated with spina bifida in some cases, as well as with repeated hyperextension of the lower back (Waldron, 1993; Barnes, 1994). However, due to a lack of understanding of the relationship between the two conditions, it is difficult to explain why this relationship is stronger in some skeletal groups than others. Thus more population studies is needed to try and clear up the question as to which exact genetic and environmental factors contribute to the development of both these conditions (Waldron, 1993).

Eisenstein (1978) investigated the incidence of spondylolysis in South African blacks and whites of both sexes and found that the incidence of the condition was the highest in white females (5.7%), followed by white males (3.8%), black males (3.5%) and black females (2.6%). The fifth lumbar vertebra showed the highest incidence of the condition, followed by the fourth lumbar vertebra, which correlated with the results of previous studies (Roche & Rowe, 1951; Stewart, 1953). However, when considering these results in relation to trauma, it seems unlikely that the highest incidence of spondylolysis should be found amongst females, as one would expect to see a higher frequency of trauma in males due to differences in occupation and physical activities between males and females.

2.2.3.4. Schmorl's nodes

Schmorl's nodes are described as herniations of the cartilaginous intervertebral disc, penetrating the vertebral body endplate (Schmorl & Junghans, 1971; Resnick & Niwayama, 1978; Dar *et al*., 2010; Burke, 2012). Schmorl's nodes are mostly encountered in the thoracic and lumbar regions of the spine, as these regions carry a higher amount of strain than the vertebrae of the upper spinal area (Hansson & Roos, 1983; Dar *et al*., 2010).

The aetiology of this condition is somewhat controversial. Several studies have revealed that there isn't a positive correlation between the frequency of Schmorl's nodes and age (Hilton *et al*., 1976; Weiss, 2005; Burke, 2012) and that it occurs in both younger and older individuals. Trauma to the spine is widely considered to be a cause of Schmorl's node formation (Resnick & Niwayama, 1988; Pfirrman & Resnick, 2001; Weiss, 2005). Acute injury to the spine due to axial loading may cause the development of nodes. Repetitive stresses caused by flexion of the spine (such as when lifting heavy objects) have been associated with the formation of Schmorl's nodes (Capasso & Kennedy, 1999; Burke, 2012). Numerous studies have also shown that lifestyle activities, for example, sports such as gymnastics or wrestling, place a high physical demand on the vertebral column and may aid in the development of Schmorl's nodes (Swärd, 1992; Hamanashi et al., 1994).

Heritability, causing congenital weakening of the vertebral endplate has also been shown to contribute on a large scale to the development of Schmorl's nodes (Resnick & Niwayama, 1978; Pfirrman & Resnick, 2001). Williams and colleagues (2007) reported that genetic factors are major determinants in the development of Schmorl's nodes and that these nodes are more frequently encountered in individuals suffering from diseases such as Scheuermann's disease and chondrodysplasia. These two diseases, as well as other types of deseases, including Paget's disease, osteomalacia, hyperparathyroidism and infection produce premature weakening of the vertebral end-plate, predisposing the individual to the manifestation of Schmorl's nodes (Paajanen *et al*., 1989; Ortner, 2003; Dar *et al*., 2010; Burke, 2012).

Schmorl's nodes were reported in three skeletal populations from South Africa, namely Gladstone (Van der Merwe, 2006), Venda (L'Abbé, 2005) and Koffiefontein (L'Abbé *et al*., 2003). Van der Merwe (2006) reported an incidence of 24.7% of in the Gladstone population from Kimberley, South Africa. The majority of individuals affected were between the ages of 25 and 35 years. This incidence we considered to be high when compared to that of the

Venda (L'Abbé, 2005), but similar to the Koffiefontein population (L'Abbé *et al*., 2003). Both the Gladstone and Koffiefontein populations were subjected to strenuous mining activities, which most likely contributed to the high incidence of Schmorl's nodes observed in these populations.

2.2.4. Congenital abnormalities

2.2.4.1. Introduction

Congenital malformations are the result of foetal development that undergoes pathological changes to produce anomalies that may be present at birth or observed years later. Such abnormalities are often caused by deleterious genetic mutations and there are several of these conditions that may affect the skeleton. Skeletal malformations include several skull malformations, spine deformities, pelvic malformations, as well as deformities of the upper extremities, lower extremeties, fingers and toes (Aufderheide & Rodríguez-Martín, 1998). Spina bifida and craniostenosis (specifically sagittal synostosis) are the only two conditions that will be discussed for the purpose of this study.

2.2.4.2. Spina bifida

This condition is characterized by the incomplete fusion of one or more of the neural arches in the spine and is one of the most frequently encountered congenital defects. This means that the posterior parts of the vertebrae that enclose the spinal cord are undeveloped and this causes the spinal cord to be exposed. Two types exist for this condition of which *Spina bifida aperta* or *cystica* is more severe than *Spina bifida occulta*. *Spina bifida cystica* is results in a neural tube defect, whereas *Spina bifida occulta* is a less serious developmental condition that may or may not give rise to a neural tube defect. In cases where the neural arch is cleft, but no neural tube defect is present, the condition is referred to as only a cleft neural arch (Barnes, 1994).

It is, however, difficult to distinguish between these types of neural clefting on a palaeopathological level. The most frequent location of neural arch deformity occurs in the first segment of the sacrum (S1), although all lumbo-sacral segments may be involved (Aufderheide & Rodríguez-Martín, 1998; Mann & Hunt, 2005).

Spina bifida is a frequently reported condition in archaeological remains and varying degrees of severity have been documented, although the less severe form of the abnormality is more common (Ortner, 2003). Interpretation regarding the classification and severity of a condition such as spina bifida may be problematic, as it is difficult to distinguish between various forms of a congenital anomaly. This leads to the question being asked whether a crevice of smaller extent is only a variety of the normal condition. The more severe form is undoubtedly a congenital anomaly, as individuals with spinal cord prolapse may die shortly after birth. This suggests that mild or less severe cases of spina bifida are merely harmless varieties of the condition. These are the types of cases often found in archaeological contexts (Vargová & Horáčková, 2010).

2.2.4.3. Craniostenosis

Normal cranial suture closure progresses with the advancement of age, but when cranial sutures fuse prematurely, the condition is known as craniostenosis which may be responsible for deformity of the skull in some cases (Ortner, 2003). The term was introduced by Virchow (1851) to describe changes that take place in the skull due to premature closure of cranial sutures and explained that this caused inhibition of growth and growth displacement in the skull, giving the bulging appearance observed in this condition.

The most common form of craniostenosis is sagittal synostosis, which gives rise to scaphocephaly, a condition described as the skull being 'heel-shaped' or dolichocephalic. Scaphocephaly often has no complications, unless it is accompanied by premature fusion of other cranial sutures such as the lamboid suture, which may cause abnormal brain and skull development (Aufderheide & Rodríquez-Martín, 1998; Shahinian *et al.*, 1998). This condition may start to develop as early as the intrauterine period, although a child may be several months old before positive evidence of fusion is observed through roentgenographic evidence (Hemple *et al*., 1961).

Craniostenosis results due to a hereditary or congenital condition, or even due to metabolic disturbances. It appears to be more prevalent in males than in females. Depending on the suture involved, characteristics associated with this condition include a bulbous frontal bone and low-set orbits relative to the frontal bone (Mann & Hunt, 2005). Although numerous explanations have been offered to account for these characteristics, the question remains whether premature suture closure is a symptom or a cause, with the most likely components associated with this event being the brain, dura mater and cranial base (Bennett, 1967).

2.2.5. Generalized, non-specific signs of disease

2.2.5.1. Cribra orbitalia and porotic hyperostosis

Cribra orbitalia (CO) is a condition which is characterized by sieve-like lesions of the orbital roof and is often associated with porotic hyperostosis (PH) of the skull (cribra crania externa). It has been labelled as a palaeopathological condition and has been discribed in many past populations all over the world. The condition is displayed as pitting within the orbital roof of the eye socket (usually occurring bilaterally), whereas porotic hyperostosis is characterized by pitting of the skull vault, often seen in the parietal, occipital and frontal bones. The lesions may vary in size, some being less than 1mm with others forming large apertures. This phenomenon is seen more frequently within subadult or infant individuals of past populations. During the last few decades CO and PH seem to have diminished much in modern human specimens, but it still has a high prevalence amongst newly discovered archaeological remains (Cybulski, 1977; Stuart-Macadam, 1985; Ortner, 2003).

The exact nature of the relationship between CO and PH is unclear and although CO may be accompanied by PH, this is not always the case. Also, CO is a more common finding than PH. The nature of the relationship between orbital and vault lesions may be better understood by comparing the etiology of both conditions with one another on a macroscopic, microscopic, radiographic and demographic level (Keenleyside & Panayotova, 2006; Walker *et al.*, 2009).

From a macroscopic perspective, cranial lesions almost always occur in association with orbital lesions, although this is not the case *vice versa*. Both cranial and vault lesions can occur symmetrically and asymmetrically, but the latter is uncommon. Microscopically, the orbital bone shows thinning of the compact layer, as well as enlarged spaces of cancellous bone. Cranial bones portray the same characteristics, but may also show a thick spongiosa. Radiographic data studied enabled the identification of seven criteria that may be used to diagnose either one of the two conditions. These include “hair-on-end” trabeculation, outer table thinning, texture changes, horizontal plate thickening, orbital rim appearance, frontal sinus height and diploic to compact bone ratio. Studies proved that individuals showing both orbital and vault lesions displayed these characteristics to a greater extent than individuals having either one of the two conditions. Demographic data suggested that neither orbital or vault lesions occurred in infants younger than six months and that the age group of 6 months to 6 years showed the highest frequency of severe lesions (Stuart-Macadam, 1989b).

The cause of CO and PH has been the subject of many discussions and research, and it is likely that there may be numerous causes of these two conditions. Several primary aetiological factors have been named which include anaemia, periostitis, osteomyelitis and osteitis. Postmortem erosion may, however, play a role in the overestimation of the frequency of the condition in that it is mistaken for CO or PH. Secondary effects of diseases such as vitamin C deficiency (scurvy), hemangioma or osteopenia may also lead to the formation of lesions within the cranial vault or orbital roof. Thus, CO and PH are more likely symptoms of other diseases. It is then also linked to diet, which in turn, may reflect socioeconomic status of the individual/population in which it is found (Ortner, 2003; Wapler *et al.*, 2004; Brickley & Ives, 2008; Walker *et al.*, 2009).

The iron-deficiency anaemia theory states that it is the most common form of anaemia and is defined as a reduction in the haemoglobin concentration and amount of erythrocytes in the blood. Iron is an essential factor needed for the production of new red blood cells in the bone marrow. When there is an iron shortage, the lifespan of the red blood cells is reduced. This triggers the overproduction of new red blood cells to compensate for the already existing erythrocytes not being able to function properly and supply enough oxygen to the cells of the body. This process may then cause hyperplasia of the bone marrow (bone marrow expansion), giving rise to lesions within the orbit and vault. An iron-deficient diet, however, may not be the only cause of iron-deficiency anaemia. Factors such as excessive blood loss, chronic disease, parasitic infections and infectious disease in a population may also play a role in the development of anaemia (Roberts & Manchester, 1995). Stuart-Macadam (1992) describes infectious disease as a factor in the development of iron-deficiency anaemia and links it to the possible environmental circumstances in which the population existed, such as climate, hygiene, diet, time period of infection, economy and geographical setting. Anaemia due to infectious disease is also supported by one of the body's own responses. When an infective organism is present in the blood, the body withdraws iron from the blood which the organism uses to develop, thus leaving the blood iron deficient (Walker, 1985).

Wapler and colleagues (2004) named a few factors that may have contributed to the occurrence of CO and they found that the condition is not always synonymous with anaemia. In about 75% of all the cases they included in their study, no signs of anaemia were found. Their results showed a number of probable causes which include post-mortem erosion (20%), hypervascularisation (5.9%), osteitis (20%), anaemia (35%), anaemia and others (4.7%), anaemia and osteitis (3.5%) and other factors (10.6%). They showed that the condition is often caused by a variety of factors and that more than half the cases showed no association with anaemia.

For several years scientists accepted the hypothesis that chronic iron-deficiency anaemia is the probable cause of cranial vault and orbital roof lesions, thus saying that these two conditions are osseous responses to this type of anaemia. Only in the past decade did researchers start to challenge this statement and offered alternative explanations and evidence to argue the cause. Walker and colleagues (2009) argued that iron-deficiency anaemia cannot be responsible for the marrow hypertrophy that causes CO and PH, because the body responds to iron-deficiency anaemia by reducing the production of red blood cell and not increasing it as is necessary to cause a hypertrophic response of the bone marrow. Furthermore, a different type of anaemia is suggested to cause CO and/or PH. They argue that anaemias causing erythropoiesis, such as megaloblastic anaemia and haemolytic anaemias may be to blame, rather than iron-deficiency anaemia.

Whatever the exact cause(s) of CO and PH, the presence of these two conditions has been labelled as an indicator of poor health and/or nutritional status in ancient populations. The morphology of the lesions may indicate the degree of biological stress that the individual experienced during his life and at the time of death. Analyses such as these help scientists to better understand the circumstances in which the population existed and may help to place their dietary habits in context to their health status (Facchini *et al*., 2004; Wapler *et al*., 2004; Slaus, 2008).

2.2.5.2. Periostitis

Periostitis is defined as inflammation of the periosteum and the condition is usually caused by chronic disease. The lesions, however, may be caused by either specific or non-specific conditions and may result due to hypertrophic osteopathy, chronic stress injuries, subperiosteal hematomas, osteomyelitis and bone cancer, as well as scurvy, leprosy, treponemal infection, tuberculosis and overlying soft tissue infection (Ortner, 2003; Vigorita, 2008). Periostitis is marked macroscopically by osteoblastic bone patterns deposited on the cortex, usually as woven bone. Periosteal lesions may also become healed after longer periods of time and then appear as thickened bone areas (Larsen, 1997). It is difficult to determine the exact nature and cause of such a lesion, although microscopic analysis can be used to aid diagnoses and to make differentiation between infectious conditions more accurate (Van der Merwe *et al*., 2010).

Periostitis may stimulate the formation of woven bone, which may later form part of the underlying cortex as the bone becomes remodelled, thus giving the bone a swollen appearance (Ortner, 2003). Seven different morphological variants of periostitis have been described by Resnick and Niwayama (1995). Possible diagnostic options were also given for each of the variants. Distinction between the variants was made largely based on the organization of layers that formed, as well as on orientation relative to the bone. In most cases, inflammatory processes due to infection played a role in the development of periostitis.

Treponematosis is a common cause of periostitis, and is associated with the infection in infants (congenital form) or adults portraying secondary stage infection of treponemal disease. Periostitis is almost never seen in adults with early acquired infection (Roy & Laird, 1973). Secondary treponemal disease often shows inflammation of the periosteum that affects the shafts of the tibiae, femora, fibulae and humerii (Veerapen *et al*., 1985).

The assessment of periosteal lesions aids the palaeopathologist in understanding the health status of the community being investigated and although it is classified as a non-specific indicator of disease, it is none the less important (Larsen, 1997).

2.2.5.3. Enamel hypoplasia

Enamel hypoplasia is classified as a generalized, non-specific indicator of health, rather than a dental disease indicator. The term ‘enamel hypoplasia’ refers to any changes that affect enamel thickness of teeth and is used to describe developmental imperfections that take place in the enamel crown of teeth. This defect remains throughout life and cannot be remodelled (Hillson, 1986). These changes include anything from light single lines to deep pits and grooves in the enamel, although linear enamel hypoplasia (LEH) is most commonly seen in individuals portraying the defect. Usually, not all teeth are affected; the incisors and canines are most frequently involved, with the molars often not displaying any horizontal lines (Aufderheide & Rodríques-Martín, 1998). Ogden (2008) has also reported that this condition may manifest as cuspal enamel hypoplasia (CEH), which involves distinctive disruption of the cusp pattern and incomplete enamel hypoplasia.

The combination of nutritional imbalance and acute infectious disease may cause this condition to arise (Goodman & Rose, 1991). Enamel hypoplasia is formed when amelogenesis is disrupted because of physiological stress, causing incomplete incrementation of the crown matrix. Individuals experiencing enamel hypoplasia are far more frequent in Third World countries than in developed countries. This supports the notion that enamel hypoplasia is associated more with populations experiencing nutritional and other environmental stresses (Goodman & Armelagos, 1985).

Goodman & colleagues (1984a) studied the chronological distribution of enamel hypoplasia in prehistoric Dickson Mounds populations. They discovered a peak frequency of hypoplasias between the ages 2 and 4 years of age. This suggested that children of this population possibly suffered weaning related stress and hypoplasia chronologies were most probably influenced by age-related host resistance factors. This study supports another performed by Sarnat & Schour (1941), stating that the age range in which enamel hypoplasia develops is usually between 3 and 7 years.

The prevalence of enamel hypoplasia was studied by El-Najjar and colleagues (1978) by looking at this condition in its varying expressions (pits, grooves and lines) in a group of 200 living children, compared to 200 specimens of low socio-economic status from the Hamann-Todd collection. They discovered that there was a higher incidence among whites than blacks, which is in contrast with living populations. Also, enamel hypoplasia was found to be more prevalent in the skeletal sample than in living individuals. This suggests that the nutritional status of the early 20th century skeletons were far worse during their lifetime than it is in living individuals today.

Enamel hypoplasia is a common finding in modern, historic and prehistoric humans. It is also commonly found amongst primates. Fossil hominids from Swartkrans, Sterkfontein and Olduvai Gorge have been reported to show signs of enamel hypoplasia (Hillson, 1986). Several samples from South African prehistoric sites showed a high frequency of enamel hypoplasia. These sites include K2/Mapungubwe (Steyn, 1994), Oakhurst (Patrick, 1989), Maroelabult (Steyn *et al*., 2002b), Koffiefontein (L'Abbé *et al*., 2003) and Venda (L'Abbé, 2005).

2.3. Growth and stature

2.3.1. Introduction

Assessment of human growth plays a vital role in the understanding of health among past and present populations, as both genes and environmental factors such as infection and nutrition influence the growth outcome of a population. Retardation of the growth process during childhood and adolescence may result in a short-statured adult. Many studies that link stature and growth have been published (e.g., Floud *et al*., 1990; Saunders, 1992; Steckel, 1995). The comparison of growth profiles between different groups may provide information about the degree of growth faltering of a population relative to another and enables one to interpret the effect of environmental factors that influence growth (King & Ulijaszek, 1999).

Human growth is influenced by complex interactions that take place between genes and the environment (Bouchard, 1991). There are several determinants that influence growth and a detailed understanding of these factors is needed in order to make accurate conclusions on the normality of a population's growth status. It is important to take into account that there is a difference between male and female growth after infancy, specifically during the adolescent growth spurt. The male growth spurt lasts longer and growth occurs more rapidly in males than in females (Roche & Sun, 2003). Therefore, it is important to differentiate between the sexes when constructing growth charts and interpreting stature of individuals in a specific group.

The most crucial growth period of children is between birth and 3 years. The pattern of growth, whether normal or stunted, can thus only be accurately determined after the age of 3 years (Bogin, 1999). This would suggest that the study of skeletal remains of immature individuals is of particular importance in archaeological samples.

Growth patterns for children from archaeological populations and living populations are largely comparable and very much the same (Larsen, 1997). The length of long bone diaphyses in children aged 0 to 12 were used to study growth velocity in a Libben population and compared to a healthy Colorado children sample (Lovejoy *et al.*, 1990). Their results demonstrated that there is a strong correlation between weight and stature and that the source of differences between these two parameters is located within the developmental patterns of long bones. Similar patterns of growth were seen between the two groups, except for retardation in growth velocity in the first three years of life in the Libben population. This was attributed to a high level of infectious disease, as reflected by the many individuals with periostitis within this age group.

A study done by Saunders (1992) focused on subadult growth and investigated the practical problems associated with growth studies and comparison of different samples. Factors that complicate analyses include bone preservation and the lack of sufficient infant skeletal specimens in different populations. It must also be kept in mind that shorter stature may be due to genetic differences between groups and not the result of retarded growth patterns. Skeletal indicators of bone pathology may, however, be associated with smaller individuals in specific growth periods. Further research is required in this field to prove otherwise. It is unlikely that longitudinal growth studies of past peoples will ever be possible, but with the refinement of cross-sectional comparisons between modern and past data our understanding of growth related statures may become clearer.

2.3.2. Factors influencing growth

2.3.2.1. Introduction

Growth standards have been set up for many populations world-wide through normal growth studies that enable one to compare the growth of a single individual to a general standard in order to determine whether a child is growing to his/her optimum potential. If not, several factors may be investigated to determine the possible reasons for retarded growth.

Factors that are involved in creating individual and population variation in growth include genes, nutrition, climate, altitude, disease, socioeconomic status, migration and urbanization, as well as mental well-being. Differences related to these factors may determine the time of onset of maturation, as well as the extent to which an individual grow and mature (Bogin, 1999).

2.3.2.2. Genes

Genes influence growth by coding for hormones and their receptors that are responsible for growth patterns that take place at specific age intervals. Genes are also responsible for normal variation in growth patterns between individuals and populations. However, genetic interactions may be influenced by environmental factors, which may cause an increase or retardation in growth. Chromosomal variations or mutations, on the other hand, may cause abnormal growth and/or development, for example the lack of one X chromosome in females causes the individual to be very short and is known as Turner syndrome. However, most genes that influence stature are located on autosomal chromosomes and not on the sex chromosomes (Brook, *et al*., 1974).

Genetic make-up may also influence birth weight, infant and childhood stature, skinfold thickness and body fatness (Baker *et al*., 1992; Brook *et al*., 1975; Gloria-Bottini *et al*., 2001). Although studies based on specific genes are sparse, significant links have been made between certain genes and their effect on phenotypic variation.

Genetic make-up, however, may largely influence length at birth, growth rate from birth to 2 years and changes in growth rate. Growth rate may be affected by genotype-sex interactions as males were found to have a faster growth rate than females during puberty (Towne *et al*., 1993). These genetic influences on growth and stature are established through the formation and release of hormones that mediate the different growth processes. Variation in the release of these hormones is thus associated with stature differences. Specific hormones function at certain ages, for example the secretion of the luteinizing hormone that increases between the ages of 2 and 18 years (Towne *et al*., 2000). It is important to realize that many hormones associated with growth are almost exclusively under genetic control (Hong *et al*., 1996), but that these genes are subject to environmental interactions.

2.3.2.3. Nutrition

Nutrition is closely linked with growth as an adequate supply of amino acids, essential nutrients, water and lipids are necessary for normal growth processes to occur during childhood. Populations that experience food shortages often display growth delays and on average, children are shorter and lighter than in populations that have copious food supplies (Bogin, 1999).

Adult statures are also influenced by nutrition as growth delays occurring during childhood contribute to adult statures being slightly shorter compared to adult statures from nutritionally advantaged groups. The variation within a group may also be higher than the variation between groups (Bogin, 1999). Adequate nutrition enables individuals to grow to their full potential, which explains why there often is a greater difference between male statures from nutritional advantaged groups than there is between males belonging to nutritional disadvantaged groups. Females do not show such large differences in stature variation between nutritional advantaged and disadvantaged groups than do males (Tobias, 1972; Larsen, 1997).

The diet associated with hunter-gatherers is regarded as being of a high quality and variety, but low in quantity and food sources are often unreliable (Cohen, 1989). Arid desert conditions in which hunter-gatherers such as the Khoesan mostly resided may have led to them being undernourished and subjected to growth retardation.

Agricultural subsistence, on the other hand, provides higher quantities of food and more reliable sources, but often food is of a lower quality. It has been labelled to have been responsible for a decline in health of a population due to the limited variability causing malnutrition. In the past, meat was often scarce and maize formed the greater part of an agricultural diet (Cook, 1984; Goodman *et al*., 1984b), suggesting that the quality of food was poor. The agricultural diet was also influenced by variation in rainfall, climate, crop diseases and pests that might have lead to food shortages. Food quantity and quality influenced by these factors were responsible for variation in growth of children. During the months that adequate food supplies were available, growth was significantly faster in height and weight of children compared to a decline in growth experienced during the season in which food supply is low (Bogin, 1999). Although climatic seasons vary from region to region, growth trends of children from populations depending on an agricultural lifestyle are comparable and tend to show similar growth patterns.

2.3.2.4. Infection

Growth faltering may also result due to infection. High levels of infection during the first few years of life may significantly affect growth rates. Several studies have demonstrated the relationship between growth and infectious disease (Jantz & Owsley, 1984; Lovejoy *et al*., 1990; Mensforth, 1985). Growth rates and/or long bone lengths of populations exposed to undernutrition and infection were compared to modern growth references and all were found to display reduced rates of growth.

Infection and undernutrition may be linked in two ways. Poor nutrition may lead to a reduced capacity of the immune system to fight infection or infectious disease may lead to malabsorption of nutrients, elevated basal metabolic rate due to fever and/or protein catabolism for the production of immune-proteins (Tomkins *et al.*, 1983; Briend, 1990; Grimble, 1992). Diseases that are known to be influenced by nutritional status include, amongst others, tuberculosis, leprosy, malaria and intestinal parasites (King & Ulijaszek, 1999). The majority of diseases that may be linked to nutritional status are population density dependant, implying that people living in high density population groups are often more likely to be exposed to infectious disease.

Growth retardation associated with undernutrition and infectious disease may be present in a population for months or even years, depending on the severity of infection and the status of the nutritional environment. Stunting of children in such populations occurs within the first two years of life, after which growth continues as normal (Eveleth & Tanner, 1990).

2.3.2.5. Socioeconomic status

Soscioeconomic status (SES) is defined as the combined measure of a person’s economic and social position relative to other groups or individuals in the community, calculated by the occupation and level of education of the parents, family size and living space of the individual concerned (Bogin, 1999). There are three categories associated with SES: high, middle and low. The variables that determine the SES level which a group or individual belongs to include income, education, occupation and wealth (Malina *et al.*, 1981; Bogin, 1999).

Low income and little education are typically factors that place an individual within a low SES. Poverty is almost always linked to poor nutrition, high prevalence of infectious disease and illiteracy (Black, 1980; Spence *et al*., 1993; Grantham-McGregor *et al*., 2000), which contributes to a decline in health status of a population due to the lack of health care and knowledge concerning the treatment of disease and proper nutrition.

Children of a low SES are generally shorter in stature and of smaller body size than children of a higher SES (Malina *et al*., 1981; Bogin, 1999). The nutritional intake of children of a low SES is usually very low compared to children from a higher SES due to financial difficulty experienced by families earning a poor monthly income. A study performed by Tobias and Netscher (1976) focused on the decreasing femoral length of South African blacks over a period of five decades. They showed that the growth of femora of Zulu and Tonga individuals declined from early 1900's to mid 1900's. This negative secular trend was attributed to social and economic decline for these groups during the given time period.

Numerous other studies also reported the presence of a decline in mean adult stature during the 20th century of populations from various African countries (Burgess & Wheeler, 1970; Sharper & Saxton, 1969; Sharper *et al*., 1969). However, this is not true for hunter-gatherer populations from Africa. Several populations from Kenya (middle Africa) portrayed a negative secular trend during the first half of the 20th century (Sharper *et al*., 1969), while the Khoesan group from the Kalahari showed a positive secular trend form 1900 to 1973 (Tobias, 1962; Tobias, 1985). Although the reasons for a negative secular trend in several African populations were strongly linked to socioeconomic status, the reasons for the increase in mean adult stature observed in the Khoesan may be somewhat more complex. Socioeconomic status is clearly not the only factor influencing the occurrence of a change in mean adult stature and it is possible that this type of secular trend (whether positive or negative) is being oversimplified by ascribing it to only socioeconomic status.

2.3.2.6. Migration and urbanization

Throughout the world, urban areas of the 19th century were often subjected to crowdedness, poor sanitation and a high pathogenic load. There are several studies that show that during the 1800's children living in rural areas tended to be taller than children from urban areas (Malina *et al*., 1981; Meredith, 1979; Steegmann, 1985). This pattern, however, seems to have been reversed during the 1900's. Studies performed on children during the 1900's reported that urban living children were taller and heavier in weight than children living in rural areas (Bogin, 1999). This may be explained by numerous environmental changes affecting rural and urban areas that took place around the transition from the 19th to 20th century. The development of urban areas encouraged the migration of people living in rural areas to nearby cities, as these urban areas provided employment, health care and educational opportunities (Fogel, 1986; Tanner & Eveleth, 1976). The onset of migration to urban areas encouraged gene flow between populations, giving rise to changes in physiological, morphological and sociocultural aspects of the people involved (Bogin, 1999), and thus also enforced changes in the growth and development of individuals.

Evidence of urbanizastion during the 1900's would thus suggest the development of a positive secular trend in stature for those individuals migrating from rural areas to cities. Although this is the logical conclusion made on the subject, Tobias (1985) commented that a lack of information on the interaction between migration, urbanization and the occurrence of secular trends prevents one form understanding its combined effects on human growth and development.

2.3.3. Growth studies in an archaeological setting

2.3.3.1. Introduction

Growth studies and stature reconstruction have been used extensively by physical anthropologists to reconstruct the nutritional adaptation and growth patterns of past populations (e.g. Cohen & Armelagos, 1984; Mummert *et al*., 2011). The process of human growth is sensitive to environmental and economic change, as these factors may inhibit growth to a certain extent. Archaeological populations that display retarded growth in comparison to neighbouring groups are thought to have been subjected to a change in their economic and environmental circumstances.

It is, however, important to keep in mind that due to genetic make-up the populations' mean stature may reveal them to be shorter than individuals belonging to a different population. This suggests that although individuals belonging to a group with short stature or smaller body size, a relatively healthy lifestyle might have been in place (Seckler, 1982). Therefore, care should be taken when making use of growth studies alone to explain an archaeological population's health status.

Several problems and limitations exist when dealing with growth studies of immature skeletal remains which will be discussed in this section.

2.3.3.2. Estimating growth and stature in archaeological populations

Assessment of growth in immature individuals in an archaeological setting depends on skeletal measurements, such as long bone lengths, plotted against age which is determined by dental maturation (Steyn & Henneberg, 1996; Saunders, 2007). The data is then compared to reference samples based on contemporary populations.

There are, however, several problems and limitations associated with this methodology (Lampl & Johnston, 1996, Mummert *et al*., 2011). The first problem usually encountered deals with the preservation of immature skeletal material. Skeletal remains of infants and juveniles are often not as well preserved as that of adult skeletons, which makes it difficult to obtain accurate growth rates for the population (Saunders *et al*., 1993; Steyn & Henneberg, 1996).

The second problem deals with the difference of growth rates between males and females. Boys and girls do not follow exactly the same growth patterns, and since it is difficult and usually impossible to determine sex in juvenile remains, no distinction can be made between male and female data. Thus, pooling of data occurs which limits the accuracy of the research outcome (Armelagos *et al*., 1972; Sundick, 1978; Saunders, 1992; Saunders, 2007). Furthermore, the standards set for male and female growth rates are based on modern populations. When applying these modern growth and stature reconstruction methods to archaeological remains, one thus assumes that there is an isometric relationship between the modern and archaeological populations (Hens *et al*., 1998; Porter, 2002). If this relationship not fulfilled, the accuracy of the estimation will be decrease.

The accuracy of age estimation of skeletons also plays a role in determining growth. Dental development techniques are the most reliable methodology to use for age estimation. The problem comes in with the preservation of teeth in immature skeletons, as well as with normal inter-individual variability. A substantial number of studies only included individuals in which the teeth were available for analysis (Armelagos *et al*., 1972; Sundick, 1978; Lovejoy *et al*., 1990; Steyn & Henneberg, 1996; Saunders 1992).

When dealing with adult stature estimates in archaeological material, data appear to be more accurate and reliable than in the case of immature skeletons. Mature skeletons are often better preserved and in most cases the sex of the individual is evident. A study performed by Formicola (1993) compared the use of different formulae constructed for various modern European populations that have been used in the stature estimation of archaeological remains. In general, good results were obtained for stature estimates, with the exception of very short and very tall individual statures. Several formulae tended to underestimate the stature of very short individuals, as well as overestimate the stature of very tall individuals. When dealing with archaeological remains, it is important to keep in mind that variation between modern and archaeological population statures often plays a role in the accuracy of such calculations.

2.4. Dental health and pathology

2.4.1. Introduction

Teeth are protected by a hard outer layer of enamel that covers and protects the inner tissue known as dentine. This enamel layer may be impaired by a defective diet or infection, leading to caries, antemortem tooth loss, attrition or periodontal disease (Passmore & Eastwood, 1986).

There are many studies that deal with dental pathology and ways to reconstruct patterns in prehistoric diet (eg., Hillson, 1979; Walker & Erlandson, 1986; Lukacs, 1989; Lukacs, 1992). Lukacs (1989) classified dental diseases into four categories: infectious, degenerative, developmental and genetic. Infectious dental diseases include antemortem tooth loss, dental abscesses, caries, periodontal disease and pulp chamber exposure. These conditions arise due to pathogenic microorganism activity. The degenerative disease category focuses on antemortem tooth loss induced by attrition, periodontal disease, as well as calculus accumulation due to tartar. Fluorosis, amelogenensis imperfecta, microstructural defects, dental crowding, malocclusion, secondary dentine deposition and hypercementosis all form part of developmental diseases. The environment plays a crucial role in the occurrence of these developmental dental conditions. The last category (genetic dental disease) includes cleft palate, hypodontia, hyperdontia and malocclusion. The dental pathology profile of a population provides valuable information concerning diet, nutrition, food preparation and subsistence that helps to identify the degree of nutritional and other stresses within the group.

Lifestyle observations can be made from teeth by looking at occlusal dental wear, caries and antemortem tooth loss. Analyses of the dental health and pathology of past populations may provide valuable insight into the overall health, subsistence and social organization of a specific group (Iscan & Kennedy, 1989). Dental health is affected by processes such as dental caries, periodontal disease and dental wear. These occurrences seem to be more frequent in groups that have a high general use of refined sugar. Changes in dietary habits of a population can contribute tremendously to their dental health (Passmore & Eastwood, 1986). Numerous studies have been done on the reconstruction of diet and the vital role it plays in interpreting dental health and lifestyle of an archaeological population (e.g., Cohen, 1989; Lukacs, 1992; Morris, 1992; Sealy *et al*., 1992; Larsen, 2000; Wols & Baker, 2004). As teeth are often available in archaeological specimens and usually well preserved, it proves to be a relevant tool for investigation of health and lifestyle among past peoples.

2.4.2. Caries

Dental caries is recognized by focal demineralization of dental enamel and is classified as a disease process, rather than lesions invading the crown or root surface of teeth. Caries are produced by organic acids formed by bacteria when carbohydrates and sugar are fermented (Newburn, 1982; Larsen *et al*., 1991). This means that dental pathology, such as caries, may be linked to the acid/alkali balance in the oral cavity. A lack of oral hygiene promotes the formation of caries due to the persistence of this acidic medium in the mouth and thus the development and presence of caries are influenced, not only by diet, but also by hygiene (Hillson, 1979; Morris, 1992). The oral cavity provides a favourable environment for the sustainment of bacteria as saliva serves as a nutritional source for bacteria operating in the mouth (Madigan *et al*., 2003).

Another factor contributing to the formation of caries is the presence of plaque. Plaque is deposited on the surface of teeth every day due to the intake of food and it contains various species of bacteria (Hillson, 1998; Holm, 1990). The presence of two species of bacteria has been implicated as causative agents in dental caries, which are *Streptococcus sobrinus* and

Streptococcus mutans, both lactic acid-producing organisms. *S. sobrinus* is capable of forming colonies on smooth tooth surfaces, making it the primary culprit in the formation of caries. *S. mutans* is more commonly found in crevices between teeth and small fissures, but may also attach to the smooth surface of teeth (Madigan *et al*., 2003)

This disease process is influenced by tooth crown morphology and size, occlusal surface attrition, food texture, age, nutrition, systemic disease and the presence of fluoride or other geochemical factors (Leverett, 1982; Milner, 1984; Powell, 1985; Hildebolt *et al*., 1988). It is the most frequently found dental disease and affects people of all age groups and socio-economic statuses.

The shift from foraging to a farming lifestyle in ancient and historic populations has had a major influence on the diet of populations. A decrease in the diversity of food occurred, as well as a large increase in the amount of carbohydrates included in the diet (Larsen, 2000; Cohen, 1989). Several studies show an increase in caries and antemortem tooth loss frequencies with agriculture (Powell, 1985; Schneider, 1986; Lukacs, 1992; Hillson, 1998). For example, Turner (1979) determined average frequencies for decayed teeth in three groups. Foragers had only 1.7% of teeth decayed, while mixed foraging and agriculture displayed an average of 4.8% decaying teeth. Purely agricultural groups showed the highest percentage of decayed teeth (8.6%). Antemortem tooth loss was more common in individuals suffering from caries, which indicates that teeth may be lost due to decay or abscessing.

The fluoride content in drinking water may also affect the frequency of dental caries in a population due to the fact that fluoride plays a role in the protection of teeth against caries. Optimal intake of fluoride decreases the solubility of dental tissue and therefore aids in slowing down the formation of caries (Holm, 1990; Larsen, 1997; Van Loveren & Duggal, 2001). However, the intake of too much fluoride may cause fluorosis of teeth, which is a condition marked by white or brown stains on the teeth, which may or may not be accompanied by pitting of teeth (Roberts & Manchester, 1995; Singh *et al*., 1962).

When recording caries, it is important to distinguish between true caries and areas which had been discoloured or darkened. In order to perform a study on dental health in a population, it is vital to know the number of teeth present in the group so that caries prevalence rates can be determined as a percentage of the number of teeth. The prevalence of caries in males and females sometimes differ, and may cause implications for dental health studies as this difference is not always present. Also, a difference in the prevalence of caries between males and females may imply that the diet of males and females differed (Roberts & Manchester, 1995). A study by Lukacs & Largaespada (2006) suggests that higher frequencies of caries may be found in females than in males due to, not only differences in food intake and frequent snacking amongst females, but also due to earlier eruption of teeth in girls giving rise to longer exposure of teeth to cariogenic oral environment and also, due to pregnancy and life-history. It is thus suggested that a greater understanding of the underlying causes of sex differences in caries rates is needed before interpreting the reasons for variation in caries frequency between males and females, since these causes may very often be population specific.

2.4.3. Antemortem tooth loss

Antemortem tooth loss (AMTL) is classified as a non-specific dental disease indicator and may be caused by several factors, including caries, attrition, trauma, intentional tooth extraction or periodontal disease (Roberts & Manchester, 1995; Hillson, 1998). It is, however, difficult to distinguish between these causes, making it impossible to assign a specific cause to a case or population (Morris, 1989).

Intentional extraction of teeth is found in certain population groups, such as the "Cape Coloured" people. The removal of the anterior teeth (incisors and canines) is performed for cultural purposes and is often referred to as the "passion gap" or Cape Flats smile amongst the people of the Cape (Allen *et al*., 1990). Cultural performances such as this are regarded as ritualistic and characteristic of a specific group. Reasons for the pulling of teeth include gangsterism, peer pressure, fashion and removal due to accidental damage to teeth (Friedling & Morris, 2007).

AMTL is especially high in prehistoric and historic populations, partly due to poor dental health (Walker, 1978). For example, Hartnady and Rose (1991) found that AMTL was abnormally high in an archaeological sample from the Lower Pecos region with 46% of teeth lost. They concluded that this was due to a diet high in carbohydrates which promoted caries, resulting in early tooth loss. Later Stone Age archaeological skeletal samples from southern African have also been found to portray abnormally high frequencies of AMTL similar to other hunter-gatherer archaeological groups, such as that of the Lower Pecos region.

There are several Later Stone Age skeletons that have been found to portray AMTL and other dental pathology (Morris *et al*., 1987; Jerardino *et al*., 1992; Sealy *et al*., 1992). A skeleton excavated at Snuifklip, Vleesbaai, showed a significant amount of AMTL. This is surprising, as one would expect to find an overall healthy dental condition in the individual, as a lifestyle of hunting and gathering is suspected. The high caries and AMTL observed may suggest that a lack of fluoride in the diet or drinking water along the coast caused the teeth to be more vulnerable to decay, leading to AMTL (Morris *et al*., 1987). Severe attrition caused by unrefined food containing abrasive material may also lead to AMTL (Steyn, 1994; Scott *et al*., 2006). AMTL may thus result as a consequence of one or more environmental factors and/or the presence of poor dental health.

2.4.4. Attrition

Dental wear is the process by which the hard tissue of teeth is eradicated through mastication and is classified as a physiological process. However, attrition can also indicate pathology if dental wear is caused by something other than normal mastication of food, i.e. abrasive or chemical/erosive material (Auferheide & Rodríquez-Martín, 1998). Attrition may provide information regarding the diet and possible methods of food preparation employed by a population. Such information is useful in reconstructing biological and cultural evolution of a group.

The amount of wear on teeth often indicates a younger or older age, as well as the presence of sand/grit in the food. Wear due to diet is often seen on the posterior teeth, rather than the anterior teeth. Hunter-gatherer groups often have more wear on the anterior teeth due to the use of teeth for alternative purposes to chewing, for example using the incisors as tools (Smith, 1984; Larsen, 2000; Cohen, 1989). Smith (1984) investigated the systematic differences between hunter-gatherer and agriculturalist molar wear. Hunter-gatherers showed more evenly distributed wear on all molars, where as agriculturalists had a more restricted wear pattern and tended to develop oblique wear planes. The flatness of molar wear can thus be a good indicator of change in food and food preparation. This indicates that there are clear differences in attrition between groups, time periods and geographic locations.

2.4.5. Periodontal disease

Periodontal disease is one of the most common dental diseases in both past and modern populations. As calculus accumulates around the teeth and bone of the maxilla and mandible, periodontal pockets are formed which is an important factor in the development of periodontal disease. This may initiate inflammation of the soft tissue and bone, followed by resorption of the bone, exposing tooth roots. Eventually, tooth loss may also occur (Hillson, 1986).

It has been suggested that periodontal disease is over diagnosed in skeletal material, as a number of factors may contribute to increased tooth loss. These factors include attrition, caries and postmortem damage which may be mistaken for loss of bone around the roots of teeth. Therefore, caution should be taken when diagnosing this disease (Roberts & Manchester, 1995).

The presence of periodontitis has been recorded for a skeleton as old as three million years old (Lavigne & Molto, 1995), and is a condition often recognized in modern studies dealing with ancient remains. Periodontitis is usually recorded in a generalized form, although there are several causes that may lead to only localized periodontal disease (Aufderheide & Rodríquez-Martín, 1998). However, it is almost impossible to distinguish between different forms of periodontitis in skeletal remains, as important clinical diagnostic information is lacking. Recording the prevalence of periodontitis may still provide valuable information regarding dental health and cultural practices, regardless of whether the condition is localized or generalized.

2.4.6. Periapical abscesses

A dental abscess results due to infection of the pulp cavity of a tooth which becomes exposed due to caries or periodontal disease. Inflammation is caused by pyogenic bacteria that generate pus which then accumulates in the pulp cavity, often forming a sinus to allow drainage. When this stage is reached, the abscess can be identified archaeologically (Roberts & Manchester, 1995).

Acute periapical lesions are the most common form of abscesses found in skeletal material. These lesions usually subside with sufficient drainage of pus in the living individual. Acute periapical inflammation may become chronic if the lesion remains inflamed. Inflammation is then followed by the formation of granulation tissue around the root apex. As this mass of tissue grows, bone resorption continues to take place, increasing the size of the bone cavity (Hillson, 2000).

Periapical abscesses may be observed as either unhealed or healed. The margins of a healed abscess will be smooth and similar to the surrounding bone, whereas an unhealed abscess may show irregular margins with some degree of pitting surrounding the sinus (Mann & Hunt, 2005).

2.4.7. Amelogenesis imperfecta

This condition is classified as an inherited abnormality of teeth affecting the development of enamel. A minimum of 16 forms of this genetic defect is recognised which makes exact classification difficult, as it depends on the pattern of inheritance, as well as on the appearance of the enamel, i.e. smooth, rough or pitted (Cawson & Odell, 2002). Structural defects that are associated with the enamel crowns in this condition include features such as hypocalcification, hypoplasia and hypomaturation. However, the dentine and pulp remain normal. Both deciduous and permanent dentitions can be affected (Cawson & Odell, 2002; Giunta, 1989).

Three main types and patterns of inheritance exist for amelogenesis imperfecta, of which the first is the hypocalcified type. This type is the most common and is inherited through an autosomal dominant pattern. Teeth affected by this type are of normal size and shape, but the enamel is often affected by hypoplasia and is rapidly lost by attrition or abrasion due to poor mineralization in the developmental process. Dentine exposure is common in this form of the condition (Soames & Southam, 1993).

The second type is known as the hypomaturation type and is recognised by opaque, mottled or brownish-yellow to white teeth. Enamel may also be largely affected by attrition, but not to the extent found in the hypocalcified type. Two inheritance patterns exist for this type: autosomal recessive and X-linked forms (Soames & Southam, 1993).

Hypoplastic types of amelogenesis imperfecta are either autosomal dominant, autosomal recessive or X-linked. A defect in the formation of the enamel matrix mainly results in this type of the condition (Cawson & Odell, 2002; Soames & Southam, 1993). Considerable variation is seen in this type which often makes clinical classification very difficult. Enamel often has a rough appearance with pitting, irregular grooving and/or wrinkling. In some cases, the crown appears as a sharp cusp with a thin layer of hard enamel (Soames & Southam, 1993).

Developmental defects of enamel are often difficult to diagnose correctly in skeletal remains as clinical data is unavailable. The occurrence of amelogenesis imperfecta in archaeological remains is often associated with other conditions such as linear enamel hypoplasia or fluorosis (Littleton & Townsend, 2005). Therefore, it is important to make a differential diagnosis in such cases as adequate evidence for making a specific diagnosis is usually lacking.

2.5. The Khoesan of Southern Africa

2.5.1. Origins

Pre-colonial contact phase

The Khoesan is believed to be the oldest group of people residing in Africa amongst all surviving groups today. In ancient times the Khoesan occupied vast areas of Eastern and South Western Africa. However, their numbers have greatly diminished through time and today they are found almost exclusively in southern Africa. Excavations throughout Africa showed that people with skeletal features similar to that of the Khoesan inhabited Africa during prehistoric times. Archaeological sites (both inland and coastal) that provide records supporting the presence and distribution of Later Stone Age people include, amongst others, Elandsbay Cave, Steenbokfontein, Melkhoutboom, Klasies River Cave, Blombos, Taung and Sterkfontein (Tobias, 1978a; Smith *et al*., 2000; Mountain, 2003). These sites are classified as Later Stone Age sites.

Characteristics of the Later Stone Age include the use of ostrich egg shell beads and amulets as jewellery, the making of specialized equipment for hunting and fishing, formal graves for burying the dead and a range of tools used for making artifacts (Deacon, 1984).

Later Stone Age peoples, who are believed to be the ancestors of the modern-day Khoesan, have resided in southern Africa for many thousands of years as hunter-gatherers. The Later

Stone Age period dates back to about 22 000 years and continue to about 2000 years ago. It is marked by the flaking of stone to produce tools, but with more refinement and of smaller size than that of the Early and Middle Stone Age. Bone artefacts, eggshell beads, bows and arrows, rock paintings and engravings surfaced during this period (Mountain, 2003). There are numerous Later Stone Age sites throughout the Western Cape that depicts the Khoesan's way of life. The Matjies River Rock Shelter is one such site. It was estimated that the shelter began to be occupied by Later Stone Age people around 12 000 years ago and they continued to reside there until about 2000 BP. The shelter became well known for the large amounts shell midden deposits, several human skeletons, as well as various stone tools and eggshell jewellery that were excavated (Deacon, 1999; Mountain, 2003). It is estimated that the total number of individual skeletons excavated from the site ranges between 40 and 120. These skeletal remains form the largest collection of Later Stone Age material available in South Africa and are thus of immense value (L'Abbé *et al*., 2008; Sealy, 2006). This site is one of many that demonstrate the typical way of life of these hunter and gatherer people and gives archaeologists and physical anthropologist the opportunity to perform lifestyle investigations into these early Holocene inhabitants of southern Africa.

Hunter-gatherers were forced to take advantage of every opportunity that could possibly provide essential resources, as they were subjected to constant climate and environmental change. Some groups became inland hunters, while others settled to be coastal foragers. Inland hunters were very knowledgeable regarding plants and its use for food and medicine. As many as 25 plant species have been identified at the Elandsbay Cave archaeological site (Mountain, 2003), with several other sites also yielding evidence of plant use. Antelope were the main source of protein and were hunted by the men, while the women and children gathered plants. Coastal foragers, on the other hand, lived predominantly on fish, shellfish and other marine animals. Many of these coastal dwellers resided in caves and consumed marine, as well as terrestrial animal food sources (Smith *et al*., 2000). This suggests that hunter-gatherers consumed a much varied diet rich in nutrients that contributed immensely to their health and well-being, although at times these food sources were unreliable due to climatic changes.

Pastoralism provided a more reliable way of obtaining food and started with the domestication of animals. The first domesticated animals of Southern Africa appeared about 2000 years ago (Smith *et al*., 1991) and subsequently, many Khoesan groups were introduced to pastoralism by their neighbouring black groups. Little is known about the origins of pastoralism, but evidence suggests that one of the earliest herding economies was established at around 1950 BP at Die Kelders on the southern coast of the Cape Province, South Africa (Schweitzer, 1974; Mitchell, 2002). During this time period, pastoralists were concentrated along the larger rivers in southern Africa, while hunter-gatherers occupied the vast regions between the rivers. Khoesan pastoralists were, without doubt, present in the lower and middle Orange River area, although it is not clear from which time period they had started to occupy the region (Morris, 1992). This led to the formation of different economic groups within the Khoesan spectrum.

Before the arrival of the European colonists in the Cape, the Khoesan hunters and herders had already come in contact with other black African groups on various occasions and although conflict broke out between these groups, trading and intermarriage occurred. The Khoesan were often employed by especially the Xhosa people as rainmakers and teachers of fauna and flora. The relationship between the Khoesan and other black groups were complex, as it ranged from cooperation and mutual dependence to conflict and war. Khoesan people were absorbed into Bantu-speaking groups, and often they were used as stock raiders by Sotho chiefs, placing them in disfavour with other groups. If they resisted in cooperating with the Sotho chief, they were regarded as outcasts or destroyed (Smith *et al*., 2000). Situations such as these forced the Khoesan to retreat into areas where the land was not yet occupied by black agro-pastoralists.

Colonial contact phase

With the arrival of the European colonists in the Cape of Good Hope, the Khoesan was at first described as “Strandlopers” or “Watermans” and was soon regarded as people earning a low income. These small hunters and herders of the Cape initially had a good reputation as they were said to have offered honey and dried fish to Dutch travellers that came across their path (Inskeep, 1978). As the number of colonists increased in the Cape, conflict was bound to happen, as land needed to be shared between these two culturally very different groups. The herders of the Cape (Khoekhoen) were the first to be affected by the intrusion of the Dutch colonists. Van Riebeeck and his men started trading metal for cattle, which created a relationship to the advantage of both groups. However, the land inhabited by the herders was still threatened by the ongoing arrival of new colonists and they started driving hard bargains for their cattle. Subsequently, the Dutch built their own farm areas and started breeding cattle which the Khoekhoen regarded as a serious threat. Not only were they losing land, but they were also losing business. Tension between the herders and the Dutch led to the first serious conflict in 1659, where the Khoekhoen "confiscated" seven of the Dutch East India Company's oxen to demonstrate their disapproval of the colonists' farming actions. As tension between the Company and the herders persisted, the legal system of the Cape steadily evolved to apply more pressure on the Khoekhoen and deprive them of access to land, as land may only have been owned by Dutch colonists (Mountain, 2003). Slowly but surely the herders of the Cape were driven more inland and away from the coastal areas of the southern Cape region.

The Khoekhoen (otherwise referred to as the "Hottentots") were regarded as cattle thieves as they could not be trusted by the colonist farmers. This hostile relationship persisted from 1657 and continued throughout the next two and a half centuries (Van der Merwe, 1938). The "Bushmen" (hunters), however, had somewhat less contact with the Dutch during the 17th century, during which their relationship with the "Hottentots" was mostly trading orientated. As the herders migrated towards inland areas, the "Bushmen" and "Hottentots" allied themselves with one another to pose more resistance to the Dutch colonists (Smith *et al*., 2000). The expansion of the Cape northern frontier predicted devastation for the Khoesan people of the interior, as their social system and independent existence were threatened. Many of them were already impoverished and had no choice but to adapt to the colonists' way of life (Marks, 1972; Penn, 2005). Many Khoesan people were taken as slaves by the Dutch farmers and were forced to live an agricultural lifestyle, with all their needs provided by the farmer. These slaves then formed the lower social class of the community. The majority of slaves taken by the colonists were children as the Dutch believed that the younger the slave, the easier it would be to adopt the European culture. Therefore, the children of the adult slaves were taken away from the parents to be raised by missionaries or neighbouring farms (Smith *et al*., 2000).

Conflict had also arisen between the black slaves and the Khoesan slaves, as the Khoesan did not accept black slaves imported from the west coast of Africa because that meant a decrease in working opportunities for them (Schoeman, 2007). This suggests that the Khoesan had to adapt their culture in more than one way to survive and be sociably coherent with both black and white groups, as no peaceful coexistence could be kept while keeping their culture unaltered.

The northern frontier of the Cape Colony began to open at the beginning of the 18th century, meaning that the zone was leaning towards a balance of power between all parties competing for land and resources. This balance was reached by 1800 due to the war that raged between the colonists and Khoesan between 1770 and 1800. The Khoesan were able to create resistance against the colonists and forced many of them to abandon farm areas in the region of the Northern Cape frontier. In the meantime, the Cape government came to realise that they need to recognise the Khoesan as a group of people with rights to land and resources and instituted such rights by the Hottentot Proclamation of 1809, which signalled that the new British government of the Cape intended to recognize the Dutch colonists' subjugation of the Khoesan people and facilitate the process of giving equal rights to both parties (Penn, 2005).

After 1828 the Khoesan living within the boundaries of the Cape Colony were subjected to Ordinance 50, which meant that they were classified as free persons and could work for farmers out of their own will. Many, however, remained beyond the borders of the Colony, surviving against the odds (Smith *et al*., 2000). The southward movement of Mzilikazi's tribes to the Cape and their inland movement to the high veld during the 1820's caused many other groups, including the Khoesan, to flee these areas (Edgecombe, 1991), once again placing pressure on the Khoesan people. This caused them to migrate deeper inland and into the Kalahari desert and other areas of Botswana. There are, however, some populations in the Kalahari that are not refugees from other areas, but have been living there for hundreds of years (Lee, 1979; Mountain, 2003). The 19th century proved to have brought an end to much of Khoesan independence in southern Africa, but none the less they remained fighting for their culture, land and rights.

As the science of anthropology and osteology evolved during the 19th century, the immense value of human skeletal remains was recognised. The collection of skeletal material in South Africa was sparked by the 1905 visit to the country by the British Association for the Advancement of Science (BAAS) which stimulated physical anthropological research on African remains. It had not been long before physical anthropologists and museum curators recognised the biological qualities and cultural treasures of the Khoesan people (Legassick & Rassool, 2000).

Towards the end of the 19th century and the beginning of the 20th century, the trafficking of Khoesan skeletal remains became a very popular activity in the Cape Colony. Louis Peringuey, the director of the South African Museum, shifted his focus largely to research on the Bushmen after the BAAS visit in 1905. His research kicked off with the production of plaster cast models of live Bushmen from the Northern Cape. Shortly after, he began to collect skeletal samples of the Khoesan people. This caused other institutions to do the same and lead to a dramatic increase in the collection of such remains. As the demand grew and skeletal remains were sold to institutions and collectors, more and more illegal activities came to light. In order to obtain as many skulls and complete skeletons as possible, Peringuey began offering great amounts of money to the magistrate of Namaqualand regarding the finding of specimens, to which he warmly responded and so the trade for human remains started (Legassick & Rassool, 2000). Paying for remains further sparked the competition between institutions. Another source of competition was one George St Leger Lennox ('Scotty Smith'), a thief and opportunist from Upington, who accidently discovered the market for human remains and made use of the opportunity to scavenge for specimens and then sell it to the McGregor Museum (Metrowich, 1970). At this stage Dr Rudolf Pöch, an Austrian anatomist, was already in South Africa and it had become known that he and Scotty Smith had met.

Pöch arrived in Kimberley during May 1909 after being granted permission and support by the South African government to embark on an expedition to study the Khoesan. Pöch travelled slowly through the Northern Cape and Kalahari regions, taking photographs, recording dialects and staying with certain groups in order to document their lifestyle. He created the image that he is only interested in studying and documenting the lives and culture of the Khoesan, but the central feature of his work involved a large collection of skeletal remains shipped to Vienna, Austria. His intense research on the Bushmen gave him the image of a lone and heroic researcher who did remarkable work in the field of physical and cultural anthropology. Pöch's research was later described as one of "systematic grave robbery" and of "clandestine deals for newly dead corpses in the name of science" (Legassick & Rassool, 2000, p.12). He also surrounded himself with fellow researchers and assistants to help him with the acquisition of the skeletal remains and this contributed to the intensity of the struggle between South African museums to each acquire their share of Bushmen remains (Legassick & Rassool, 2000).

The export of Khoesan skeletal material was neither supported nor stopped by the government at the time and no law was intact preventing illegal trafficking of Khoesan remains (Legassick and Rassool, 2000). This resulted in hundreds of Khoesan skeletons being curated into South African museums, as well as being exported to various European countries.

The Khoesan today

In modern times the Khoesan people continue to fight for first people status and with the establishment of the National Khoi-San Council in 2001 gained an official mechanism through which constitutional privileges can be negotiated. Today, many Khoesan individuals are commingled with Cape coloured groups, although about 50 000 people still reside in the Kalahari region of Botswana (Hitchcock, 2002). Many Khoesan argue for the repatriation of their ancestral remains, as well as for fair representation by the media to raise awareness of their current status and heritage. Their primary objectives are to regain their independence and cultural freedom (Mountain, 2003), as well as to be politically recognized and represented (Hitchcock, 2002).

2.5.2. A reference to names

Some confusion exists regarding the terms "Khoesan," "San," "Bushmen," "Hottentot" and "Khoekhoen" or "Khoikhoi." The name "Khoesan" is used as a biological term by scientists to distinguish these hunter-gatherers from neighbouring black or farming groups. This term may also refer to a group of "Bushmen" and "Hottentots" who were forced to live together due to political marginalization enforced by the expansion of the Dutch colony in the 17^{th} and 18^{th} centuries (Booyens, 1980; Smith *et al*., 2000).

"San" refers to the hunter-gatherer groups, i.e. people who did not own any livestock and did not practice any form of farming. The name was given to the hunters by the Khoekhoen of the Cape and means "different people from ourselves." The Khoekhoen (Khoikhoi) people, also referred to as Hottentots, were herders and the San were often classified as being inferior to them (Boonzaier *et al*., 1996; Booyens, 1980; Smith *et al*., 2000). It is important to mention that these names are based on cultural, and not biological differences.

"Bushmen" is the name given to the hunter-gatherers by the Dutch settlers during the 17^{th} century (Smith *et al*., 2000). The name may also refer to people who speak the San languages (Tobias, 1978b).

2.5.3. Health among the Khoesan

2.5.3.1. Nutrition

Hunting and gathering have been the main activity by which the Khoesan obtained food sources for many thousands of years. The foraging system includes not only the gathering of plant foods and/or meat, but also reflects the organization of people around food preparation and the allocation of labour associated with certain activities. The division of labour is universally based on sex; the men hunt and gather, while the females primarily gather and prepare the food. The consumption and distribution of food resources is almost always shared between families within a group in order for each member belonging to the band receiving an equal share of the feast (Lee, 1979).

Until quite recently, small groups of San in the Kalahari maintained an independent foraging lifestyle. Their diet typically included wild vegetables, hunted meat and plants. Not only was such a diet highly variable, but surprisingly rich in nutrients (Cohen, 1989). The Khoesan possessed an intimate knowledge of their natural environment and collected a surprisingly broad spectrum of edible plants, which included fruits and nuts, berries, edible gum, roots and bulbs, mushrooms, leafy greens and beans. Species that were regularly hunted include warthog, gemsbok, kudu, steenbok, duiker, hare, eland and game birds (Lee, 1979). The Khoesan's diet was thus considered to be mixed, which should have protected them against malnutrition. However, a shortage of sufficient caloric intake due to the unreliability of food sources was regarded as the Khoesan's nutritional weakness during the time that they maintained such a lifestyle (Truswell & Hansen, 1976).

Studies performed on hunter-gatherer groups reveal that such groups of people worked very hard to acquire food and resources, yet their health status was rather good (Larsen, 2000). The quality of their diet was rated as successful, but the quantity and reliability of obtaining food raised some concerns. Seasonal weight loss did occur, due to dry seasons and winter months during which food sources were scarce (Cohen, 1989). An interesting point that should be noticed is that adult male and female weights did not increase with age past the age of 40 years. This is, however, not the case in western countries, where weight continues to increase with age until 55 to 65 years of age on average (Lee, 1979). Also, heart disease, high blood pressure and obesity were found to be scarce or absent among the Khoesan (Truswell & Hansen, 1976). This may be attributed to low levels of animal fats within their diet.

The San's characteristically distended bellies do not necessarily reflect malnutrition, but rather high gut volume (Cohen, 1989), as food is stored minimally and usually consumed within 48 hours of arriving at the camp. However, if a hunting session provided a large amount of meat, strips may be dried as biltong and stored. The main reason for lack of food storage is not only the absence of storage facilities, but the practice of food sharing between members of a group (Lee, 1979). Such practice promotes the consumption of fresh resources, aiding the promotion of good health among the Khoesan.

2.5.3.2. Infection and bone pathology

Hunter-gatherer Khoesan groups generally were in good health. This is mainly due to separation from populations of the outside world and low population density experienced within groups. Sanitary conditions were also good, partly due to their frequent migration from one campsite to another. These shifts prevented the accumulation of bacteria and possible pathogens, decreasing the risk of infection (Tanaka, 1980). Another factor contributing to good hygienic conditions involves sanitary rituals performed by the Khoesan. These include defecating into the sand some distance from the camp, which allows for feces to be dried up rapidly by the sun, preventing the growth and spread of pathogens (Silberbauer, 1965).

It has been reported that tuberculosis is common amongst the San and other contemporary hunter-gatherer groups (Cohen, 1989; Truswell & Hansen, 1976). This disease, however, have been reported to be more severe during the 1900's than previously documented (Cohen, 1989). Non-venereal syphilis was also found to be common in the San. Apart from diseases, the San was also subjected to injuries due to accidents and animals while pursuing food and hunting. Fractures, sprains and dislocations sometime occurred (Tanaka, 1980).

Truswell and Hansen (1976) studied living !Kung in northwestern Botswana and reported that lumbar lordosis, tuberculosis and syphilis were common in this group. Heberden's nodes and osteoarthritis were sometimes noticed in elderly individuals. Healed injuries and amputations were also present in hunting male individuals.

A health study performed on foragers of the Later Stone Age in Southern Africa yielded interesting results (Pfeiffer, 2007). The skeletal sample included specimens from Matjes River Rock Shelter, as well as other locations throughout the Cape. No cases of severe infection were noted, except for one adult male who presented with a pervasive hypertrophic bone condition of unknown cause. Eburnation, however, was seen in about 4% of adults. Healed fractures were present in 8% of adult individuals, but were absent among infant, juvenile and adolescent remains. Among the juvenile remains, only one showed signs of porotic hyperostosis. Cribra orbitalia was more common, with 30.2% of juvenile crania examined affected. Growth arrest lines were seen mostly in juveniles between the ages 3 and 12 years. Of the specimens that presented with cribra orbitalia, nine also presented with growth arrest lines, indicating that there appears to be a relationship between the two features (Pfeiffer, 2007). These results are comparable to the Iron Age sites at K2 and Mapungubwe (Steyn & Henneberg, 1995) which yielded similar trends in the incidence and age-range of cribra orbitalia. Growth arrest lines, however, proved to be common in the 13-20 year age group of K2, whereas lines were found to be more frequent at a younger age in the Later Stone Age foragers of the Cape. It should, however, be noted that recently the meaning of these growth arrest lines has been questioned (Alfonso-Durruty, 2011; Papageorgopoulou *et al.*, 2011). Growth arrest lines, also known as Harris lines have been shown to be an unreliable indicator of stress (Alfonso-Durruty, 2011), as well as correspond with normal growth spurts (Papageorgopoulou *et al.*, 2011).

2.5.3.3. Stature and body size

Pfeiffer and Sealy (2006) demonstrated that Holocene skeletons from the Cape Ecozone had statures similar to that of modern Khoesan people. Mean statures for both males and females of previously documented Khoesan specimens fall within the range of relatively short adult modern humans. They hypothesized that small-bodied foragers of the Cape experienced a decrease in growth from 3000 to 2000 BP, and then their stature increased again after 2000 BP. They stated that their consistently reduced statures may be linked to the amount of food available, and not to the type of protein or food exploited.

Wilson and Lundy (1994) also proved that statures of prehistoric San of the south-western coastal region of South Africa are similar to that of modern San. They also stated that Khoesan specimens estimated to be shorter than 150 cm were found to have lived between 2000 to 3000 BP. The Kouga mummy were estimated to have been from this period and had a stature of about 145 cm (Steyn *et al.*, 2007), which supports the hypothesis that foragers of the Cape experienced decreased statures during the given time period. Sexual dimorphism was also evident, but the difference between male and female skeletal samples was not large enough to be statistically significant. However, a study by Kirchengast (2000) showed a significant difference between the stature of males and females of a northern Namibian sample and linked a greater stature to larger body size and more successful reproduction.

The !Kung San people appear to the outside eye to be small and gracile. The mean height of !Kung men between the ages 15 and 83 was estimated to be 160.92 cm with a range of 141 cm to 175 cm. The mean height for females (aged 15-75 years) was estimated to be less at 150.14 cm with a range of 139.5 cm to 159 cm (Truswell & Hansen, 1976). This data correlate with below 'normal' statures for adult modern populations. The average body weight measured among the Khoesan also proved to be below the desirable weight in relation to height as compared to US standards (Truswell & Hansen, 1976). Various explanations have been proposed as to why they are so small. The San's reduced stature may be due to chronic semistarvation, but others believe their height-weight ratio fits that of people living in hot, dry conditions (Lee, 1979). Tobias (1961, 1964) concluded that Khoesan built and stature are adapted for strenuous hunting conditions and is shaped by genes, not exclusively by environmental conditions.

Tobias (1962) reported that a positive secular trend in Khoesan stature exists. The increase in stature over time has been demonstrated by comparing data from earlier studies (Werner, 1906; Kaufmann 1910; Seiner, 1913) to more recent studies based on Khoesan stature (Toerien, 1955; Bronté-Stewart & Brock, 1960; Wells, 1960). Three Khoesan groups were examined: Northern, Central and Southern groups. An increase in stature was observed in all three groups. Possible reasons for this apparent increase in the Khoesan population was attributed to better nourishment and improved environmental conditions, irrespective of genetic make-up or genetic differences between populations. It has also previously been reported that Khoesan individuals grow taller when better nourished than otherwise expected (Wells, 1960). However, more evidence is needed to determine the exact pattern of nutrition during the past century that contributed to the steady increase in Khoesan stature.

A study performed by Cameron (1991) on the growth and nutritional status of a sub-Saharan African sample provides some information regarding subadult growth patterns of populations living in poor economic conditions. Three life phases were included: birth to five years of age, childhood and adolescence. About 40% of infants suffered from mild to moderate malnutrition. Malnutrition, however, increased to 50% with the onset of adolescence. The outcome of this pattern suggests that adult heights are below average and that the greatest amount of stature retardation takes place during adolescence, which is normally the period in which the largest amount of growth in body height takes place (Cameron, 1991).

2.5.3.4. Dental health

The amount of occlusal wear and dental health of three recent archaeological samples from Riet River, Kakamas and Griqua areas were studied by Morris (1992). The results showed that occlusal wear increased with age and that generally the anterior teeth had worn down more, relative to the posterior teeth. Individuals over the age of forty showed large amounts of attrition on all teeth, except the third molars, while the incisors were most affected. The Griqua group had much less dental wear than either one of the other two groups. This rate of attrition is similar to that of the San from Botswana and rural South African black populations.

Dental health in sub-adult individuals was considered to be very good, with no caries or antemortem tooth loss noted. In Riet River populations, caries are frequent in younger adults, with over 50% of individuals affected. This is not the case, however, in Kakamas populations: caries are rare with only 25% of younger adults affected. Younger adults of the Griqua populations display a slightly higher frequency of caries with almost 50% of individuals affected. Older adults in all three groups have a lower frequency in caries, but a higher frequency of antemortem tooth loss, indicating that loss of teeth occurred due to the presence of caries. The overall dental condition of the Kakamas teeth is consistent with a hunter-gatherer diet, whereas that of the Riet River people are more complex and difficult to interpret.

Evidence of the Kakamas individuals' lifestyle suggests an essentially hunting style with some pastoralism, yet the caries frequency is high. This may be explained by ground water levels in the area containing insufficient fluorine, which is essential for protection of teeth against decay. Lastly, Griqua dentitions are consistent with a diet of mixed foods (agricultural and pastorial). These findings are similar to the dental health of other hunter-gatherer and/or farming groups from Oakhurst (George), the Eastern Mediterranean, South Asia, Illinois, the Ohio River Valley, Georgia and Equador (Buikstra, 1984; Cassidy, 1984; Kennedy, 1984; Larsen, 1984; Ubelaker, 1984; Smith *et al*., 1984; Patrick, 1989).

Sealy and colleagues (1992) also performed a study on diet and dental caries among Later Stone Age inhabitants of the Cape Province (South Africa), in which they compared Holocene skeletons from the western coastal Cape region, a group of skeletons from Faraoskop (inland from Elandsbay) and those of Oakhurst (southern Cape). Data on dental caries revealed that 2.6%, 8.7% and 17.7% of teeth were carious for the three groups respectively. The high incidence of caries in these three groups may possibly be attributed to the low fluoride content of the water in the Cape region. Areas with relatively high fluoride content in the ground water have been linked to a lower incidence of caries in the population groups that have occupied the region, such as the Northern Cape and Kalahari regions (Van Reenen, 1966; Morris, 1984).

These and other related studies (Morris, 1984; Patrick, 1989; Sealy, 1989; Sealy *et al*., 1992) thus suggest that high dental pathology amongst Holocene skeletons were due to several factors, such as severe dental wear, low fluoride content of ground water and diet.

2.6 Comparative populations

2.6.1. Introduction

The interpretation of the frequency of specific palaeopathological conditions in a population is often a difficult task. Therefore, to gain additional insight into the health status of the study population, comparison between the group studied and previously studied populations may help to more accurately describe the results at hand, as well as place the current population in perspective with regard to their health and lifestyle at a certain point in time.

Populations that were used in this study for comparison included groups from the Later Stone Age, Iron Age, contact phase and modern groups of southern Africa. Oakhurst represent a group from the Later Stone Age, while K2/Mapungubwe and Toutswe represent Iron Age populations (archaeological groups) used in this study. The Riet River, Kakamas and Griqua samples, as well as the Cobern Street, Marina Residence and Polyoak populations are examples of protohistoric (contact phase) populations used, and lastly, modern skeletal samples included the 20th century Venda, Gladstone, Koffiefontein and Maroelabult.

2.6.2. Oakhurst

The Oakhurst rock-shelter is situated along the south coast of South Africa, east of the town of George. Excavations at this site were carried out by A.J.H. Goodwin from 1932 to 1935. The remains excavated from this site were dated between 10 000 and 6000 BP, thus classified as a Later Stone Age population.

A total of 42 skeletons were excavated and analysed for signs of palaeopathological conditions. The presence of cribra orbitalia, Harris lines, osteoarthritis, enamel hypoplasia and fractures were seen in this group (Patrick, 1989). Is was reported that the individuals from this site most likely experienced nutritional stress and were in general poor health due to their overdependence on a marine diet, which does not include all essential nutrients (Sealy *et al*., 1992).

2.6.3. K2/Mapungubwe

The K2 and Mapungubwe sites are situated in the Limpopo Province of South Africa. Occupation of these sites was dated to be between 1000 and 1300 AD and forms part of the Iron Age. The population excavated from these sites was classified as agro-pastoralists. Several excavations were performed at the sites of which the first series were conducted between 1933 and 1940. During this time particular attention was given to the exhumation of skeletons. Several series of excavations were performed on the sites during the decades that followed. Excavations ended in 1993.

The sample comprised of 106 skeletons of which 96 were exhumed and K2 and 12 at Mapungubwe hill. The remains included 25 adults, 10 adolescents and 71 juveniles (Steyn, 1994). The presence of several palaeopathological conditions suggested that this population was subjected to disease due to possible poor sanition, overcrowding and restricted natural resources (Dittmar & Steyn, 2004). These conditions include enamel hypoplasia, Harris lines, periostitis, parasitic infections and a possible case of treponematosis. However, the population was reported to have been in general good health and well adapted to their environment (Steyn, 1994; Steyn & Henneberg, 1995). When looking at dental health, a high caries frequency was observed, suggesting that they had a diet rich in carbohydrates, which is typical of agriculturalists (Steyn, 1994).

2.6.4. Toutswe

Toutswe traditional sites in east and central Botswana represent some of the earliest Iron Age communities in southern Africa and have been dated between 700 and 1250 AD. Excavation of skeletal remains from several sites associated with the Toutswe tradition was performed between the early 1970's and 2003, and housed at the University of Botswana's archaeological museum.

The sample comprised of 84 skeletons from 10 tradition sites in Botswana and included 30 adults and 54 juveniles. Palaeopatholgical conditions observed in this population included spina bifida, degenerative disease, trauma, cribra orbitalia, porotic hyperostosis and a possible case of DISH. There were, however, not one case of infectious disease reported, which suggested that the population was in general good health. A relatively low caries frequency was also noted, suggesting that they followed an unrefined and low carbohydrate diet (Mosothwane, 2004).

2.6.5. Riet River

This site is located along the Riet River between Jacobsdal and Koffiefontein in the Northern Cape, South Africa. Excavation of most of the skeletons from the Riet River burials was performed during the 1920's and 1930's. This population were Khoesan, and is therefore a valuable comparative sample in this study.

The skeletal remains were dated before 1820 AD and the sample consisted of 83 skeletons of which 64 were adults and 19 were juveniles. Various palaeopathological conditions were observed in this population, which included cribra orbitalia, enamel hypoplasia, degenerative disease, spina bifida and fractures (Morris, 1984). A very high intensity of caries was also noted, suggesting that this group, believed to be hunter-gatherers, were influenced by agriculture (Morris, 1992).

2.6.6. Kakamas

The skeletons representing the Kakamas sample were excavated along the Orange River between Augrabies Falls and Upington in the Northern Cape, South Africa, as well as near the village of Abrahamsdam, north-west of Niekerkshoop. Excavations were performed by T.F. Dreyer and A.J.D. Meiring in 1936 (Dreyer & Meiring, 1937). The remains are believed to be hunter-gatheres from the 18th and early 19th century (Morris, 1984; Morris, 1992).

The sample consisted of 56 skeletons that included 46 adults and 10 juveniles. Enamel hypoplasia, cribra orbitalia, infective arthritis, spondylolysis and fractures were observed. A low caries frequency was also noted, suggesting that the individuals were hunter-gatherers. It was concluded that the population was generally in good health (Morris, 1992).

2.6.7. Griqua

The Griqua skeletal sample is believed to date from 1815 to 1862 and was excavated from a cemetery northwest of Campbell and west of the Papkuil road in the Northern Cape, South Africa. The graves were excavated by P.V. Tobias and his students between 1961 and 1971. The Tobias series included a total of 35 skeletons. A smaller number of Griqua graves were also excavated during 1919 by V.H. Brink at old Griqua stations (Brink, 1933). This population represents Khoesan individuals that followed a lifestyle of mixed economy, i.e. an agricultural lifestyle, but with occasional hunting and gathering.

A total of 41 skeletons were studied by Morris (1984, 1992) that included 28 adults and 13 juveniles (35 from the Tobias series and six from the Brink series). Enamel hypoplasia, cribra orbitalia, spondylolysis, craniostenosis and a fracture was reported. An average frequency of caries was also noted, which suggested that the Grigua diet was different from that of the San hunter-gatherers (Morris, 1992).

2.6.8. Cobern Street

Human remains were exposed in Cobern Street, Cape Town, while the foundations of a new complex were being built in September, 1994. A total of 63 burials were excavated that represented 121 individuals, of which 88 were adults and 33 subadults. The site is believed to date back to the mid-1700’s.

Unfortunately, during construction many of the graves were disturbed. For this study, the remains of 29 adults were selected of which 20 were young adults and 9 were older (41+

years) adults. The presence of calculus, caries, antemortem tooth loss, abscesses, linear enamel hypoplasia and occlusal wear was assessed. This sample represents one of the poor communities of the 18th century Cape Colony, as the remains are believed to be that of contract workers and slaves that were employed in the vicinity of the harbour (Manyaapelo, 2007).

2.6.9. Marina Residence

The discovery of human remains in 1999 at Marina Residence, a residential part on the Victoria and Alfred Waterfront construction site, led to inspection of the area, after which permission was granted for the exhumation of the graves. The cemetery is believed to date back to the 18th and 19th centuries (Halkett, 2000).

The excavation yielded a total 57 burials representing 69 individuals, of which 56 were adults, five subadults and eight individuals who could not be aged with accuracy. For this study, only 40 adult individuals were selected. Similar to Cobern Street, the remains is believed to be that of a poor community in Cape Town. This cemetery was found to be in close proximity to the Cobern Street burial area. The results indicated that the Cobern Street and Marina Residence skeletal samples shared similar frequencies portrayed by dental health indicators (Manyaapelo, 2007).

2.6.10. Polyoak

The Polyoak area is situated in Diep River (14km from present day Cape Town CBD). Human remains were discovered on the site in 2000 during construction and are believed to be from the late 19th century. Excavation yielded a sample of a minimum of 34 individuals, of which 15 were adults and 19 subadults. All individuals were buried in a coffin (Morris, 2000).

A total of nine adult individuals were selected for the Polyoak study. In comparison to Cobern Street and Marina Residence, the Polyoak sample presents with better oral hygiene, but higher frequencies of caries than the other two groups. It was concluded that the Polyoak sample also represents a poor group from the Cape, but that this group differ from the Cobern

Street and Marina Residence sample with regards to diet and oral behaviour (Manyaapelo, 2007).

2.6.11. Maroelabult

The development of mining activities at Maroelabult farm in the Northwest Province, South African, led to the discovery of graves in two related, informal cemeteries. Excavation yielded 47 skeletons, which included 16 adults, five adolescents and 26 juveniles. The remains were believed to date from the last decade of the 19^{th} to the early 20^{th} century and the skeletons were those of black farm workers around the time of the second Anglo-Boer War. From the remains it was clear that some medical care was provided as the remains of one individual indicated a surgically treated fracture of the forearm. Other pathological conditions encountered included a possible case of treponematosis, tuberculosis, osteomyelitis, cribra orbitalia, periostitis, persistently open anterior fontanelles and degenerative disease (Steyn *et al*., 2002). In general, poor dental health was observed, as well as multiple cases of dental abnormalities such as supernumerary teeth and abnormal tooth morphology (Steyn *et al*., 2002).

2.6.12. Koffiefontein

During 2002, human remains were discovered at the Koffiefontein diamond mine in the Free State, South Africa. The discovery of diamonds in 1870 brought about a rush of thousands of people to the area, resulting in crowded living conditions and few clean living spaces. An outbreak of typhoid fever in 1896 claimed the lives of many mine workers. Archival documents also stated that bodies were buried in shallow graves due to an overwhelming number of deaths (L'Abbé *et al*., 2003).

The remains were that of 36 black adult individuals of which 33 were male, two female and one individual of unknown sex. The presence of many pathological conditions were noted, including vertebral osteophytes, Schmorl's nodes, periostitis, cribra orbitalia, osteochondrosis and enamel hypoplasia (L'Abbé *et al*., 2003). The poor living conditions and hard physical labour accompanied by malnutrition most likely contributed to many of these individuals being vulnerable to infection.

2.6.13. Venda

The Venda people, found in the Limpopo Province of South Africa, is a group that had very little contact with the European colonists through the 17^{th} to mid-19^{th} centuries. At the end of the 19^{th} century, however, the Venda was introduced to western ways of life with the settlement of missionaries in their region. After the incorporation of Venda into the Union of South Africa after the second Anglo-Boer War (1899-1902) the Venda people's traditions and culture were slowly being influenced by European beliefs and economic systems that brought about change (Stayt, 1931), and by the mid-20^{th} century it was clear that very little traditional ways of life were still intact in the area. This transformation of the Venda community during the 20^{th} century includes the introduction of immunization against several diseases in the 1980's, thus providing health care to the community. The group were, however, exposed to poor living conditions and lack of sanitation that most likely played a large role in the degradation of their health.

With the development of the Nandoni Dam, several rural villages had to be relocated, which provided the opportunity for studying skeletal remains exhumed for the purpose of resettling graves in the process. The skeletal sample consisted of 157 skeletons, of which 102 were adults, 37 juveniles and 14 individuals of unknown age. All individuals died between 1910 and 1999 (L'Abbé & Steyn, 2007). The sample thus represents a 20^{th} century rural community that experienced several physical and social hardships, but with medical care and medicine provided by the western world, the frequency of skeletal pathology observed in the sample was less than originally anticipated for a developing nation such as the Venda. Skeletal pathology observed includes sub-periosteal lesions, leprosy, osteomyelitis, fractures, osteoarthritis, vertebral osteophytes and Schmorl's nodes (L'Abbé, 2005).

2.6.14. Gladstone cemetery

The discovery of diamonds in Kimberley during the second half of the 19^{th} century brought hundreds of opportunists to the area and provided work for thousands of people. However, working in harsh environmental conditions and staying in crowded areas close to the mine resulted in the spread of several epidemics. Mortality rates were also reported to have been high due to poor sanitary conditions and very few medical personnel on site. The first hospital was set up in 1871, which was a mere tent without any patient beds. By the end of

1872 a new hospital, the Diggers Central, was erected that had 26 beds and three medical doctors, which provided free medical care to all patients in the mining area. Another hospital, the Provincial, was opened next to the Diggers Central hospital to help with the patient load. These two hospitals, however, could not handle the large amounts of mineworkers seeking medical care and in eventually, in 1879 the Kimberley Hospital was opened. During the 1880's and 1890's many casualties were reported. Causes of death included injury and violence, infectious disease (e.g. tuberculosis) and scurvy (Stoney, 1900; Roberts, 1976). The Gladstone cemetery was opened during 1883 and enlarged in 1897.

In 2003 the Sol Plaatjie municipality accidently dug thought several unmarked graves while constructing a storm-water trench next to the Gladstone Cemetery. The graves were dated from 1897 to 1900. After excavation, the skeletal remains were accessioned into the McGregor museum in Kimberley. The sample comprised of 107 individuals, which included 93 adults, nine adolescents, two juveniles, one antenatal and two individual of unknown age. Skeletal pathology encountered included treponematosis, osteomyelitis, tuberculosis, scurvy, fractures, amputations, degenerative diseases, periostitis and cribra orbitalia. Poor dental health and oral hygiene was also reported for this group (Van der Merwe, 2006).

Table 2.1 A summary of the comparative populations used in this study

Population	Sample size	Dated	Area/location exhumed from	References
Later Stone Age				
1. Oakhurst	42	10 000 – 6000 BP	Eastern Cape, RSA	Patrick, 1989 Sealy *et al*., 1992
Iron Age				
2. K2/mapungubwe	106	1000 – 1300 AD	Limpopo Province, RSA	Steyn, 1994 Steyn & Henneberg, 1995
3. Toutswe	84	700 – 1250 BP	East and central Botswana	Mosothwane, 2004
Contact phase				
4. Riet River	83	Before 1820 AD	Riet River, Northern Cape, RSA	Morris, 1984 Morris, 1992
5. Kakamas	56	18th and early 19th century	Orange River, Northern Cape, RSA	Morris, 1984 Morris, 1992
6. Griqua	35	1815 - 1862	Northwest of Campbell, Northern Cape, RSA	Morris, 1984 Morris, 1992
11. Cobern Street		Mid to late 18th century	Cape Town, RSA	Manyaapelo, 2007
12. Marina Residence		18th to 19th centuries	Cape Town, RSA	Manyaapelo, 2007
13. Polyoak		Early 19th century	Cape Town, RSA	Manyaapelo, 2007
Modern (post 1900 AD, late 19th and early 20th century)				
7. Maroelabult	47	Late 19th and early 20th century	Maroelabult, Northwest Province RSA	Steyn *et al*., 2002
8. Koffiefontein	36	Late 19th century	Koffiefontein, Free State, RSA	L'Abbé, 2003
9. Venda	157	1910 – 1999	Limpopo Province, RSA	L'Abbé, 2005
10. Gladstone	107	1897 - 1900	Kimberley, Northern Cape, RSA	Van der Merwe, 2006

Chapter 3: Materials and Methods

3.1. Materials

Khoesan skeletal material housed at the University of Vienna's Robert Pöch Collection and Musée de l'Homme (Paris) was used for this study. A total of 140 specimens from the Robert Pöch Collection, as well as 15 specimens from Museé de l'Homme were included which provides a sample size of 155 individuals. Three specimens in the Pöch collection were found to have belonged to the McGregor Museum in Kimberley at an unknown point in time. These three skulls were listed as MMM131, MMM134 and MMM135. The possibility exists that these specimens were traded by the curators of the two museums sometime during the early to mid 1900's.

It is unclear whether these specimens are Khoikhoi or San specifically, but for the purpose of this study all are classified as Khoesan as it is irrelevant to distinguish between the different terms, as the study involves looking at health within a broader spectrum of groups subjected to marginalization during the given period of time. Thus the sample does not represent a homogenous breeding population.

The specimens were collected in the late 19th and early 20th century from various regions in southern Africa, predominantly from the Western Cape, Northern Cape and Kalahari by Dr Rudolf Pöch and his assistants before being exported to various locations in Europe and elsewhere. A catalogue published (in German) on the remains housed in Vienna (Pacher, 1961) provides some information regarding the origin, preservation and sex of these skeletons, however, knowledge concerning the exact place of origin is unknown in most cases. The exact ages are not given in the catalogue either, but in some cases reference is made to whether the individuals were adult or juvenile. Also, seven individuals listed in the Pacher catalogue as coming from Vereeniging were excluded from the study sample, not only due to the skeletal material appeared very robust, and also due to time constraints.

The preservation of the skeletons varied. Overall, the material was preserved fairly well, although there were a few specimens that were poorly preserved. The remains were stored in the original boxes in which it had been placed (Figure 3.1). Some of these boxes provided a reference to the location from which the specific skeleton was retrieved. However, in many cases the exact location from where the remains were found/excavated could not be traced.

3.2. Methods

3.2.1. Introduction

Standard anthropometric measurements (Knussmann & Barlett, 1988; Steyn & Işcan, 2013) were taken of the cranium, mandible and postcranial elements. A summary of all the measurements recorded for adult males and females may be found in Appendix 3. Craniological and osteometrical analyses are not presented in this study, but are reserved for future studies.

3.2.2. Sex estimation

Males often have greater size and length of bones than females, although one must be careful in making use of size only to determine sex, as some males are more gracile, while some females are more robust. When assessing sex, both morphological and osteometric techniques should be employed (Loth & Işcan, 2000b).

The pelvis and skull express the most distinguishable characteristics when assessing sexual dimorphism. It is generally accepted that the pelvis is the most accurate feature for sex determination. Non-metric pelvic features such as a heart-shaped inlet, narrow sub-pubic angle, triangular pubis, narrow sciatic notch and a laterally directed acetabulum suggest that the remains are that of a male. Female adaptations include an oval inlet, a wide sub-pubic angle, rectangular pubis, wide sciatic notch and an anterolaterally directed acetabulum (Ferembach *et al*., 1980; Loth & Işcan, 2000b; Byers, 2005). The pelvis, however, may not always be useful in determining sex when dealing with different populations. It was found that in 91% of black South African males the greater sciatic notch was narrow and deep, but that only 33% of white South African males displayed this type of shape in the greater sciatic notch. White males tended to have a wider, more asymmetrical shape of the greater sciatic notch (Patriquin *et al*., 2003). Therefore, as many bones as possible should be used to estimate sex.

The male cranium is usually more robust with rough areas of muscle attachment, larger supra-orbital ridges, a pronounced glabella, a rugged occipital protruberance, medium to large mastoid processes, rectangular orbits, the presence of mandibular ramus flexure and a sloped forehead. Female crania, in turn, are more gracile with relatively small supra-orbital ridges and mastoid processes, rounded orbits, smooth muscle lines and vertical foreheads (Ferembach *et al*., 1980; Krogman & Işcan, 1986; Loth & Henneberg, 1996; Loth & Işcan 2000b; Byers, 2005).

Concerning osteometric analysis, discriminant function formulae are available for the cranium, mandible, pelvis and long bones of South African blacks (Steyn & Işcan, 1999; Asala, 2001; Patriquin *et al*., 2003; Asala *et al*., 2004; Franklin *et al*., 2005). This method is fairly easy to use and provide a reliable alternative to morphological traits. It is also valuable in cases where fragmentary skeletal remains are present. However, one should keep in mind that these formulae are not based on Khoesan morphological standards. One should thus take care when interpreting using these formulae, as the Khoesan is in general gracile with short stature.

Also, low levels of sexual dimorphism have been reported for Khoesan populations (Kurki *et al.*, 2010), which often makes it difficult to distinguish male and female skeletons. Therefore, all possible methods for sex estimation should be utilized in ambiguous cases.

3.2.3. Age estimation

Children (0-12 years of age)

Age estimation in children is usually more accurate in juveniles than in adults due to relatively constant growth and development (Ferembach *et al*., 1980; Loth & Işcan, 2000a). Estimating age in children was done by assessing tooth eruption (Ubelaker, 1999), fontanelle closure (Loth & Işcan, 2000a), fusion of the bones of the skull base and mandible (Scheuer & Black, 2000), long bone lengths (Stewart, 1979; Hoffman, 1979) and fusion of the elements of the vertebral column (Scheuer & Black, 2004).

Tooth development and eruption is considered by many as the most accurate method for determining age in juveniles (Byers, 2005; Scheuer & Black, 2004). For this purpose a chart is used, such as the tooth formation and emergence chart by Ubelaker (1999). It demonstrates the sequence in which deciduous and permanent teeth develop and erupt in relation to age. The age estimates given for each eruption phase represent the mean time of eruption in years, meaning that there is some inter-individual variation present within groups. Unfortunately, tooth development could not be assessed in all cases as no radiographs were done.

Closure of the fontanelles in infants is useful up to about the age of two years. The anterior fontanelle begins to close after birth and subsequently becomes smaller until it is fused completely at around the age of two. The posterior fontanelle, however, starts ossifying at two to three months and is complete at around six months. The metopic suture closes between the ages of two and six, but may remain open throughout life (Loth & Işcan, 2000a; Scheuer & Black, 2004).

Fusion of the parts of the occipital bone is useful in estimating age up to five years. The occipital bone comprises of four units: the pars squama, the two parts of the pars lateralis and the pars basilaris. Fusion between the pars squama and pars lateralis occurs between one and three years. Suture closure between the pars basilaris and pars lateralis, however, occurs slightly later between three and seven years of age (Scheuer & Black, 2004).

Also, at birth the two parts of the mandible is not yet fused, as fusion is only complete at around six months after birth (Bass, 1995; Scheuer & Black, 2000).

Long bone lengths from prenatal, natal and postnatal subadults can be used to estimate age and is fairly accurate up to the age of 10 years. The length of the long bone is plotted against the age in years of a known sample to create a chart from which the probable age of the unknown specimen can be determined. These estimates are usually relatively accurate, but due to growth variation the accuracy decreases with age (Stewart, 1979; Hoffman, 1979; Steyn & Henneberg, 1996).

Fusion of the different elements of the vertebral column can act as an indicator of age from birth up to five years of age. The vertebral bodies and its accompanying neural arches are not yet fused at the time of birth. Fusion times differ between the cervical, thoracic and lumbar vertebrae. These fusion times may indicate specific stages of development and thus help to estimate age in infants. Scheuer and Black (2004) give detailed descriptions of fusion between the neural arches, as well as its fusion to the vertebral bodies. In summary, all segments are unfused in infants less than one year of age, the neural arches fuse together between year one and two and lastly, if all segments are fused, the estimated age ranges between two and six years.

Adolescents (13-20 years of age)

Closure of epiphyses in long bones provides the most accurate estimation of age in this group (Ferembach *et al*., 1980; Bass, 1995; Loth & Işcan, 2000a; Schaefer *et al*., 2009). Complete union of the epiphyses and diaphyses roughly occurs in the following sequence: elbow (12-14 years), hip (13-15 years), ankle (14-16 years), knee (15-17 years), wrist (16-18 years) and shoulder (17-19 years). For more detailed analysis on epiphyseal closure of the individual bones, information provided by Scheur and Black (2000) was used.

Other indicators of adolescent age include eruption of the third molars and closure of the spheno-occipitalis synchondrosis, but these indicators vary considerably between different populations and are thus less accurate in estimating a specific age (Krogman & Işcan, 1986). However, the latest research suggests that the closure of the spheno-occipitalis synchondrosis is inadequate as an age marker and has a limited value for age estimation as the time of closure varies considerably between individuals and populations (Bassed *et al*., 2010).

Adults

Estimation of age at death in adults is often challenging and once established, is given in terms of an age range, rather than a specific age (Loth & Işcan, 2000a). Numerous techniques exist for age estimation in the adult, including both osteological features and histological methods.

The medial end of the clavicle and the first segment of the sacrum (S1) usually fuse between the ages of 20 and 30 years of age, although variation occurs between populations. It has been reported, however, that fusion between the S1 and S2 segments of the sacrum may occur as late as 35 years of age (Belcastro *et al*., 2008). An open S1 and/or unfused epiphysis of the medial clavicle thus indicate that the individual is likely to be younger than the age of 35 years.

Osteological features regularly used in adult age estimation include alterations in the pubic symphysis, auricular surface and sternal rib ends, as well as closure of cranial sutures (Byers, 2005; Rösing *et al*., 2007; Styen & Işcan, 2013). This study was conducted using ectocranial suture closure (Acsadi & Nemeskeri, 1970), pubic symphyses (Brooks & Suchey, 1990;

Meindl *et al*., 1985), as well as sternal rib end alterations (Oettlé & Steyn, 2000) as methods for estimation of age. The use of the auricular surface as an age estimation technique was kept in mind, but was found to be difficult to use on the current study sample and it provided very wide age ranges.

Several changes can be observed on the pubic symphysis with advancing age. These changes were described by McKern and Stewart (1957) and Gilbert and McKern (1973), amongst others and subsequently, the phase descriptions were modified by Meindl and colleagues (1985) and Brooks and Suchey (1990). Currently, the Brooks and Suchey phases are most commonly employed. Using the pubic sypmphysis in age estimation is rather easy as casts are available, however, experience is needed for accurate analysis as this method is difficult to use for the inexperienced scientist. Another disadvantage is that is has not yet been tested on South Africans.

Alterations in the sternal end of the 3rd, 4th and 5th ribs are one of the most reliable and accurate methods to use in adult age estimation. The method was introduced by Işcan and colleagues (1984; 1985) and has been adapted for South African blacks by Oettlé and Steyn (2000). Casts are available for this method which makes it easier to use. Also, the rib ends are not influenced by physical activity or disease. A disadvantage of this method is that sternal rib ends are not always available and well preserved.

Cranial suture closure is one of the most widely used methods for determining age in adults. The Nemeskéri method makes use of age estimates modified by Acsádi & Nemeskéri (1970) and is based on the assumption that sutures on the external surface of the cranium closes with advancing age (Krogman & Işcan, 1986). The advantages of this method are that the skull is usually available and it is has an easy application. However, it is not accurate and the age ranges are wide (Steyn & Işcan, 2013).

For this study, degenerative skeletal changes, i.e. the presence of osteoarthritis, vertebral osteophytosis and dental wear was used as an indicator of the general age group to which an individual may belong. The age groups in which the individuals were placed were then standardized using the guidelines for age estimation ranges as described by Falys and Lewis (2011).

Also, no formal palaeodemographic analysis (life tables) was performed, as the group of individuals studied do not present a homogenous breeding population.

3.2.4. Palaeopathological assessment

All material was visually assessed for any indication of pathological bone alterations. Pathologies were compared to standard palaeopathological literature and illustrations recorded in, for example, Steinbock (1976), Roberts & Manchester (1995), Aufderheide & Rodriquez-Martin (1998), Ortner (2003) and others. Non-specific indicators of disease recorded include the presence of cribra orbitalia, porotic hyperostosis, periostitis, enamel hypoplasia and consistently open anterior fontanelles. These conditions were described in more detail in the literature review (Chapter 2).

Cribra orbitalia was scored on presence and severity, based on criteria devised by Stuart-Macadam (1982, 1989b). This model involves lesions being scored as either light, medium or severe. The lesions were also scored on their status, i.e. active (unremodelled) or healed (remodelled) based on the scoring system described by Mensforth *et al*. (1978).

The presence of specific pathological conditions was also recorded. Conditions were classified as infectious disease, metabolic disorder, congenital abnormality, traumatic event or degenerative skeletal change. A description of the skeletal location, age and sex of the individual in which the specific condition occurred was given.

The incidence of pathological conditions was compared to other populations such as Mapungubwe/K2, Oakhurst, Toutswe, Venda and Gladstone. Chi-squared tests were performed to assess whether significant differences exist in the frequency of lesions between populations, as well as between males and females of this study.

3.2.5. Reconstruction of antemortem stature

Methods used in the estimation of stature are based on either regression formulae, stature:bone length ratios or total skeletal height and adjustment for soft tissue. It is important that sex and/or ancestry of the individual is also known before calculating stature (except when using femur:stature ratio), as regression formulae are often constructed based on a specific population or sex (Sjøvold, 2000). The most accurate methods to use are those based on total skeletal height (TSH), but it is often not possible to employ such a method as the complete skeleton is needed and in many cases not all skeletal elements are preserved.

Estimation of antemortem stature is useful in determining not only individual heights, but also in providing a mean stature for males and females within the population. Formulae for estimation of stature described by Lundy and Feldesman (1987) were used in this study, as no regression formulae are available for the Khoesan. It was considered appropriate to make use of the formulae constructed based on the South African black population (Lundy & Feldesman, 1987). This method involved taking standard anthropometric measurements of all the long bone available, after which the appropriate measurements were then substituted into the revised regression formulae constructed to calculate stature in black males and females. To do the final estimation, a correction factor for soft tissue was added (Raxter *et al*., 2006). The calculated statures were then compared to data from Holocene skeletons from the Cape Ecozone (Pfeiffer & Sealy, 2006), the Dobe !Kung (Dart, 1937; Truswell & Hansen, 1976), Bushmen statures recorded by Tobias (1962), as well as the Toutswe group (Mosothwane, 2004).

3.2.6. Skeletal growth

The comparison of long bone lengths between populations may give an indication as to whether a group of individuals are growing to their optimum potential or not. It is important to emphasize that when constructing a growth curve for a specific group of individuals, only individuals are used for which a reliable dental age could be determined, as dental age estimation methods (dental eruption and development) has been labelled as being the most accurate method for age estimation in subadult individuals (Saunders, 1992; Buikstra & Ubelaker, 1994; Steyn & Henneberg, 1996).

Maximum diaphyseal long bone lengths were measured for all individuals for which dental age could be established. No differentiation was made between males and females, and therefore all long bone length data was pooled. The averages for all long bones per age group were then calculated and compared to data from Mapungubwe/K2 (Steyn, 1994), Toutswe (Mosothwane, 2004), an archaeological Arikara population (Merchant & Ubelaker, 1977) and a Libben population (Lovejoy *et al*., 1990).

3.2.7. Dental health and pathology assessment

The presence of caries, antemortem tooth loss, periodontal disease, enamel hypoplasia, degree of attrition and presence of abscesses was recorded. The methods of investigation are described in more details below. The results were compared to various other South African populations, including Oakhurst (Patrick, 1989), K2/Mapungubwe (Steyn, 1994) and Riet River, Kakamas and Griqua populations (Morris, 1992a).

Caries

The presence of dental caries was scored for all teeth available. No reference was made to the position of caries on teeth. The data were then analyzed using calculations described by Lukacs (1989, 1995). This method involves calculating the individual caries frequency, caries intensity, mean number of carious teeth per individual and caries intensity per tooth type. Due to antemortem tooth loss, the intensity of caries in a population may be underestimated. It is therefore necessary to include a correction factor (Lukacs, 1995).

The individual caries frequency was calculated by dividing the number of individuals affected by carious lesions (NAI) by the number of individuals investigated (n), and then multiplied by 100 to obtain a percentage value.

Individual caries frequency =

$$\frac{\text{Number of individuals affected by carious lesions (NAI)}}{\text{Number of individuals investigated (n)}} \times 100$$

The caries intensity was calculated by dividing the number of carious lesions by the number of teeth present in the sample and multiplying the value by 100%.

Caries intensity =

$$\frac{\text{Number of carious lesions}}{\text{Number of teeth present in the sample (NT)}} \times 100$$

The average number of carious lesions per mouth was calculated by dividing the total number of teeth affected by dental caries (NTA) by the total number of individuals affected by carious lesions (NAI).

Carious teeth per mouth =

$$\frac{\text{Number of carious teeth (NTA)}}{\text{Number of individuals affected by carious lesions (NAI)}} \times 100$$

The caries intensity per tooth type was calculated by dividing the total number of all teeth affected by dental caries (NTA) by the total number of teeth present (NT), from which a percentage was deducted.

Caries intensity per tooth type =

$$\frac{\text{Number of teeth affected by dental caries (NTA)}}{\text{Number of teeth present (NT)}} \times 100$$

Antemortem tooth loss influences the percentage of carious lesions observed in a population because caries is the number one cause of antemortem tooth loss. Therefore, a caries correction factor was calculated (Lukacs, 1995). This method involves calculating the proportion (P) of teeth that were lost antemortem due to caries and then multiplying the proportion value with the total number of teeth lost antemortem.

Caries correction factor (p) =

$$\frac{\text{Number of carious teeth added to the number of teeth lost antemortem}}{\text{Total number of teeth examined added to the number of teeth lost antemortem}} \times 100$$

Estimated number of teeth lost due to caries (Ena) =

Total number of teeth lost antemortem X caries correction factor

To obtain the corrected estimated number of teeth with caries (Ec), the number of carious teeth observed (Ona) is added to the estimated number of teeth lost antemortem due to caries (Ena). The total corrected number of teeth (Ne) is then calculated by adding the observed number of teeth to the number of teeth lost antemortem.

Estimated number of teeth with caries (Ec) =

Estimated number of teeth lost due to caries + number of carious teeth observed

Total number of teeth (Ne) =

Number of teeth observed + number of teeth lost antemortem

Lastly, the caries correction factor can be calculated by dividing the estimated number of teeth with caries (Ec) by the estimated number of teeth present (Ne) and multiplying the answer by 100%.

Corrected caries rate =
Total estimated number of teeth with caries X 100
Total number of original teeth

The intensity of carious lesions was also divided by sex and tooth type to observe the difference between the sexes and to see if some teeth were more frequently affected than others. There are, however, few appropriate reference samples available that have made use of the caries correction rate.

Antemortem tooth loss

Antemortem tooth loss was calculated in a similar manner (Lukacs, 1989). Individual AMTL frequency, AMTL intensity, mean number of teeth lost per individual and prevalence of specific tooth types lost were calculated.

Individual AMTL frequency was calculated by dividing the number of individuals affected by AMTL (Nai) by the total number of individuals investigated (n) in the sample and then multiplying it by 100 to obtain a percentage value.

Individual AMTL frequency =
Number of individuals affected by AMTL X 100
Number of individuals in the sample

AMTL intensity was calculated by dividing the number of teeth lost antemortem by the total number of tooth places present in the sample and multiplying the value by 100 to obtain a percentage. The number of tooth places is used to compensate for postmortem tooth loss.

AMTL intensity =
Number of teeth lost antemortem X 100
Number of tooth places present in the sample

The mean number of teeth lost per individual was calculated by dividing the number of teeth lost antemortem per mouth by the total number of individuals affected by AMTL. The value was then multiplied by 100.

Number of teeth lost antemortem per mouth =

$$\frac{\text{Number of teeth lost AM}}{\text{Total number of individuals affected by AMTL}} \times 100$$

The prevalence of specific tooth types lost was calculated by dividing the total number of a specific tooth type that had been affected by antemortem tooth loss by the total number of that tooth type investigated in the sample.

AMTL intensity per tooth =

$$\frac{\text{Total number of the tooth type affected by AMTL}}{\text{Total number of the tooth type places present in sample}} \times 100$$

Enamel hypoplasia

Enamel hypoplasia may manifest as transverse lines, grooves or pits in the enamel (Goodman *et al.*, 1984a; Goodman & Rose, 1991; King, 2002; Ortner, 2003). The presence of hypoplasia was observed as horizontal lines on the enamel of teeth and recorded only when the defect could be observed macroscopically.

The frequency of enamel hypoplasia was calculated as the proportion of individuals displaying the phenomenon in relation to the total number of individuals examined.

Frequency of EH =

$$\frac{\text{Number of individuals with the defect}}{\text{Total number of individuals examined}} \times 100$$

The intensity for specific tooth types was also recorded by dividing the number of a specific tooth type affected by EH by the total number of that specific tooth type present in the sample. The value was then multiplied by 100.

EH intensity =

$$\frac{\text{Number of a specific tooth type affected by EH}}{\text{Total number of that specific tooth type present in the sample}} \times 100$$

Attrition

Attrition was assessed using an eight point system designed by Molnar (1971). This method allows for scoring of all tooth types and is based on the various degrees of dentine exposure. The tooth types included incisors, canines, premolars and molar teeth. All teeth present in an individual were assigned a number ranging from one to eight based on the abrasion of cusps and the appearance of dentine patches. The average rate of attrition for each tooth type was calculated for males and females, as well as for the total sample. A score of 1 indicated no wear, where as a score of 8 indicated that only the roots remained. Thus, the category of wear increased with the degree of attrition observed. The descriptions of each category are summarized in Table 3.1.

The average score of attrition for all individuals analysed was compared to that of K2/Mapungubwe (Steyn, 1994), Riet River, Kakamas and Griqua populations (Morris, 1984) and the Cobern Street, Marina Residence and Polyoak groups (Manyaapelo, 2007).

Tartar deposition

Tartar, or dental calculus, is recognized as hard inorganic material deposited near the root surface or crown of teeth (Roberts & Manchester, 1995; Hillson, 1998). The presence and frequency of tartar were recorded for all scorable individuals. Comparison between male and female frequencies was also performed.

The results were compared to that of the Gladstone population (Van der Merwe, 2006), Toutswe (Mosothwane, 2004) and the Cobern Street, Marina Residence and Polyoak groups (Manyaapelo, 2007).

Periodontal disease

Periodontal disease was recognized by resorption of the alveolar bone and/or process. It is usually associated with older age, but may be found in younger individuals. Periodontal disease is also often associated with scurvy (Ortner, 2003).

This condition was scored only based on its presence or abscence in the maxilla and/or mandible of the individual. Sex frequency of the affected individuals was also specified for comparison between males and females. Lastly, the results were compared to that of the Gladstone population (Van der Merwe, 2006).

Abscesses

Abscesses are usually recognised as sinuses that formed due to the drainage of pus present in the pulp cavity. The presence and frequency of such periapical abscesses were recorded for all scorable individuals. Sex frequency was also specified for comparison between males and females.

Comparisons were then performed between the current population and Gladstone (Van der Merwe, 2006), Venda (L'Abbé, 2005) and the Cobern Street, Marina Residence and Polyoak populations (Manyaapelo, 2007).

Miscellaneous

The presence of impacted canines was recorded for individuals in which impaction could be observed as the canines protruded either the maxilla or mandible. Male and female frequencies were also specified for comparison between the sexes.

The results could not be compared to other southern African populations, as this phenomenon was not reported to be present in any of the populations used for comparison in preceding conditions.

Lastly, conditions that could not be identified specifically were recorded as miscellaneous. Detail pertaining to such conditions is provided in the Literature Review (Chapter 2) and the Results (Chapter 4).

Table 3.1. Description of dental wear categories

Category of wear	**Incisors and canines**	**Premolars**	**Molars**
1	Unworn	Unworn	Unworn
2	Minimal wear facets	Minimal wear facets, no dentine exposure	Minimal wear facets, no dentine exposure
3	Small dentine patches may be present	Small dentine patches present, cusp pattern partially obliterated	Small dentine patches present, cusp pattern partially obliterated
4	Small dentine patches present	Two or more dentine patches present	Three or more dentine patches present
5	Extensive dentine patches present	Two or more dentine patches present, secondary dentine may be present	Three or more dentine patches present, secondary dentine may be present
6	Moderate to extensive secondary dentine	Enamel still present, moderate to extensive secondary dentine	Enamel still present, moderate to extensive secondary dentine
7	Almost all enamel worn away, extensive secondary dentine	Almost all enamel worn away, extensive secondary dentine	Almost all enamel worn away, extensive secondary dentine
8	All enamel worn away, roots functioning in occlusal surface	All enamel worn away, roots functioning in occlusal surface	All enamel worn away, roots functioning in occlusal surface

Figure 3.1 One of the original boxes in which Khoesan specimens were placed in the Rudolf Pöch skeletal collection.

Chapter 4: Results

4.1. Demographic characteristics

Individual skeletal reports that describe the country/place of origin, preservation, age, sex, dentition, trauma and pathology can be found in Appendix 1. Appendix 2 contains all information regarding the grave goods associated with each individual. The grave goods were found with the skeletons in each case. The Pacher catalogue contained no reference with regards to objects associated with the skeletal material. Table 4.1 provides a summary of the locations in southern Africa from which the skeletons were collected. The information regarding location was retrieved from the original boxes in which the remains are still stored today, as well as the Pacher catalogue. Specific locations could not be determined for 65 skeletons of the complete sample (n = 50 from Vienna and n = 15 from Paris) and these were classified as unknown skeletons from southern Africa.

4.1.1. Preservation

Preservation of the skeletons ranged from excellent to poor. The Rudolf Pöch Collection contains complete skeletons, incomplete skeletons of which several bone elements were missing (i.e. long bones and/or cranium), as well as crania for which no postcranial bones were either collected or preserved. The Musée de l'Homme Collection had only one complete skeleton and 14 crania. Unfortunately the complete skeleton was mounted, which limited assessment of the different skeletal elements. Table 4.2 gives a summary of the completeness of the sample. None of the skeletons investigated had soft tissue present and there were no names associated with any of the individuals.

4.1.2. Sex distribution

The total sample of 155 skeletons comprised of 53 males, 71 females and 31 individuals of unknown sex (Table 4.3). Several of the individuals for which no sex could be established were infants or juveniles. The Rudolf Pöch Collection contained 48 males, 63 females and 29 individuals of unknown sex (Table 4.4), while the sample from the Musée de l'Homme consisted of 5 males, 8 females and 2 individuals of unknown sex (Table 4.5). In most cases the pelvis and/or cranium was present to assist with the estimation of sex. For ambiguous cases, discriminant function formulae were employed (Asala, 2001; Steyn & Işcan, 1999) where possible. Lastly, the documented sex of adult individuals in the Pacher catalogue was compared to the estimated sex. The known sex of the individuals matched that of the estimated sex in all cases, except for one. Individual S8 was estimated to have been female, although the Pacher catalogue stated male. Unfortunately the Pacher catalogue provided no information regarding the sex of juvenile and infant individuals.

4.1.3. Age distribution

One third of all individuals (53 individuals, 34.2% of total sample) investigated were younger than the age of 20 years. Fifteen of the 53 individuals were infants (younger than 2 years of age), with 16 children being between the ages of 3 and 10 years and 22 adolescents being aged 11 to 19 years. The younger adults group (20-39 years) consisted of 40 individuals, whereas the middle adults formed the largest group of 44 individuals. There were few older adults (59+ years), with only 8 individuals in this group. Six individuals could only be classified as older than 20 years of age and two individuals as older than 40 years. There were also two individuals of unknown age. Age estimations have been summarised in Table 4.6. The distribution of age is graphically presented by Figure 4.1. The estimated ages in all cases were found to correlate with the ages documented in the Pacher catalogue.

The sample contains individuals representative of all age groups, although one should be careful as to assume that the sample represents a specific Khoesan population at that stage, as skeletons were collected in a large geographical area containing several Khoesan populations. Also, collection of the material was performed randomly, with a number of individuals taking part in this process, selecting graves for excavation and collecting skeletal material where opportunity arose.

4.2. Palaeopathological observations

All pathological (specific and non-specific) conditions observed in the complete sample are summarized in Table 4.7. A total of 122 pathological cases (the number of isolated pathological conditions encountered) were recorded. However, some individuals were found to have more than one pathological condition. A total of 83 out of the 155 individuals displayed one or more pathological conditions.

4.2.1. Infectious disease

4.2.1.1. Treponematosis

Seven (4.5%) of the 155 individuals investigated showed signs of possible treponematosis (Table 4.8). Only one of the seven individuals was younger than 10 years of age and presented with a case of possible congenital treponemal disease, whilst one individual was an adolescent of unknown sex. Four of the adult individuals of known age were male and one was female.

The most common pathological feature observed was gummatous lesions found on the skull (Figure 4.2), which was present in 71.4% of affected individuals. Periostitis of the tibia, also known as sabre-shin (Figure 4.3), was present in 42.9% of individuals diagnosed with possible treponematosis. Destruction of the nasal bones (septum and inferior conchae) was observed in two individuals, which accounted for 28.6% of affected individuals (Figure 4.4). Periostitis of the fibula (28.6%), femur (28.6%), radius (14.3%), ulna (14.3%), humerus (14.3%) and clavicle (14.3%) were also recorded. Osteomyelitic changes were observed in only one affected individual (Figure 4.5).

Only one juvenile individual presented with signs of possible treponematosis. In this case (S64), the individual was estimated to have been between the ages of 7 and 9 years. Therefore, the possibility exists that this case represents congenital syphilis. The right tibia and both femora had a thickened appearance due to advanced periostitis. The right tibia displayed the sabre-shin appearance associated with treponematosis. Osteomyelitic changes with cloacae formation were evident on the left femur (Figure 4.5). However, no gummatous lesions on the skull or other lesions that suggested treponematosis were present. The teeth were normal. One should include osteomyelitis in the differential diagnosis, although the presence of several affected bones rather indicates a possible treponemal infection.

One case of possible treponematosis was observed in an individual of unknown sex between the ages of 15 and 20 years (#3592). A gummatous lesion on the left parietal bone suggested treponematosis. Unfortunately, no postcranial bones were available for this individual and thus no further pathological assessment could be performed.

A female individual between the ages of 20 and 30 years (S7) presented with two healed and two active gummatous lesion of the skull. Several other small porotic areas were also observed on the cranium. Destruction of the nasal bones was also evident. The tibiae had a striated appearance on the anterior surfaces. Periosteal bone formation was observed on the proximal and central areas of the left fibula. No other lesions indicative of treponematosis were observed, although the postcranial bones were generally osteoporotic.

A male individual aged between 30 and 60 years (C47) presented with a healed infectious lesion on the left parietal bone of the skull that might indicate treponematosis. Only the skull was available in this case, thus no further pathological analysis could be performed.

Two male individuals between the ages of 35 and 65 years had lesions that suggested treponematosis. Individual S42 displayed periostitis of the right clavicle, humeri, ulnae, right radius, right femur, as well as both tibiae and fibulae. The nasal bones had a flattened and thickened appearance. However, no lesions were observed on the cranium. Individual C16, on the other hand, displayed a healed gummatous lesion on the left parietal bone of the skull. Unfortunately, no postcranial bones were available for this individual and thus no further analysis could be performed.

The last individual with possible treponematosis was estimated to have been between the ages of 45 and 75 years. The cranium generally appeared uneven and irregular to the touch. The skull displayed healed gummatous-like lesions on the parietal and frontal bones that might be indicative of treponematosis. No postcranial material was present for this individual and thus no further analysis could be done.

Treponematosis in South African studies was also reported for the Gladtone (Van der Merwe, 2006), Maroelabult (Steyn *et al*., 2002) and possibly K2 (Steyn & Henneberg, 1995) sites, for which similar patterns of skeletal involvement to this study were noted (Table 4.9). Possible treponemal infection was noted in 8.4% of individuals investigated in the Kimberley sample, which is somewhat higher than observed in this study. Only one male individual from the K2 site presented with subperiosteal bone lesions and osteomyelitic changes possibly indicating treponemal disease. Similar lesions were observed on a skeleton from Maroelabult. However, the Maroelabult skeleton also presented with gummatous lesions on the skull suggestive of treponematosis, which was absent in the K2 skeleton. No statistically significant difference was observed between the study population and any one of the comparative populations.

4.2.1.2. Osteomyelitis

One case of osteomyelitis was seen in a male individual between the ages of 25 and 40 years (S123). Severe osteomyelitis with cloaca formation was localized to the left radius (Figure 4.6). The humerus and hand bones appeared to be normal. The osteomyelitic changes observed in this individual were classified as non-specific due to the absence of any signs of trauma or specific infectious disease. The evidence thus suggests that the infection developed due to haematogenous osteomyelitis.

Osteomyelitis was also reported in the Maroelabult, Kimberley (Gladstone) and Venda populations. One individual from Maroelabult showed signs of osteomyelitis in the mandible that possibly resulted from a dental abscess (Steyn *et al*., 2002). One case of osteomyelitis was noted in the Kimberley sample. An adult male individual presented with severe osteomyelitis of the right tibia, fibula and foot which most likely developed due to an infectious process of the surrounding soft tissue. Three individuals (2.65% of individuals investigated) from the Venda sample were tentatively diagnosed with primary osteomyelitis. A fourth individual showed signs of probable osteomyelitis, secondary to a primary infection of leprosy or yaws (L'Abbé, 2005).

4.2.1.3. Tuberculosis

A male individual (S6) estimated to have been between 45 and 60 years of age was the only individual where tuberculosis was included in the differential diagnosis. Wide-spread lesions were observed on the postcranial bones and the skeletal material was generally osteoporotic. The scapulae, second and third ribs, os coxae and tibiae displayed a woven bone appearance. The visceral side of the ribs and the pleural side of the scapulae showed new bone formation. The thoracic and lumbar vertebrae revealed widespread osteophytic activity (new bone formation), although the general appearance of the vertebral bodies seemed osteoporotic. Sacralization of the L5 vertebra was also present. A healed infectious lesion was evident on the cranium in the area of the lambda and posterior third of the sagittal suture (Figure 4.7). Lesions caused by tuberculosis have been reported to occupy areas on the skull close to or spreading over the cranial sutures (Danziger *et al.*, 1976; Ortner, 2003). The position of the lesion on the skull, as well as the presence of bone remodelling of the lytic-like lesion supports a possible diagnosis of tuberculosis. The differential diagnosis in this case includes osteomyelitis, treponematosis as well as hypertrophic osteoarthropathy resulting from an unknown long-term infection.

One male individual from Kimberley was also reported to possibly have suffered from tuberculosis. The differential diagnosis included brucellosis, osteomyelitis, a fungal infection and a possible avulsion injury (Van der Merwe, 2006). A differential diagnosis is often made in cases suspected of being tuberculosis, as it is difficult to diagnose this infection specifically, due to it being a soft tissue invasion, which then spreads to the adjacent bone tissue areas.

The presence of tuberculosis has also been reported in two other South African populations. Tuberculosis was included in the differential diagnosis of a three-year old child from Maroelabult who presented with subperiosteal bone growth on the pleural side of the ribs (Steyn *et al*., 2002). Pistorius and colleagues (1998) also reported a possible case of tuberculosis in a male individual from Makgope in the Bankeveld who presented with severe rib lesions.

4.2.2. Metabolic and nutritional disorders

4.2.2.1. Rickets (Vitamin D deficiency)

Two individuals showed signs of possible rickets. Both individuals were infants. As rickets commonly occur in children between the ages of six months and two years (Passmore & Eastwood, 1986; Stuart-Macadam, 1989a), the abnormal skeletal features observed in these two cases are believed to indicate a deficiency in vitamin D. The first infant (S15) was estimated to have been between 12 and 18 months old. The femora, tibiae and fibulae had a bowed appearance. Porosities could be seen on all the lower limb long bones. Thickening of the lower limb long bone metaphyses was also observed. The second infant (C36) was 18±3 months old and also displayed bowed femora (Figure 4.8) and tibiae, however, the fibulae were normal. The humeri displayed periosteal bone reactions in this case. Cribra orbitalia was also observed in both infants.

There are very few reported cases of rickets encountered in skeletal remains in southern Africa. Pfeiffer and Crowder (2004) reported a case of rickets in a mid-Holocene skeleton from Byneskranskop that belonged to a child aged between two and five months. The diagnosis was based on the presence of various abnormal skeletal features as outlined by Ortner and Mays (1998), which included deformation of the leg bones, porosities in various areas of the skeleton, as well as thickening of the long bones. The two infant skeletons investigated in the sample at hand thus display similar abnormal features as seen in the case from Byneskranskop, which supports a diagnosis of vitamin D deficiency.

4.2.3. Trauma

4.2.3.1. Cranial trauma

A total of 113 crania were inspected for trauma, of which 44 (38.9%) were male, 59 (52.2%) female and 10 (8.9%) of unknown sex. Three skulls showed signs of healed traumatic lesions. Two of these individuals were female (S47a, S75/S58) and one was male (S67).

Individual S47a was a female aged 30 to 40 years and presented with a well-healed traumatic lesion on the right parietal bone that appeared to have possibly been inflicted by a sharp object (Figure 4.9). The male individual, aged 50 to 70 years, also presented with a well-healed lesion on the right parietal. The lesion appeared circular and about 1.5cm in diameter (Figure 4.10). The third individual (a female aged 30 to 50 years) presented with a well-healed lesion (circular) on the occipital bone that were about 0.5 cm in diameter.

The location of the traumatic lesions (i.e. to the posterior part of the cranium), in all three cases suggested that the injuries were enforced while the individuals were in a defensive state, rather than in an attacking position, as no signs of injuries were visible to the anterior part of the skull.

4.2.3.2. Postcranial trauma

Fractures

A total of 122 individuals were investigated for postcranial fractures. Healed, perimortem or unhealed fractures were seen in eight individuals (6.6%). A full description of these fractures can be found in Appendix A. Four of these individuals were male and four were female.

Single fractures were seen in all four females, as well as in three males. Only one male individual (S24) presented with multiple fractures.

Perimortem trauma was observed in two individuals. A male individual (S10) presented with a hangman's fracture. Both pedicles and articular facets of the axis were fractured and ended in the vertebral body (Figure 4.11). The Pacher catalogue stated that the individual had been "justifiziert", meaning "put to justice" in Gabarone, Botswana. No other trauma was present in this case. An adult female (S108) presented with rib fractures of the 4^{th}, 5^{th} and 6^{th} ribs that showed no signs of healing (Figure 4.12). The injury is believed to have occurred around the time of death.

Antemortem trauma was observed in six individuals; three males and three females. One male (S24) and two females (S107 and S112) presented with a possible parry fracture of the ulna (Figure 4.13). The left ulna was affected in S107, whereas the right ulna suffered the fracture in S112. All three parry fractures were well healed and remodelled. This type of fracture is usually inflicted as a result of the individual lifting his/her arm in defence and subsequently suffers a blow to the ulna causing a fracture (Smith, 1996). However, the possibility exists that these fractures were caused by accident, irrespective of the fracture location (Schultz, 1972). Individuals S107 (40 to 60 years) and S112 (35 to 50 years) had no other visible injuries. It has been reported that parry fractures are more common in females than in males (Wells, 1964) which also supports the notion that these fractures may be due to violence.

The fact that individual S24 (a male aged 40 to 55 years) also sustained other injuries, suggests that the fracture to his left ulna may well be accidental. Individual S24 suffered a fracture of the left femoral head that healed only partially. It appears as though a second fracture occurred in the subtrochanteric area of the femur before death (Figure 4.14). This second fracture might have occurred due to the left leg being largely porotic, possibly due to it being unused because of discomfort caused by the first fracture.

Individual S95 (male) suffered a fracture to the left femoral shaft (Figure 4.15). The fracture was well healed and remodelled. Secondary osteoarthritis of the femoral head and acetabulum was also observed due to the severity of the trauma to the femoral shaft. No articulation of the femoral head with the os coxa occurred.

A fracture of the left proximal humerus was seen in a female individual (S4), which was also well healed and remodelled (Figure 4.16). Secondary osteoarthritis of the shoulder joint with articulation of the proximal humerus was also observed.

Pseudoarthrosis was seen in one male individual (S61). A fracture of the left clavicle was evident that showed signs of bone remodelling (Figure 4.17), but healing was not successful, possibly due to constant movement preventing the fracture from healing (Rodríguez-Martín, 2006).

Other South African studies also reported the presence of fractures. The Venda population presented with an incidence of 7.1% (n = 8) in which adult males and females were equally affected and fractures ranged from healed, partially healed to unhealed (L'Abbé, 2005). The Gladstone population also presented with well-healed, healing and perimortem fractures that affected 33.7% (n = 34) of the total sample. No statistically significant difference was seen between the current study and the Venda population ($\chi^2 = 0.027$; $p = 0.8695$). However, an extremely significant difference was seen between the current study and Gladstone ($\chi^2 = 26.566$; $p < 0.0001$), with the Khoesan population affected much less than the Gladstone group. These results suggest that the current study group was not sustain as many work-related injuries as seen in Gladstone's mining community, but rather suffered from occasional injuries brought about by isolated accidents or events.

Spondylolysis

One individual presented with spondylolysis (Figure 4.18). Individual S8 (a female aged 25 to 35 years) presented with bilateral separation of the neural arch of the fourth lumbar vertebra. An adult male from Kakamas and two individuals (one male and one female) from the Griqua area also presented with spondylolysis (Morris, 1984). This condition was also noted in seven individuals from the Gladstone population (Van der Merwe, 2006). Spondylolysis thus appears to be a common condition amongst southern African populations. The most likely explanation for the occurrence of this condition is some form of hard physical labour, causing possible trauma to the lower back resulting in the separation of the neural arches of the vertebrae (Mann & Hunt, 2005). As the exact nature of physical labour is known in some cases, for example the Gladstone mining community, a higher incidence of spondylolysis may well be connected to physical activity causing excessive strain on the lower back. This suggests that the current sample were not subjected to physical labour exerting excessive strain on the lower back, for example mining activities, causing spondylolysis as the condition is present in a very low frequency in the population studied.

Miscellaneous

Individual S53, a male aged 30 to 45 years, presented with possible trauma of the pelvis. The pubic sympheses were fused together (Figure 4.19). Trauma in the pubic bone area might have caused this fusion to occur. The possibility also exists that the fusion of the pubic symphyses might have occurred as the result of intensive activity, causing osteoarthritis of the symphyseal joint resulting in immobility of the joint space (Judd, 2010). The sacro-iliac joints appeared normal. No other signs of pathology of trauma were present.

4.2.4. Degenerative joint disease and joint pathology

4.2.4.1. Osteoarthritis (DJD)

Osteoarthritis was observed in 32 (38.1%) of the 84 individuals investigated. Of these individuals, 19 (59.4%) were female, 12 (37.5%) were male and one individual (3.1%) was of unknown sex. The incidence of osteoarthritic changes is summarized in Table 4.10. A significant difference was seen between males and females, with females being more affected than males ($\chi^2 = 6.02$; $p = 0.0141$).

Arthritic changes in the sterno-clavicular joint were observed in only one individual (S6), who was a male estimated to have been between the ages of 40 and 60 years.

Seven individuals displayed osteoarthritis of the acromio-clavicular joint, of which two were male (S24 and S67) and five were female (S4, S13, S47, S49 and S55/S56). S24 and S67 both showed unilateral osteoarthritis of the acromo-clavicular joint. S24 was estimated to have been between 40 and 55 years, while S67 was slightly older, with an age of 50 to 70 years at death. S4 was the only female estimated to have been younger than 40 years (25-40 years). Osteoarthritic changes in this individual were caused by trauma to the left humerus that subsequently healed and caused osteoarthritis of the shoulder joint. Individuals S13, S47, S49 and S55/S56 were all estimated to have been older than 40 years of age at the time of death and bilateral osteoarthritis of the shoulder joint was seen in all four individuals. The changes seen here may be associated with advancing age.

Osteoarthritis involving the axis (C2 vertebra) was observed in 3 individuals, of which one was male (S6) and two were female (S28 and S113). All three individuals were estimated to have been older than 45 years of age at the time of death and is likely to be associated with normal degenerative changes. S113 displayed eburnation in conjunction with the degenerative changes observed in the axis.

Osteoarthritic changes in the acetabulum were observed in two individuals. Individual S58/S75 (30-40 years of age) displayed arthritis in the right acetabulum, as well as in the hands, right ankle (Figure 4.21) and lumbar vertebrae. Individual S95 was estimated to have been 25 to 35 years of age and displayed severe osteoarthritis of the left acetabulum (Figure 4.20) and femoral head which was associated with a healed fracture of the left femur. Osteoarthritis of the left wrist was also observed which is most likely associated with the same traumatic incident. This person thus presented with post-traumatic joint changes.

Arthritic changes in the knee joint were seen in seven individuals. Six of these individuals (S6, S28, S40, S52, S96, S109 and S113) were older than 35 years at the time of death. One individual (S52), a female estimated to have been between the ages of 25 and 40 years, showed osteophytic lipping of the knees, elbows and wrists. It is unusual to see such a high degree of osteoarthritis in a younger adult. It is possible that this individual performed hard physical labour or strenuous activity for a long period of time that caused an early onset of osteoarthritis.

The tibio-talar joints were affected by osteoarthritis in a 40 to 60 year old female (S49), however, the tarsals and metatarsals were unaffected. The tarsals of both feet in a female individual S28 (estimated to have been older than 50 years) also showed arthritic changes. The arthritic changes seen in these two individuals are most likely associated with advanced age.

The elbow joint showed arthritic changes in 11 individuals (11.5% of all individuals investigated). All individuals, except for one, were estimated to have been older than 25 years of age at the time of death. Individual S7 was a female 20 to 30 years old and showed bilateral osteophytic lipping of the elbows, with the left side more severely affected than the right elbow. The wrist joint was also affected in three of the individuals (S47, S49 and S52) whose elbow joints showed arthritic changes. Osteophytic changes such as this seen in younger individuals may be associated with excessive physical stress related to cultural activities rather than old age (Bridges, 1991).

Osteoarthritis of the tempero-mandibular joint was seen in only one individual (S49), which was a female estimated to have been between 40 and 60 years of age. Only three teeth had been lost antemortem in this case, which means that the biomechanical stress on the mandible associated with tooth loss cannot explain the occurrence of arthritic changes in this case. However, the normal process of advancing age may account for the changes seen in this joint (Roberts & Manchester, 2005).

Vertebral osteophytosis was seen in 19 individuals, which comprised 19.8% of all individuals investigated. The development of vertebral osteophytic spurs may due to either normal degenerative changes or due to pathology (Nathan, 1962; Herkowitz *et al*., 2006). Osteophytes occurred mostly in individuals over the age of 30 years, which suggests that these spurs are the result of normal degenerative changes associated with advancing age. Osteophytosis of the lumbar vertebrae was seen in 17 individuals, making the lumbar area the most frequent vertebral site affected. Three individuals estimated to have been between the ages of 25 and 40 years (S27, S104 and S115) displayed osteophytic spurs only in the lower lumbar area. The development of lumbar osteophytes in young adults may be associated with hard physical labour (Videman *et al*., 1990; Lovell, 1994; Brown *et al*., 2008), and it is assumed that physical activity played a role in the development of osteophytes in these three individuals.

The Gladstone sample (n = 101) from Kimberley (Van der Merwe, 2006) presented with 24 individuals (23.7%) who had osteoarthritis. A statistically significant difference was seen between the current sample and Gladstone ($\chi^2 = 4.459$; $p = 0.0347$). The incidence of arthritic changes in the Gladstone sample is thus less than seen in the current sample. Arthritis was also noted in the Toutswe population (Mosothwane, 2004), in which 11 of the 84 individuals investigated (13.1%) showed signs of arthritic changes. Osteoarthritis was reported in eight individuals (7.1%) belonging to the Venda population (L'Abbé, 2005). An extremely statistically significant difference was also seen in between the current sample and Toutswe ($\chi^2 = 13.784$; $p = 0.0002$), as well as Venda ($\chi^2 = 28.625$; $p < 0.0001$). In general, the current sample was affected to a greater extent than either the Gladstone, Toutswe or

Venda populations, which suggests that the Khoesan's lifestyle involved high amounts of physical activity.

A high prevalence of osteoarthritis has also been reported for hunter-gatherer and agricultural populations from Europe and the New World. High frequencies of arthritis in two Neolithic hunter-gatherer populations from Gotland, Sweden were reported by Molnar and colleagues (2011). The first population presented with 42.9% of individuals affected, while 18% of individuals from the second population was affected. Bridges (1991) examined and compared archaic hunter-gatherers and agriculturalists from the Southeastern United States. A high prevalence of degenerative joint disease was reported for both groups, with the shoulder, elbow and knee marked as the most common joint sites affected. Similar results were obtained in the current study, with the most common joints affected also being the shoulder, elbow and knee.

4.2.5. Non-specific disease indicators

4.2.5.1. Cribra orbitalia (CO) and porotic hyperostosis (PH)

The orbits of 120 individuals were investigated for the presence of cribra orbitalia, while the crania of 121 individuals were investigated for porotic hyperostosis. A total of 23 individuals (19.2%) displayed CO, while only 7 individuals (5.8%) showed signs of PH (Table 4.11). Table 4.12 provides a summary of CO and PH in specific age groups. Both CO and PH were observed in three individuals (S15, C16 and C29).

CO was displayed bilaterally (Figure 4.22) in all individuals with the condition, except in one case (S140). Only the left orbit in individual S140 was affected. Fourteen adults, seven juveniles and two infants presented with the condition, of which six individuals had active lesions and 17 individuals displayed remodelled lesions. Active lesions were seen in two infants and four juveniles. All adult individuals showed remodelled lesions.

PH (Figure 4.23) was seen in one adult (C16), one adolescent (#3592), one juvenile (C29) and four infants (S15, S117, C39 and C40). All four infants and the juvenile individual portrayed active lesions, while the adolescent and adult individuals had remodelled lesions.

Cribra orbitalia has been observed in several other populations from southern Africa. The incidence of CO and PH in various South African populations is summarized in Table 4.13.

Patrick (1989) reported that 61.1% of individuals scored for CO from the Oakhurst sample showed signs of the condition, with nine individuals of the 11 affected being younger than 20 years of age. The prevalence of CO in this population appears to be very high, although the results may possibly be attributed to a small sample size (n = 18). A statistically significant difference ($\chi^2 = 14.86$; $p < 0.0001$) was seen between the current group and the Oakhurst sample, but these results may also be attributed to small sample size. No PH was reported for the Oakhurst sample.

The Toutswe population (Mosothwane, 2004) displayed both CO and PH, with 17.1% of individuals observed showing signs of CO and 14.3% of observable specimens portraying PH. All six individuals displaying CO were younger than 20 years of age, whereas PH was seen in four individuals younger than 20 years and one adult. Two of the cases displaying PH were associated with CO. No statistically significant difference was seen between the current results and that of Toutswe for either CO or PH (CO: $\chi^2 = 0.07$; $p = 0.7870$ and PH: $\chi^2 = 2.77$; $p = 0.0960$).

CO was also seen in the K2 (Steyn, 1994) sample, where 14 individuals (37.8%) were affected, of which 12 were younger than 20 years of age. A statistically significant difference was seen between the current study and K2 ($\chi^2 = 5.48$; $p = 0.0192$), with K2 more affected.

The Riet River and Kakamas samples (Morris, 1984) showed a frequency of 9.5% and 3.8% for CO, respectively. A statistically significant difference was observed between the current study and Kakamas ($\chi^2 = 7.05$; $p = 0.0079$), with Kakamas much less affected. Also, a frequency of 11% for CO was reported for the Gladstone sample (Van der Merwe, 2006). No statistically significant difference was observed between the current study and either Riet River or Gladstone.

The CO frequency in the present sample is similar to that of Toutswe, but is higher than that seen in the Riet River, Kakamas and Gladstone groups. K2 and Oakhurst, on the other hand, display greater frequencies of CO than the current population. The Toutswe population, however, displayed a higher frequency of PH than the present sample.

4.2.5.2. Periostitis

A total number of 117 individuals were investigated for signs of non-specific periostitis, of which 39 were male, 50 female and 28 of unknown sex. Periosteal bone lesions were observed in nine individuals (7.7%), of which three (2.6%) were male, two (1.7%) female and four (3.4%) were individuals of unknown sex. The results are summarized in Table 4.14. No significant difference was found between males and females ($\chi^2 = 0.68$; $p = 0.4096$).

The skeletal element affected the most by periosteal bone growth was the tibia (evident in six of the nine individuals) followed by the fibula (four individuals affected) and radius (three individuals affected). Lesions suggestive of periostitis were also seen in the humerus, ulna and femur (n = 2 in each one of the skeletal areas), as well as in the scapula, clavicle, ribs, os coxa and feet (n = 1 in each of the skeletal areas).

Periostitis was also observed in other southern African populations (Table 4.15), ranging from 5.7% to 18.7%. A statistically significant difference was seen between the current study and Gladstone ($\chi^2 = 5.98$; $p = 0.0145$), with the Gladstone group affected more than the current study sample. The results of this study were thus similar to that reported for other southern African groups, with the exception of the Gladstone population.

4.2.5.3. Enamel hypoplasia

A total of 55 individuals could be investigated for signs of linear enamel hypoplasia (LEH) due to some specimens having severe attrition and many teeth having been lost postmortem. Of these individuals 20 were adult males, 23 adult females, four juveniles with mixed dentition and eight infants with deciduous dentition. The total number of teeth investigated for the presence of LEH included 1031 permanent teeth and 129 deciduous teeth. Of the permanent teeth, 186 were affected. No deciduous teeth showed signs of LEH and all teeth affected by the condition were permanent (Table 4.16).

Of the 47 individuals with permanent teeth, 17 (36.2%) were affected by LEH (Figure 4.25). Five (25.0%) males, 10 (43.5%) females and two (50.0%) individuals of unknown sex showed signs of the condition. The results are summarized in Table 4.17. No significant difference was observed between male and female individuals ($\chi^2 = 1.61$; $p = 0.2045$).

The incidence of LEH sorted by tooth type is summarized in Table 4.18. The lateral incisor was found to be affected the most in both the maxilla and mandible (30.4% and 22.4%, respectively). In general, the maxillary teeth (21.8%) were affected to a greater extent than the mandibular teeth (14.2%).

Enamel hypoplasia in various South African populations is summarized in Table 4.19. The incidence of enamel hypoplasia in the Venda population was reported to be 13.3% (L'Abbé, 2005). Other studies also reported incidences of enamel hypoplasia, including K2/Mapungubwe (Steyn, 1994; 63.3%), Oakhurst (Patrick, 1989; 50.0%), Koffiefontein (L'Abbé *et al*., 2003; 61.1%), Maroelabult (Steyn *et al*., 2002; 18.8%) and Gladstone (Van der Merwe, 2006; 18.4%). A statistically significant difference was seen between the current study results and that of Venda ($\chi^2 = 9.49$; $p = 0.0021$), K2/Mapungubwe ($\chi^2 = 7.77$; $p = 0.0053$), Koffiefontein ($\chi^2 = 4.48$; $p = 0.0344$) and Gladstone ($\chi^2 = 7.48$; $p = 0.0062$). These results suggest that the current study sample displayed an incidence of enamel hypoplasia lower than seen in the archaeological populations of K2/Mapungubwe and Oakhurst, but higher than that observed in modern skeletal samples such as Venda and Maroelabult, which indicates that the current sample had an average incidence of enamel hypoplasia when compared to other groups from southern Africa.

4.2.5.4. Persistently open anterior fontanelles

Three infants older than six months of age presented with an open anterior fontanelle. Individual S9 was estimated to have been between nine and 18 months of age, while individual S11 was most likely between 15 to 18 months old. The third individual (C35) was estimated to have been younger than one year, but older than six months. S11 presented with the largest open fontanelle of the three individuals (Figure 4.26).

Individual S9 showed no other signs of pathology. However, individuals S11 and C35 both presented with periostitis. Individual S11 had periostitis on the antero-medial sides of the tibiae. In individual C35 the radii and fibulae were affected. It is thus possible that these infants suffered from malnutrition and/or infectious disease.

Delayed closure of the anterior fontanelle suggesting possible chronic infection and/or malnutrition was reported in four juvenile skeletons from an early 20th century rural population from the North West Province. Only two of the four skeletons showed other pathological changes such as periostitis (Steyn *et al*., 2002). Delayed closure of the anterior fontanelle is often associated with poor health and chronic illness, although several explanations have been posed to explain this phenomenon, including genetic abnormalities, endocrine disorders and malnutrition (Behrman *et al*., 1992; Ortner, 2003). The exact cause of this condition can thus not be established with complete confidence, although it does indicate the presence of disease and/or delayed growth and development.

4.2.6. Congenital abnormalities

4.2.6.1. Cleft neural arch

A total of 76 individuals were investigated, in which two cases of spina bifida occulta without neural tube defect was encountered (2.6%). In both these cases only one vertebra was affected. Individual S31 was a female adolescent that presented with a cleft neural arch of T12. The first lumbar vertebra of the second individual (S47) was affected by this condition (Figure 4.27). S47 was a female individual aged between 40 and 55 years. The presence of spina bifida occulta in these two individuals was most likely asymptomatic.

This condition was also noted in other studies based on southern African populations (Steyn, 1994; Mosothwane, 2004; Van der Merwe, 2006). The K2 population presented with four cases (three adults and one juvenile) of spina bifida (Steyn, 1994). An incidence of 3.5% was noted in the Toutswe population (Mosothwane, 2004). Van der Merwe (2006) reported an incidence of 3.4% in the Gladstone population from Kimberley. Spina bifida was also present in the Riet River (5.4%) and Griqua (3.6%) populations (Morris, 1984).

The Khoesan population investigated in this study presented with a similar incidence of spina bifida to that of the Toutswe, Gladstone and Griqua populations. The current results suggest that the K2 population was affected more by this phenomenon than the Khoesan population. However, it should be taken into account that the small adult sample size from K2 may cause the condition to be overestimated in the population.

4.2.6.2. Craniostenosis

The presence of craniostenosis was investigated in a total of 116 crania. Four individuals (3.5%) were affected, which included three adults and one adolescent. All four individuals presented with premature closure of the sagittal suture. Three of the individuals were female (S62/S59, S97 and #3599) and one were male (MMM 134). Individual S62/S59 was estimated to have been 18 to 25 years of age. Individual S97 was most likely an adolescent, whereas individual #3599 was a young adult (20 to 39 years). MMM 134 was also a young adult (20 to 39 years). None of the crania appeared to be malformed.

Two individuals (2.4%) with sagittal synostosis were also encountered in the Gladstone sample. No statistically significant difference was seen between the present sample and the Gladstone population ($\chi^2 = 0.19$; $p = 0.6629$).

4.3 Skeletal growth

4.3.1. Subadult growth

The mean lengths of the different long bones per age are summarized in Table 4.20. In general, the mean lengths increase with age. The mean age of the estimated age was used in each individual for whom age could be estimated by using dental eruption and maturation charts. A decrease in length of all the bones was seen from ages 4.5-5.5 to 5.5-6.5 and is most likely due to a very small sample size. Unfortunately only 19 infants and juveniles had complete long bones present that could be measured, making this a small sample. No individuals were present in the 7.5-8.5 and 9.5-10.5 age groups.

The mean long bone lengths of the present study were compared to that of K2 (Steyn, 1994), Toutswe (Mosothwane, 2004), an Arikara archaeological population (Merchant & Ubelaker, 1977) and the Libben skeletal collection (Lovejoy *et al*., 1990). The K2 sample only lacked individuals for the 10.5-11.5 years age group. Toutswe, on the other hand, had no individuals for the 0.5-1.5, 2.5-3.5, 4.5-5.5 and 8.5-9.5 year age categories. The Arikara sample lacked individuals for the 8.5-9.5 year age group. The Libben population was representative of all age groups. The Khoesan, K2 and Toutswe samples have relatively small sample sizes, making it difficult to deduce statistically accurate conclusions regarding the growth of the present sample when compared to that of the two comparative populations. The Arikara population presented with a relatively large sample size for the first three years of life, but had few individuals available from four years onwards. The Libben sample is the largest sample used for comparison in this study.

The growth of the long bones is illustrated in Figures 4.22 to 4.27. The lengths of all long bones were, in general, shorter than that of the comparative populations. This was expected, as adult Khoesan statures are known to be shorter than that of other populations (Tobias, 1962; Pfeiffer & Sealy, 2006).

During the early years of life (newborn to about two years of age) the growth rate of the Khoesan children appears to be similar to that of the other groups. However, after that the growth rate decreases and from about three years onwards the long bone lengths of the Khoesan juveniles remain below the average lengths of the comparative groups. Although a slower growth rate of the current sample is clearly shown by Figures 4.22 to 4.27, the data should be used with care when comparing specific factors such as population mean as the small sample sizes makes the data less reliable with regards to accuracy. However, the general trend of the growth chart for all the long bones in this study appear to follow a normal growth pattern with no definite or severe stunting observed at any stage.

4.3.2. Adult stature

Antemortem stature was calculated for 76 adult individuals (35 males and 41 females) for which long bones were available (Table 4.21). Male statures ranged between 141.3 cm and 170.1 cm, with a mean value of 157.9 cm. Female statures ranged from 133.2 cm to 165.6 cm, with an average height of 149.2 cm.

A summary of the statures of this study compared to that of other South African groups can be found in Table 4.22. These statures were compared to values recorded for other Khoesan groups and proved to be similar in range and average. Khoesan (/?Auni =Khomani San) statures measured for males averaged 159.3 cm, while females averaged 148.8 cm in a study conducted by D.F. Bleek (Dart, 1937). Truswell and Hansen (1976) also reported mean heights of 160.92 cm for men and 150.14 cm for women in a study conducted on the Dobe !Kung group. Pfeiffer & Harrington (2011) mentioned that the small body size of the Khoesan was most likely established during the Holocene and that this trait persisted until modern times. It is clear from the current study group and the comparative samples that small body size and stature is characteristic of the Khoesan.

An average stature of 165.3 cm and 154.4 cm was reported for males and females of the Gladstone population, respectively (Van der Merwe, 2006), which are slightly higher than that reported for the current sample. The Venda population presented with similar stature estimates than that of Gladstone, with an average height of 166.9 cm for males and 157.8 cm for females (L'Abbé, 2005). Also, an average stature of 163.6 cm and 153.0 cm were reported for males and females, respectively, of the K2/Mapungubwe skeletal sample. The current sample thus has shorter average statures for both males and females than that of the Gladstone, Venda and K2/Mapungubwe populations.

The current sample is thus shorter than other black southern African populations, but similar in stature to other archaeological and modern Khoesan groups of southern Africa (Dart, 1937; Tobias, 1962; Truswell & Hansen, 1976; Pfeiffer & Sealy, 2006).

4.4 Dental health

4.4.1. Dental caries

A total of 116 individuals, comprising of 46 males, 56 females and 14 individuals of unknown sex were investigated for the presence of caries. As summarized in Table 4.23, 28.4% of individuals investigated presented with caries (Figure 4.34). A total of 23.9% of males and 37.5% of females were affected. About 7% of individuals of unknown sex showed signs of caries. Males presented with an average of one carious lesion per mouth, whereas females had an average of two carious lesions per mouth. Also, 6.5% (111 teeth) of all teeth investigated (a total of 1722 teeth) were affected by caries. No significant difference was seen between males and females ($\chi^2 = 2.164$; $p = 0.1413$) for individual frequencies.

A correction prevalence of caries was also calculated (Table 4.24) using the method described by Lukacs (1995). This was done to compensate for teeth lost antemortem due to caries, as caries is the leading cause of antemortem tooth loss. The results indicated a correction caries prevalence of 8.7% for males (an increase of 4.0%), 14.1% for females (an increase of 4.9%) and 1.3% (an increase of 0.2%) for individuals of unknown sex.

The caries intensity (not corrected) was also calculated for tooth type and sex (Table 4.25). Males and females showed similar patterns in terms of the tooth type affected. The molars were mostly highly affected, with M2 showing the highest intensity (11.2% overall), followed by the premolars (PM1 = 5.4%; PM2 = 6.4%). The incisors and canines were the least affected, with I2 being the least affected (1.7%) of all the tooth types. Chi-square analysis between males and females for specific tooth types showed that a statistically significant difference ($\chi^2 = 9.51$; $p = 0.0020$) was observed only in the premolars, with females affected more than males.

Caries was also noted in other South African populations. A total of 43 individuals (47.8%) of the Gladstone population were affected by caries and a caries intensity of 4.3% was calculated. The caries intensity of the present study was compared to that of the Gladstone population, as well as to various other South African populations (Table 4.26).

When assessing caries frequency, it was noted that the frequency of the current sample is quite different to that of the other populations. Chi-square analysis performed for caries intensity revealed that there is a statistically significant difference between the current study group and all the other comparative populations, except Griqua, Venda and Maroelabult. The chi-square results indicated that the caries intensity of the current study sample is most similar to groups of mixed economy such as the Griqua, and thus higher than encountered in the hunter-gatherer groups, but less than seen in the agricultural populations. This suggests that their diet most likely contained a fair amount of carbohydrates that promoted caries. It is also likely that for certain periods of time they might have relied on hunting for subsistence, during which meat would have formed the greater part of their diet, contributing to a decrease in caries intensity.

4.4.2. Antemortem tooth loss (AMTL)

A hundred and sixteen individuals were investigated for antemortem tooth loss (Figure 4.35), of which 46 were male, 56 were female and 14 were individuals of unknown sex (Table 4.27). Of these individuals, 19 males and 25 females were affected. An average of 10.6 and 9.5 teeth were lost antemortem per mouth in males and females, respectively. No teeth were lost antemortem in individuals of unknown sex. An AMTL intensity of 13.7% was seen in males, whereas females showed an intensity of 13.3%. No significant difference was seen between males and females ($\chi^2 = 0.114$; $p = 0.7356$).

AMTL intensity per tooth type was calculated and summarized in Table 4.28. In general, the incisors and molars showed the highest incidence of AMTL. In males, the first incisor was mostly lost antemortem, whereas females showed the highest AMTL intensity for the third molar. The high frequency and intensity of AMTL in this population may be due to the high prevalence of caries, although one should also take into consideration possible trauma (including interpersonal violence) or tooth modification (i.e. removal of the central and lateral upper incisors seen in coloured groups from the Cape) as factors contributing the AMTL prevalence in the current population. A statistically significant difference was seen only in the second molar ($\chi^2 = 4.41$; $p = 0.0358$), with females more affected than males.

It is possible that males experienced more interpersonal violence causing loss of the anterior teeth than females, hence the fact that the first incisors were most frequently lost in males. In females, it is likely that caries were the main contributing factor to AMTL, as the third molar was most frequently lost.

The incidence of AMTL in the present study was compared to that of various other South African populations (Table 4.29). The results of the present study were found to be similar to that of the Marina Residence and Polyoak populations. The Griqua and Venda groups presented with a higher AMTL intensity that the current group, whereas the Riet River, Kakamas, Gladstone, Koffiefontein and Cobern Street groups presented with lower AMTL intensities. A statistically significant difference was observed between the current group and all comparative populations, except Marina Residence and Polyoak.

4.4.3. Attrition

The maxillary teeth of 19 males and 20 females were scored for dental wear, whereas the mandibular teeth of 17 males and 20 females were assessed. The average rate of attrition sorted by tooth type and sex is summarized in Table 4.30.

When pooling male and female values, the highest average scores in the maxilla were seen in the central and lateral incisors. However, in the mandible, the central incisors and first molars showed the most severe signs of attrition. In both the maxilla and mandible, as well as for male and female values, the third molars were the least worn of all tooth types inspected.

In the maxilla, the average scores for all tooth types proved to be higher in females than in males. However, in the mandible (Figure 4.36), average dental wear scores in females exceeded that of males in the frontal incisor, lateral incisor, second premolar, first molar, second molar and third molar. In general, a greater amount of dental wear was seen in females than in males.

The average rate of attrition was compared to other South African studies (Table 4.31). The method used for scoring attrition (eight point scoring system described by Molnar, 1971) is the same for the present study, K2/Mapungubwe, Cobern Street, Marina Residence and Polyoak groups. The Riet River, Kakamas and Griqua groups, however, were analysed by Morris (1984) using a scoring system adapted from Brothwell (1963). Steyn (1994) calculated corresponding values for these three groups in order to compare it to the K2/Mapungubwe population. These adapted values were used in this study for comparison to the current sample.

Attrition for the group under study appears to be average when compared to other South African groups, having an average value less than that of the Riet River, K2 and Polyoak populations, but high in comparison to the Kakamas, Griqua and Mapungubwe groups.

4.4.4. Other dental pathological conditions

A summary of dental pathologies, including tartar deposition, periodontal disease, abscesses and impacted canines, is given in Table 4.32. A total of 116 individuals were investigated for the presence of these four dental pathologies, of which 46 were male, 56 female and 14 individuals of unknown sex.

4.4.4.1. Tartar deposition

A total of 51 (44.0%) individuals were found to have calculus deposits. Of these individuals 25 (54.4%) were male and 26 (46.4%) were female. Dental calculus was not noted in any individuals of unknown sex. There was no statistical significant difference between males and females (χ^2 = 0.634; p = 0.4259).

The Gladstone population (Van der Merwe, 2006) also presented with dental calculus. A total of 32.2% of individuals investigated showed positive signs of tartar deposition. Mosothwane (2004) reported and incidence of 26.1% among all Toutswe individuals investigated for calculus deposits. An incidence of 78.3%, 84.0% and 40.5% were calculated for the Cobern Street, Marina Residence and Polyoak groups, respectively (Manyaapelo, 2007). The Khoesan displayed a tartar frequency similar to that of the Polyoak group, but presented with an incidence almost half that of the Cobern Street and Marina Residence. The current study did, however, had a higher frequency of calculus than seen in the Gladstone and Toutswe populations. This suggests that the current study group had a high incidence of dental calculus, with almost half of all scorable individuals affected.

4.4.4.2. Periodontal disease

Fifteen adult males (32.6%) and 16 adult females (28.6%) that totalled to 31 (26.7%) individuals were found to have suffered from periodontal disease (Figure 4.37). No individuals of unknown sex were affected by this condition. There was no statistical significant difference between males and females (χ^2 = 0.195; p = 0.6588).

Periodontitis was also reported in 39.5% of the Gladstone population (Van der Merwe, 2006). This condition was not reported on in the other comparative populations used for this study. The present study showed a lower incidence of periodontal disease than seen in the Gladstone population. Poor oral hygiene is most likely to blame for this condition occurring in the Khoesan. However, periodontitis in the Gladstone population were probably due to the combination of poor oral hygiene and the presence of scurvy, accounting for the higher incidence of periodontal disease seen in this mining community.

4.4.4.3. Abscesses

Periapical abscesses (Figure 4.38) were noted in 34 (29.3%) of individuals investigated. Of these 13 (28.3%) were male and 21 (37.5%) were female. No individuals of unknown sex presented with abscesses. No significant difference was observed between males and females (χ^2 = 0.967; p = 0.3254).

Abscesses were also noted in 14.4% of the Gladstone population (Van der Merwe, 2006), as well as in 7.2% of the Venda population (L'Abbé, 2005). A frequency of 32.1%, 33.3% and 44.4% were reported for the Cobern Street, Marina Residence and Polyoak groups, respectively. The present study showed a frequency of abscesses similar to that of Cobern Street and Marina Residence, which suggests that the current study group were also following diet and oral health patterns often seen in poor communities, as reported for Cobern Street and Marina Residence (Manyaapelo, 2007).

4.4.4.4. Impacted canines

Impacted permanent canines (Figure 4.39) were seen in two males (4.4%) and three females (5.4%). No individuals of unknown sex were affected by this condition. This condition occurs due to a disturbance in the normal eruption pattern of permanent teeth. The underlying cause is believed to be genetic and the product of polygenic, multifactorial inheritance. Also, it is almost always encountered bilaterally (Peck *et al*., 1994). All individuals affected displayed bilateral impacted canines. Both males (S24, #3582), as well as one female (S101) had impacted canines in the maxilla. The remaining two females (S52, C15) displayed impacted canines in the mandible. All individuals were adult, except for individual #3582, which had been an adolescent.

The Kouga mummy (Steyn *et al.* 2007) also showed impaction of the maxillary canines. The presence of this phenomenon in both an archaeological case of a Khoesan individual and in a historic group (the current study) suggests that the occurrence of impacted canines may not be an unusual feature in the Khoesan people and that it has a likely genetic origin.

4.4.4.5. Developmental defects

A juvenile individual (S32), aged 11 to 13 years, presented with malformation of the enamel in the anterior and posterior teeth (Figure 4.40). All six teeth (three molars and three premolars) present were affected. Unfortunately the other teeth were lost postmortem. Several pits and grooves could be seen and the teeth appeared to be malformed due to some type of hypoplastic condition. The formation and deposition of enamel appeared to be disrupted during development. Due to the brittle nature of the teeth, the enamel crowns appeared to be chipped in small areas on both the molars and premolars.

The differential diagnosis included congenital treponematosis, hypoplastic amelogenesis imperfecta and cuspal enamel hypoplasia. Congenital treponemal disease seems to be the more likely cause of condition, since treponematosis has been encountered in the present study. However, no other skeletal lesions such as subperiosteal bone growth could be established in the individual, as only the cranium and ribs were present. Unfortunately no other skeletal elements were present. The absence of Hutchinson's incisor and Moon's molar, however, contributed to this case possibly not being one of congenital treponematosis.

Another probable cause of the condition may be a genetic defect such as a hypoplastic form of amelogenesis imperfecta. This defect often causes the enamel crowns to have deep pits and grooves, as well as a brittle appearance, which is seen in this case. However, no other studies on palaeopathology and health status of Southern African groups (Patrick, 1989; Steyn, 1994; Mosothwane, 2004; L'Abbé, 2005; Van der Merwe 2006) have reported the presence of this condition.

A severe form of enamel hypoplasia, such as cuspal enamel hypoplasia (Ogden, 2008) may also have caused the disruption in cusp pattern formation. The malformation of the enamel crowns, as well as the young age at death and the presence of cribra orbitalia suggest that this individual was in poor health. Whatever the cause of this defect, it is clear that the enamel crowns were permanently disrupted and the structure of the dentine affected.

Table 4.1 The locations at which Khoesan specimens, currently housed in Vienna and Paris, were collected during the early 20th century in southern Africa.

Place	Number of specimens
Rudolf Pöch skeletal collection	
Western Cape, RSA	
Blinkfontein	3
Kalkbaai	3
Nooitgedagt	5
Valsbaai	9
Eastern Cape, RSA	
Middledrift	1
Northern Cape, RSA	
Belmont	2
Griqua area	6
Groot Mier	1
Kalahari	18
Kuruman	3
Marydale	2
Steenbokkloof	1
Top Dog farm	4
Tsineng	6
North West, RSA	
Gamopedi	5
Namibia	
Witkop	1
Botswana	
Bakwena area	1
Kgalagadi area	1
Southern Africa	
Unknown*	50
Museé de l'Homme skeletal collection	
Southern Africa	
Unknown	15
TOTAL	155

*Three individuals (S1, S2 and S3) belonged to a Bushmen tribe known as ≠ Gabe. It is not clear which area of the Kalahari this tribe occupied at the time, i.e. South Africa, Namibia or Botswana. Subsequently, they were classified as unknown.

Table 4.2 Completeness of skeletal material.

	RP	**MDLH**	**TOTAL**
Complete	30	1	31
Incomplete	90	-	90
Crania only	20	14	34
TOTAL	140	15	155

RP = Rudolf Pöch

MDLH = Museé de l'Homme

Table 4.3 Summary of the sex distribution of the total skeletal sample.

Sex	**n**	**%**
Male	53	34.2
Female	71	45.8
Unknown	31	20.0
Total	155	100

n – number of individuals

Table 4.4 Summary of the sex distribution of individuals from the Rudolf Pöch Skeletal Collection.

Sex	**n**	**%**
Male	48	34.3
Female	63	45.0
Unknown	29	20.7
Total	140	100

n – number of individuals

Table 4.5 Summary of the sex distribution of individuals from the Musée de l'Homme.

Sex	**n**	**%**
Male	5	33.3
Female	8	53.4
Unknown	2	13.3
Total	15	100

n – number of individuals

Table 4.6 Summary of the age distribution of the total skeletal sample, with age categories according to Falys and Lewis (2011).

Age range in years	**n**	**%**
0-2	15	9.7
3-10	16	10.3
11-19	22	14.2
20-39	40	25.8
40-59	44	28.4
59 +	8	5.2
> 20	6	3.9
> 40	2	1.3
Unknown (adults)	2	1.3
Total	155	100

n – number of individuals

Table 4.7 Summary of pathological cases encountered in the complete sample.

Pathological condition	**Number of cases**			**Case numbers**
	Adults	**Subadults***	**Total**	
SPECIFIC PATHOLOGY				
Infectious disease				
Treponematosis	5	2	7	S7, S42, S64, C16, C47, 3592, 5563
Osteomyelitis	2	-	2	S64, S123
Tuberculosis	1	-	1	S6
Nutritional disorders				
Rickets	-	2	2	S15, C36
Trauma				
Cranial lesions	3	-	3	S47a, S67, S75/58
Post-cranial: perimortem fractures	2	-	2	S10, S108
Post-cranial: antemortem fractures	6	-	6	S4, S24, S61, S95, S107, S112
Spondylolysis	1	-	1	S8
Miscellaneous	1	-	1	S53
Degenerative joint disease				
Osteoarthritis	31	-	31	Refer to Table 4.10
Erosive arthropathy	1	-	1	S58/75
Congenital abnormalities				
Cleft neural arch	2	-	2	S31, S47
Sagittal synostosis	4	-	4	S62/59, S97, MMM134, 3599
NON-SPECIFIC PATHOLOGY				
Cribra orbitalia	14	9	23	Refer to Table 4.11
Porotic hyperostosis	1	6	7	Refer to Table 4.11
Periostitis	5	4	9	S6, S7, S11, S42, S64, S75/58, S123, C35, C36
Enamel hypoplasia	9	8	17	S3, S7, S10, S19, S62/59, S68, S71, S97, S101, S103, S142, 1604, 3591, 3592, 3593, 3594, 3597
Persistantly open anterior fontanelle	-	3	3	S9, S11, C35
TOTAL	88	34	122	

*individuals younger than 20 years of age

Table 4.8 Possible treponemal infection and the bones affected.

Case #	**Sex**	**Age (years)**	**Skull** (n_e=7)	**Nose** (n_e=7)	**Clav** (n_e=3)	**Hum** (n_e=3)	**Ulna** (n_e=3)	**Rad** (n_e=3)	**Femur** (n_e=3)	**Tibia** (n_e=3)	**Fib** (n_e=3)
S7	F	20-30	x	x						x	x
S42	M	35-55		x	x	x	x	x	x	x	x
S64	Juv	7-9							x	x	
C16*	M	35-65	x		-	-	-	-	-	-	-
C47*	M	30-60	x		-	-	-	-	-	-	-
3592*	?	15-20	x		-	-	-	-	-	-	-
5563*	M	45-75	x		-	-	-	-	-	-	-
Total	n=7		5	2	1	1	1	1	2	3	2
% aff**			71.4	28.6	33.3	33.3	33.3	33.3	66.7	100.0	66.7

Clav – clavicle
Hum – humerus
Rad – radius
Fib – fibula
n – number of individuals
n_e – number of individuals with the specific skeletal element
* individuals that had no postcranial elements present; absence of skeletal element indicated by (-)
** per skeletal element

Table 4.9 Treponematosis in various South African archaeological populations.

Population	**n**	**Na**	**%**	**Chi^{2*}**	**p-value**	**Source**
Current study	155	7	4.5	-	-	This study
Venda	113	1	0.9	2.97	0.0848	L'Abbé (2005)
Gladstone	107	9	8.4	1.67	0.1963	Van der Merwe (2006)
K2/Mapungubwe	106	1	0.9	2.71	0.0997	Steyn (1994)
Maroelabult	47	1	2.1	0.55	0.4583	Steyn *et al.* (2002)

n – total number of individuals
Na – number of individuals affected by treponemal disease
*degrees of freedom = 1

Table 4.10 Degenerative joint disease (DJD) in the total skeletal sample.

Case	**Sex**	**Age**	**Arthritic changes**										**Total**	
#		**(yrs)**	Sc	Ac	Ax	Vo	Ac	Knee	Foot	Elb	Wr	Tmj	Nia	%
S4	F	25-40		x										
S7	F	20-30								x				
S13	F	35-50		x		x								
S28	F	45-65			x	x		x	x					
S40	F	40-60						x						
S45	F	50-70				x								
S47	F	40-55		x		x				x	x			
S49	F	40-60		x		x			x	x	x	x		
S51	F	35-50				x								
S52	F	25-40						x		x	x			
S55/56	F	45-60		x		x				x				
S56/55	F	40-60				x								
S63	F	45-60				x								
S74	F	45-60								x				
S99	F	35-65								x				
S102	F	35-50				x								
S107	F	40-60				x				x				
S113	F	45-60			x	x		x						
S115	F	25-40				x								
Total Females			0	5	2	13	0	4	2	8	3	1	19	59.4
S6	M	45-60	x		x			x						
S22	M	35-50				x								
S24	M	40-55		x						x				
S27	M	25-40				x								
S29	M	30-40				x				x				
S44	M	30-45								x				
S58/75	M	30-40				x	x		x					
S67	M	50-70		x										
S95	M	25-35					x							
S96	M	45-75						x						
S104	M	25-40				x								
S109	M	35-50						x						
Total Males			1	2	1	5	2	2	1	3	0	0	12	37.5
S33	U					x								
Total unknown			0	0	0	1	0	0	0	0	0	0	1	3.1
TOTAL = 84			**1**	**7**	**3**	**19**	**2**	**7**	**3**	**11**	**3**	**1**	**32**	**38.1**

Sc = sterno-clavicular joint
Ac = acromio-clavicular joint
Ax = axis (C2 vertebra)
Vo = vertebral osteophytes
Ac = acetabulum
Elb = elbow
Wr = wrist
Tmj = temporomandibular joint
Nia = number of individuals affected by DJD

Table 4.11 Cribra orbitalia (CO) and porotic hyperostosis (PH) in the total skeletal sample.

Case #	**Sex**	**Age**	**CO (n = 120)**	**PH (n = 121)**
S15	U	12-18 mnths	Active lesions	Active lesions
S32	U	11-13	Active lesions	-
S52	F	25-40	Remodelled lesions	-
S75 + S58	F	30-50	Remodelled lesions	-
S102	F	35-50	Remodelled lesions	-
S105	F	25-40	Remodelled lesions	-
S110	M	30-40	Remodelled lesions	-
S117	U	6-12 mnths	-	Active lesions
S121	M	25-35	Remodelled lesions	-
S125	M	30-60	Remodelled lesions	-
S127	U	4-6	Active lesions	-
S140*	M	30-45	Remodelled lesions	-
S142	F	20-30	Remodelled lesions	-
MMM134	M	>20	Remodelled lesions	-
C13	F	30-60	Remodelled lesions	-
C16	M	35-65	Remodelled lesions	Remodelled lesions
C29	U	7-9	Active lesions	Active lesions
C36	U	18±3 mnths	Active lesions	-
C39	U	6-9 mnths	-	Active lesions
C40	U	<6 mnths	N/A	Active lesions
#3582	M	14-18	Remodelled lesions	-
#3591	M	25-40	Remodelled lesions	-
#3592	U	15-20	-	Remodelled lesions
#3593	F	13-17	Active lesions	-
#3597	F	>20	Remodelled lesions	-
#23590	F	15-20	Remodelled lesions	-
#24893	F	30-60	Remodelled lesions	-
TOTAL			**Na = 23**	**Na = 7**

* unilateral CO present
n – the total number of individuals investigated
Na – number of individuals affected by the condition
M – male
F – female
U - unknown

Table 4.12 Number of individuals with cribra orbitalia (CO) and porotic hyperostosis (PH) in specific age groups.

	0-2 yrs	**3-10 yrs**	**11-19 yrs**	**20+ yrs**
CO	1	1	4	14
PH	3	0	1	0
CO and PH	1	1	0	1
Total	5	2	5	15

Table 4.13 CO and PH in South African populations.

Sample	n	CO	%	Chi^{2*}	*p*-value	n	PH	%	Chi^{2*}	p-value	Source
Current study	120	23	19.2	-	-	121	7	5.8	-	-	This study
Oakhurst	18	11	61.1	14.86	0.0001**	-	-	-	-	-	Patrick (1989)
Toutswe	35	6	17.1	0.07	0.7870	35	5	14.3	2.77	0.0960	Mosothwane (2004)
K2	37	14	37.8	5.48	0.0192**	-	-	-	-	-	Steyn (1994)
Riet River	74	7	9.5	3.29	0.0697	-	-	-	-	-	Morris (1984)
Kakamas	53	2	3.8	7.05	0.0079**	-	-	-	-	-	Morris (1984)
Gladstone	82	9	11.0	2.46	0.1168	-	-	-	-	-	Van der Merwe (2006)

n – the total number of individuals investigated
CO – cribra orbitalia
PH – porotic hyperostosis
*degrees of freedom = 1
**statistically significant difference observed

Table 4.14 Non-specific periostitis in the total skeletal sample.

Case #	Sex	Age	Scapula	Clavicle	Ribs	Hum	Ulna	Radius	Os coxa	Femur	Tibia	Fibula	Feet
S6	M	45-60	x		x				x		x		
S7	F	20-30									x	x	
S11	U	15-18mnths									x		
S42	M	35-55		x		x	x	x		x	x	x	
S64	U	7-9								x	x		
S75 + S58	F	30-50					x				x	x	x
S123	M	25-40						x					
C35	U	6-12mnths						x				x	
C36	U	15-18mnths				x							
TOTAL			**1**	**1**	**1**	**2**	**2**	**3**	**1**	**2**	**6**	**4**	**1**

Hum – humerus
U – unknown

Table 4.15 Periostitis in various South African populations.

Population	**n**	**Na**	**%**	**Chi^{2*}**	**p-value**	**Source**
Current study	117	9	7.7	-	-	This study
Venda	113	7	6.2	0.20	0.6547	L'Abbé (2005)
Gladstone	107	20	18.7	5.98	0.0145**	Van der Merwe (2006)
K2/Mapungubwe	106	6	5.7	0.36	0.5485	Steyn (1994)
Koffiefontein	36	4	11.1	0.08	0.7773	L'Abbé *et al.* (2003)
Maroelabult	47	8	17.0	3.14	0.0764	Steyn *et al.* (2002)

n –total number of individuals investigated
Na – number of individuals affected by periostitis
*degrees of freedom = 1
**statistically significant difference observed

Table 4.16 LEH in permanent and deciduous teeth.

	n	**Na**	**%**
Permanent	1031	186	18.0
Deciduous	129	0	0.0
TOTAL	**1160**	**186**	**16.0**

n – total number of teeth investigated
Na – number of teeth affected by LEH

Table 4.17 Summary of linear enamel hypoplasia in permanent teeth (LEH).

Sex	**n**	**Na**	**%**
Male	20	5	25.0
Female	23	10	43.5
Unknown	4	2	50.0
TOTAL	**47**	**17**	**36.2**

n –total number of individuals investigated with permanent dentition
Na – number of individuals affected by LEH

Table 4.18 LEH sorted by tooth type for permanent teeth.

	Maxilla			**Mandible**		
Tooth	n	Na	%	n	Na	%
I1	53	15	28.3	47	9	19.2
I2	56	17	30.4	58	13	22.4
C	69	18	26.1	50	11	22.0
PM1	57	9	15.8	66	9	13.6
PM2	61	12	19.7	68	10	14.7
M1	89	16	18.0	82	9	11.0
M2	81	17	21.0	76	8	10.5
M3	58	10	17.2	60	3	5.0
TOTAL	**524**	**114**	**21.8**	**507**	**72**	**14.2**

n – total number of teeth investigated per tooth type
Na – number of teeth affected by LEH

Table 4.19 Enamel hypoplasia in various South African populations.

Population	**n**	**Na**	**%**	**Chi^{2*}**	**p-value**
Current study	47	17	36.2	-	-
Venda	90	12	13.3	9.49	0.0021**
K2/Mapungubwe	60	38	63.3	7.79	0.0053**
Oakhurst	22	11	50.0	1.11	0.2930
Koffiefontein	37	22	61.1	4.48	0.0344**
Maroelabult	16	3	18.8	1.70	0.1919
Gladstone	90	14	15.6	7.48	0.0062**

n – total number of individuals investigated
Na – number of individuals affected by enamel hypoplasia
*degrees of freedom = 1
**statistically significant difference observed

Table 4.20 Long bone lengths of infant and juvenile individuals.

Age (yrs)*	**Humerus**		**Radius**		**Ulna**		**Femur**		**Tibia**		**Fibula**	
	n	mean	n	mean	n	mean	n	mean	n	mean	n	mean
0-0.5	2	68.5	1	54.0	1	61.0	2	82.5	2	70.5	1	63.0
0.5-1.5	4	100.0	4	78.0	5	87.4	5	125.2	5	98.4	2	112.0
1.5-2.5	2	105.5	-	-	-	-	1	122.0	-	-	-	-
2.5-3.5	1	112.0	1	84.0	1	95.5	1	146.0	1	124.0	1	121.0
3.5-4.5	1	123.0	1	95.0	1	106.0	1	165.0	1	135.0	1	128.0
4.5-5.5	1	142.0	1	111.0	1	118.0	1	200.0	1	162.0	1	158.0
5.5-6.5	1	124.0	1	100.0	1	112.0	2	193.0	1	142.0	-	-
6.5-7.5	2	150.0	2	117.5	2	129.0	2	221.5	2	182.5	2	176.5
7.5-8.5	-	-	-	-	-		-	-	-	-	-	-
8.5-9.5	-	-	-	-	-	-	1	265.0	1	222.0	-	-
9.5-10.5	-	-	-	-	-		-	-	-	-	-	-
10.5-11.5	1	238.0	1	181.0	1	199.0	1	343.0	1	283.0	1	272.0

n – number of bones measured
*age in years displayed in intervals of half a year (6 months = 0.5 years)

Table 4.21 Summary of the estimated antemortem stature for males and females.

Sex	**n**	**Minimum (cm)**	**Maximum (cm)**	**Mean (cm)**	**Std. deviation**
Male	35	141.3	170.1	157.9	2.777
Female	41	133.2	165.6	149.2	2.789

n – number of individuals

Table 4.22 Summary of the statures of the current study and that of other South African populations.

Population	**Males**		**Females**		**Source**
	n	**mean (cm)**	**n**	**mean (cm)**	
Current study	35	157.9	41	149.2	This study
/?Auni =Khomani San	20	159.3	21	148.8	Dart (1937)
Dobe !Kung	79	160.9	74	150.1	Truswell & Hansen (1976)
Lake Chrissie San	14	149.1	9	136.0	Toerien (1955)
Magon San	40	157.9	41	147.4	Tobias (1962)
Gladstone	73	165.3	14	154.4	Van der Merwe (2006)
Venda	23	166.9	28	157.8	L'Abbé (2005)
K2/Mapungubwe	6	163.6	3	153.0	Steyn (1994)

n – number of individuals

Table 4.23 Summary of dental caries.

	Per individual[1]			**Per mouth**[2]			**Per tooth**[3]		
	n	NAI	%	NAI	NTA	C/m	NT	NTA	%
Male	46	11	23.9	11	37	1.0	781	37	4.7
Female	56	21	37.5	21	72	2.0	784	72	9.2
Unknown	14	1	7.1	1	2	0.0	157	2	1.2
Total	116	33	28.4	33	111	1.0	1722	111	6.5

1 – total number of individuals affected by dental caries / total number of individuals present
2 – total number of carious teeth / total number of individuals affected by dental caries
3 – total number of carious teeth / total number of teeth present
n – total number of individuals investigated
NAI – total number of individuals affected by dental caries
NTA – total number of teeth affected by dental caries
C/m – average number of carious lesions per mouth
NT – total number of teeth present

Table 4.24 Corrected prevalence of caries.

Sex	**AMTL**	**P**	**Ena**	**Ona**	**n**	**Ne**	**Ec**	**Ccr %**
Male	202	0.24	48.5	37	781	983	85.5	8.7
Female	239	0.30	71.7	72	784	1023	143.7	14.1
Unknown	0	0.01	0	2	157	157	2	1.3
Total	441	0.26	114.7	111	1722	2163	225.7	10.4

AMTL – antemortem tooth loss
P – proportion of teeth that were lost antemortem due to caries (caries correction factor)
Ena – estimated number of teeth lost due to caries
Ona – number of carious teeth observed
n – number of teeth investigated
Ne – total number of teeth
Ec – estimated number of teeth with caries
Ccr% - caries correction rate

Table 4.25 Caries intensity sorted by sex and tooth type.

Tooth	**Male**			**Female**			**Unknown**			**Chi^{2*}**	**p-value**	**Total**		
	n	Na	%	n	Na	%	n	Na	%			n	Na	%
I1	72	1	1.4	65	2	3.1	19	1	5.3	0.46	0.4976	156	4	2.6
I2	81	1	1.2	78	2	2.6	19	0	0	0.38	0.5360	178	3	1.7
C	94	2	2.1	97	5	5.2	21	0	0	1.25	0.2636	212	7	3.3
PM1	98	3	3.1	99	8	8.1	6	0	0	2.35	0.1253	203	11	5.4
PM2	96	1	1.0	100	12	12.0	6	0	0	9.51	0.0020**	202	13	6.4
M1	124	9	7.3	135	17	12.6	48	1	2.1	2.04	0.1532	307	27	8.8
M2	112	13	11.6	119	17	14.3	38	0	0	0.37	0.5430	269	30	11.2
M3	104	7	6.7	91	9	9.9	0	0	0	0.64	0.4237	195	16	8.2
Total	781	37	4.7	784	72	9.2	157	2	1.3			1722	111	6.5

I – incisor
C – canine
PM – premolar
M – molar
n – number of teeth investigated
Na – number of teeth affected by caries
*degrees of freedom = 1
**statistically significant difference observed

Table 4.26 Carious lesions in the current sample and other South African populations.

Population	**n**	**Na**	**Nt**	**Nta**	**Caries frequency (%)**	**Caries intensity (%)**	**Carious teeth/ mouth**	**Chi^{2*}**	**p-value**	**Source**
Current study	116	33	1722	111	28.4	6.5	1.0	-	-	This study
Gladstone	92	51	2694	116	55.4	4.3	2.8	9.86	0.0017**	Van der Merwe (2006)
Riet River	46.5[a]	-	1061	46	41.7	4.3	1.0	5.49	0.0191**	Morris (1992)
Kakamas	42.5[a]	-	989	13	18.8	1.3	0.3	37.91	<0.0001**	Morris (1992)
Griqua	26	-	575	30	42.3	5.2	1.2	1.13	0.2876	Morris (1992)
Oakhurst	13	11	192	34	84.6	17.7	4.0	31.27	<0.0001**	Sealy *et al*. (1992)
"Wild Bushmen"	104	-	3335	17	7.7	0.5	0.2	162.19	<0.0001**	Van Reenen (1966)
"Farm Bushmen"	221	-	7052	56	12.2	0.8	0.3	236.73	<0.0001**	Van Reenen (1966)
Venda	97	59	2016	157	60.8	7.8	1.6	2.51	0.1131	L'Abbé (2005)
Maroelabult	23	13	582	26	56.6	4.5	2.0	3.05	0.0807	Steyn *et al*. (2002)
K2/Mapungubwe	-	-	306	56	54.5	18.3	1.4	48.31	<0.0001**	Steyn (1994)
Cobern Street	28	21	734	118	75.0	16.1	4.2	56.45	<0.0001**	Manyaapelo (2007)
Marina Residence	32	27	759	120	84.4	15.8	3.8	54.71	<0.0001**	Manyaapelo (2007)
Polyoak	9	7	210	57	77.8	27.1	6.3	101.01	<0.0001**	Manyaapelo (2007)

n = number of individuals investigated
Na = number of individuals affected
Nt = total number of teeth investigated
Nta = number of teeth affected by caries
[a]Individuals with only a mandible/maxilla account as one half of one individual (Morris, 1992)
*degrees of freedom = 1
**statistically significant difference observed

Table 4.27 Summary of antemortem tooth loss (AMTL).

Sex	**Per individual**[1]			**Per mouth**[2]			**Intensity**[3]		
	n	Nai	%	Nai	Na	C/M	Nt	Na	%
Male	46	19	41.3	19	202	10.6	1472	202	13.7
Female	56	25	44.6	25	239	9.5	1792	239	13.3
Unknown	14	0	0	0	0	0	448	0	0
Total	116	44	37.9	44	441	10.0	3712	441	11.9

1 – total number of individuals affected by antemortem tooth loss / total number of individuals investigated
2 – total number of teeth lost antemortem / total number of individuals affected by antemortem tooth loss
3 – total number of teeth lost antemortem / total number of tooth places present
n – total number of individuals investigated
Nai – number of individuals affected by antemortem tooth loss
Na – number of teeth lost antemortem
C/M – average number of teeth lost antemortem per mouth
Nt – total number of tooth places present in the sample

Table 4.28 Antemortem tooth loss sorted by sex and tooth type.

Tooth	Male			Female			Unknown			Chi[2*]	p-value	Total		
	n[a]	Na	%	n[b]	Na	%	n[c]	Na	%			n	Na	%
I1	184	32	17.4	224	30	13.4	56	0	0	1.23	0.2676	464	62	13.4
I2	184	30	16.3	224	24	10.7	56	0	0	2.75	0.0971	464	54	11.6
C	184	18	9.8	224	12	5.4	56	0	0	2.90	0.0884	464	30	6.5
PM1	184	21	11.4	224	22	9.8	56	0	0	0.27	0.6033	464	43	9.3
PM2	184	23	12.5	224	19	8.5	56	0	0	1.77	0.1838	464	42	9.1
M1	184	23	12.5	224	34	15.2	56	0	0	0.60	0.4382	464	57	12.3
M2	184	24	13.0	224	47	21.0	56	0	0	4.41	0.0358**	464	71	15.3
M3	184	31	16.8	224	51	22.8	56	0	0	2.22	0.1363	464	82	17.7
Total	1472	202	13.7	1792	239	13.3	448	0	0			3712	441	11.9

n – total number of tooth places present for each tooth type
Na – total number of teeth lost antemortem
[a] n = (4 x 46 individuals) = 184 tooth places for each tooth type for males
[b] n = (4 x 56 individuals) = 224 tooth places for each tooth type for females
[c] n = (4 x 14 individuals) = 56 tooth places for each tooth type for unknown individuals
*degrees of freedom = 1
**statistically significant difference observed

Table 4.29 Antemortem tooth loss in various other South African populations.

Population	**n**	**Na**	**AMTL intensity (%)**	**Chi^{2*}**	**p-value**	**Source**
Current study	3712	441	11.9	-	-	This study
Gladstone	2694	63	2.3	195.94	<0.0001**	Van der Merwe (2006)
Riet River	1557	95	6.1	40.09	<0.0001**	Morris (1992)
Kakamas	1317	54	4.1	66.31	<0.0001**	Morris (1992)
Griqua	894	152	17.0	17.10	<0.0001**	Morris (1992)
Venda	2016	347	17.2	31.31	<0.0001**	L'Abbé (2005)
Koffiefontein	1016	63	6.2	27.02	<0.0001**	L'Abbé *et al.* (2003)
Cobern Street	849	61	7.2	15.55	<0.0001**	Manyaapelo (2007)
Marina Residence	885	104	11.8	0.00	0.9496	Manyaapelo (2007)
Polyoak	263	27	10.3	0.62	0.4310	Manyaapelo (2007)

n – total number of tooth places present
Na – total number of teeth lost antemortem
*degrees of freedom = 1
**statistically significant difference observed

Table 4.30 Average rate of attrition (scored 1 to 8) by sex and tooth type.

	Male		**Female**		**Total**	
Maxilla	n	mean	n	mean	n	mean
I1	15	4.1	17	4.8	32	4.5
I2	16	3.9	17	4.6	33	4.3
C	17	3.7	18	4.3	35	4.0
PM1	17	3.7	19	4.1	36	3.9
PM2	19	3.7	19	4.2	38	3.9
M1	19	4.1	20	4.3	39	4.2
M2	19	3.1	20	3.4	39	3.2
M3	19	2.2	16	2.3	35	2.8
Mandible						
I1	13	4.0	14	4.4	27	4.2
I2	15	3.9	19	4.1	34	4.0
C	17	4.1	19	3.9	36	4.0
PM1	17	3.8	20	3.8	37	3.8
PM2	17	3.9	19	4.1	36	4.0
M1	17	4.0	20	4.2	37	4.1
M2	17	3.2	19	3.4	36	3.3
M3	16	2.1	17	2.5	33	2.3

n – number of teeth investigated
I – incisor
C – canine
PM – premolar
M – molar

Table 4.31 Comparison of average molar attrition values for various South African populations.

Population	**n**	**Average attrition**	**Source**
Current study	39	3.8	This study
K2	18	4.0	Steyn (1994)
Mapungubwe	5	3.2	Steyn (1994)
Riet River	51	2.4 (~4)*	Morris (1984)
Kakamas	43	2.1 (~3)*	Morris (1984)
Griqua	26	1.6 (~2)*	Morris (1984)
Cobern Street	28	3.5	Manyaapelo (2007)
Marina Residence	36	3.5	Manyaapelo (2007)
Polyoak	10	4.0	Manyaapelo (2007)

n – number of individuals scored
*values in brackets are the adapted values by Steyn (1994) to correspond with the Molnar (1971) scoring system

Table 4.32 Frequency of other dental pathologies present in the current sample.

Pathological condition	**Male (n = 46)**		**Female (n = 56)**		**Unknown (n = 14)**		**Total (n = 116)**	
	Na	%	Na	%	Na	%	Na	%
Tartar deposition	25	54.4	26	46.4	0	0	51	44.0
Periodontal disease	15	32.6	16	28.6	0	0	31	26.7
Abscesses	13	28.3	21	37.5	0	0	34	29.3
Impacted canines	2	4.4	3	5.4	0	0	5	4.3

n – total number of individuals investigated
Na – number of individuals affected by the condition

Figure 4.1 Age distribution of the complete sample presented as percentage values

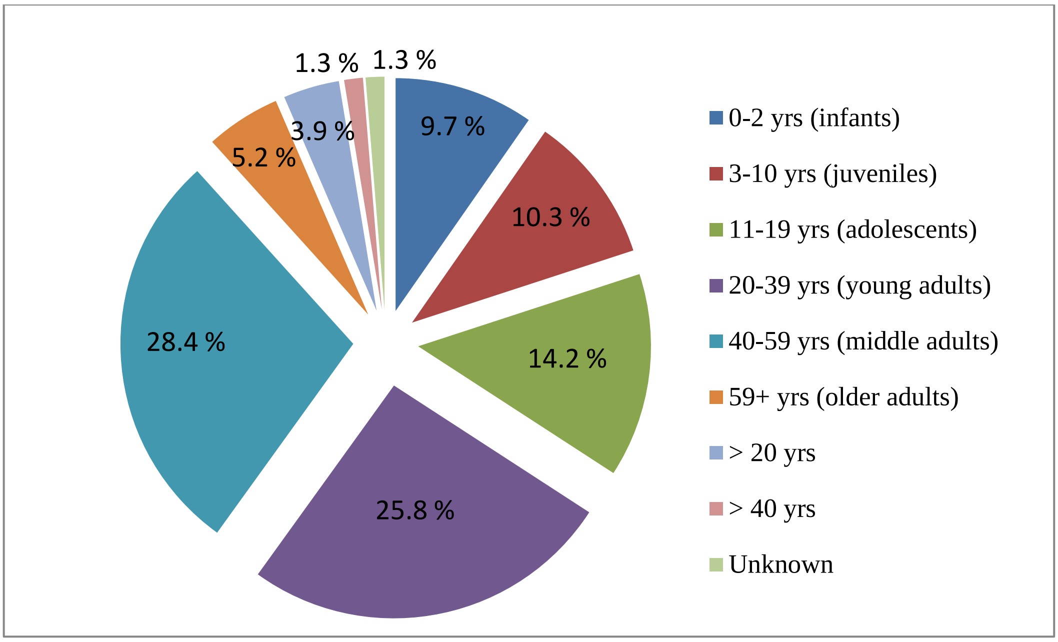

Figure 4.2 Active gummatous lesion on the frontal bone of a female individual between the ages of 20 and 30 years (S7).

Figure 4.3 Sabre-shin of the tibia in a male individual (S42) aged 35 to 55 years.

Figure 4.4 Destruction of the nasal structure, septum and inferior conchae in a female (S7) aged 20 to 30 years.

Figure 4.5 Osteomyelitic changes and cloaca (indicated by arrow) on the left femur in a juvenile individual (S64), 7 to 9 years of age, diagnosed with possible treponematosis.

Figure 4.6 Non-specific osteomyetilis with cloacae formation in the left radius of a male individual (S123) estimated to have been between the ages of 25 and 40 years.

Figure 4.7 Healed infectious lesion on the cranium of a male individual (S6) aged 45 to 60 years involving the sagittal suture and the lambda junction.

(note: writing on skull indicated that the individual had been female. However, skeletal analysis suggests that the individual had been male.)

Figure 4.8 Bowed femora indicative of rickets in an infant (C36) 15 to 18 months old.

Figure 4.9 Healed traumatic lesion on the right parietal of a female (S47a) aged 30 to 40 years.

Figure 4.10 Healed circular traumatic lesion on the right parietal bone of a male (S67) aged 50 to 70 years.

Figure 4.11 Hangman’s fracture in a male individual (S10) aged 30 to 40 years.

Figure 4.12 Perimortem fractures of the ribs in a female (S108) aged 35 to 50 years.

Figure 4.13 Parry fracture of the left ulna of a female individual (S107) aged 40 to 60 years.

Figure 4.14 An unhealed fracture in the subtrochanteric area of the left femur of a male (S24) aged 40 to 55 years (the second fracture sustained).

Figure 4.15 A well-healed fracture of the left femoral shaft in an adult male individual (S95). Also note the severe osteoarthritis of the femoral head caused by this injury.

Figure 4.16 A well-healed fracture of the left proximal humerus showing severe osteoarthritis and ankylosis of the shoulder in a female (S4) aged 25 to 40 years.

Figure 4.17 Pseudoarthosis of the left clavicle in an adult male individual (S61).

Figure 4.18 Spondylolysis of L4 in a female (S8) aged 25 to 35 years of age.

Figure 4.19 Fused pubic symphyses in a male (S53) aged 30 to 45 years.

(Note: the fracture is due to postmortem damage)

Figure 4.20 Severe osteoarthritis of the left acetabulum due to trauma of the femoral shaft in a male individual (S95), aged 25 to 35 years.

Figure 4.21 Osteoarthritis of the right calcaneus and talus in a 30 to 40 year old male (S58/S75).

Figure 4.22 Cribra orbitalia in a female individual (#23590) aged 15 to 20 years.

(note: The inscription on the skull indicates that it had been collected in a cave in or close to Humansdorp)

Figure 4.23 Porotic hyperostosis in an infant (S117) aged 6 to 12 months.

Figure 4.24 Periostitis of the left ulna in a female (S75skull/S58) aged 30 to 50 years.

Figure 4.25 Enamel hypoplasia in a female (S62skull/S59) aged 18 to 25 years.

Figure 4.26 Persistently open anterior fontanelle in a juvenile individual (S11) aged 15 to 18 months

Figure 4.27 Spina bifida (cleft neural arch) in a female (S47) aged 40 to 55 years.

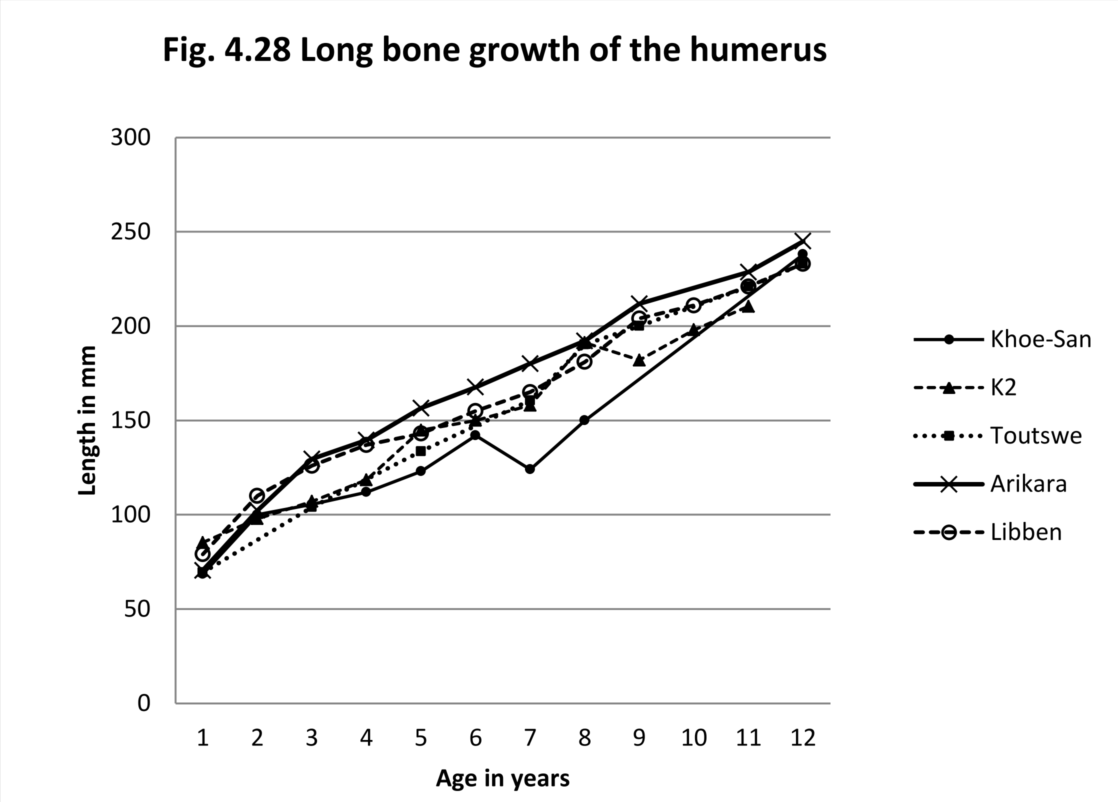
Fig. 4.28 Long bone growth of the humerus
Length in mm
300
250
200
150
100
50
0
1 2 3 4 5 6 7 8 9 10 11 12
Age in years
Khoe-San
K2
Toutswe
Arikara
Libben

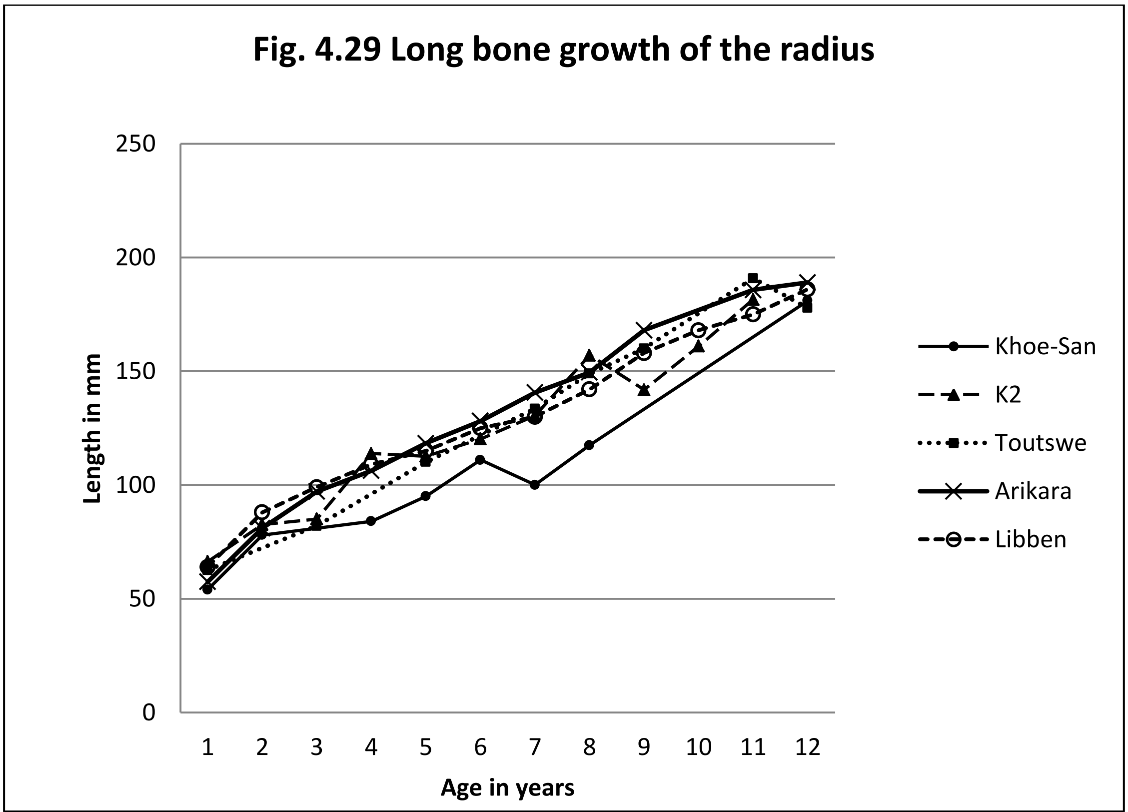
Fig. 4.29 Long bone growth of the radius
Length in mm
250
200
150
100
50
0
1 2 3 4 5 6 7 8 9 10 11 12
Age in years
Khoe-San
K2
Toutswe
Arikara
Libben

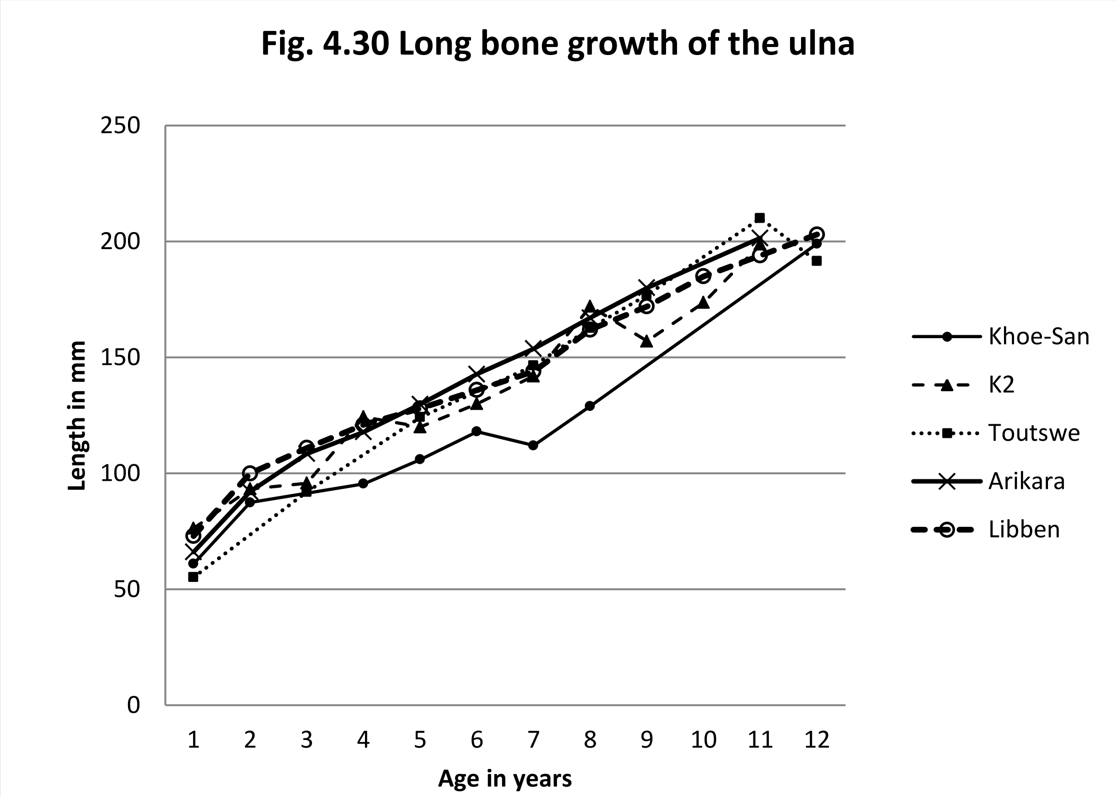
Fig. 4.30 Long bone growth of the ulna
Length in mm
0
50
100
150
200
250
1
2
3
4
5
6
7
8
9
10
11
12
Age in years
Khoe-San
K2
Toutswe
Arikara
Libben

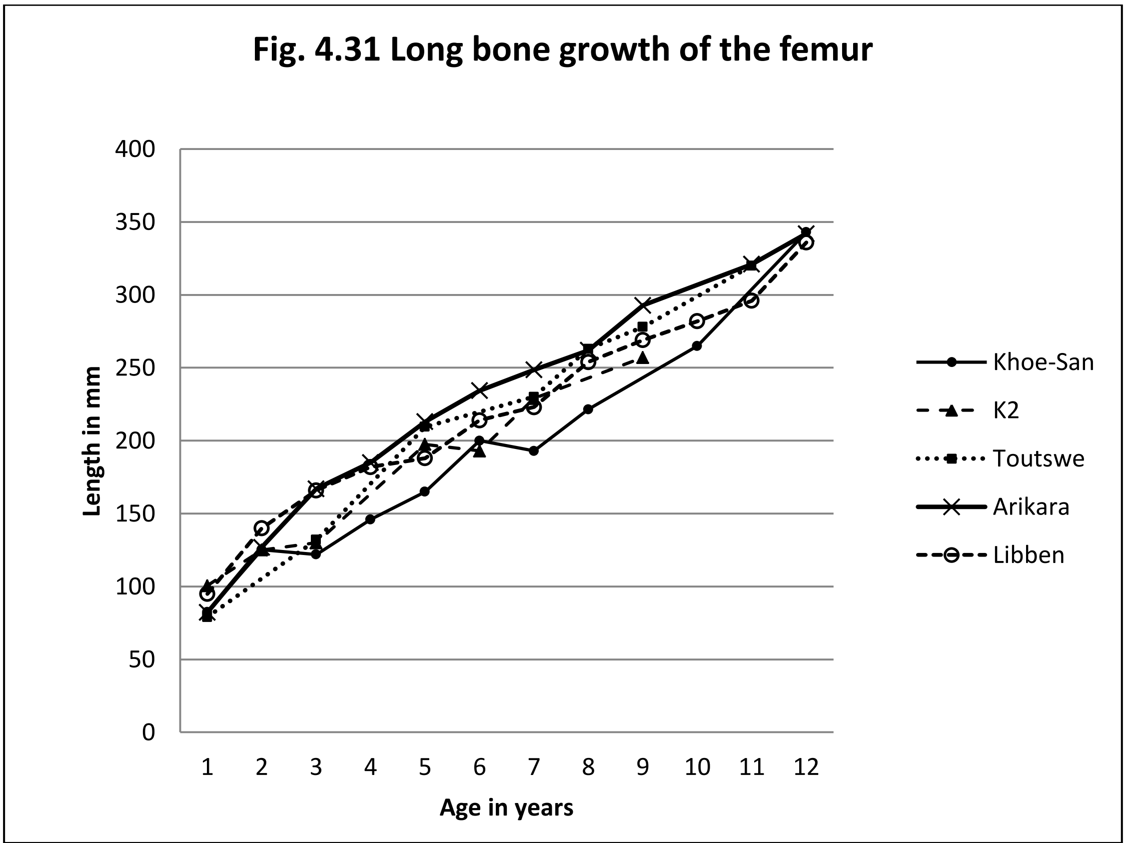
Fig. 4.31 Long bone growth of the femur
Length in mm
0
50
100
150
200
250
300
350
400
1
2
3
4
5
6
7
8
9
10
11
12
Age in years
Khoe-San
K2
Toutswe
Arikara
Libben

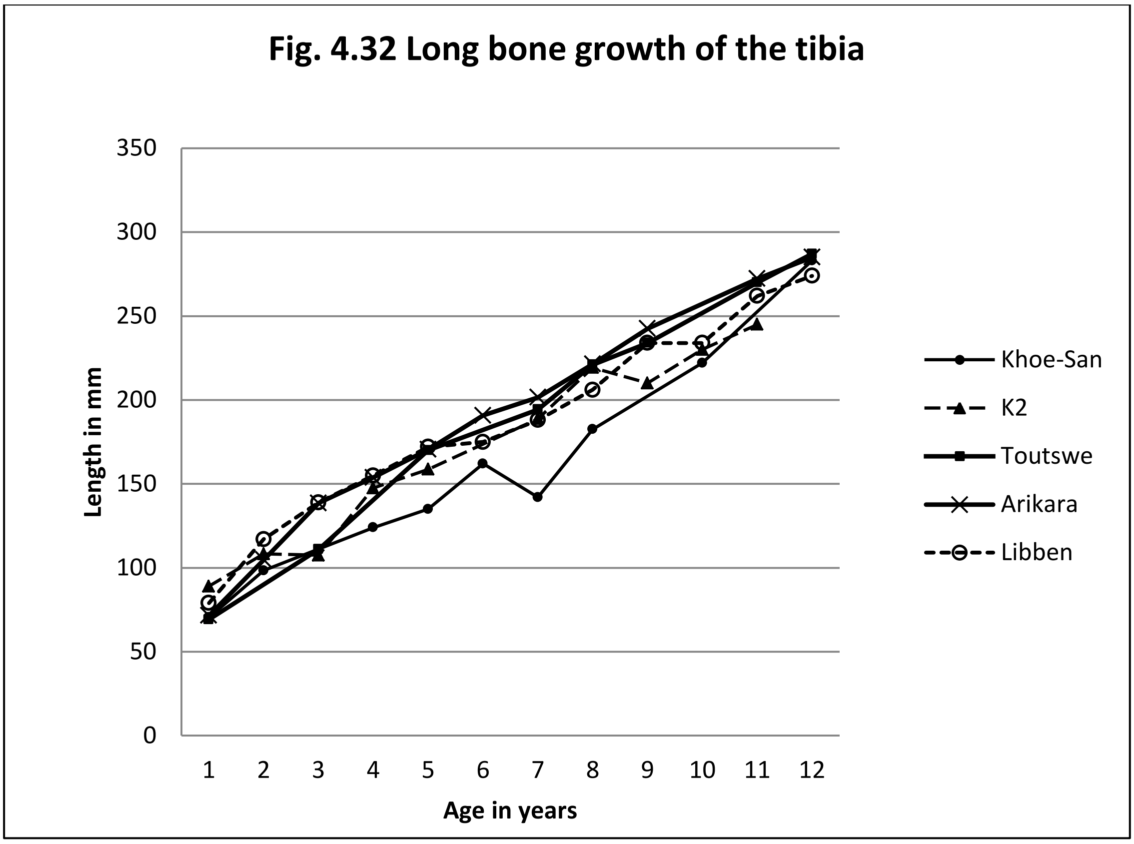
Fig. 4.32 Long bone growth of the tibia
Length in mm
350
300
250
200
150
100
50
0
1 2 3 4 5 6 7 8 9 10 11 12
Age in years
Khoe-San
K2
Toutswe
Arikara
Libben

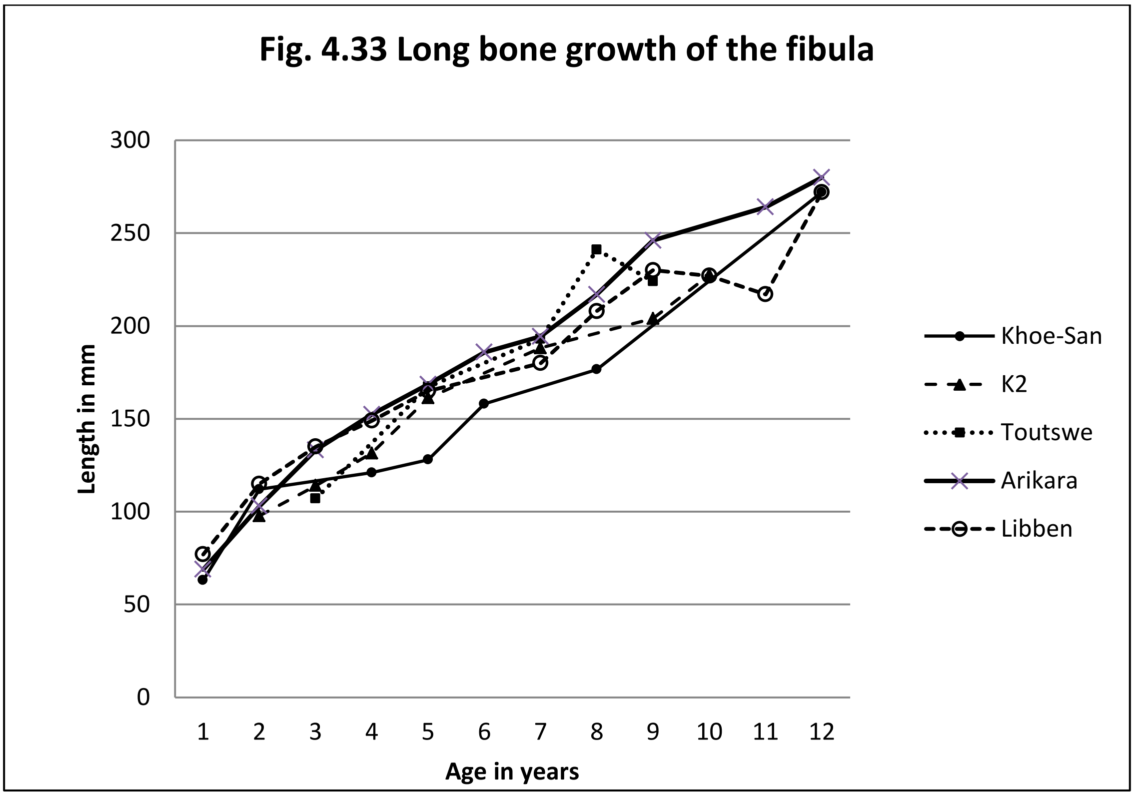
Fig. 4.33 Long bone growth of the fibula
Length in mm
300
250
200
150
100
50
0
1 2 3 4 5 6 7 8 9 10 11 12
Age in years
Khoe-San
K2
Toutswe
Arikara
Libben

Figure 4.34 Dental caries in a female (S115) aged 25 to 40 years.

Figure 4.35 Complete antemortem tooth loss in a female (S55/S56) between the ages of 45 and 60 years.

Figure 4.36 Attrition in a female (S51) aged 35 to 50 years.

Figure 4.37 Periodontal disease in an adult male individual (S22).

Figure 4.38 Periapical abscesses in the maxilla of an adult male individual (S24).

Figure 4.39 Impacted canines in a female individual (S101) aged 18 to 25 years.

Figure 4.40 Severely malformed enamel crowns of the molars and premolars in a juvenile (S32) aged 11 to 13 years.

Note: The top row (from left to right) represents a first molar and two second molars. It was not clear if the molars were upper or lower teeth, as the teeth were loose and the roots not yet fully developed, making analysis difficult. The bottom row represents (from left to right) a lower first premolar and two upper first premolars.

Chapter 5: Discussion

5.1. Introduction

The study sample at hand may be described as a heterogenous sample, as the skeletons were collected from various places in southern Africa and represents individuals of San and Khoe origin. The sample also, most likely, contains San or Khoe individuals with possible white or black admixture. The group is thus representative of the larger Khoesan population as they were found during the late 19th and early 20th century throughout southern Africa.

From an archaeological perspective, details regarding the manner of burial and the context in which the skeletal remains were found are unknown. Information pertaining to the exact location of graves and exhumation practices were not recorded, as the race for obtaining Khoesan skeletal material at the time caused several individuals to partake in the collection and trading of the remains. This means that valuable information pertaining to the skeletons were lost in the process of collection, which is a sad consequence of the unethical manner in which the remains were obtained. Fortunately, in many of the cases, the geographical area where the skeletons were found was recorded. A large number of skeletons came from the Northern Cape and Kalahari regions. This suggests that the sample may contain several individuals of hunter-gatherer or partly hunter-gatherer origin.

Analysis of the skeletons revealed the presence of a few associated grave goods, which appeared to be mostly decorative in nature. These goods included ostrich egg shell beads, metal arm bands, blue and green glass beads, clothing buttons and animal bones. The presence of glass beads, for example, suggests that either trading may have taken place between the Khoesan and other communities, or that they bought accessories in towns or markets in the Cape Colony. It is, however, unclear exactly where the individuals in this sample resided, for example, towns, farms or open landscapes, and thus makes it very difficult to trace the origin of these goods. The associated grave goods may also indicate that different communities merged over the course of a few hundred years following the arrival of the Dutch colonists. The end result for the Khoesan group would have been a mixed economy between colonial farming, pastoralism and hunter-gatherer lifestyles. However, one should be careful as to classify an individual into a specific subsistence group.

The demographic profile of the Khoesan group reveals characteristics similar to other populations reported on from the same time period, for example the Venda (L'Abbé, 2005), although as explained above, one should be careful to interpret this data because these individuals may not have been entirely representative of the once living population. About 34% of individuals died before the age of 20 years. The infant mortality rate is less than reported in the Toutswe, K2/Mapungubwe and Oakhurst archaeological populations, although still high. A total of about 54% individuals lived to be adults, aged between 20 and 60 years of age. However, few individuals (about 5%) survived to be older than 60 years of age. These mortality patterns suggest that the population was in relative good health and that the majority managed to reach adulthood.

The high infant mortality may also suggest a high fertility rate. It has been reported that Khoesan women exhibit prolonged duration of lactation due to the dry climate of their environment in the northern parts of southern Africa resulting in a shortage of water available to their offspring. This may cause in a dramatic reduction of body fat and maternal health (Martorell, 1981; Quandt, 1983; Kirchengast, 2000), and offspring may not survive if the mother experiences physiological exhaustion from continued infant feeding. Howell (1976) reported that Khoesan females breast-feed their children to about four years of age, resulting in extreme physiological demands experienced by mother. This suggests that the reproductive success amongst the Khoesan was compromised by their health and physiological stress experienced by the reproductive females. It is thus possible that continued reproduction resulted in a high number of offspring, but a low number of surviving infants.

The number of males and females in the sample are about equal. Also, individuals representing all age groups are included. Demographically, the individuals appear to represent a normal, although heterogenous, population. However, one should keep in mind that the demographic profile may have been influenced by the manner in which collection of the remains took place. Collection practices may have favoured equality in numbers between males and females instead of revealing the actual male-female ratio of the Khoesan population at the time.

The primary objective of this study was to investigate the health status of the Khoesan people during the late 19th and early 20th century. In general, the preservation of the remains was good and allowed for the visualization of all pathological lesions present. A discussion of the pathological conditions encountered, skeletal growth and stature, as well as dental health and pathology is given below.

5.2. Palaeopatholgical indications of health

The presence of palaeopathological conditions encountered in the study group is reviewed in this section. These conditions include infectious disease, nutritional disorders, degenerative joint disease, congenital abnormalities and non-specific indicators of disease.

5.2.1. Specific infectious diseases

The marginalization and transition from a hunter-gatherer subsistence or pastoralism to colonial farms/urban environment brought about a drastic change in the lifestyle of the Khoesan, which most probably promoted a decline in the health status of the sample under study. The new living conditions were most likely sedentary, which promoted poor sanitation and hygiene. The manifestation and spread of infectious diseases was most likely a direct result of this change – from vast, open, dry spaces to crowded, sultry living conditions.

Also, the general health of the late 19th and early 20th century Khoesan was most likely compromised by the absence of a balanced diet, poverty, increased contact to pathogenic micro-organisms due to poor living conditions and hard physical labour on farms for long periods of time (Guenther, 1976; Smith *et al*., 2000; Mountain, 2003). These factors most likely acted as underlying causes for a possible increase in the occurrence of infectious disease in the population.

Khoesan individuals were employed on farms as cattle herders, unskilled workers and domestic servants together with individuals from other black African groups, where they received low wages and rations of corn meal, tea, sugar and tobacco. Living in close proximity to individuals from other black African groups increased the Khoesan's exposure to infections such as treponemal disease and tuberculosis (Guenther, 1976).

When looking at specific infectious diseases found in southern Africa as portrayed by skeletal remains, the presence of treponemal infections have been reported in a few populations. Most studies reported only single cases of this infection (Steyn, 1994; Steyn *et al*., 2002b; L'Abbé, 2005). However, it has been estimated that only about 20% of individuals suffering form treponemal infection may show bone changes (Resnick & Niwayama, 1995c). Therefore, the prevalence of this infection is believed to be largely underestimated in archaeological populations (Roberts & Mancester, 2005). The current study group revealed a frequency of 4.5% of affected individuals in the total sample, which is higher than that reported for Maroelabult (Steyn *et al*., 2002b), K2 (Steyn, 1994) and the Venda (L'Abbé, 2005). Also, a higher prevalence (8.4%) of treponemal infection than seen in the current study group was reported for the Gladstone group, a late 19th century mining population from Kimberley which was also subjected to hard physical labour and poor living conditions (Van der Merwe, 2006). This suggests that the lifestyle of poor communities in more recent times caused them to experience an increase in the prevalence of treponematosis as seen in the Gladstone sample, as well as the current study group.

It is unclear whether the Khoesan had access to the western society's health care. At the time, no effective treatment was available for most infectious diseases in any case. The present study sample contained six individuals with possible treponemal disease and one juvenile with possible congenital treponematosis. Four different forms of treponemal disease exist (yaws, pinta, bejel and venereal treponematosis), although only venereal treponemal disease has a congenital variant. All forms of the infection may lead to the development of skeletal lesions, except pinta (Hackett, 1976; Ortner, 2003; Waldron, 2009). However, venereal treponematosis is the only fatal form of this infection (Roberts & Manchester, 2005). In order to determine which form of treponematosis is present in a skeletal sample, one needs to take into consideration geographical location, as well as skeletal location. Venereal treponematosis is found world-wide, while yaws occurs in the tropical areas. Bejel is located predominantly in the Middle East and West Africa (Waldron, 2009). The most common skeletal features indicative of venereal treponemal disease is gummatous lesions on the cranium and sabre-shin tibiae (Hackett, 1976; Powell, 1988; Ortner, 2003; Waldron, 2009), which were the most frequently encountered lesions in individuals with possible treponemal disease in the current study.

The presence of a possible case of congenital treponematosis, as well as cranial lesions and tibial deformity thus suggest that the individuals in the present study sample suffered from possible venereal treponemal disease. Also, individuals in the current sample most likely resided in dry areas of southern Africa such as the Kalahari and northern Cape, diminishing the possibility of bejel or yaws being the cause of the skeletal lesions, as these forms are mainly located in the tropical areas of the world.

Other infectious diseases observed in the Khoesan group included osteomyelitis and possible tuberculosis. Non-specific osteomyelitis was observed in a male individual that showed no other signs of trauma or infection. This condition is more often associated with poor sanitation and rural environments (Van der Merwe, 2006), which is consistent with aspects of the Khoesan people's living environments in the Cape Colony during the 19th and early 20th century.

Unfortunately, only isolated cases of tuberculosis in South African archaeological groups have been published (Pistorius *et al*., 1998; Steyn *et al*., 2002b; Van der Merwe, 2006). Limited data based on skeletal evidence suggesting the presence of tuberculosis as an infectious agent in South African groups are thus available. Only one possible case of tuberculosis was observed in this study. The individual had periosteal lesions on the ribs, scapulae, os coxae and tibiae which may indicate possible tuberculosis. No treatment was available for tuberculosis during the late 19th and early 20th century, as antibiotics for the treatment of this infection as only introduced in the 1940's (Steyn *et al*., 2013). It is possible that more than one individual in the current study group may have suffered from tuberculosis, but have succumbed to the disease before the development of skeletal lesions. Truswell and Hansen (1976) reported that tuberculosis was fairly common amongst living Khoesan groups of the Kalahari, which supports the notion that it's possible that the prevalence of tuberculosis is underestimated in the late 19th and early 20th century Khoesan, as not all individuals with tuberculosis would have developed skeletal lesions.

The results of this study thus indicate that the population was not free from infectious disease, as a total of nine individuals (16.4%) in the study population showed signs of infectious disease. It is possible that individuals portraying signs of specific infectious disease (such as tuberculosis) were not found during the period in which the skeletons were collected and also, that some individuals may have succumbed to infection prior to developing a bony response. One of the problems with the interpretation of these results is that the skeletal sample represents individuals who succumbed to infection, and possibly excludes individuals in the population who did not suffer from the infection and/or died from the specific disease under investigation. Therefore, it is likely that the observed frequency of the disease becomes overestimated in the population (Wood *et al*., 1992).

5.2.2. Congenital and developmental abnormalities

All congenital conditions encountered in this study appeared to be asymptomatic. The presence of a cleft neural arch was seen in two (2.6%) individuals, while craniostenosis (sagittal synostosis) was observed in four (3.5%) individuals.

A cleft neural arch (in some studies referred to as spina bifida) have been reported in other southern African populations, including K2/Mapungubwe (Steyn, 1994), Gladstone (Van der Merwe, 2006) and Toutswe (Mosothwane, 2004). It is thus not an unusual finding. All of these populations also show low frequencies similar to the current study.

The presence of sagittal synostosis in this study were seen only in adult individuals, which suggests that fusion of the cranial sutures occurred when brain growth was nearly completed as no severe deformity was observed. All four of the crania affected did, however, appear slightly elongated (anterior-posterior expansion). Cranial capacities also appeared normal. This phenomenon has also been encountered in the Gladstone population (two individuals; 2.4%), although no statistically significant difference was observed between the present study and the Gladstone population.

5.2.3. Metabolic, nutritional and non-specific indicators of disease

Nutritional disorders observed in the Khoesan group included two possible cases of rickets (vitamin D deficiency in children). The development of rickets was most likely secondary rather than primary. Primary causes that may possibly lead to the development of rickets include malnutrition and infectious disease (Ortner, 2003). Truswell and Hansen (1976) reported that only mild malnutrition was encountered in the Khoesan due to seasonal availability, but that no severe nutritional disorders were seen. Various plant species gathered in the veldt provided excellent nutrition to traditional Khoesan groups, although the quantity of such sources were often unreliable in the dry season (Tanaka, 1976; Truswell & Hansen, 1976). It is thus unlikely that individuals that formed part of a hunter-gatherer subsistence economy would have developed a vitamin D deficiency due to their diet being insufficient. The current study group most likely contained few individuals who lived by hunting and gathering alone, although the presence of such individuals cannot be ruled out.

Truswell and Hansen (1976) also reported that they encountered three infants with rickets in their study of living Khoesan individuals. In Khoesan culture, infants are completely covered from the sun for at least the first few months after birth to protect them from dehydration, which most likely promoted the development of rickets in these three individuals. A cultural habit such as this may also have been a contributing factor to the development of rickets in the two infants of the present study.

One should also keep in mind that a high infant mortality rate was seen in the current study, which suggests that some of the small children may have been chronically ill. Infants affected by infection and other disease may have been kept indoors for even longer periods of time than healthy infants. Both of the infants with possible rickets in this study, also showed signs of cribra orbitalia and periostitis, which may suggest the presence of other conditions or ill health. Whether the two infants in the present study developed rickets by being kept indoors due to acute infection, cultural habit or both, it is clear that they were in poor health at the time and possibly died due to a combination of infection and malnutrition.

Non-specific indicators of disease encountered in this study included cribra orbitalia (19.2%), porotic hyperostosis (5.8%), periostitis (7.7%) and enamel hypoplasia (36.2%). The presence of multiple non-specific indicators suggests that this group experienced physiological hardships related to both lifestyle and disease.

The frequency of cribra orbitalia (CO) was less than encountered in the K2 (Steyn, 1994) and Oakhurst (Patrick, 1989) samples, but more than in Toutswe (Mosothwane, 2004), Gladstone (Van der Merwe, 2006) and the hunter-gatherer populations from Riet River and Kakamas (Morris, 1992). A statistically significant difference was seen between the present sample and Oakhurst, K2 and Kakamas (Table 4.13). The most relative comparative group in terms of lifestyle and environment in this case is most likely Kakamas. The current sample has a relatively high frequency of CO when compared to Kakamas, suggesting that the study group possibly experienced malnutrition and/or chronic disease to a greater extent than seen in this hunter-gatherer group. This proposes that the Khoesan experienced a decline in general health from the protohistoric era of Kakamas to the more recent period of the late 19th and early 20th century.

All lesions indicative of cribra orbitalia (CO) and porotic hyperostosis (PH) were found to have developed during childhood, as the adults all displayed remodelled lesions. CO and PH normally develop during childhood, as children tend to be more sensitive to environmental stressors (Ortner, 2003). The presence of a large number of individuals with remodelled lesions thus indicates that the majority of individuals affected by CO experienced physical hardships, i.e. nutritional stress and/or a high pathogen load, during their childhood years. This suggests that many individuals experienced compromised health during subadulthood in this population, but that some managed to survive and adapt to the environment.

The possible aetiology of CO and that of porotic hyperostosis (PH) remains complex. Walker and colleagues (2009) suggested that with increased environmental hardships such as drought, food shortages and infection, populations experience periods of compromised health. Consequently, lactating females produce milk deficient in essential nutrients such as vitamin B_{12} and vitamin C. These nutrients then give rise to the development of marrow hypertrophy and orbital haematomas, leading to the development of PH and CO. The presence of a high mortality rate in the study population and the presence of active lesions of CO and PH in infant and juvenile individuals suggest that reproductive/lactating mothers were not able to provide the necessary nutrition to their offspring. It is thus possible that the transition from hunting and gathering to the sedentary lifestyle and limited nutritional basis associated with agriculture caused an increase in the frequency of CO in the present study sample.

The presence of periostitis was also assessed, which showed that the current study group had a lower frequency of periosteal lesions (and thus most likley a lower pathogen load and less malnutrition) than seen in Koffiefontein (L'Abbé, 2003), Maroelabult (Steyn *et al*., 2002b) and Gladstone (Van der Merwe, 2006). A statistically significant difference was only seen between the present sample and the Gladstone population. One should, however, keep in mind that the Gladstone sample contained no juvenile individuals and thus all 20 individuals with periostitis were adults, while the current study group only contained five adult individuals and four juvenile individuals with skeletal signs of periostitis. This makes it difficult to compare the current sample to Gladstone, as both groups came from unique settings.

Several causes of periostitis have been proposed, but the most frequently implicated is trauma or infection (Aufderheide & Rodríquez-Martín, 1998; Roberts & Manchester, 2005). It is possible that many Khoesan individuals suffered from chronic infection and/or traumatic events as they came in contact with complex social and economic structures. An increase in population density and crowding of living spaces often enhances the spread of infection, leading to a more individuals developing periostitis if long-term infection persists.

There are several infections, metabolic conditions and endocrine disorders that may affect the formation of dental enamel. Enamel hypoplasia serves as an indication that the presence of acute episodes of disease or malnutrition compromised the health of the individual, subsequently causing a disturbance in the process of enamel formation during childhood (Goodman & Rose, 1991; Hillson, 2000; Roberts & Manchester, 2005). High frequencies of enamel hypoplasia have been linked to populations of low socio-economic status, indicating that numerous factors contribute to the development of enamel hypoplasia, including poor diet and unsanitary conditions leading to increased exposure to pathogens (Dobney & Goodman, 1991; Roberts & Manchester, 2005). Specific diseases such as treponematosis may affect the normal development of teeth, leading to a disruption in enamel formation (Hillson *et al*., 1998). It has also been suggested that vitamin D deficiency may cause poor mineralization of enamel. Calcium is essential for enamel formation, and calcium absorption is reduced when vitamin D levels are lowered. With reduced calcium levels, the process of enamel formation (amelogenesis) is disrupted. Also, the presence of enamel hypoplasia may manifest before classic skeletal signs of rickets develop (Kunzel, 2003). In this study signs suggestive of treponematosis, rickets and malnutrition was encountered, which indicates that there may have been several conditions present in the Khoesan population to account for the development of enamel hypoplasia.

When comparing the presence of enamel hypoplasia in the present sample to other South African studies, the K2/Mapungubwe (Steyn, 1994) and Koffiefontein (L'Abbé, 2003) samples presented with a significantly higher frequency of enamel hypoplasia than encountered in the current study. The Gladstone (Van der Merwe, 2006) and Venda (L'Abbé, 2005) samples, however, had a significantly lower frequency of enamel hypoplasia. This suggests that the children in the current group were not free from infection and malnutrition, and frequently suffered from acute phases of ill health.

Also, the presence of large open anterior fontanelles in three infants was found to be abnormal for the estimated ages of the individuals. In all three of the individuals the anterior fontanelles extended anteriorly. However, posterior extention of the fontanelle was seen only in one infant. According to Kiesler and Ricer (2003), the anterior fontanelle is closed in 96% of infants by two years of age, although some inter-population differences have been reported

(Aisenson, 1950; Faix, 1982; Omotade *et al*., 1995). Although all three infants in this study were estimated to have been between one and two years of age, it was clear that the anterior fontanelles were extremely large and closure would not have been completed by age two.

Reasons for large fontanelles in infants may be attributed to a number of disorders or abnormalities, for example hydrocephalus, skeletal disorders, endocrine abnormalities, infective diseases and malnutrition (Behrman *et al*., 1992; Aufderheide & Rodríquez-Martín, 1998; Steyn *et al*., 2002a). Therefore, the presence of other signs of disease in the individual should be taken into consideration. Two of the three infants in this study also had periosteal reactions, which suggest that chronic infection and/or malnutrition may have contributed to the delayed closure of the fontanelles in these individuals.

Whatever the exact causes of these conditions, the presence thereof suggests that the population, and especially the children were subjected to poor health and nutrition, suffering from periods of physiological hardships brought on by infectious disease, parasites, poor sanitation and malnutrition.

5.2.4. DJD

All degenerative lesions, whether caused by disease, hard and prolonged physical labour or merely resulting from normal activity as age advances are conditions that provide us with general information regarding the lifestyle and activities performed within a population.

Both hunter-gatherers and agriculturalists are known to walk or run for long distances, either hunting or performing farming activities (Bridges, 1991). Therefore, one would expect to see some osteoarthritic involvement of the major weight-bearing joints, as well as the vertebrae in these groups. In this study, vertebral osteophytosis was encountered most commonly, followed by osteoarthritis of the elbow, shoulder and knee. Osteoarthritic involvement of the vertebrae is frequently seen in both modern and archaeological populations (Roberts & Manchester, 2005). Vertebral osteophytosis encountered in this study is believed to be that of normal degenerative processes, as no cases of specific pathology associated with the vertebrae were seen, and the development of osteophytic spurs were observed more in older individuals than in young adults.

Of the major joints, the elbow (n = 11), followed by the shoulder (n = 7) and knee (n = 7) was mostly affected. These results are consistent with a study performed by Bridges (1991), which stated that these three joint were most commonly affected in both hunter-gatherers and agriculturalists. Furthermore, the results of Bridges's study (1991) indicated that although the patterning of arthritis was similar between the two groups, it may not be related to subsistence economy. Thus, it is possible that groups whose lifestyle involves a high degree of physical activity, regardless of differences in their lifestyle, may portray the same pattern of osteoarthritis when looking at the major joints. It is unclear when looking at the pattern of osteoarthritis whether the individuals in this study were exclusively hunter-gatherers or farm workers.

When assessing sex differences in the current study group, there were a significant difference between the number of males and females affected, with females being more frequently affected than males. It was clear that the vertebrae and elbows of females were more commonly affected than that of males. Sexual dimorphism related to osteoarthritis varies considerably between skeletal samples (Bridges, 1991). Some studies report that for pre-agricultural groups, females tend to show lower frequencies of osteoarthritis in the shoulder (Larsen, 1982). However, this is not the case with the current group. High frequencies of osteoarthritis in the shoulder and elbow of females suggest that they performed physical duties mainly using the upper limbs, for example washing of clothes and grinding maize.

A total of 32 individuals (38.1%) of the study sample were affected by degenerative joint disease. In general, the current study group showed a higher frequency of degenerative joint disease than Gladstone, Toutswe and Venda. This suggests that they were subjected to very high levels of physical activity. Other studies have also reported high frequencies of degenerative joint disease in hunter-gatherer and agricultural societies (Bridges, 1991; Molnar *et al*., 2011), which suggests that populations such as these perform a high degree and variety of physical activities. The Khoesan of the late 19th and early 20th century may have taken part in routine physical activities such as herding of livestock, harvesting fresh produce and carrying water and wood that resulted in more than a third of adult individuals having osteoarthritis.

5.3. Trauma

The various types and frequency of trauma can provide valuable information regarding a population's lifestyle, activities, inter-individual relationships and the presence or absence of medical care (Steinbock, 1976; Ortner, 2003).

The presence of three healed traumatic cranial lesions and two parry fractures suggests that some degree of inter-personal violence or violence between the Khoesan and other groups or law enforcement officials was present in this population. It has been suggested that the occurrence of inter-personal violence increases within a group when they are subjected to environmental stress and deterioration, leading to an increase in competition for natural and food resources (Torres-Rouff & Costa Junqueira, 2006). Khoesan groups have been reported to show little to no violence against one another and are believed to be peaceful in nature (Bannister, 1991; Smith *et al*., 2000). However, it has also been reported that the Khoesan individuals living in the Cape Colony were easily tempted and often indulged in spirituous liquor (Theal, 1905). It is thus possible that inter-personal violence related to alcohol abuse within Khoesan groups caused the cranial lesions and parry fractures encountered in the study sample. Also, both cases of parry fractures and two of the three cases of cranial lesions were seen in female individuals. This suggests that the females may have been subjected to male violence within the Khoesan group.

It is likely that there was competition between the Khoesan and other African groups for employment on farms by the European settlers. Individuals of black African groups were taller and stronger, and thus more in favour of being employed as farm labourers (Guenther, 1976), placing the Khoesan at a disadvantage in terms of finding work, which may have led to violence occurring between Khoesan and other black African groups. Also, with the merging of Khoekhoe and San groups with other African groups on farms and in urban areas in the Cape Colony, cultural differences may have ignited aggressive behaviour amongst individuals where living spaces were shared.

The relationship between farmers and Khoesan labourers were mostly one of interdependence without excessive violence (Guenther, 1976), as farmers exchanged blankets and tobacco for marama beans, a staple food collected by the Khoesan in the veldt (Tanaka, 1976), during seasons of drought. However, ill feelings between the Dutch farmers and the Khoesan developed, as many cases of livestock theft and slauthering of farm animals involving

Khoesan individuals were being reported (Guenther, 1976; Penn, 2005). Stock theft by the Khoesan would undoubtedly have caused the involvement of law enforcement officials, which may have led to violent attacks on the Khoesan.

Individuals found guilty of offences such as murder and stealing of livestock were sentenced to death by hanging under British Colonial law, which ruled throughout southern Africa during the 17th, 18th and 19th centuries (Penn, 2005). The Hangman's fracture seen in a male individual indicated that the individual had most likely died by hanging, and was possibly sentenced to death for stealing and killing of livestock.

Perimortem fractures were also seen in one other individual, an adult female, who presented with unhealed trauma to the 4th, 5th and 6th ribs. This suggests that the individual was possibly involved in some kind of accident or violent event that proved to be fatal, as no other pathology was seen. The presence of perimortem trauma supports the notion that violence and/or fatal accidents did occur in this population and that the Khoesan most likely had reason to be fearful of other black African groups, Europeans and the police.

Healed fractures of the femur (n = 2), humerus (n = 1), ulna (n = 1), spondylolysis (n = 1), as well as pseudoarthrosis of the clavicle (n = 1) indicate that this group experienced many traumatic events, possibly related to hunting or physical work activities. Khoesan individuals employed on farms frequently left their jobs to hunt and gather for a few weeks at a time (Guenther, 1976). Khoesan farm labourers were thus exposed not only to the possibility of sustaining injuries whilst working on farms, but also while hunting.

However, the frequency of postcranial fractures was lower than seen in either the Venda or Gladstone populations. A statistically significant difference was observed between the present study sample and the Gladstone population, with the Khoesan sample much less affected by trauma than the Gladstone mineworkers. This was expected, as Gladstone was subjected to high risks of injury, in light of them performing mining activities, which most likely resulted in many postcranial fractures, dislocations and amputations. Although the current study populations had a lower frequency of traumatic events than seen in the Venda, no statistically significant difference was observed. In both of these groups the exact aetiology of trauma is unknown and has been found to be relatively low in occurrence. Also, the frequency of trauma in the current study group proved to be more than that encountered in the Oakhurst (Patrick, 1989), K2 (Steyn, 1994) and Toutswe (Mosothwane, 2004) populations, which suggests that these archaeological populations may have experienced less violence than encountered in the more recent groups, such as the present study group.

It is possible that many of the injuries observed in the late 19th and early 20th century Khoesan may be more violence related than seen in any of the comparative groups, as no specific lifestyle activity (such as mining) causing numerous traumatic lesions stands out in this group. Also, six of the 11 individuals affected by trauma were female, ruling out the possibility that hunting accidents could have accounted for most of the traumatic events encountered, as it can be assumed that it was predominantly the males that hunted. There is thus evidence to suggest some male-on-female interpersonal violence.

5.4. Skeletal growth and stature

Human growth is influenced by a combination of genetics and an individual's ability to adapt to factors related to the environment (Eveleth & Tanner, 1990; Cameron, 1991; Strauss & Dietz, 1998). These factors may either inhibit or increase an individual's growth trajectory. When studying general living conditions and its effect on health in skeletal populations, the height of one individual can reflect little about the information pertaining to the larger group's overall health, but cumulative growth data may provide valuable insight into the population's lifestyle experiences when compared to data published on other populations (Chaning-Pearce & Solomon, 1986; Cameron, 1991; Mummert *et al*., 2011).

Growth retardation in children resulting in short adult stature has been ascribed to many factors, including economic well-being, which in turn affect their nutrition and health. Non-specific disease indicators of skeletal remains, such as periostitis, cribra orbitalia and porotic hyperostosis are believed to indicate that a group experienced physiological stress due to disease and malnutirition (Ortner, 2003). Presence of specific and non-specific health indicators in conjunction with retarded growth often reflects individuals from a low socio-economic status (Lovejoy *et al*., 1990; Mummert *et al*., 2011). Eleven out of the 19 subadult individuals included in this study showed signs of non-specific pathology. It is thus possible that more than half of the subadult long bone measurements were that of individuals who most likely suffered from chronic disease and/or malnutrition, which indicates that the sample is not an accurate representative of the healthy population, but contain individuals with suspected retarded growth due to physiological stress.

In this study, growth within the first two years of life appears to be similar to that of the comparative populations, but reduced growth is seen from about three years for all the long bones (Figs. 4.22 to 4.27) as compared to the K2 (Steyn, 1994), Toutswe (Mosothwane, 2004), Arikara (Merchant & Ubelaker, 1977) and Libben populations (Lovejoy *et al*., 1990). Thus, it is clear that the Khoesan children were shorter than those of all the comparative populations. Although a normal growth pattern is evident in the present sample, reduced growth rates during childhood resulted in smaller adult statures relative to the comparative populations. Although small body size and stature has mostly been ascribed to malnutrition and chronic disease (Bogin, 1999; Pfeiffer & Sealy, 2006), the slow growth rates observed in Khoesan populations most likely has a strong genetic component (Tobias, 1961, 1962; Corlett & Woollard, 1988).

Both nutrition and the environment play a role in whether the full genetic potential of adult stature is reached in an individual. Evolutionary changes in genes are partly brought about by changes in the environment. Evolutionary studies indicate that a specific phenotype (such as stature) is the result of both spontaneous genetic mutations and environmental influences driving certain genetic changes working together to shape a specific physical form over many generations (Bogin, 1999; Pfeiffer & Harrington, 2011). Thus, it is likely that a specific population during any given point in time may experience, for example, short stature due to a specific genetic composition, but one should keep in mind that those genes evolved over hundreds of years.

Later Stone Age evidence suggests that infants were of an average size comparable to other groups from southern Africa, and that the growth curve of these juveniles followed a continuation of a normal curve, but at a slower rate, that resulted in small adult stature. Small adult stature is thus the result of slow growth rates and not stunting, as no severe stunting events took place at any time (Harrington & Pfeiffer, 2008; Pfeiffer & Harrington, 2010). Small body size and short stature of the Khoesan is thus not a result of early maturation as seen in the African pygmy groups, but characteristic of a group whose genetic potential and adaptation for growth and adult stature were established as early as the Holocene (Pfeiffer & Harrington, 2011; Pfeiffer, 2012).

It has been suggested that a smaller body size may be advantageous to groups living in the Kalahari and along the western coast of southern Africa, as it allows for more successful hunting, less chance of sustaining injury on rocky terrain and would require less energy for hunting and long distance travelling (Pfeiffer & Harrington, 2011). This suggests that over hundreds of years the small body size and stature of the Khoesan have been genetically shaped to enable them to survive harsh environments and travel through dry, rough landscapes.

Thus, the growth of the subadults resulting in petite adult statues observed here is most likely due to a combination of genes and physiological stress. Pfeiffer (2012) states that the most plausible explanation for the small body size of Later Stone Age individuals and their descendents seems to be a biocultural combination of behavioural adaptation and nutritional constraints, rather than nutritional deficiencies. Several studies related to Khoesan stature have been published, with some of the earliest papers dating back to the 1930's (Dart, 1937). Evidence pertaining to the reasons for such short stature has been reviewed by many authors (Wells, 1960; Wilson & Lundy, 1994; Sealy & Pfeiffer, 2000; Pfeiffer & Sealy, 2006; Mummert *et al*., 2011), including Tobias (1955-56; 1961; 1962; 1972).

Tobias's research (1961; 1962; 1972) states that genes, and not the environment, shaped the body size and stature of the Khoesan people, and that changes in the average stature of Khoesan males and females during the 20th century were possibly due to secular trend within the population. However, evidence presented by Pfeiffer & Sealy (2006) and Mummert and colleagues (2011) states that quality and reliability of food, as well as infectious or chronic disease impact one's ability to reach full height as predicted by one's genetic potential. It is, however, unlikely that through hundreds of years, every Khoesan group failed to find a biological niche that favours health, nutrition and consequently, taller stature (Pfeiffer, 2012). The short stature and small body size of the Khoesan may thus represent adaption, rather than a compromised physique.

Tobias (1962) also stated that the average male and female statures for the Khoesan population (specifically San) dated pre-1915 were recorded to be 155.87 cm and 148.12 cm respectively. The mean values for adult male and female stature of the current study fall close to these averages, although slightly higher. This suggests that the current study sample most likely included individuals of both San and Khoikhoi origin, as Khoikhoi statures were reported to be slightly more than that of the San (Pfeiffer & Sealy, 2006).

During the last century, a positive secular trend for stature was reported for the Khoesan (Tobias, 1962), but studies performed on African pygmy groups suggested the absence of a secular trend (Travaglino *et al*., 2011). The presence of a secular trend possibly indicates that the living conditions of a group have been significantly altered over a certain period of time. This suggests that the Khoesan may have been subjected to changes influencing their culture and lifestyle, as well as their genetic potential for stature. Furthermore, this evidence may also suggest that the Khoesan is most likely genetically very different from African pygmies, and would therefore have a different genetic potential directing stature.

One should keep in mind that the transition of hunter-gatherers to agriculturalists/farmers possibly influenced the Khoesan's average statures during the 18th, 19th and early 20th century, as food became a more reliable resource, resulting in increased growth from an improved nutritional status (Bogin, 1999; Mummert *et al*., 2011). This suggests that subtle changes in stature could have occurred over the last few centuries since the Khoesan started living and working on colonial farms during the 1700's. However, no major difference was seen in either male or female stature means when comparing the current study sample to other modern Khoesan groups and Holocene skeletons (Tobias, 1962; Pfeiffer & Sealy, 2006). It is possible that more reliable food sources on farms and urban areas in the Cape Colony had a positive effect on stature on the one hand, but on the other hand the increased exposure to infectious disease and a general decline in health may have prevented a positive stature trend from taking place.

The average male and females statures obtained from this study are, as expected, less than that of black southern African groups, i.e. Gladstone, Venda and K2/Mapungubwe. The Khoesan differs from other African groups geographically, biologically and culturally. The reason for their small stature can most certainly be ascribed to their genetic make-up which has, through evolution, been influenced by adaptation to their environment, biology and culture. It is thus clear that the smallness of Khoesan stature and body size represents adaption, but the exact reasons remain unclear.

5.5. Dental health

5.5.1. Dental caries

A summary of the prevalence of caries for the study group is shown in Table 4.23. The results were compared to various other southern African populations (Table 4.26). A statistically significant difference was observed between the current sample and all comparative groups, except for the Griqua (Morris, 1992), Venda (L'Abbé, 2005) and Maroelabult (Steyn *et al*., 2002b). It was noted that the caries intensity calculated in this study were in general higher than that of hunter-gatherer groups (Van Reenen, 1966; Morris 1992), but lower than that of modern urbanized groups (Manyaapelo, 2007), the 20th century Venda (L'Abbé, 2005), as well as archaeological Iron Age groups such as K2/Mapunguwe (Steyn, 1994).

The higher intensity of caries in the current sample (6.5%) when compared to hunter-gatherer groups, such as Riet River (4.3%), Kakamas (1.3%) and Bushmen groups ("wild" bushmen, 0.5%; "farm" bushmen, 0.5%) studied by Van Reenen (1966) was expected, as this sample is heterogenous and comprises of individuals from both hunter-gatherer and agricultural lifestyles. The diet of hunter-gatherers contains very few sugars and refined carbohydrates, which decreases their risk of developing caries (Cohen & Armelagos, 1984; Morris 1992). It is thus likely that the caries intensity observed in this study reflects a diet that contained more carbohydrates than found in the typical hunter-gatherer diet.

It was also noted that the caries intensity for this study was less than that reported for Cobern Street, Marina Residence and Polyoak (Manyaapelo, 2007). A significant difference was observed between the current sample and all three of these groups. Sugar, refined milled flour and maize meal were common dietary products used throughout the seventeenth and eighteenth centuries in the Cape (Morris, 1992). The skeletal samples from Cobern Street, Marina Residence and Polyoak typically reflect a diet rich in carbohydrates, as they worked near the harbour and on colonial farms. As many Khoesan individuals have been employed by colonists, their diets were most likely substituted with some form of refined carbohydrates, resulting in an increase in caries intensity. However, many remained hunter-gatherers, who had very little access to refined carbohydrates such as sugar. The results thus portray that of a mixed group that contains both individuals of poor and excellent dental health.

The results of this study were found to be most similar to that of the Griqua and Venda. The Griqua has been described as a population of mixed economy, bearing anatomically heterogenous features. The Griqua diet most likely included meat from hunting and maize meal as staple food, as their social and economic circumstances were quite different from that of hunter-gatherers, such as Riet River and Kakamas which is believed to have survived mainly on meat and veldt plants (Morris, 1992). They are most likely the group that can be described as being most similar to the current study sample in terms of social and economic circumstances. These results parallel that of a study performed by Turner (1979) in which it was reported that caries frequencies of hunter-gatherers were less than 2% (such as Riet River and Kakamas), mixed economies about 5% (such as Griqua) and agricultural economies more than 10% (such as K2/Mapungubwe and Polyoak). The current study population thus appears to have been in transition between the traditional hunter-gatherer diet and a more modernized diet utilized by agricultural groups.

When looking at caries intensity sorted by tooth type the molars were affected the most, which is generally seen in most cases (Hillson, 1998). The premolars were second most affected, followed by the canines and incisors. The incisors have been reported to be affected more commonly than the canines (Hillson, 1998), however, in this case the incisors were least affected. The reason for this is not clear, although it may be related to some activity performed by the females of this group, as the caries intensity of the canine for females were found to be more than that seen in males. No statistically significant difference was seen between males and females with regard to caries intensity in the canine teeth. A significant difference was, however, seen between males and females for caries occurring in the second premolar. In general, the diet of males and females appear to have been very much alike, as a significant difference was only observed for one tooth type.

5.5.2. Antemortem tooth loss

Antemortem tooth loss (AMTL) is usually the result of large carious lesions, severe periodontal disease, attrition or trauma (Scott & Turner, 1988; Hillson, 1998). Therefore, it is expected that high frequencies of AMTL will be present in a populations that had a high caries intensity and frequency of periodontal disease, as well as experienced a high degree of molar attrition.

The results from this study indicate that the population experienced a relatively high AMTL intensity. Several factors have possibly contributed to almost 38% of individuals experiencing AMTL. Firstly, the presence of carious lesions (found in about 28% of individuals) most likely caused AMTL as these lesions tend to increase in size, destroying teeth. Secondly, periodontal disease was observed in almost 27% of adult individuals. In severe cases this would have caused AMTL. Thirdly, a high degree of attrition was observed in the study sample, which would have made teeth more vulnerable to abscesses due to dentine exposure that may have resulted in AMTL. Lastly, the intentional removal of the upper incisors in the Khoesan (a cultural habit encountered in the Khoekhoe from the Cape) possibly also contributed to an increased AMTL frequency and intensity (Morris, 1989; Allen *et al*., 1990).

The molars and incisors were mostly affected when looking at AMTL sorted by tooth type. The molars are often more frequently affected by caries than the other teeth, as more crevices and fissures are present for plaque to adhere to and promote carious activity (Bonfigliolo *et al*., 2003). This suggests that molars were most likely lost due to carious lesions. However, incisors may have been lost not only due to caries, but also due to wilful extraction of incisors performed as a cultural ritual.

When comparing the results to other South African populations, it was noted that the current study group had an AMTL intensity similar to that of Marina Residence and Polyoak (Manyaapelo, 2007), but were significantly different from all other comparative groups (Morris, 1992; L'Abbé *et al*., 2003; L'Abbé, 2005; Van der Merwe, 2006). Both the Griqua and Venda samples showed a higher AMTL intensity than the study sample. The Griqua population portrayed a low attrition rate, suggesting that a high caries rate and/or dental trauma were most likely to blame for their high intensity of AMTL. Unfortunately, no data is available on dental attrition for the Venda sample, but degenerative dental changes due to old age, dental mutilation and wilful extraction of teeth have been mentioned as possible causes of the relatively high AMTL intensity observed in this group (L'Abbé, 2005).

AMTL in the current study was also found to be much higher than that of Riet River and Kakamas, but this is as expected, since both of these hunter-gatherer groups had a low caries intensity. Gladstone also had an AMTL intensity much lower than that of the current sample, but this may possibly be attributed to the young age of the individuals from Gladstone.

It can be concluded that AMTL in the Khoesan population studied here are multifactorial, and can most probably be associated with the loss of teeth due to large carious lesions resulting in tooth destruction, the presence of periodontal disease, severe attrition and possible intentional removal of the incisors.

5.5.3. Attrition

The wearing away of teeth as age advances is seen as a natural biological process. The degree of wear is often associated with the culture of a population and tends to decrease from prehistoric to modern populations as the sophistication of food preparation and production methods in modern times resulted in more refined foods (Brothwell, 1963; Molnar, 1971). Different populations also tend to show different wear patterns, depending on cultural practices and the use of teeth as tools (Hinton, 1981; Scott & Turner, 1988).

In general, the central incisors, in both the maxilla and mandible of the Khoesan under study, displayed the highest degree of wear. The second and third molars showed the least amount of wear. These results are consistent with the findings of Van Reenen (1964; 1982), in which he reported that the anterior teeth of the Kalahari San showed a higher degree of attrition than the posterior teeth. In this study, the use of the anterior teeth as possible tools may have resulted in reduced crown height of the upper and lower incisors. It is possible that the anterior teeth were used for stretching and softening of animal skins in the process of making clothes, or other similar activities.

Attrition rates between males and females were similar, except in the maxillary central incisors, for which females showed a higher degree of wear than males. Sex differences in crown wear differ between populations and each population should be investigated within its own biological and cultural context in order to discover the reason behind male and female discrepancies (Scott & Turner, 1988). It is possible that females used their central incisors as tools more often than males for a specific activity, such as making clothes from animal skins.

When comparing the rate of attrition of the current study group to that of other South African groups, it was found that the results were similar to that of all groups, except the Griqua population that showed a much lower degree of wear. Hunter-gatherers often show a great degree of dental wear due to the unrefined nature of their food (Scott & Turner, 1988; Scott *et al*., 2006). The dental wear rates of archaeological populations such as K2 and Mapungubwe are similar to that of hunter-gatherers (such as Riet River and Kakamas) and may be explained by the high amount of abrasive material found in their food (Steyn, 1994).

It can be concluded that the Khoesan group examined in this study showed a relatively high degree of dental wear which is consistent with attrition rates observed in hunter-gatherer populations. Also, the use of the anterior teeth as tools may have contributed to more advanced wear being observed in the anterior than posterior teeth.

5.5.4. Other dental pathologies

5.5.4.1. Tartar deposition

A total of 44% of the sample presented with tartar. It has been reported that tartar deposition is often higher in populations that follow a protein-rich diet that contains very little or no carbohydrates, such as seen in hunter-gatherers (Lillie, 1996; Eshed *et al*., 2006). A possible explanation for these results involves the fact that calculus formation depends on the process of mineralization, which requires an alkaline environment. Caries, on the other hand, develops in an acidic environment where high amounts of carbohydrates are consumed and is based on the process of demineralization (Waldron, 2009). However, one should be careful as to underestimate the frequency of tartar in skeletal remains, as deposits can easily disappear due to taphonomic factors or excavation and cleaning processes (Bonfigliolo *et al*., 2003).

The results thus suggest that little dental hygiene was practiced, and that the diet of this group probably included a fair amount of meat. Also, as many individuals are mature adults, a build-up of calculus most likely occurred as seen in some of the individuals. The frequency of tartar deposition in this study is higher than that of the Gladstone sample in which the lower frequency of calculus has been ascribed to the young age of the individuals (Van der Merwe, 2006).

5.5.4.2. Periodontal disease

A total of 26.7% of the complete sample were found to have suffered from periodontal disease. This condition has been shown to have a strong correlation to age, although it can be significantly influenced by dental hygiene and general dietary practices (Scott & Turner, 1988). It has been suggested that periodontal disease is over-diagnosed in skeletal populations, as this condition may develop merely due to the body compensating for extreme attrition, and is thus not always the result of disease or nutritional deficiency (Roberts & Manchester, 2005).

A study by Leigh (1925) stated that hunter-gatherers portrayed less periodontal disease than people from mixed economies, while individuals practicing agricultural economies showed the highest frequency where generalized resorption affected all teeth. The results of the current study are consistent with a mixed economy as described in Leigh's study, as periodontal disease was not observed as a generalized trend that affected all teeth, but were encountered more frequently than expected in a typical hunter-gatherer population.

A possible explanation for agricultural communities experiencing higher frequencies of periodontal disease than hunter-gatherer groups may be found in the difference in diet between the two subsistence economies. Periodontal disease is often associated with an insufficient amount of vitamin C in the diet of a population, although skeletal signs such as haemorrhaging, indicating the full onset of scurvy, may be absent as periodontal disease may reflect only mild vitamin C deficiency or may represent as an early sign of scurvy (Lavigne & Molto, 1995; Brickley & Ives, 2005). Agricultural communities' diet often contains few fresh produce, but large amounts of maize as a staple food, with the occasional addition of meat. Their diet is often lacking in sufficient levels of vitamin C, which promotes the development of periodontal disease (Larsen, 1997; Van der Merwe *et al*., 2009). Hunter-gatherer populations, however, utilize a wide range of plant species and include a few bush foods that are exceptionally rich in vitamin C, such as morula fruit and baobab flesh (Tanaka, 1976; Truswell & Hansen, 1976). A population of mixed economy, such as seen in the present study, would thus be more prone to developing periodontal disease than populations solely following a hunter-gatherer lifestyle.

5.5.4.3. Abscesses

Abscesses were observed in 29.3% of the Khoesan population. Although the rate at which abscesses occur in different subsistence economies does not always differ significantly, the causes as to the development of abscesses may vary (Scott & Turner, 1988). Severe attrition and carious lesions are almost always to blame, but dental trauma may also play a role in populations that exhibit dental mutilation (Scott & Turner, 1988; Hillson, 1998).

The development of abscesses in the current study group is most likely due to large carious lesions, severe attrition and poor dental hygiene. No dental mutilation of teeth was encountered and can thus not account for abscesses observed in the area of the incisors and canines.

5.6. Summary

In summary, the aim of this study was to provide information concerning the health status of the Khoesan during the late 19th and early 20th century, as well as examine the status of the skeletal collections used for this study. Apart from the Pacher catalogue (1961), very little information was available on either the Rudolf Pöch or Musée de l'Homme collections. In this study, it was aimed to provide information regarding the Khoesan's health at the time, as well as document the contents of the collections and their state of preservation, which may be useful for further studies.

Colonization of the Cape Colony by Europeans, as well as the southward movement of black African groups during the past few centuries forced the Khoesan into a period of transformation, in which they experienced immense pressures related to survival and cultural freedom. Western culture and law forced the Khoesan from their land, while black African groups competed with them for resources and work opportunities on Dutch farms. The Khoesan's subsequent social and economic marginalization could be confirmed by pathological lesions encountered in this study. As far as their overall health and general well-being is concerned, it was evident that the study group was subjected to infectious disease, possible malnutrition, trauma and degenerative joint disease. The presence of non-specific disease indicators also revealed that individuals suffered from possible chronic disease, as well as acute episodes of poor health. It was clear that many individuals suffered from poor health, but that in many cases, they managed to survive and adapt to their changing environment. Palaeopathological results were consistent with that of groups of a low socio-economic status and that the children may have been particularly vulnerable.

Growth and stature results indicated that the small stature of the Khoesan has remained unchanged during the late 19th and early 20th century, as reconstructed statures were similar to that reported for Holocene skeletons (Pfeiffer & Sealy, 2006; Pfeiffer, 2012), as well as for modern Khoesan groups (Dart, 1937; Tobias, 1962; Truswell & Hansen, 1976). Although the reasons for the small stature of the Khoesan are yet to be pinpointed, it was concluded that genes shaped by adaptation to the environment were to blame for decreased growth rates resulting in the small adult statures observed in the present and other study.

Overall, the results indicated that the study group's diet and dental health is not consistent with either a hunter-gatherer or agricultural economy, but reveals a group in transition between the two subsistence economies. Dental health results also indicated that in general, the diet most probably consisted of a combination of meat and carbohydrates. Caries frequencies were less than seen in agricultural groups, but more than that encountered in hunter-gatherer groups. One should also keep in mind that the study group contained both individuals with excellent and very poor dental health, suggesting that the Khoesan group were divided into smaller groups of different subsistence economies and lifestyles, resulting in differences in diet within groups belonging to the larger Khoesan population.

This highlights the fact that different communities belonging to the same population group may indeed experience different social, cultural and economical circumstances. A study such as this may help to increase our understanding of the impact of social and economic marginalization on the health and well-being of vulnerable communities such as the Khoesan.

Emphasis should be placed on the value of the Khoesan skeletal collections in Vienna and Paris: not only for researchers, but also for their descendants. The remains of Khoesan individuals currently housed at these two locations are handled with respect and stored with care. It is currently the responsibility of the both descendants and museum curators to deal with the unethical manner in which these collections came into being several decades ago, and to negotiate workable terms for both parties. However, the need continues to exist for more thorough anthropological research on the Khoesan collections under discussion and it is hoped that by studying these specimens, some of their dignity might be salvaged.

Chapter 6: Conclusion

1. The skeletal remains investigated in this study represent the Khoesan population from southern Africa during the late 19th and early 20th century. The sample comprised of male, female and subadult individuals and thus signifies a relatively normal population distribution. The remains were, however, collected from various places throughout southern Africa, making this a heterogenous sample. The sample most likely contains individuals of both hunter-gatherer and agricultural origins.

2. The high prevalence of infectious disease suggests that for the most part, these people were of poor health and subjected to high levels of disease. They most probably had poor sanitation and possibly lived in overcrowded spaces on farms and in urban areas, which promoted the spread of disease. One should, however, keep in mind that some individuals maintained a hunter-gatherer lifestyle, which placed them at lower risk of contracting infectious disease. This may have contributed to a decreased frequency of infectious disease in the population. The presence of non-specific disease indicators in relatively high frequencies was expected, as this group is known to have been of low socio-economic status. Health indicators such as cribra orbitalia, porotic hyperostosis, periostitis, enamel hypoplasia and persistently open anterior fontanelles indicated that this group most likely suffered from a high pathogen load and possibly chronic disease, whilst not receiving proper nutrition as they were subjected to a poor lifestyle. This in turn fuelled their susceptibility to disease. Thus, they experienced physiological hardships related to both lifestyle and disease.

3. Subadult growth was found to be somewhat stunted relative to the comparative populations. As children are more sensitive to environmental stress, one would have to recognise the negative impact that malnutrition and poor lifestyle conditions may have on the long bone growth of juveniles. However, within the Khoesan group there is a prominent genetic component which predicts short stature. It can thus be concluded that subadult growth rates were, for the most part, established by their genetic make-up, but that environmental factors

(such as poor nutrition and chronic disease) undoubtedly played a role in the development of their stunted growth pattern.

4. Average adult statures for males and females were shorter than that of other African groups and similar to other Khoesan groups. A slow growth rate during the juvenile years would have resulted in short adult stature as seen in this group. These results were expected, as the Khoesan is known to be of short stature. Their stunted stature is most likely the result of both genetic composition and the influence of environmental factors.

5. Healed trauma indicated that this population may have experienced inter-personal violence and/or were subjected to violent attacks, as well as suffered fractures due to accidents, most likely related to hunting or physical work activities. Cranial trauma and the presence of parry fractures suggests that violence amongst individuals did occur, which most likely resulted due to a limited amount of daily resources, or due to defending themselves from members of other groups in their community. However, the general occurrence of traumatic events in this group was found to be of low frequency.

6. The high frequency of degenerative disease observed in the vertebrae, elbow, shoulder and knee suggested that this group was subjected to very high amount of physical activity, whether it be walking or running for long distances when hunting, or taking part in physical labour on farms. Such high frequencies of degenerative changes are consisted with that seen in hunter-gatherer and agricultural societies.

7. Dental caries frequencies and intensities indicated that this group were of possible mixed economy, or simply in the process of transition between hunter-gatherer and agriculturalism, as they had a higher amount of caries than hunter-gatherers, but less than agricultural populations. Antemortem tooth loss intensities were found to be much higher than that of hunter-gatherers, and could most likely be attributed to carious lesions, periodontal disease, severe attrition and possible intentional removal of the upper incisors. Also, a high degree of attrition was encountered. This may be explained by high amount of abrasive material in their food, as well

as the use of the anterior teeth as tools. Wear patterns were similar to that of hunter-gatherers. The presence of dental calculus, periodontal disease and abscesses suggested that dental hygiene was poor. No signs of dental health care were encountered.

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Appendix 1

Skeletal reports were written for each skeleton in order to document the preservation, age, sex, antemortem stature, dentition, pathology and trauma present for remains located in both the Vienna (S1 to C94) and Paris (#1604 to #24893) collections. The country or place of origin was documented as described in Pacher's catalogue (1961) for the remains in the Robert Pöch collection. The boxes in which the remains are stored also provided information regarding the area or place of origin of these specimens. Pachers' catalogue (1961) made reference to the sex of the individuals as well; this was confirmed by skeletal analyses. In all cases but one (S8), the sex was found to be consistent with that described by the catalogue. As for the specimens from the Musée de l'Homme collection, the only information regarding the place of origin is found within the museum's catalogue.

Robert Pöch Skeletal Collection

S1

Country/place of origin: Southern Africa (from the ≠Gabe tribe, possibly in Botswana).

Preservation: Fair. All skeletal remains were present, except for the tibiae, thoracic vertebrae, lumbar vertebrae and a few phalanges.

Age: M3 was erupted and in occlusion. The medial end of the clavicle, spheno-occipitalis synchondrosis, first and second sacral segments, distal femora and proximal fibulae were unfused. The distal humerus, proximal radii and proximal femora were closed. This evidence suggests that the individual had been between 15 and 20 years of age.

Sex: Records state male. An intermediate greater sciatic notch, intermediate sub-pubic angle, small mastoids and the absence of a brow ridge made it difficult to confirm the sex, but the young age of the individual should be kept in mind. The sacrum appeared to be long and narrow.

Stature: The individual was estimated to have been about 143.76 ± 2.777 cm.

Dentition: All permanent teeth have erupted and are present. No caries, abscesses, tartar or enamel hypoplasia was present. Dental wear could be seen on all teeth. M3 showed wear only in the enamel. M1, the premolars, canines and incisors showed small dentine patches.

Pathology and trauma: No pathology or trauma was observed.

Other notes: The individual presented with an asymmetric pelvis. No interparietal groove or inferior frontal eminence was present, but a slight mons temperosphenoidalis was observed.

Conclusion: The remains were probably those of a male between the ages of 15 and 20 years.

S2

Country/place of origin: Southern Africa (from the ≠Gabe tribe, possibly in Botswana).

Preservation: Fair. All skeletal elements were present, except for the thoracic vertebrae, lumbar vertebrae, femora, tibiae, five metacarpals, one metatarsal and a few phalanges.

Age: There is slight osteophytic lipping on the cervical vertebrae and the spheno-occipitalis synchondrosis is fused. The degree of cranial suture closure indicated an individual between 30 and 60 years of age. The sternal rib ends indicated phase 5 (33 to 43 years). This individual was probably between the ages of 35 and 50 years at the time of death.

Sex: A wide sciatic notch, wide subpubic angle, a rectangular pubic bone, short sacrum, vertical forehead, smooth brow ridge, sharp supra-orbital margins and small mastoids indicate female. Records also state female.

Stature: This person was estimated to have been 149.24 ± 3.168 cm.

Dentition: Upper and lower incisors, as well as canines were lost postmortem. The upper and lower left PM1 and also the upper and lower right PM2 were lost postmortem. The maxillary PM3 on both right and left sides were lost postmortem as well. The rest of the teeth are present. No caries or abscesses can be observed. The teeth could not be scored for enamel hypoplasia as it is too worn.

Pathology and trauma: No pathology or trauma was evident.

Other notes: An inferior frontal eminence, mons temperosphenoidalis and interparietal groove were present.

Conclusion: The remains were possibly that of a female between the ages of 35 and 50 years at the time of death.

S3

Country/place of origin: Southern Africa (from the ≠Gabe tribe, possibly in Botswana).

Preservation: Fairly well. All skeletal elements were present except for the thoracic vertebrae, lumbar vertebrae, tibiae and a few hand phalanges.

Age: The medial end of the clavicle and the spheno-occipitalis synchondrosis was closed. S1 of the sacrum was also fused. Cranial suture closure indicated an individual between the ages of 15 and 40 years of age. Sternal rib ends indicated phase 4 (30 to 37 years). A final estimate of 30 to 40 years of age was made.

Sex: A narrow subpubic angle, rectangular pubic bone, medium glabella, medium mastoids, prominent brow ridges and prominent muscle markings on the cranium indicated male. Records also stated male.

Stature: An estimation of 158.089 ± 2.777 cm was calculated using the physiological length of the femur.

Dentition: All teeth are present, except for the maxillary left I2 and P1 which was lost postmortem. The mandibular teeth showed no caries or abscesses. An abscess could be seen in the upper right P1. Caries were present in the upper right P1 upper left M3. Slight tartar was observed. Enamel hypoplasia was evident on the upper central incisors, upper right lateral incisor and upper left canine and second premolar. The lower lateral incisors and left canine also showed enamel hypoplasia.

Figure A1. *Abscess of the upper right first premolar*

Pathology and trauma: No pathology or trauma could be seen, except for the presence of enamel hypoplasia.

Other notes: No interparietal groove was present, but a slight inferior frontal eminence was evident. Mons temperosphenoidalis could also be seen.

Conclusion: The remains were that of a male with an estimated antemortem stature of about 158 cm. He was between the ages of 30 and 45 years at the time of death.

S4

Country/place of origin: Koranna area, Kalahari, South Africa.

Preservation: Excellent. All skeletal elements were present.

Age: All permanent teeth were erupted and the third molars were in occlusion. Slight wear could be seen on all teeth. The first segment of the sacrum was unfused, but the spheno-occipitalis synchondrosis was closed. Cranial suture closure indicated that the individual had been between the ages of 15 and 40 years. Sternal ends of the ribs revealed phase 4 (28 to 32 years). A final estimate of 25 to 40 years of age was made.

Sex: A wide subpubic angle, intermediate greater sciatic notch, sharp supra-orbital margins, small mastoids and smooth brow ridges indicated female. Records also state female.

Stature: The physiological length of the femur was used to calculate an estimate of 153.722 ± 2.789 cm.

Dentition: The maxillary right I2, left I1 and I2, as well as the mandibular right P1 and C were lost postmortem. All teeth, except the upper and lower M3's show slight wear. No caries or abscesses were present.

Pathology and trauma: The left proximal humerus and scapula were fused together, showing severe osteoarthritis of the shoulder. This might have happened due to a possible fracture of the humerus that healed and caused secondary osteoarthritis. No other pathology was observed.

Figure A2. *Anterior view of the left shoulder*

Figure A3. *Posterior view of the left shoulder*

Other notes: Slight mons temperosphenoidalis was present.

Conclusion: These were the remains of a young adult female with an estimated stature of about 154 cm.

S5

Country/place of origin: Koranna area, Kalahari, South Africa.

Preservation: All skeletal elements were well preserved and complete.

Age: The medial end of the clavicle was fused and the third molars were in occlusion. Medium wear was seen on all teeth. Cranial suture closure indicated an individual between the ages of 30 and 60 years. Slight lipping was present on L1 and L2 vertebrae. Sternal rib end analysis confirmed phase 5 (33 to 43 years). A final estimate of 35 to 50 years of age was made.

Sex: All features indicated an individual of female sex. Records also stated female.

Stature: Antemortem stature was estimated using the physiological length of the femur and calculated as 165.575 ± 2.789 cm.

Dentition: All teeth were present. No caries, abscesses or enamel hypoplasia was observed. Slight tartar was present on all teeth.

Pathology and trauma: No pathology or trauma was present.

Other notes: No interparietal groove could be seen, but both an inferior frontal eminence and mons temperosphenoidalis were present.

Conclusion: The remains were that of an adult female approximately 165 cm tall.

S6

Country/place of origin: Koranna area, Kalahari, South Africa.

Preservation: Fairly good. All skeletal elements were present.

Age: Advanced wear was observed on all teeth. Cranial suture closure indicated and adult between the ages of 35 and 65 years. The pubic symphysis suggested an age between 34 and 86 years (phase 6). The final estimate was made to be between 45 and 60 years of age.

Sex: All morphological features indicated male. Records also stated male.

Stature: The physiological length of the femur was used to calculate and estimate of 158.089 ± 2.777 cm.

Dentition: The maxillary right M2 and M3 were lost antemortem. The upper left I2, P2 and M3 were lost postmortem. All other teeth are present. Tartar could be seen on all teeth. The upper left M2 presented with an abscess and caries. No enamel hypoplasia was present.

Pathology and trauma: Wide-spread periosteal lesions were found on the scapulae, ribs and os coxae. Woven bone appearance could be seen on the tibiae. Healed infectious lesions were observed on the cranium. These lesions were present around the lambda area and covered the posterior third of the sagittal suture. A possible case of tuberculosis was established. In general, the remains appeared osteoporotic. Osteoarthritis of the left knee was present with some eburnation. The axis also showed osteophytic activity. Sacralization of L5 was observed with widespread osteophytic changes present in that area. Several vertebrae presented with osteophytes. There were, however, no signs of cribra orbitalia or porotic hyperostosis.

Figure A4. *Healed infectious lesions on the parietal and occipital bones*

Figure A5. *Periostitis of the ribs*

Figure A6. *Osteoarthritis of the axis*

Figure A7. *Osteoarthritis and eburnation of the left distal femur*

Other notes: Slight mons temperosphenoidalis was observed.

Conclusion: The remains were that of a middle aged male individual, about 158 cm tall. Possible tuberculosis was present.

S7

Country/place of origin: Koranna area, Kalahari, South Africa.

Preservation: All skeletal elements were present, except for the cervical vertebrae.

Age: The iliac crests were recently fused, the medial end of the clavicle was closed and the first segment of the sacrum was open. The spheno-occipitalis synchondrosis was closed. The third molars were in occlusion. An estimate of 20 to 30 years was made.

Sex: Rectangular pubic bones, prominent preauricular sulcus, a wide subpubic angle, a wide greater sciatic notch, very small mastoids and a medium glabella indicated female. Records also stated female.

Stature: An estimate of 144.307 ± 2.789 cm was calculated using the femur.

Dentition: The upper right canine, lower right canine and lower right I1 were lost postmortem. The rest of the teeth were all present. An abscess was observed in the maxilla that affected the right canine, right lateral incisor, as well as the right central incisor. The lower right P2 contained caries. Enamel hypoplasia was also present.

Figure A8. *An abscess of the upper right I1, I2 and C*

Pathology and trauma: The cranium contained two healed gummatous lesions, two active lesions and other porotic areas. Nasal destruction was observed in the interior nasal area. Both tibiae had a striated appearance (saber shin). The left fibula showed signs of periosteal bone formation on the proximal and central area. It is thus possible that the individual had suffered from treponemal disease. No cribra orbitalia was present. The skeleton was generally osteoporotic with several porous lesions. Osteophytic lipping was present on both elbows, but somewhat more pronounced on the left.

Figure A9. *Porotic appearance of the cranium*

Figure A10. *A healed gummatous lesion on the right parietal bone*

Figure A11. *An active gummatous lesion of the cranium*

Other notes: Slight mons temperosphenoidalis could be seen.

Conclusion: These were the remains of a 20 to 30 year old female who had been approximately 144 cm tall. Several pathological changes indicating treponematosis were observed.

S8

Country/place of origin: Koranna area, Kalahari, South Africa.

Preservation: Condition of the remains was fair. The skull and mandible, as well as tibiae were missing. The cervical and thoracic vertebrae were also lacking. Only L4 was present of the lumbar vertebrae. All remaining skeletal elements were present and available for analysis.

Age: The first segment of the sacrum and the medial end of the clavicle were fused. An age between 21 and 46 years was portrayed by the pubic symphysis (phase 3). Sternal rib ends showed phase 3 (23 to 27 years). A final estimate of 25 to 35 years was made.

Sex: Records stated male, but morphological features suggested otherwise. A short and broad sacrum, wide subpubic angle, wide greater sciatic notch and the presence of a prominent pre-auricular sulcus suggested female. Unfortunately no skull was available for analysis to assist in the sex determination of this individual.

Stature: Using the physiological length of the femur, an estimate of 150.953 ± 2.789 cm was calculated.

Dentition: No teeth were available for analysis.

Pathology and trauma: Bilateral spondylolysis of L4 vertebra was present. No other pathology or trauma was noticed.

Figure A12. *Spondylolysis of the fourth lumbar vertebra*

Conclusion: These remains belonged to a young adult female, approximately 150 cm tall.

S9

Country/place of origin: Koranna area, Kalahari, South Africa.

Preservation: Fairly poor. The only skeletal elements present were the skull, mandible, left scapula, left ulna, left femur, L1 to L5, T1-T12, C2-C4, 1 metatarsal and 4 unfused epiphyses.

Age: All teeth available were deciduous. The lower central incisors were fully erupted, with the lateral incisors and canines just starting to erupt. The two halves of the mandible were fused. The anterior fontanelle was still open and the occipital bones were not yet fused. The vertebral bodies were not yet fused to the neural arches in both lumbar and thoracic vertebrae. A final estimate of 9 to 18 months was made.

Sex: The sex of the child could not be determined as the individual is too young. Records do not state sex of the infant.

Dentition: All teeth were deciduous. The only teeth that had erupted were the mandibular I1 (left and right), I2 (left and right), as well as the left canine. The upper left I1 was also erupted. All other teeth were unerupted.

Pathology and trauma: No cribra orbitalia or porotic hyperostosis was present. The anterior fontanelle was persistently open.

Figure A13. *Delayed closure of the anterior fontanelle*

Other notes: The presence of an inferior frontal eminence and mons temperosphenoidalis was noted, as well as a slight interparietal groove.

Conclusion: The remains were that of an infant child of unknown sex that presented with a persistently open anterior fontanelle.

S10

Country/place of origin: Bakwena area, Botswana.

Preservation: Fairly good. All skeletal elements were present, except for the lumbar and thoracic vertebrae and a few phalanges.

Age: All teeth are permanent and show medium dental wear. The medial end of the clavicle and S1 were closed. Cranial suture closure indicated an individual between the ages of 35 and 65 years. Sternal rib phase of 4 (30 to 37 years) were established. A final estimate of 30 to 45 years of age was made.

Sex: Medium mastoids, a square chin, flaring gonials, a narrow subpubic angle, triangular pubis and a narrow greater sciatic notch indicated male. Records confirm that the individual was male.

Stature: Antemortem stature was calculated to be 156.647 ± 2.777 cm using the physiological length of the femur.

Dentition: All teeth were present, except for the upper left first incisor, lower second premolars, lower incisors and lower right canine that had been lost post-mortem. No caries, abscesses or tartar could be seen. Enamel hypoplasia was evident.

Pathology and trauma: A possible Hangman's fracture was located in the axis. The fracture occurred through the superior facets and ended in the vertebral body on both the right and left side. No cribra orbitalia, porotic hyperostosis or subperiosteal bone growth was noticed.

Figure A14. *Hangman's fracture of the axis*

Other notes: Inferior frontal eminence was present, as well as slight mons temperosphenoidalis, but no interparietal groove could be seen.

Conclusion: The remains were that of an adult male, about 156 cm tall who were executed by hanging, resulting in a fracture of the axis.

S11

Country/place of origin: Marydale, Northern Cape, South Africa.

Preservation: Fair. The following skeletal elements were present: 24 ribs, 2 clavicles, 2 scapulae, all long bones, 2 os coxae (unfused), 2 calcanii, L4 and L5, C2-C6, T1-T3, T5 and T6, as well as various small unfused bones.

Age: All epiphyses of the long bones were unfused. Deciduous teeth present; central incisors erupted, but lateral incisors, canines and M1 partially erupted. Occipital bones were not yet fused. An estimate of 15 to 18 months was made.

Sex: The sex of the infant could not be determined.

Dentition: No mandibular teeth were available. The upper left incisors, canine and M1 were present. The upper right I1 and M1 was also present. The upper right canine was lost postmortem. No visible enamel hypoplasia was observed.

Pathology and trauma: A very large persistently open anterior fontanelle was observed. The antero-medial sides of the tibiae had a woven bone appearance. No cribra orbitalia or porotic hyperostosis was observed.

Figure A15. *Large anterior fontanelle*

Conclusion: The remains were that of an infant child who showed signs of possible malnutrition or long-term disease.

S12

Country/place of origin: Zoutpan, Western Cape, South Africa.

Preservation: Fairly good. The skull, right humerus and cervical vertebrae were missing. The rest of the skeletal elements were present.

Age: The medial end of the clavicle was fused, while S1 was recently fused. Sternal rib phase 5 was established (38 to 46 years). A final estimate of 35 to 50 years was made.

Sex: The pelvis and mandible appeared to be that of a male. A long and narrow sacrum, intermediate greater sciatic notch and slight gonial flare of the mandible contributed to male status. Records confirmed that the individual was male.

Stature: Stature was calculated using the physiological length of the femur to be 170.123 ± 2.777 cm.

Dentition: No maxillary teeth were available. The lower right I1, I2, C and P1, as well as the lower left I1 and M3 were lost postmortem. Advanced attrition was present on all molars, while medium wear could be seen on the other teeth. No caries or abscesses were observed.

Pathology and trauma: No visible pathology was present.

Conclusion: The remains were possibly those of a male between the ages of 35 an 50 years of age. He had been approximately 170 cm tall.

S13

Country/place of origin: Southern Africa.

Preservation: Fair. The mandible, right humerus, C1, C4 and various hand and foot bones were missing. The skull and all the postcranials were present.

Age: The medial end of the clavicle and S1 were closed. Advanced attrition was present on all teeth. Sternal rib phase was determined to be 5 to 6 (33 to 59 years). An estimate of 35 to 50 years was made.

Sex: The individual showed overwhelmingly female features: very wide greater sciatic notch, wide subpubic angle, preauricular sulcus, rectangular pubis, smooth brow ridge, small mastoids and glabella. Records also state female.

Stature: An estimate of 141.538 ± 2.789 cm was calculated using the femur.

Dentition: Only the upper central incisors were lost postmortem in the maxilla. No mandible or mandibular teeth were present. Caries were present in the upper right and left M2. No abscesses were found. Enamel hypoplasia were present, but could not be scored due to advanced wear of the teeth.

Pathology and trauma: L5 showed advanced osteophytic activity, while L4 only showed some lipping. Slight lipping was seen in both shoulder joints. No other observable pathology or trauma was present.

Figure A16. *Osteoarthritis of the fourth lumbar vertebra*

Other notes: A definite interparietal groove, as well as slight mons temperosphenoidalis and inferior frontal eminence were present.

Conclusion: The remains were that of an adult female individual, about 141 cm tall.

S14

Country/place of origin: Southern Africa.

Preservation: Poor. Only the skull, 9 epiphyses and 5 foot phalanges were present.

Age: The deciduous M1's were already in occlusion. The permanent M1's were just starting to erupt. No mandible was present for analysis. The permanent incisors had not yet erupted. The squamous and lateral parts of the occipital bone were fused, where as the squamous and basilar parts were partly fused. An estimate of 5 to 7 years was made.

Sex: Sex was not determined due to the young age of the child.

Dentition: All four upper incisors, as well as the left m1 were lost postmortem. The canines, right M1 and both m2's were present; 5 teeth in total. No visible enamel hypoplasia was present.

Pathology and trauma: No pathology or trauma was observed.

Conclusion: The remains represented that of a child between the ages of 5 and 7 years.

S15

Country/place of origin: Groot Mier, Northern Cape, South Africa.

Preservation: Fairly good. All skeletal elements were present, although various bones were unfused.

Age: The deciduous central incisors and first molars were completely erupted. The lateral incisors and canines were partially erupted. The two halves of the mandible were fused and the fontanelles were closed. The thoracic and lumbar vertebral arches were fused together, but were loose from the vertebral bodies. An estimate of 12 to 18 months was made.

Sex: Sex could not be determined due to the young age of the child.

Dentition: The upper and lower second deciduous molars are in the tooth sockets and had not erupted yet. The first deciduous molars have erupted fully. The upper canines were partially erupted, but the lower canines were lost postmortem. The upper and lower second incisors were partially erupted. All central incisors were fully erupted, although both the mandibular and the upper right were lost postmortem. The permanent first molars were visible in the tooth sockets.

Pathology and trauma: Cribra orbitalia presented as active, light scattered lesions in both orbits. Porotic hyperostosis was also evident an active light scattered lesions on the cranium. The tibiae, fibulae and femora were bowed, but the tibiae were affected most severely. Slight porosities were visible on the long bones. This may possibly indicate a case of rickets.

Figure A17. *Bowed appearance of the femora*

Figure A18. *Cribra orbitalia of the right orbit*

Figure A19. *Cribra orbitalia of the left orbit*

Conclusion: The remains belonged to that of an infant with possible rickets.

S16

Country/place of origin: Nooitgedagt, Western Cape, South Africa.

Preservation: Poor. The skull was fragmented and overall the bones were fragile and brittle. The skeletal elements present were 9 tarsals, 15 metatarsals, patellae, 13 loose epiphyses, 8 ribs and a few fragments, left scapula, axis and clavicles.

Age: The 3 parts of the pelvis were unfused. The long bones epiphyses were unfused, although the roots of the incisors were completely developed and all teeth were permanent. The individual was estimated to have been between the ages of 9 and 13 years.

Sex: Sex could not be determined as the individual is too young, but records stated female.

Dentition: All permanent teeth, except the third molars were fully erupted. Only the lower lateral left incisor was lost postmortem. No caries, abscesses or enamel hypoplasia were present. Very little dental wear was visible.

Pathology and trauma: Postmortem damage to the bones was too severe to score specific pathology. No cribra orbitalia could be observed.

Conclusion: The remains were that of a child between the ages of 9 and 13 years.

S17

Country/place of origin: Koranna area, Kalahari, South Africa.

Preservation: Fairly good. All skeletal elements were present, except for the right humerus, vertebrae and a few bones of the foot.

Age: The medial end of the clavicle, S1 and the spheno-occipitalis synchondrosis were unfused. The proximal humerus was partly fused, the wrist and elbow closed and the iliac crests were completely open. All cranial sutures were open. A final estimate of 16 to 20 years was established.

Sex: A wide greater sciatic notch, presence of a preauricular sulcus, small mastoids, a pointed chin and sharp supra-orbital margins indicated female. Records confirm that the sex is female.

Stature: Using the femur, a stature of 144.861 ± 2.789 was calculated.

Dentition: All permanent teeth were erupted and the following were lost postmortem: upper right and left premolars, the upper right and left lateral incisors, the upper left third molar, the lower right P1 and I2, as well as both lower central incisors. No caries, abscesses or enamel hypoplasia was present. Slight to medium wear was observed on all teeth.

Pathology and trauma: No signs of pathology or trauma were present.

Other notes: A slight inferior frontal eminence was observed.

Conclusion: These remains belonged to an adolescent female individual who was approximately 144 cm tall.

S18

Country/place of origin: Koranna area, Kalahari, South Africa.

Preservation: Fair. All were present, except the right humerus, cervical vertebrae and the hand and foot bones.

Age: The third molars were in occlusion and medium wear could be seen on all teeth. The spheno-occipitalis synchondrosis was closed, but the first segment of the sacrum was unfused. Cranial suture closed suggested an individual between the ages of 30 and 60 years. An estimate of 30 to 45 years was established.

Sex: A long and narrow sacrum, medium glabella, prominent muscle marking on the cranium and a well developed gonial area indicated male. Records confirmed that the individual was male.

Stature: Making use of the physiological length of the femur, a stature of 161.693 ± 2.777 cm was calculated.

Dentition: Only the upper right canine, both upper central incisors and the lower right central incisor were lost postmortem. All other teeth were present. An abscess was noted in the upper right first molar. Medium wear could be seen on the incisors, with slightly more wear on the molars. No caries or enamel hypoplasia was noticed.

Figure A20. *An abscess of the upper right first molar*

Pathology and trauma: No signs of trauma or pathology were present.

Other notes: A slight interparietal groove was present.

Conclusion: The remains belonged to a male between the ages of 30 and 45 years.

S19

Country/place of origin: Koranna area, Kalahari, South Africa.

Preservation: Fair. All skeletal elements were present, except for the atlas, right humerus, right ulna, both radii and a few foot bones.

Age: The third molar was erupted and in occlusion. The medial end of the clavicle, as well as the iliac crests was open. All sacral segments were still unfused. The spheno-occipitalis synchondrosis was closed. The epiphyseal lines of the proximal humerus were still visible. An estimate of 16 to 22 years was made.

Sex: A very prominent preauricular sulcus, a wide sciatic notch, no glabella and sharp supra-orbital margins indicated female. Records confirmed that the individual was indeed female.

Stature: Using the physiological length of the femur, an antemortem stature of 133.231 ± 2.789 cm was calculated.

Dentition: All four upper incisors and both canines were lost postmortem. The upper and lower right third molars were also lost postmortem. The lower right P2, P1, C, I2, I1 and left I1 was lost postmortem as well. No caries or abscesses were present. Slight wear could be seen on all teeth. Enamel hypoplasia was evident.

Pathology and trauma: No signs of trauma or pathology were noticed, except for the presence of enamel hypoplasia.

Other notes: No interparietal groove or inferior frontal eminence was present, but slight mons temperosphenoidalis could be seen.

Conclusion: The remains were that of a young adult female, about 133 cm tall.

S20

Country/place of origin: Koranna area, Kalahari, South Africa.

Preservation: Fairly poor. Postmortem damage was visible on many skeletal elements. Only the right half of the calvarium, right half of the mandible and a part of the left side of the mandible (gonial end missing) were available for analysis as far as the skull is concerned.

Other elements present include the left humerus (head broken), right scapula, both radii, both ulnae, sacrum, left pelvis, all of the lower long bones, 4 ribs and fragments, C7, T1-T12, L1-L4, L5 (body only), manubrium and a few foot bones.

Age: No teeth were available, but it was clear that the third molars had erupted. The iliac crests were unfused, as well as the first two segment of the sacrum. The epiphyseal lines of the knee were still slightly visible. A final estimate of 16 to 22 years was made.

Sex: A wide greater sciatic notch, rectangular pubis, broad and short sacrum and a delicate mandible indicated female. Records confirmed female.

Stature: A stature of 142.646 ± 2.789 cm was calculated using the physiological length of the femur.

Dentition: No teeth were available – all had been lost postmortem.

Pathology and trauma: No pathology or trauma could be seen.

Other notes: A slight inferior frontal eminence was present.

Conclusion: The remains belonged to a young adult female with an antemortem stature of about 142 cm.

S21

Country/place of origin: Koranna area, Kalahari, South Africa.

Preservation: Fairly poor. No skull was available for analysis. The mandible was broken. Postcranials that were present included the clavicles, rib fragments, manubrium, radii, ulnae, scapulae, os coxae (fragmented), all the long bones of the lower limbs, left patella, 6 tarsals and 5 metatarsals.

Age: The third molars were erupted and the medial ends of the clavicles were fused. An estimate of 30 to 60 years was made.

Sex: The Pacher catalogue (1961) stated male, but morphological features of the pelvis strongly suggested female. A very wide greater sciatic notch and the presence of a preauricular sulcus definitely suggested female. The mandible was somewhat robust, but had a pointed chin.

Stature: A stature of 160.091 ± 2.789 cm was calculated using the physiological length of the femur.

Dentition: Only the lower right M1, lower left M1 and M2 were present. The rest of the teeth were lost postmortem. No caries or abscesses could be seen. Tartar was present on all 3 teeth. Medium to advanced wear was noticed.

Figure A21. *The mandible with only three molars remaining*

Pathology and trauma: No pathology or trauma was observed.

Conclusion: The remains were possibly that of a middle-aged female.

S22

Country/place of origin: Blinkfontein, Western Cape, South Africa.

Preservation: Good. All skeletal elements were present.

Age: The third molars had erupted and were in occlusion. The medial end of the clavicle, S1 and the speno-occipitalis synchondrosis were fused. Sternal rib phase analsysis showed phase 5 to 6 (38 to 55 years). A final estimate of 35 to 50 years was made.

Sex: A narrow subpubic angle, triangular pubis, long and narrow sacrum, a prominent glabella and round supra-orbital margins indicated male. Records confirmed male.

Stature: The femur was used to calculate a stature of 161.934 ± 2.777 cm.

Dentition: Several of the teeth were lost antemortem: upper right M3, M2, P1, the canines, all incisors and the lower right M3, central incisors, the left P1, P2, M1 and M3. Abscesses were present in the upper right P1, lower right M1, lower left canine and P1. Severe periodontal disease was present. Medium to severe wear could be seen on all teeth.

Figure A22. *The mandible showing periodontitis and abscessing of the right M1*

Figure A23. *Antemortem tooth loss in the left side of the mandible*

Pathology and trauma: Slight lipping was seen on L4 and L5. No other osteophytes were present. No other pathology and trauma were seen.

Other notes: Slight inferior frontal eminence was present.

Conclusion: The remains were that of middle-aged male, approximately 161 cm tall.

S23

Country/place of origin: Blinkfontein, Western Cape, South Africa.

Preservation: Fair. No skull was available for analysis. Skeletal elements present included all long bones, the right clavicle, both scapulae, sternum, C2-C7, 24 ribs, both os coxa, right patella, 14 tarsals, 10 metatarsals, 15 foot phalanges, 16 carpals, 10 metacarpals and 22 hand phalanges.

Age: The third molars were unerupted. All long bone epiphyses were open. The shoulder, wrist, hip, knee and ankle were unfused. The elbow was partly fused. A final estimate of 12 to 14 years was made.

Sex: An intermediate greater sciatic notch, rectangular pubis and pointed chin indicated female. Records confirmed that it was the remains of a female.

Dentition: No maxillary teeth were available. All the mandibular teeth were present and available for analysis, except the third molars that had not yet erupted. No enamel hypoplasia, caries or abscesses was present. Slight to almost no wear was seen on all teeth.

Pathology and trauma: There were no signs of pathology or trauma.

Conclusion: The remains were possibly that of an adolescent female.

S24

Country/place of origin: Blinkfontein, Western Cape, South Africa.

Preservation: Good. All skeletal elements were present, except the first cervical vertebra.

Age: The first segment of the sacrum, as well as the spheno-occipitalis synchondrosis was fused. Cranial suture closure indicated that the age of the individual was between 30 and 60 years. The pubic symphysis suggested phase 5 (27 to 60 years). Sternal rib ends were interpreted as phase 5 to 6 (38 to 55 years). A final estimate of 40 to 55 years was made.

Sex: A narrow subpubic angle, triangular pubis, narrow sacrum, prominent glabella and brow ridge, large mastoids and prominent muscle markings on the skull indicated male. Records confirmed that the individual was male.

Stature: The physiological length of the femur was used to calculate a stature of 150.640 ± 2.777 cm.

Dentition: The upper right M3, P1, C, I2, I1, as well as the upper left I1, I2, P1 and P2 were lost antemortem. The lower central and lateral incisors were also lost antemortem, but this appeared to be due to an infectious process or possible granuloma. The upper left canine was imbedded in the maxilla and protruded anteriorly. The lower left canine was also impacted in the mandible. Severe periodontal disease could be seen around all upper and lower teeth. The upper right first premolar had an abscess. Medium to severe wear could be seen on all teeth.

Figure A24. *Possible infectious process or granuloma in the area of the lower incisors*

Figure A25. *The maxilla showing antermortem tooth loss, an impacted canine and abscessing*

Pathology and trauma: Osteoarthritis was evident on the left elbow with eburnation on the distal humerus. A bony outgrowth was present on the left fourth rib. A possible fracture could be seen in the left orbit. The left leg appeared to be porotic due to minimized use caused by a fracture of the femoral head that was only partly healed. The femoral head may have suffered a second subtrochanteric fracture in the unhealed area of the first fracture. It appears to have fractured just before the time of death as it showed no healing. A healed fracture in the distal shaft of the left ulna was also present. The radius appeared normal, which indicated that the healed ulnar fracture might possibly be a defence fracture. The distal end of the left clavicle appeared to have formed a callus. The right knee (distal femur and proximal tibia) showed significant osteophytic lipping. The teeth were not scorable for enamel hypoplasia. No cribra orbitalia or porotic hyperostosis was present.

Figure A26. *Osteoarthritis of the left elbow*

Figure A27. *Subtrochanteric fracture of the left femur*

Other notes: A slight inferior frontal eminence could be seen. No mons temperosphenoidalis or interparietal groove could be seen.

Conclusion: The remains were that of a middle-aged male, about 150 cm tall. Various pathologies were present.

S25

Country/place of origin: Kalahari, South Africa.

Preservation: Fairly good. All skeletal elements were present, except for the mandible, left scapula, both patellae and the first two cervical vertebrae.

Age: The medial end of the clavicle was fused recently. The first segment of the sacrum was open and the iliac crest lines were still visible. The sternal ends of the ribs displayed phase 3 (23 to 27 years). The spheno-occipitalis synchondrosis was open. An estimate of 20 to 30 years was made.

Sex: A very wide greater sciatic notch, wide subpubic angle and rectangular pubis indicated female. Records confirmed that the person was female.

Stature: Using the physiological length of the femur, an antemortem stature of 146.246 ± 2.789 cm was calculated.

Dentition: The upper right molars and P2, as well as the upper left I1, P2 and M3 were lost postmortem. No mandibular teeth were present. An abscess was visible in the upper left M1. Advanced wear could be seen on all teeth, and thus enamel hypoplasia could not be scored. No caries were evident.

Pathology and trauma: There were no signs of pathology or trauma.

Other notes: An inferior frontal eminence and mons temperosphenoidalis were present. No interparietal groove could be seen.

Conclusion: The remains belonged to that of a young adult female with an antemortem stature of about 146 cm.

S26

Country/place of origin: Zoutpan, Western Cape, South Africa.

Preservation: Fair. The skull and mandible were absent, as well as the cervical vertebrae, T1 and T2.

Age: The first segment of the sacrum was unfused. The medial end of the clavicle and all long bone epiphyses were closed. The sterna ends of the ribs were classifies as phase 5 (33-47 years). Slight lipping was present on L1, L4 and the elbows. A final estimate of 30 to 45 years was made.

Sex: A wide greater sciatic notch, preauricular sulcus, wide subpubic angle and rectangular pubis indicated female. Records also stated female.

Stature: The physiological length of the femur was used to calculate an antemortem stature of 152.061 ± 2.789 cm.

Dentition: No teeth were available.

Pathology and trauma: No signs of pathology or trauma were present.

Conclusion: The remains were that of an adult female with an antemortem stature of about 152 cm.

S27

Country/place of origin: Zoutpan, Western Cape, South Africa.

Preservation: Poor. The only skeletal elements present were the scapulae, humerii, os coxae, sacrum, right femur, C2-C7, T1-T12 and L1-L5.

Age: The first segment of the sacrum was open. All long bone epiphyses were closed. Slight lipping could be seen on L4 and L5. The pubic symphysis suggested an age between 19 and 34 years (phase 2). An estimate of 25 to 40 years was made.

Sex: A narrow greater sciatic notch, triangular pubis and narrow subpubic angle indicated male. Records also stated male.

Stature: An antemortem stature of 151.841 ± 2.777 cm was calculated using the physiological length of the femur.

Dentition: No teeth were available.

Pathology and trauma: No trauma was observed. Osteophytic lipping was present on the fourth and fifth lumbar vertebrae.

Conclusion: The remains were possibly that of an adult male, about 151 cm tall.

S28

Country/place of origin: Nooitgedagt, Western Cape, South Africa.

Preservation: Fair. The mandible, all hand bones and foot phalanges were absent.

Age: Pronounced antemortem tooth loss was visible. Sternal rib end phase was determined to be 6 (44 to 59 years). Cranial suture closure indicated that the individual had been between the ages of 35 and 65 years. Advanced osteoarthritic changes were present on various parts of the skeleton. It was estimated that the individual had been over the age of 45, but not older than 65 years at the time of death.

Sex: A prominent preauricular sulcus, wide greater sciatic notch, small mastoids, medium glabella and a broad sacrum indicated female. Records also stated female.

Stature: Using the physiological length of the femur, an antemortem stature of 152.891 ± 2.789 cm was calculated.

Dentition: No mandibular teeth were present. The only tooth present was the upper right canine. All upper molars, upper left premolars and all incisors were lost antemortem. The upper right premolars and the upper left canine were lost postmortem. Severe wear was observed on the upper right canine. Abscessing was present in die upper left molars.

Figure A28. *Maxilla showing abscessing*

Pathology and trauma: No cribra orbitalia or porotic hyperostosis was present. Osteoarthritic changes were seen in both feet, knees, lumbar vertebrae and the second cervical vertebra.

Figure A29. *Anterior view of the axis showing osteoarthritis*

Figure A30. *Posterior view of the axis showing osteoarthritis*

Other notes: A slight interparietal groove and slight mons temperospenoidalis was seen. No inferior frontal eminence was present. The box that contained the remains also contained unfused epiphyses and hand bones not belonging to the individual in this case.

Conclusion: The remains were possibly that of an adult female, approximately 152 cm tall.

S29

Country/place of origin: Nooitgedagt, Western Cape, South Africa.

Preservation: Fairly good. All skeletal elements were present, except for the right fibula and all vertebrae.

Age: Slight wear can be seen on all teeth. The medial end of the clavicle, S1 and the spheno-occipitalis synchondrosis were closed. Sternal rib phase 4 (30-37 years) was apparent. Cranial suture closure indicated that the individual had been between the ages of 30 and 60 years. A final estimate of 30 to 40 years was made.

Sex: A long sacrum, narrow subpubic angle, narrow greater sciatic notch, pronounced brow ridge and glabella, square chin and robust-looking cranium suggested male. Records confirmed that is had been a male individual.

Stature: The physiological length of the femur was used to calculate an antemortem stature of 165.798 ±2.777 cm.

Dentition: All teeth were present, except for the upper right I1 and lower left I1 that had been lost postmortem. Slight tartar was seen on all teeth. A small degree of periodontal disease could be seen around the mandibular teeth. No enamel hypoplasia or caries was present. Slight wear could be seen on all teeth.

Pathology and trauma: No cribra orbitalia, porotic hyperostosis or periosteal bone growth was present. Slight lipping could be seen on L4, L5 and the elbows.

Other notes: An inferior frontal eminence was present. No mons temperosphenoidalis or interparietal groove was observed.

Conclusion: The remains were probably that of an adult male with an antemortem stature of about 165 cm.

S30

Country/place of origin: Nooitgedagt, Western Cape, South Africa.

Preservation: Fairly poor. No skull or mandible was present. The only skeletal elements that were present were the scapulae, clavicles, manubrium, humerii, ulnae, the right radius, right os coxa, femora, left tibia, fibulae, 4 tarsals, 20 ribs, T1-T12 and L1-L5.

Age: The proximal tibia was recently fused, but the distal femora were still open. The shoulder and wrist were unfused. The elbow was fused, while the hip was recently fused. The iliac crests were still completely open. No teeth were available for analysis. A final estimate of 13 to 16 years was made.

Sex: The skeleton was gracile and small and a wide greater sciatic notch was present. These characteristics indicated female. Records also stated female.

Dentition: No teeth were available for analysis.

Pathology and trauma: No signs of trauma or pathology were evident.

Conclusion: The remains possibly belonged to an adolescent female individual.

S31

Country/place of origin: Nooitgedagt, Western Cape, South Africa.

Preservation: Very poor. The skull and mandible were fragmentary. The axis, left scapula, pelvis and femora were fragmented and significantly damaged. All skeletal elements were present, except the left clavicle, C1 and C3-C7.

Age: The third molars were erupted, but unworn. The femoral heads, as well as the elbows were fused. The proximal tibia and distal radius were recently fused. The iliac crests and the first segment of the sacrum were open. All cranial sutures were open. A final estimate of 15 to 19 years was made.

Sex: A delicate cranium, small mastoids, wide greater sciatic notch, wide subpubic angle and rectangular pubis indicated female. Records confirmed that is had been a female.

Dentition: All upper left teeth, as well as the upper right incisors were lost postmortem. The lower right I1, I2, C, P1 and the left I1 and P2 were also lost postmortem. No caries, abscesses or enamel hypoplasia were present. Slight to medium wear was present on all teeth.

Pathology and trauma: Spina bifida occulta was present in the T12 vertebra. No other signs of trauma or pathology were noticed.

Other notes: An inferior frontal eminence was present, as well as slight mons temperosphenoidalis. No interparietal groove was seen.

Conclusion: The remains were that of a female individual between the ages of 15 and 19 years.

S32

Country/place of origin: Kalkbaai, Western Cape, South Africa.

Preservation: Fair. Only the skull, mandible and rib fragments were present.

Age: The permanent first molars had erupted. The upper M2 had also erupted. The lower M1 root was not closed, but had developed completely. An estimate of 11 to 13 years was made.

Sex: Sex determination could not be done due to the young age of the individual.

Dentition: The deciduous upper second molars were still intact. The permanent upper first and second molars were also erupted. The permanent lower first molars and right first premolar were also erupted and intact, but the permanent lower right M2 only partly erupted, while the lower left first premolar was unerupted. Six of the teeth were severely deformed, possibly due to severe malnutrition. The crowns of the teeth were severely defected and contained pits and grooves. The roots of the affected teeth were not fully developed. All affected teeth were permanent. Differential diagnoses included a congenital form of treponematosis and amelogenesis imperfecta.

Figure A31. *Defected crown formation the molars and premolars*

Pathology and trauma: Bilateral cribra orbitalia of medium severity was present. The lesions were active. Other than the malformed teeth, no other pathology was noted.

Figure A32. *Cribra orbitalia present in both orbits*

Other notes: The base of the skull and the ribs were stained red.

Conclusion: The remains were possibly that of a child about 12 years of age with severe dental malformation and cribra orbitalia.

S33

Country/place of origin: Kalkbaai, Western Cape, South Africa.

Preservation: Fairly poor. No skull or mandible was present. The only skeletal element that were present was the manubrium, first rib, right ulna, fragmented femur, fragmented tibia, sacrum fragments, left radius, 9 carpal bones with fragments, 4 metacarpals with fragments, fibula fragments, the medial half of the clavicle, one lumbar vertebra and various other small bone fragments.

Age: All long bones were fused. The medial end of the clavicle was also closed. It was estimated that the individual had been older than 40 years.

Sex: Unknown. The pelvis was significantly damaged and analysis could not be performed to determine sex.

Stature: Antemortem stature was calculated using the maximum length of the radius and found to be 149.078 ± 3.387 cm.

Dentition: No teeth were available for analysis.

Pathology and trauma: Lipping could be seen on the one lumbar vertebra present. No other trauma or pathology was noticed.

Conclusion: The remains were that of an individual over the age of 40 years of unknown sex.

S34

Country/place of origin: Kalkbaai, Western Cape, South Africa.

Preservation: Poor. The scapulae, os coxae, sacrum, ribs and some of the hand and foot bones were fragmentary. The mandible, atlas, right patella, T9-T12 and L1 were absent. The rest of the remains were present.

Age: Advanced wear could be seen on all teeth present. The medial end of the clavicle and the spheno-occipitalis synchondrosis were closed. Cranial suture closure indicated that the individual had been between the ages of 45 and 75 years. It was estimated that the person had been over the age of 40 years.

Sex: The greater sciatic notch was intermediate and the mastoids and glabella were medium. Overall, the cranium was robust. Metric sex analysis yielded intermediate results. A tentative diagnosis of male was made based on the morphological features of the skull.

Stature: The physiological length of the femur was used to calculate an antemortem stature of 164.596 ± 2.777 cm.

Dentition: The only teeth present were the upper right M2, M1, P2, C I1 and the left C, M1 and M2. The third molars, left P2, the first premolars, lateral incisors and the left central incisor were lost postmortem. No caries, abscesses or enamel hypoplasia were present. Advanced wear could be seen on all teeth present.

Pathology and trauma: No cribra orbitalia or porotic hyperostosis was present. The remains were too damaged to score osteoarthritic changes. No other signs of pathology or trauma were noted.

Other notes: A slight inferior frontal eminence could be seen, although no mons temperosphenoidalis or interparietal groove was present.

Conclusion: The remains belonged to an adult male over the age of 40 years that were about 164 cm tall.

S36

Country/place of origin: Twee Rivieren, Kalahari, South Africa.

Preservation: Poor. No skull or mandible was available. Skeletal elements present included two vertebrae (fragmented), radii and ulnae, fragmented pieces of the os coxae, fragmented sacrum, both femora, tibiae, fibulae and patellae.

Age: The ankle, knee and pelvis were unfused. It was determined that the individual had been a juvenile younger than the age of 12 years.

Sex: Sex could not be determined due to the individual being too young.

Dentition: No teeth were available for analysis.

Pathology and trauma: The bones were too brittle and damaged to assess pathology and trauma.

Conclusion: The remains were possibly that of a child younger than the age of 12 years.

S37

Country/place of origin: Valsbaai, Western Cape, South Africa.

Preservation: Fair. No mandible, tarsals, metatarsals or any of the hand bones were available. The first and second cervical vertebrae were also missing.

Age: A full set of deciduous teeth was present. All fontanelles were closed. All parts of the occipital bones were fused. The arches of the cervical vertebrae were fused together, but were not yet fused to the vertebral bodies. An estimate of 2 to 4 years was made.

Sex: Unknown. The individual was too young to determine sex.

Dentition: All teeth were deciduous and intact. Only the upper teeth were present. No enamel hypoplasia was noticed.

Pathology and trauma: No cribra orbitalia or porotic hyperostosis was present. No other signs of pathology or trauma were observed.

Other notes: The postcranial bones were stained black, possibly by mud or the type of soil that covered it.

Conclusion: The remains were possibly that of a child between the ages of 2 and 4 years.

S38

Country/place of origin: Valsbaai, Western Cape, South Africa.

Preservation: Fairly good. All skeletal elements were present, except for the left fibula and atlas.

Age: The third molars were in occlusion. All teeth showed medium to advanced wear. The medial clavicle was closed. Sternal rib ends displayed phase 4 (28-32 years). Cranial sutures indicated that the individual was between 30 and 60 years old. The first segment of the sacrum was recently fused. A final estimate of 25 to 40 years was made.

Sex: A wide greater sciatic notch, wide subpubic angle, preauricular sulcus, small mastoids, sharp supra-orbital margins and a gracile cranium indicated female. Records also stated female.

Stature: A stature of 145.969 ± 2.789 cm was calculated using the physiological length of the femur.

Dentition: The right and left upper molars and the left P1 were present. The lower right M3, right C and left M1, M2 and M3 were also present. The rest of the teeth were lost postmortem. No caries, abscesses or enamel hypoplasia were noticed. Medium to severe wear was present on all teeth.

Pathology and trauma: No pathology was present. A possible nose fracture was observed.

Other notes: An interparietal groove and mons temperosphenoidalis were present. A slight inferior frontal eminence could be seen.

Conclusion: The remains belonged to an adult female, about 145 cm tall.

S40

Country/place of origin: Valsbaai, Western Cape, South Africa.

Preservation: Fairly good. All skeletal elements were present, except for the first two cervical vertebrae, thoracic vertebrae, lumbar vertebrae and a few foot bones. The scapulae were fragmented.

Age: Advanced wear could be seen on all teeth. The medial end of the clavicle, S1 and spheno-occipitalis synchondrosis was closed. Pubic symphysis analysis suggested an age between 27 and 60 years (phase 5). Cranial suture closure indicated that the person had been between 45 and 75 years. Slight lipping was present on the knees. A final estimate of 40 to 60 years was made.

Sex: A very wide greater sciatic notch, wide subpubic angle, small glabella, sharp supra-orbital margins and a pointed chin indicated female. Records also stated female.

Stature: Using the physiological length of the femur, a stature of 152.891 ± 2.789 cm was calculated.

Dentition: All maxillary teeth were intact, except for the left I2 and C that had been lost postmortem. The only mandibular teeth present and intact were the right M1, I2 and left C and P1. The lower right M2, M3 and all lower left molars were lost antemortem. The second premolars, right first premolar, left lateral incisor and central incisors were lost postmortem. Periodontal disease was evident in the mandible. Severe attrition was present on all teeth available, and thus enamel hypoplasia could not be scored.

Pathology and trauma: Other than lipping of the knees, no pathology or trauma was present.

Other notes: Pronounced mons temperosphenoidalis was present. A slight inferior frontal eminence and slight interparietal groove was noticed.

Conclusion: The remains were possibly that of an elderly female individual of about 152 cm in stature.

S42

Country/place of origin: Valsbaai, Western Cape, South Africa.

Preservation: Fair. The mandible, right scapula, atlas, right os coxa, right patella and hand bones were missing.

Age: The medial end of the clavicle and the spheno-occipitalis synchondrosis were closed. The first segment of the sacrum had recently fused. Sternal rib ends showed phase 5 (38-46 years). Cranial suture closure indicated that the individual had been between the ages of 45 and 75 years of age. A final estimate of 35 to 55 years was made.

Sex: A long sacrum, narrow greater sciatic notch, narrow subpubic angle, medium glabella and large mastoids indicated male. Records also stated male.

Stature: An antemortem stature of 154.725 ± 2.777 cm was calculated using the physiological length of the femur.

Dentition: No mandibular teeth were present. The following maxillary teeth were available: right M3, M2, M1, P1, C, I2 and left P2. The rest were lost postmortem. Caries were present in the right M3, M2, M1 and left P2. Advanced attrition was observed. The teeth were not scorable for enamel hypoplasia due to the extent of wear present. No abscesses could be seen.

Figure A33. *Caries of the maxillary left second premolar*

Pathology and trauma: No cribra orbitalia or porotic hyperostosis was present. Periosteal reactions could be seen in the humerii, ulnae, right radius, right femur, tibiae, fibulae and the right clavicle. No lesions were found on the skull and foot bones. The nasal bones were flattened and thickened. The palate appeared to be normal. These changes could indicate a possible case of treponemal disease.

Figure A34. *Periostitis of the tibiae and fibulae*

Other notes: A slight inferior frontal eminence, mons temperosphenoidalis and interparietal groove were present.

Conclusion: The remains were possibly that of a middle-aged male, about 154 cm tall that could possibly have suffered form treponemal disease.

S44

Country/place of origin: Valsbaai, Western Cape, South Africa.

Preservation: Fairly good. The skull and atlas were missing.

Age: All long bone epiphyses were closed. The first segment of the sacrum was open. Sternal rib phase analysis showed phase 4 (30-37 years). A final estimate of 30-45 years was made.

Sex: Morphological features such as the greater sciatic notch, sacrum and subpubic angle indicated male. Pronounced gonial flair in the mandible was also present. Records also stated male.

Stature: Using the physiological length of the femur, a stature of 151.601 ± 2.777 cm was calculated.

Dentition: Only the first and second maxillary molars were present – no other upper teeth were available. Periodontal disease caused almost all of the mandibular teeth to be lost antemortem. The lower canines were the only teeth not lost antemortem, but were lost postmortem. The teeth could not be scored for enamel hypoplasia. No caries or abscesses were noticed.

Pathology and trauma: Slight lipping of the elbows could be seen. No other osteophytic activity was present. No other signs of pathology were observed.

Conclusion: The remains were that of a male, approximately 151 cm tall.

S45

Country/place of origin: Valsbaai, Western Cape, South Africa.

Preservation: Excellent. All skeletal elements were present.

Age: Severe wear was present on all teeth. Lipping of the elbows was present. Sternal rib end analysis revealed phase 6 (44-59 years). Cranial suture closure indicated an individual between the ages of 50 and 80 years. Osteophytes were present on all vertebrae. A final estimate of 50 to 70 years was made.

Sex: A prominent preauricular sulcus, very wide subpubic angle, short sacrum, delicate skull, very small mastoids and a medium glabella indicated female. Records also stated female.

Stature: Using the physiological length of the femur, a stature of 147.076 ± 2.789 cm was calculated.

Dentition: All mandibular teeth were lost antemortem. The upper central incisors, first premolars, left second premolar, second molars and third molars were also lost antemortem. The following teeth were present and intact: upper lateral incisors, canines, right first premolar and first molars. Severe attrition of the few remaining teeth could be seen.

Pathology and trauma: Severe atrophy of the mandible manifested due to antemortem loss of teeth. Osteophytes were widely spread, except for the knees and ankles. Bones appear very osteoporotic. The first lumbar vertebrae had partially collapsed.

Figure A35. *Partial collapse of the first lumbar vertebra*

Other notes: Slight mons temperosphenoidalis and interparietal groove was present. No inferior frontal eminence could be seen.

Conclusion: The remains belonged to an elderly female, about 147 cm tall. Various age-related pathological changes were present.

S46

Country/place of origin: Valsbaai, Western Cape, South Africa.

Preservation: Excellent. All skeletal elements were present, except the vertebrae and a few phalanges of the hands and feet. The mandible possibly does not belong to the specimen, as it does not fit the skull.

Age: The third molars were erupted and in occlusion. Very little wear could be seen on all teeth. The medial end of the clavicle, as well as the first, second and third segment of the sacrum was open. The shoulder, knee, ankle and iliac crests were unfused. The elbow was completely fused. The hip was recently fused. A final estimate of 14 to 18 years was made.

Sex: A short sacrum, intermediate greater sciatic notch, wide subpubic angle, rectangular pubis, sharp supra-orbital margins, smooth brow and glabella, small mastoids, pointed chin and overall gracile skull indicated female. Records also stated female.

Dentition: The upper right premolars, lower left premolars, lower left M1, C, I2, I1 and lower right I1 were lost postmortem. The upper central incisors and lower right I2 were broken (postmortem damage). No caries, abscesses or enamel hypoplasia was present. Slight wear could be seen on all teeth.

Pathology and trauma: No cribra orbitalia or porotic hyperostosis was observed. No other pathology or trauma could be seen.

Conclusion: The remains were possibly that of an adolescent female.

S47

Country/place of origin: Valsbaai, Western Cape, South Africa.

Preservation: Fair. No skull was available. The right scapula was also absent. All other skeletal remains were present.

Age: The medial end of the clavicle and S1 were closed. Osteophytes could be seen on the vertebrae. Lipping of the elbows, shoulder, hip and wrist could be seen. Sternal rib phase analysis proved to be phase 6 (44-59 years). An estimate of 40 to 55 years was made.

Sex: A wide greater sciatic notch, broad sacrum, preauricular sulcus and rectangular pubis indicated female. Records confirmed that it had been female.

Stature: A stature of 152.061 ± 2.789 cm was calculated using the physiological length of the femur.

Dentition: No teeth were available.

Pathology and trauma: Spina bifida occulta of L1 could be seen. Osteophytic activity of the elbows, vertebrae, shoulder and wrist was present. No other pathology or trauma was observed.

Figure A36. *Spina bifida of the first lumbar vertebra*

Conclusion: The remains were that of an adult female, about 152 cm tall.

S47a

Country/place of origin: Valsbaai, Western Cape, South Africa.

Preservation: Only an incomplete skull was present.

Age: All teeth were lost antemortem. Cranial suture closure indicated an individual between the ages of 15 and 40 years. An estimate of 30 to 40 years was made.

Sex: A delicate looking skull, very small glabella and brow ridge, sharp supra-orbital margins and small mastoids indicated female. Records confirmed female.

Dentition: All maxillary teeth had been lost antemortem. No mandibular teeth were present. Complete resorption of the maxilla was evident.

Pathology and trauma: No cribra orbitalia or porotic hyperostosis was seen. A healed traumatic lesion (circular) was present on the right parietal bone.

Other notes: A wide interparietal groove could be seen. However, no mons temperosphenoidalis or inferior frontal eminence was present.

Conclusion: The remains were possibly that of an adult female with a healed traumatic lesion on the right parietal bone.

S48

Country/place of origin: South Africa.

Preservation: Fairly good. No thoracic or lumbar vertebrae were present. The first two cervical vertebrae were also absent. All other skeletal elements were present.

Age: The third molars were erupted and in occlusion. The spheno-occipitalis synchondrosis and the first segment of the sacrum were open. The medial end of the clavicle was closed on the right, but unfused on the left side. Sternal ends of the ribs portrayed phase 3 (25 to 29 years). A final estimate of 20 to 30 years was made.

Sex: A triangular pubis, medium brow ridge and glabella, medium to large mastoids, a square chin and robust skull indicated male. Records confirmed male.

Stature: Using the physiological length of the femur, an antemortem stature of 156.887 ± 2.777 cm was calculated.

Dentition: All teeth were present, except the lower left M1 that was lost postmortem. Caries were present in the lower right M1. No abscesses or enamel hypoplasia was observed. Medium wear was present on all teeth.

Pathology and trauma: No cribra orbitalia or porotic hyperostosis was present. No other signs of pathology or trauma were observed.

Other notes: A slight inferior frontal eminence and mons temperosphenoidalis was present, but no interparietal groove could be seen.

Conclusion: The remains were possibly that of a male individual, about 156 cm tall.

S49

Country/place of origin: Witkop, Namibia.

Preservation: Excellent. All skeletal elements were present, except for the atlas and sternum.

Age: Severe wear was present on all teeth. The spheno-occipitalis synchondrosis and first segment of the sacrum were fused. Osteophytes were present on the vertebrae. Cranial suture closure indicated that the individual had been between the ages of 45 and 75 years. Sternal rib end analysis portrayed phase 6 (44-59 years). A final estimate of 40 to 60 years was made.

Sex: The presence of a preauricular sulcus, wide subpubic angle, small and delicate skull, medium glabella, very small mastoids and sharp supra-orbital margins indicated female. Records also stated female.

Stature: Using the physiological length of the femur, a stature of 147.353 ± 2.789 cm was calculated.

Dentition: The upper and lower right M3, as well as the lower right I1, were lost antemortem. The upper right I1, I2, C and upper left P2 were lost postmortem. All other teeth were present and intact. Periodontal disease was evident around all molars. Caries were present in the upper left I2, lower left M2 and lower right M2. An abscess was seen in the lower right I2. Advanced wear was evident on all teeth.

Figure A37. *Caries of the mandibular right second molar*

Pathology and trauma: Tempero-mandibular arthritis was present. Eburnation of the left elbow and right wrist was observed. Osteophytes were present on the vertebrae (L3, L4 and L5), elbows, shoulders, wrists and ankles. The knees did not display any osteophytic activity.

Other notes: An interparietal groove and slight mons temperosphenoidalis were present.

Conclusion: The remains were that of a middle-aged female of about 147 cm in stature.

S50

Country/place of origin: Middleputz, Kgalagadi area, Botswana.

Preservation: Fair. No skull, mandible or sternum was available. All other skeletal remains were present.

Age: All long bones were unfused. The sacrum (all segments) was unfused. The pelvis was also unfused. An estimate of 7 to 11 years was made.

Sex: The sex of the individual could not be determined through analysis, but records state female.

Dentition: No teeth were available.

Pathology and trauma: No signs of pathology or trauma were present.

Conclusion: The remains were possibly that of a child between the ages of 7 and 11 years.

S51

Country/place of origin: Southern Africa.

Preservation: Fair. All skeletal elements were present. The sacrum was fragmented due to postmortem damage.

Age: The medial clavicle and S1 were fused. Cranial suture closure indicated an individual between the ages of 30 and 60 years. Lipping of the elbows, lumbar vertebrae and knees could be seen. An estimate of 35 to 50 years was made.

Sex: A wide subpubic angle, wide greater sciatic notch, birth scars on the pubis, smooth brow ridge and sharp supra-orbital margins indicated female. Records confirmed female.

Stature: An antemortem stature of 149.845 ± 2.789 cm was calculated using the physiological length of the femur.

Dentition: All upper teeth, except the right canine, first premolar and left first premolar, were lost antemortem. The lower teeth present and intact includes the left molars, left premolars, right canine and right premolars. The lower right molars and I2 were lost antemortem. The central incisors, left I2 and left canine were lost postmortem. Caries were present in the lower left P2, lower right M2 and upper left P1. Abscesses were seen in the upper central and lateral incisors, upper left canine and the lower left P2. Severe attrition was present on all teeth.

Figure A38. *Abscessing of the maxilla involving the upper central and lateral incisors*

Pathology and trauma: Osteophytes were present on the lumbar vertebrae. Ribs 3 and 4 were combined to form one rib (bifurcated rib). No cribra orbitalia or porotic hyperostosis was observed.

Figure A39. *Bifurcated rib 3 and 4*

Other notes: A pronounced occipital bun was evident in the cranium. No inferior frontal eminence, interparietal groove or mons temperosphenoidalis was present.

Conclusion: The remains were that of a female, about 149 cm tall.

S52

Country/place of origin: Southern Africa.

Preservation: Good. All skeletal elements were present.

Age: The spheno-occipitalis synchondrosis, S1 and medial end of the clavicle were fused. Cranial suture closure indicated that the individual had been between the ages of 15 and 40 years. Sternal rib ends displayed phase 4 (28-32 years). A final estimate of 25 to 40 years was made.

Sex: A wide greater sciatic notch, rectangular pubis, smooth brow ridge and glabella and small mastoids indicated female. Records confirmed female.

Stature: Using the physiological length of the femur, a stature of 153.722 ± 2.789 cm was calculated.

Dentition: All teeth were present, except the upper right I2 and the upper left I1. The lower canines were impacted in the mandible. Caries were present in the upper left and right M2, upper right M3, lower right M3 and upper left P1. An abscess was seen in the upper right M3. Medium to severe could be seen on all teeth. The individual was not scorable for enamel hypoplasia.

Figure A40. *Impacted canine in the maxilla*

Figure A41. *Caries of the upper right second and third molars*

Pathology and trauma: Bilateral remodelled cribra orbitalia was present. Osteophytic lipping to the knees, elbows and wrists was observed.

Figure A42. *Cribra orbitalia of the left orbit*

Other notes: Slight interparietal groove was present, although no inferior frontal eminence or mons temperosphenoidalis could be seen.

Conclusion: The remains belonged to an adult female approximately 153 cm tall.

S53

Country/place of origin: Southern Africa.

Preservation: Fair. No skull was available. The mandible and all postcranials, except for the cervical vertebrae, were present.

Age: Medium wear could be seen on all teeth. The medial end of the clavicle and the first segment of the sacrum were fused. Slight lipping was observed on the elbows, however, no osteophytic activity was spotted on the vertebrae. A final estimate of 30 to 45 years was made.

Sex: A long and narrow sacrum, narrow greater sciatic notch, robust mandible and an intermediate square chin indicated male. Records confirmed male.

Stature: The physiological length of the femur was used to calculate a stature of 164.837 ± 2.777 cm.

Dentition: No maxillary teeth were present. The lower central and lateral incisors were lost antemortem. The left premolars, right canine and right first premolar were lost postmortem. Medium wear was observed on all teeth. No caries, abscesses or enamel hypoplasia was present.

Pathology and trauma: No cribra orbitalia or porotic hyperostosis was observed. The pubic symphyses were fused together due to possible trauma. Postmortem damage caused a fracture in the area of the right pubic symphysis. No other signs of pathology were noted.

Figure A43. *Fused pubic symphyses*

Other notes: The box in which the remains were stored contained an extra small bag of bones, possibly not human.

Conclusion: The remains were possibly that of an adult male with an antermortem stature of about 164 cm.

S54

Country/place of origin: Southern Kalahari, north of the Orange River, South Africa.

Preservation: Good. All skeletal elements were present, except for C1 and C3 to C7 of the cervical vertebrae.

Age: The third molars had erupted and were in occlusion. The first segment of the sacrum was fused. Sternal rib end analysis showed phase 4 to 5 (30-46 years). A final estimate of 35 to 50 years was made.

Sex: A typical male pelvis and skull was observed. Records confirmed that the individual had been male.

Stature: Using the physiological length of the femur, a stature of 161.934 ± 2.777 cm was calculated.

Dentition: No maxillary teeth were present. All mandibular teeth were present and intact. No caries or abscesses could be seen. The teeth had been too worn to be scored for enamel hypoplasia.

Pathology and trauma: No signs of pathology or trauma were present.

Other notes: No inferior frontal eminence, mons temperospenoidalis or interparietal groove was present.

Conclusion: The remains possibly belonged to that of an adult male with an antemortem stature of about 161 cm.

S55 (postcranials) / S56 (skull)

Country/place of origin: Southern Kalahari, north of the Orange River, South Africa.

Preservation: Good. All skeletal elements were present, except for the first and second cervical vertebrae.

Age: The first segment of the sacrum and the spheno-occipitalis synchondrosis were fused. Cranial suture closure indicated that the individual had been between the ages of 35 and 65 years of age. Sternal rib phase analysis proved that the age at death was 44 to 59 years (phase 6). An estimate of 45 to 60 years was made.

Sex: A wide subpubic angle, rectangular pubis, smooth brow ridge, small glabella and small mastoids suggested female. Records confirmed female.

Stature: The physiological length of the femur suggested that the individual had a stature of 149.015 ± 2.789 cm.

Dentition: No teeth were available for analysis. All teeth had been lost antemortem.

Pathology and trauma: Osteophytes were present on the lumbar vertebrae. T7 to L1 was suggestive of the starting of an ankylosis process. No trauma was observed.

Other notes: Slight inferior frontal eminence was present. No mons temperosphenoidalis or interparietal groove was present.

Conclusion: The remains belonged to an adult female with an antemortem stature of about 149 cm.

S55 (skull) / S56 (postcranials)

Country/place of origin: Southern Kalahari, north of the Orange River, South Africa.

Preservation: Fair. All skeletal elements were present, except for C1 and C3-C7 of the cervical vertebrae. The right radius, as well as the both ulnae and fibulae were fragmented.

Age: All teeth were lost antemortem. The medial end of the clavicle and S1 were fused. Cranial suture closure indicated that the individual had been between 30 and 60 years of age. A final estimate of 40 to 60 years was made.

Sex: A wide greater sciatic notch, pronounced preauricular sulcus, birth scaring, wide subpubic angle, small mastoids, smooth brow ridge and glabella indicated female. Records confirmed female.

Figure A44. *Preauricular sulcus and birth scaring of the left pubis*

Stature: The physiological length of the femur suggested that the individual had been 144.307 ± 2.789 cm tall.

Dentition: All teeth had been lost antemortem. Abscesses were evident in the upper left central incisor, upper left second molar and the upper right second molar. Neither attrition nor enamel hypoplasia could be scored.

Pathology and trauma: Lipping of the third to fifth lumbar vertebrae, elbows and shoulder were present. No cribra orbitalia or porotic hyperostosis could be seen. No trauma was present.

Other notes: Slight inferior frontal eminence, slight interparietal groove and mons temperosphenoidalis were present. Prominent birth scaring could be seen in the pelvis.

Conclusion: The remains belonged to an adult female that had been about 144 cm tall.

S57

Country/place of origin: Southern Africa.

Preservation: Fair. The scapulae, humerii, radii, ulnae and fibulae and ribs were fragmented. All skeletal elements were present, except for the cervical vertebrae.

Age: Sternal rib end analysis proved that the individual had been between the ages of 44 and 59 years (phase 6). Cranial suture closure indicated an age of 30 to 60 years. There were no extensive osteoarthritic changes present. A finale estimate of 40 to 60 years was made.

Sex: A wide greater sciatic notch, wide subpubic angle, medium glabella, sharp supra-orbital margins and small mastoids indicated female. Records confirmed female.

Stature: Using the physiological length of the femur, a stature of 153.445 ± 2.789 cm was calculated.

Dentition: All teeth were present and intact, except for the upper premolars and the lower right third molar that had been lost antemortem. Signs of periodontal disease could be seen around all molars. Abscesses were present in the lower left first molar and the lower right third molar. Medium wear was present on all teeth.

Pathology and trauma: No cribra orbitalia or porotic hyperostosis was present. There were no other signs of pathology or trauma.

Other notes: An inferior frontal eminence and mons temperosphenoidalis were present, however, no interparietal groove could be seen.

Conclusion: The remains belonged to an adult female, about 153 cm tall.

S58 (skull) / S75 (postcranials)

Country/place of origin: Southern Africa.

Preservation: Fairly good. All skeletal elements were present, except for the mandible.

Age: Medium to advanced wear was present on all teeth. The medial end of the clavicle, first segment of the sacrum and all long bones were fused. Cranial suture closure indicated and individual between the ages of 15 and 40. Sternal rib phase analysis showed phase 4 (28-32 years). An estimate of 30 to 40 years was made.

Sex: A narrow greater sciatic notch, narrow subpubic angle, medium mastoids and a medium glabella indicated male. Records also stated male.

Stature: The physiological length of the femur was used to calculate a stature of 154.004 ± 2.777 cm.

Dentition: No mandibular teeth were present. All upper teeth, except the right central and lateral incisor (lost postmortem), were present and intact. No caries, enamel hypoplasia or abscesses were present. Medium to advanced wear could be seen on all teeth.

Pathology and trauma: No cribra orbitalia or porotic hyperostosis was noted. A minor degree of osteoarthritic activity was present on the lumbar vertebrae. The right ankle, as well as the hands and right acetabulum showed signs of osteoarthritis. These changes might have been brought about by possible rheumatoid arthritis, trauma or an infective process.

Figure A45. *Osteoarthrtitis of the right calcaneus and talus*

Other notes: A slight interparietal groove, slight inferior frontal eminence and definite mons temperosphenoidalis were present.

Conclusion: The remains were that of an adult male with an antemortem stature of about 154 cm.

S59 (skull) / S62 (postcranials)

Country/place of origin: Southern Africa.

Preservation: Fair. Unfortunately the skull and mandible had been glued together. All skeletal elements were present, except for the vertebrae, ribs and left patella. The scapulae were fragmented.

Age: The third molars had not yet erupted. Medium wear was noted on all teeth. The first segment of the sacrum and the iliac crests were unfused. The fusion lines of the tibiae and hip were still visible. The elbow was completely fused. All cranial sutures were open. A final estimate of 15 to 18 years was made.

Sex: A narrow greater sciatic notch, long narrow sacrum, narrow subpubic angle, medium glabella and medium brow ridge indicated male. Records also stated male.

Stature: An antemortem stature of 158.809 ± 2.777 cm was calculated using the femur.

Dentition: The third molars were unerupted. The upper left central incisor, right lateral incisor and upper right first molar were lost postmortem. The rest of the upper teeth and all lower teeth were present. Medium wear was noted on all teeth. No abscesses were evident. The teeth could not be scored for caries, as the mandible and skull were glued together. No enamel hypoplasia was observed.

Pathology and trauma: No pathology or trauma was noticed.

Other notes: An inferior frontal eminence and interparietal groove were present. No mons temperosphenoidalis was present.

Conclusion: The remains possibly belonged to a male adolescent individual, about 158 cm tall.

S60

Country/place of origin: Southern Africa.

Preservation: Fair. No skull or mandible was available. All postcranials, except the cervical vertebrae and patellae, were present.

Age: The medial end of the clavicle and the first segment of the sacrum were fused. Sternal rib end analysis indicated phase 7 (52 to 79 years). Slight lipping was present on the elbows and lumbar vertebrae. A final estimate of 50 to 70 years was made.

Sex: A narrow greater sciatic notch, narrow subpubic angle and long narrow sacrum indicated male. Records also stated male.

Stature: The physiological length of the femur was used to calculate a stature of 157.368 ± 2.777 cm.

Dentition: No teeth were available for analysis.

Pathology and trauma: The tibiae, fibulae and femora had an osteoporotic appearance. No other pathology was evident.

Conclusion: The remains were possibly that of an adult male, about 157 cm tall.

S61

Country/place of origin: Southern Africa.

Preservation: Fairly good. All skeletal elements were present, except for the vertebrae. The right ulna was fragmented.

Age: Slight wear was present on all teeth. The medial clavicle was recently fused. S1 was open. Sternal rib end analysis indicated phase 3 (25 to 29 years). A final estimate of 25 to 30 years was made.

Sex: A narrow subpubic angle, narrow greater sciatic notch, long sacrum and robust mandible indicated male. Records confirmed that it had been a male individual.

Stature: A stature of 156.887 ± 2.777 cm was calculated using the physiological length of the femur.

Dentition: The upper right second molar, upper left second premolar and lower left canine were lost postmortem. The upper right third molar was lost antemortem. The rest of the teeth were present and intact. No caries, abscesses or enamel hypoplasia was present. Slight wear could be seen on all teeth.

Pathology and trauma: An unhealed fracture of the left clavicle was present. Pseudoarthrosis occurred due to constant movement that prevented the fracture from healing. Two bifurcated ribs were also present. No cribra orbitalia or porotic hyperostosis was evident.

Figure A46. *Pseudoarthrosis of the clavicle*

Other notes: A prominent inferior frontal eminence was observed. A slight interparietal groove and slight mons temperosphenoidalis were seen.

Conclusion: The remains belonged to a young adult male, approximately 156 cm tall.

S62 (skull) / S59 (postcranials)

Country/place of origin: Southern Africa.

Preservation: Fairly good. Only the mandible and cervical vertebrae were missing. Also, a few of the ribs were fragmented.

Age: The third molars had erupted and were in occlusion. Very little wear could be seen on all teeth. The first segment of the sacrum was unfused. The iliac crests were recently fused. The medial end of the clavicle was open, as well as the spheno-occipitalis synchondrosis. A final estimate of 18 to 25 years was made.

Sex: A wide greater sciatic notch, broad sacrum, smooth brow ridge, small glabella and small mastoids indicated female. Records also stated female.

Stature: The physiological length of the femur was used to calculate a stature of 153.168 ± 2.789 cm.

Dentition: No mandibular teeth were available. All upper teeth were present, except for the right second premolar that had been lost postmortem. No caries or abscesses were present. Slight wear could be seen on the molars, while slightly more wear was present on the incisors and canines. Enamel hypoplasia was also evident on all teeth.

Pathology and trauma: Sagittal synostosis was present, as well as enamel hypoplasia. One to two lines were present on all teeth. No trauma was observed.

Other notes: No inferior frontal eminence or interparietal groove was noticed. Slight mons temperosphenoidalis was present.

Conclusion: The remains belonged to a young adult female, about 153 cm tall that presented with enamel hypoplasia.

S63

Country/place of origin: Southern Africa.

Preservation: Fairly good. All skeletal elements were present, except the patellae.

Age: Advanced wear was seen on all teeth. The medial end of the clavicle, first segment of the sacrum and the spheno-occipitalis synchondrosis were fused. Sternal rib end analysis indicated that the individual had been between the ages of 44 and 59 years (phase 6). Cranial suture closure suggested an individual between the ages of 45 and 75 years. A final estimate of 45 to 60 years was made.

Sex: A wide greater sciatic notch, wide subpubic angle, a prominent preauricular sulcus, smooth glabella and small mastoids indicated female. Records also stated female.

Stature: An antemortem stature of 159.260 ± 2.789 cm was calculated using the femur.

Dentition: The upper left first premolar, first and second molars, as well as the lower right third and second molars, second premolar, central and lateral incisors (left and right), the lower left first premolars and the lower left second and third molars were lost antemortem.

The following teeth were lost postmortem: upper right M2, upper right P2, upper left P2 and the lower right P1. The upper right first premolar and canine were broken. Abscesses were present ind the lower right M3, lower right P2, the upper left M1 and P2, as well as the upper right M2. Caries could be seen in the lower right M1 and upper left M3. Severe attrition was present on all teeth.

Pathology and trauma: Osteophytic changes could be seen on the vertebrae. No other pathology or trauma was present.

Other notes: An interparietal groove was present. Slight mons temperosphenoidalis could be seen, however, no inferior frontal eminence was noted.

Conclusion: The remains belonged to an adult female, about 159 cm tall.

S64

Country/place of origin: Southern Africa.

Preservation: Fairly poor. The skull was present, but the mandible was absent. The only post-cranials that were present were the vertebrae (except C1 and C6), the first segment of the sacrum, two unfused ischiums, the femora and right tibia.

Age: All permanent incisors were erupted. The canines and first molars were deciduous. The permanent second molars had not yet erupted. The hip, knee and ankle were unfused. A final estimate of 7 to 9 years was made.

Sex: Unknown. Sex could not be determined due to the young age of the individual.

Dentition: No mandibular teeth were available. The deciduous first molars and canines were still intact. The permanent second molars had not yet erupted. The deciduous central and lateral incisors, as well as the deciduous canines were lost postmortem. Slight wear could be seen on all teeth.

Pathology and trauma: The femora and right tibia showed periostitis and had a thickened appearance. The left femur displayed the formation of a cloaca, indicating osteomyelitis. A possible diagnosis of congenital treponemal disease was made. No cribra orbitalia or porotic hyperostosis was present.

Figure A47. *Thickened appearance of the femora*

Figure A48. *Cloaca formation and periostitis of the left femur*

Conclusion: The remains were that of a child, about 8 years old, with a possible treponemal infection.

S67

Country/place of origin: Southern Africa.

Preservation: Fairly good. All skeletal elements were present, except for the left clavicle, left ulna and atlas.

Age: Medium to severe wear could be seen on all teeth. Sternal rib end phase analysis indicated that the individual had been between the ages of 47 and 69 years (phase 6 to 7).

Cranial suture closure suggested 45 to 75 years of age. A final estimate of 50 to 70 years was made.

Sex: A narrow greater sciatic notch, long sacrum, large mastoids, medium brow ridge and rounded supra-orbital margins suggested male. Records confirmed that it had been a male.

Stature: The physiological length of the femur suggested that the individual had been 166.278 ± 2.777 cm tall.

Dentition: The upper right central and lateral incisor, as well as the lower central incisors and right lateral incisor were lost antemortem. The upper left canine was lost postmortem. All other teeth were present and intact. Abscesses were present in the lower right lateral and central incisor, lower left central incisor, upper right central and lateral incisors. No caries were visible. Periodontal disease was seen around the maxillary third molars. Medium to severe wear was present to all teeth. The teeth could not be scored for enamel hypoplasia, as attrition was too advanced.

Pathology and trauma: A healed traumatic lesion was seen on the right parietal bone of the cranium. The right shoulder presented with osteoarthritis. An abscess in the right lateral and central incisor affected the nasal area. No cribra orbitalia or porotic hyperostosis was seen.

Figure A49. *A healed circular lesion on the right parietal bone*

Other notes: An interparietal groove, mons temperosphenoidalis and inferior frontal eminence were present.

Conclusion: The remains belonged to an adult male, about 166 cm tall.

S68

Country/place of origin: Southern Africa.

Preservation: Fairly good. All skeletal elements were present, except for the left tibia and atlas.

Age: The spheno-occipitalis synchondrosis had recently fused. The medial end of the clavicle was partially fused. Slight wear was present on all teeth. Sternal rib phase analysis suggested an individual between the ages of 30 and 37 (phase 4). A final estimate of 25 to 35 years was made.

Sex: A narrow greater sciatic notch, narrow subpubic angle, medium to large mastoids, prominent brow ridge and medium glabella indicated male. Records confirmed male.

Stature: Using the physiological length of the femur, a stature of 148.237 ± 2.777 cm was calculated.

Dentition: The lower central incisors were lost postmortem. All other teeth were present and intact. No caries or abscesses were present. Enamel hypoplasia was present. Slight wear was seen on all teeth, although the least wear was seen on the third molars.

Pathology and trauma: No signs of trauma or pathology were present, except for the presence of enamel hypoplasia.

Other notes: An inferior frontal eminence and mons temperosphenoidalis were present. No interparietal groove could be seen.

Conclusion: The remains were possibly that of a young adult male, about 148 cm tall.

S69

Country/place of origin: Southern Africa.

Preservation: Poor. No skull or complete mandible was available. The only post-cranial elements present were the right humerus, the patellae, fragmented left os coxa and the left mandibular ramus.

Age: The iliac crests had recently fused – the fusion lines were still visible. Pubic symphysis analysis suggested phase 1 (15 to 23 years). An estimate of 18 to 25 years was made.

Sex: An intermediate greater sciatic notch and wide subpubic angle suggested female. Records confirmed that the individual had been female.

Stature: Using the maximum length of the humerus, an antemortem stature of 151.332 ± 3.715 cm was calculated.

Dentition: No teeth were available for analysis.

Pathology and trauma: No signs of pathology or trauma were present.

Conclusion: The remains possibly belonged to a young adult female individual, about 151 cm tall.

S70

Country/place of origin: Southern Africa.

Preservation: Fair. No skull or mandible was available. All post-cranial material was present.

Age: All long bone epiphyses were unfused. The os coxae were also unfused. The vertebral arches were fused together, but were not yet fused to the vertebral bodies. An estimate of 2 to 4 years was made.

Sex: Unknown. Sex determination could not be performed due to the young age of the individual.

Dentition: No teeth were available for analysis.

Pathology and trauma: No signs of pathology or trauma were present.

Conclusion: The remains were possibly that of a child between the ages of 2 and 4 years.

S71

Country/place of origin: Southern Africa.

Preservation: Fairly good. All skeletal elements were present, except for the vertebrae.

Age: The permanent first molars had erupted. The permanent lower central incisors were just starting to erupt. The deciduous canines, first molars and second molars were still intact. All long bone epiphyses were open. An estimate of 6 to 8 years was made. Records stated that the remains belonged to a 7 years old child.

Sex: Sex determination could not be performed as the individual was too young.

Dentition: The upper and lower deciduous lateral incisors, canines, first and second molars were still intact. The permanent first molars (mandibular and maxillary) had already erupted. The second and third permanent molars had not yet erupted. The deciduous central incisors of the maxilla and mandible had already been lost, and the lower permanent central incisors were in the process of erupting. Enamel hypoplasia was present on the lower right permanent central incisor. No caries or abscesses could be seen.

Pathology and trauma: No pathology or trauma was noted, except for enamel hypoplasia.

Conclusion: The remains belonged to a child of about 7 years of age.

S72

Country/place of origin: Southern Africa.

Preservation: Poor. No skull was available for analysis. The only skeletal elements present were the mandible, left scapula, left radius, left ulna and femora. The left femoral head showed signs of fire damage.

Age: Severe wear could be seen on all teeth present. All long bones available were completely fused. It was concluded that the individual had been older than the age of 20 years.

Sex: A robust mandible with pronounced gonial flare suggested male. Records confirmed that the individual had indeed been male.

Stature: Using the physiological length of the femur, an antemortem stature of 158.569 ± 2.777 cm was calculated.

Dentition: No maxillary teeth were present. The third molars, left second molar, first molars and first premolars of the mandible were intact. The rest of the teeth were lost postmortem. No abscesses or caries were observed. Severe attrition was present.

Figure A50. *Severe attrition in the mandibular teeth*

Pathology and trauma: No signs of pathology or trauma could be seen.

Conclusion: The remains belonged to a male individual older than 20 years with an antemortem stature of about 158 cm.

S74

Country/place of origin: Southern Africa.

Preservation: Good. All skeletal elements were present, except the cervical vertebrae.

Age: Severe wear could be seen on all teeth. The spheno-occipitalis synchondrosis and the first segment of the sacrum were fused. Sternal rib phase analysis indicated that the individual had been between the ages of 44 and 59 (phase 6). Cranial suture closure suggested an age between 45 and 75 years. A final estimate of 45 to 60 years was made.

Sex: The presence of a preauricular sulcus, wide subpubic angle, medium brow ridge and pointed chin suggested female. Records confirmed female.

Stature: The physiological length of the femur suggested an antemortem stature of 146.799 ± 2.789 cm.

Dentition: All mandibular teeth were present and intact. The upper right and left third molars and right first premolar were lost antemortem. The upper right first and second molars, as well as the upper second premolars were lost postmortem. The rest of the maxillary teeth were present and intact. Caries could be seen in the lower left first premolar. Abscesses were present in the lower left and right canines, as well as in the lower left M1. Periodontal disease was evident in around the lower right, upper right and upper left molars.

Figure A51. *Abscess of the mandibular right canine*

Figure A52. *Abscess of the mandibular left canine and periodontal disease around the molars*

Pathology and trauma: No cribra orbitalia or porotic hyperostosis was observed. Lipping of the elbows was present. The fourth and fifth lumbar vertebrae had partially collapsed.

Conclusion: The remains were possibly that of an adult female with and antemortem stature of approximately 146 cm.

S75 (skull) / S58 (postcranials)

Country/place of origin: Southern Africa.

Preservation: Good. All skeletal elements were present, except for the atlas and axis.

Age: The first segment of the sacrum, the spheno-occipitalis synchondrosis and medial end of the clavicle were fused. Sternal rib end analysis suggested and age between 33 and 43 years (phase 5). Cranial suture closure indicated that the individual had been between the ages of 30 and 60 years. A final estimate of 30 to 50 years was made.

Sex: A wide greater sciatic notch, wide subpubic angle, preauricular sulcus, medium glabella, small mastoids, sharp supra-orbital margins and a pointed chin suggested female. Records confirmed female.

Stature: The physiological length of the femur suggested a stature of 148.461 ± 2.789 cm.

Dentition: All maxillary teeth were lost antemortem. The lower molars (left and right), all incisors and the left second premolars were also lost antemortem. The lower canines, first premolars and right second premolar were lost postmortem. Thus, no teeth were available for analysis. Abscesses were observed in the lower left and lower right first molars.

Pathology and trauma: Bilateral cribra orbitalia was present as remodelled, medium scattered lesions. No porotic hyperostosis was observed. A healed traumatic lesion was seen on the occipital lobe. Periosteal reactions were present on the ulnae (radii unaffected), tibiae, fibulae, tarsals and metatarsals. The hand bones appeared to be normal. No specific signs of disease could be established.

Figure A53. *Periostitis of the ulnae*

Figure A54. *Periostitis of the right ulna*

Figure A55. *Periostits of the right fibula*

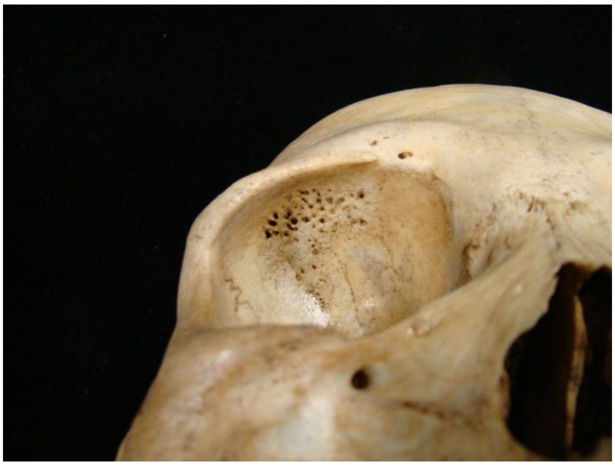

Figure A56. *Cribra orbitalia of the right orbit*

Figure A57. *Cribra orbitalia of left orbit*

Other notes: An inferior frontal eminence, slight mons temperosphenoidalis and slight interparietal groove were present.

Conclusion: The remains belonged to an adult female, about 148 cm tall.

S76

Country/place of origin: Southern Africa.

Preservation: Fairly good. All skeletal elements were present, except the left clavicle, cervical vertebrae, first thoracic vertebra and the hand bones.

Age: The third molars had erupted and were in occlusion with almost not wear present. The shoulder, iliac crests and distal femur were unfused. The elbow and ankle were completely fused. The proximal tibiae had recently fused. S1, S2 and S3 of the sacrum were open. A final estimate of 14 to 18 years was made.

Sex: A narrow greater sciatic notch, narrow subpubic angle, pronounced glabella, large mastoids and a robust mandible indicated male. Records also stated male.

Dentition: All upper and lower teeth were present and intact, except for the upper right central and lateral incisor and the lower left second premolar that had been lost postmortem. No caries of abscesses were present. No enamel hypoplasia was evident. Slight to medium wear was seen on the incisors, canines, premolars, first molars and second molars. Very little to no wear was present on the third molars.

Pathology and trauma: No cribra orbitalia or porotic hyperostosis was present. No other visible signs of pathology or trauma were detected.

Other notes: A pronounced mons temperosphenoidalis was seen. An inferior frontal eminence, as well as an interparietal groove was also present.

Conclusion: The remains were that of an adolescent male individual.

S95

Country/place of origin: Bidstoel, South Africa.

Preservation: Fair. No skull or mandible was available for analysis. All postcranial elements were present, except for the atlas and foot bones.

Age: All long bones were fused, as well as the medial end of the clavicle. The first segment of the sacrum was just starting to fuse. Sternal rib end analysis indicated that the individual had been between the ages of 28 and 32 years (phase 4). A final estimate of 25 to 35 years was made.

Sex: A narrow greater sciatic notch, narrow subpubic angle, narrow sacrum and rectangular pubis indicated male. Records confirmed that the individual had been male.

Stature: Using the physiological length of the femur, an antemortem stature of 162.655 ± 2.777 cm were calculated.

Dentition: No teeth were available for analysis.

Pathology and trauma: A well healed complete fracture of the left femur was evident that caused the left leg to be slightly shorter than the right. The fracture had caused severe osteoarthritis of the left hip. Osteoarthritis of the left wrist was also evident in the carpals and metacarpals, which might have been related to the trauma of the left femur. No other signs of pathology were noted.

Figure A58. *Osteoarthritis of the carpals and metacarpals of the left hand*

Figure A59. *Osteoarthritis of the left os coxa*

Figure A60. *Healed fracture of the left femoral shaft and osteoarthritis of the femoral head*

Conclusion: The remains belonged to a young adult male, about 162 cm tall. He had suffered a fracture of the left femur, causing severe osteoarthritis of the hip.

S96

Country/place of origin: Kuruman, South Africa.

Preservation: Fairly poor. All skeletal elements were present, except the left ulna, right radius and atlas.

Age: The medial end of the clavicle, first segment of the sacrum and the spheno-oocipitalis synchondrosis were fused. Cranial suture closure indicated that the individual had been between the ages of 45 and 75 years. It was concluded that the individual had been older than 45 years, but younger than 75 years at the time of death.

Sex: A narrow greater sciatic notch, narrow subpubic angle, prominent glabella and medium to large mastoids indicated male. Records confirmed male.

Stature: The physiological length of the femur was used to calculate a stature of 158.809 ± 2.777 cm.

Dentition: All maxillary teeth were lost antemortem. The lower right M2 and lower left P1 were lost postmortem. All remaining lower teeth were also lost antemortem. Thus, no teeth were available for analysis. No abscesses were noticed. The individual was not scorable for caries, attrition or enamel hypoplasia.

Pathology and trauma: No cribra orbitalia or porotic hyperostosis was present. Slight osteophytic activity of the knees could be seen. Postmortem trauma was present above the left orbit that had possibly been caused by a shovel or a similar object.

Other notes: An inferior frontal eminence could be seen, as well as a slight interparietal groove. No mons temperosphenoidalis was present.

Conclusion: The remains were that of an adult male older than 45 years, about 158 cm tall.

S97

Country/place of origin: Kuruman, South Africa.

Preservation: Fair. The only skeletal elements present were the skull, mandible, sternum, radii, ulnae, tibiae, fibulae, foot bones and hand bones.

Age: The third molars had not erupted yet, but the permanent M2's were in occlusion. The elbow and ankle were fused. The wrist and knees were unfused. An estimate of 12 to 15 years was made.

Sex: A smooth brow ridge, sharp supra-orbital margins, small mastoids and a pointed chin indicated female. Records confirmed female.

Dentition: None of the third molars had erupted yet. The upper lateral and central incisors, as well as the lower central incisors had been lost postmortem. The upper right first premolar and the lower left first premolars had also been lost antemortem. All other teeth were permanent and intact. No caries or abscesses could be seen. Very little wear was present on all teeth. Enamel hypoplasia was present as either one or two lines per tooth.

Pathology and trauma: Enamel hypoplasia was present. The sagittal suture was completely obliterated (sagittal synostosis). No cribra orbitalia or porotic hyperostosis was seen.

Other notes: Mons temperosphenoidalis was evident, although no interparietal groove or inferior frontal eminence was seen.

Conclusion: The remains belonged to a female adolescent that presented with enamel hypoplasia and craniostenosis.

S98

Country/place of origin: Kuruman, South Africa.

Preservation: Poor. A small bag of miscellaneous bones that did not belong to the individual was also stored in the box. All skeletal elements were present, except for the left patella and the vertebrae. The sacrum, pelvis and ribs were fractured.

Age: The third molars were in occlusion and slight wear could be seen on all teeth. The spheno-occipitalis synchondrosis was fused. The first segment of the sacrum was open. Cranial suture closure indicated that the individual had been between the ages of 15 and 40. A final estimate of 25 to 40 years was made.

Sex: A wide greater sciatic notch, broad sacrum, wide subpubic angle, smooth brow ridge and glabella and small mastoids indicated female. Records also stated female.

Stature: The physiological length of the femur suggested that the individual had been 151.507 ± 2.789 cm in stature.

Dentition: The upper and lower central and lateral incisors had been lost postmortem. The upper right premolars, upper left first premolar and lower canines were also lost postmortem. No abscesses were present, but caries were seen in the upper left canine and second premolar, as well as in the lower left first molar. Slight attrition could be seen on all teeth.

Pathology and trauma: No signs of trauma or pathology were observed.

Other notes: Slight mons temperosphenoidalis, inferior frontal eminence and interparietal groove could be seen.

Conclusion: The remains belonged to an adult female, about 151 cm tall.

S99

Country/place of origin: Gamopedi, North West, South Africa.

Preservation: Fair. All skeletal elements were present, except for the thoracic and lumbar vertebrae.

Age: The medial end of the clavicle, spheno-occipitalis synchondrosis and first segment of the sacrum were fused. Cranial suture closure suggested that the individual had been between the ages of 35 and 65 years. A final estimate of 35 to 65 years was made.

Sex: A wide greater sciatic notch, wide subpubic angle, rectangular pubis, preauricular sulcus, smooth brow ridge and small mastoids indicated female. Records also stated female.

Stature: The physiological length of the femur was used to calculate an antemortem stature of 155.660 ± 2.789 cm.

Dentition: The only teeth remaining were the upper left second molar, lower left third molar and the lower right first molar. The upper third molars, lower second molars and lower left first molar were lost antemortem. The rest of the teeth had been lost postmortem. No abscesses were seen. No caries were present in the three available teeth. Severe wear was present on all three teeth.

Pathology and trauma: Slight osteophytic lipping could be seen on the elbows. No cribra orbitalia, porotic hyperostosis or trauma was present.

Other notes: An interparietal groove, inferior frontal eminence and mons temperosphenoidalis could be seen.

Conclusion: The remains were that of an adult female, approximately 155 cm tall.

S101

Country/place of origin: Gamopedi, North West, South Africa.

Preservation: Fairly good. All skeletal elements were present, except for the first and second cervical vertebrae.

Age: The medial end of the clavicle and the first segment of the sacrum were open. The iliac crests were partly fused and the epiphyseal lines of the shoulder were still visible. The knees, ankles, hip and elbows were completely fused. The third molars had erupted and were in occlusion. A final estimate of 18 to 25 years was made.

Sex: A wide greater sciatic notch, rectangular pubis, wide subpubic angle and preauricular sulcus suggested female. Records also indicated female.

Stature: The physiological length of the femur was used to calculate an antemortem stature of 153.722 ± 2.789 cm.

Dentition: The upper canines were impacted in the maxilla. The upper right second premolar and upper left incisors were lost postmortem. All other teeth were present and intact. No abscesses were present, but caries was seen in the lower left third molar and the lower right first molar. Slight to medium wear was observed on all teeth. Enamel hypoplasia was also evident.

Figure A61. *Impacted canines in the maxilla*

Pathology and trauma: Other than the presence of enamel hypoplasia, no pathology or trauma was present.

Other notes: An inferior frontal eminence was seen, but no mons temperosphenoidalis or interparietal groove was observed.

Conclusion: The remains were possibly that of a female individual, about 153 cm tall.

S102

Country/place of origin: Kalahari, Southern Africa.

Preservation: Fairly good. All skeletal elements were present, except for the clavicles, atlas, C7 and the patellae.

Age: The first segment of the sacrum and the spheno-occipitalis synchondrosis were fused. Cranial suture closure indicated that the individual had been between the ages of 30 and 60 years of age. Sternal rib phase analysis suggested an age of 33 to 59 years. A final estimate of 35 to 50 years was made.

Sex: A wide greater sciatic notch, preauricular sulcus, birth scaring on the pubis, smooth brow ridge, sharp supra-orbital margins and small mastoids suggested female. Records also stated female.

Stature: Using the physiological length of the femur, a stature of 144.031 ± 2.789 cm was calculated.

Dentition: The upper left first premolar, upper left second molar, lower left second premolar and lower left second molar were lost postmortem. The upper right and left third molars and the lower right and left first molar were lost antemortem. All other teeth were present and intact. Abscesses were present in the lower left and right first molars. No caries or enamel hypoplasia could be seen. Medium wear was present on most teeth, with advanced wear on the first and second molars.

Pathology and trauma: Cribra orbitalia was present bilaterally, but no porotic hyperostosis could be seen. Osteophytes were present on L5. No trauma was observed.

Other notes: Metopism was present. An inferior frontal eminence could be seen, but no mons temperosphenoidalis and interparietal groove were present.

Conclusion: The remains were possibly that of an adult female, about 144 cm tall.

S103

Country/place of origin: Kalahari, west of Kuruman, South Africa.

Preservation: Fair. All skeletal elements were present, except the first and third to seventh cervical vertebrae, the thoracic vertebrae, lumbar vertebrae and a few foot bones.

Age: The third molars were just starting to erupt. The shoulder, wrist and distal femur were unfused. The proximal tibiae were recently fused. The iliac crests were completely open. An estimate of 12 to 15 years was made.

Sex: A narrow greater sciatic notch, narrow subpubic angle, pronounced glabella and medium mastoids indicated male. Records also stated male.

Dentition: All teeth were present and intact, except for the upper first premolars and the upper right second premolar that had been lost postmortem. No caries or abscesses were noticed. Enamel hypoplasia was evident.

Pathology and trauma: No pathology, other than enamel hypoplasia, was observed. No trauma was present either.

Other notes: An inferior frontal eminence and mons temperosphenoidalis were present, but no interparietal groove could be seen.

Conclusion: The remains possibly belonged to an adolescent male individual, presenting with enamel hypoplasia.

S104

Country/place of origin: Kalahari, Southern Africa.

Preservation: Fair. All skeletal elements were present, except for the first and third to seventh cervical vertebrae, the tibiae, fibulae and patellae.

Age: Medium wear was present on all teeth. All long bones were closed, as well as the spheno-occipitalis synchondrosis. The first segment of the sacrum was open. The medial end of the clavicles was also fused. Cranial suture closure indicated an age range of 30 to 60 years. Sternal rib phase analysis suggested an individual between the ages of 25 and 37 years. A final estimate of 25 to 40 years was made.

Sex: A narrow greater sciatic notch, triangular pubis, pronounced glabella and robust mandible suggested male. Records also stated male.

Stature: An antemortem stature of 156.166 ± 2.777 cm was calculated using the physiological length of the femur.

Dentition: All teeth were present and intact. No caries, abscesses or enamel hypoplasia was present. Medium wear could be seen on all teeth.

Pathology and trauma: The fourth lumbar vertebra showed rather severe osteophytic activity, whereas L5 displayed only mild osteophytic lipping. No trauma was observed.

Other notes: Mons temperosphenoidalis, as well as a slight interparietal groove could be seen. No inferior frontal eminence was present.

Conclusion: The remains were that of an adult male, about 156 cm tall.

S105

Country/place of origin: Kalahari, Southern Africa.

Preservation: Fairly good. All skeletal elements were present, except the foot bones and vertebrae.

Age: Advance wear could be seen on all teeth. The spheno-occipitalis synchondrosis, as well as the medial end of the clavicle was fused. The iliac crest lines were still visible. Sternal rib phase analysis suggested that the individual had been between the ages of 28 and 32 years of age. Cranial suture closure indicated and age range of 30 to 60 years. A final estimate of 25 to 40 years was made.

Sex: A wide subpubic angle, preauricular sulcus, smooth brow ridge and small mastoids suggested female. Records confirmed female.

Stature: The physiological length of the femur indicated that the individual had been 145.138 ± 2.789 cm tall.

Dentition: The following teeth were lost antemortem: all upper right molars, upper left M1 and M2, all lower molars (left and right), all lower premolars and the lower central incisors. The upper incisors (central and lateral), lower lateral incisors, as well as all canines and the upper right first premolar were lost postmortem. The upper right second premolar and upper left first premolar were present. Abscesses were present in the lower left canine, lower right M1, lower left and right M3, upper right M2 and upper left M1. Advanced wear was present on both teeth present.

Pathology and trauma: Cribra orbitalia was evident, although no porotic hyperostosis could be seen. No other pathology or trauma was observed.

Other notes: An inferior frontal eminence, mons temperosphenoidalis and slight interparietal groove could be seen.

Conclusion: The remains were that of an adult female individual, about 145 cm tall.

S106

Country/place of origin: Southern Africa.

Preservation: The only bones that remained were 3 unfused vertebrae. The rest of the remains had been lost postmortem.

Age: The neural arches were not yet fused together and were not connected to the vertebral body either. The unfused vertebrae indicated that the individual had been a child between the ages of 0 and 2 years.

Sex: Sex determination could not be performed due to the young age of the individual.

Dentition: No teeth were available for analysis.

Pathology and trauma: No pathology or trauma could be observed.

Conclusion: The remains possibly belonged to a child between the ages of 0 and 2 years.

S107

Country/place of origin: Gamopedi, North West, South Africa.

Preservation: Good. All skeletal elements were present, except for the atlas.

Age: Advanced wear could be seen on all teeth. Sternal rib phase analysis suggested an individual between the ages of 44 and 59 years (phase 6). Cranial suture closure indicated that the person had been between 40 and 60 years. An estimate of 40 to 60 years was made.

Sex: A wide greater sciatic notch, wide subpubic angle, small mastoids, smooth brow ridge and medium glabella suggested female. Records also stated female.

Stature: The physiological length of the femur suggested an antemortem stature of 144.861 ± 2.789 cm.

Dentition: The lower right and left molars, as well as the upper left M2 were lost antemortem. The upper right central incisor and lower right second premolar were lost postmortem. All other teeth were present. Caries were present in the upper left central incisor, upper right and left canines, upper right and left first molars, lower left second premolar, lower right first premolar, upper left M1 and upper left M3. Abscesses were seen in the upper and lower left central incisors, the lower right P1, upper left P1, upper right M1 and upper left M2. Advanced wear was present on all remaining teeth.

Figure A62. *Advanced wear on all maxillary teeth*

Pathology and trauma: A healed parry fracture of the left distal ulna was present. Osteophytic lipping could be seen on the vertebrae and elbows. C6 of the cervical vertebrae were deformed. No cribra orbitalia or porotic hyperostosis was evident.

Figure A63. *Deformation of the sixth cervical vertebra*

Figure A64. *Healed parry fracture of the left ulna*

Other notes: Slight inferior frontal eminence and slight interparietal groove could be seen. No mons temperosphenoidalis was present.

Conclusion: The remains were that of an adult female, about 144 cm tall that presented with several dental pathologies.

S108

Country/place of origin: Gamopedi, North West, South Africa.

Preservation: Fairly good. All skeletal elements were present, except for the mandible, atlas and axis.

Age: Advanced wear was present on all teeth. The medial end of the clavicle, first segment of the sacrum and spheno-occipitalis synchondrosis was fused. Sternal rib phase analysis indicated an age range of 33 to 43 years. Cranial suture closure suggested an age between 35 and 65 years. An estimate of 35 to 50 years was made.

Sex: A wide greater sciatic notch, wide subpubic angle, preauricular sulcus, smooth brow ridge, sharp supra-orbital margins and small mastoids indicated female. Records also stated female.

Stature: Using the physiological length of the femur, a stature of 147.076 ± 2.789 cm was calculated.

Dentition: No mandibular teeth were available. The upper central incisors, right lateral incisor and right first premolar had been lost antemortem. The upper right canine and left lateral incisor were lost postmortem. An abscess was present in the upper right I1. Caries could be seen in the upper right P2, upper left M2 and upper left M3. Advanced wear could be seen on all teeth present.

Pathology and trauma: Perimortem fractures of the fourth, fifth and sixth ribs were present. No cribra orbitalia or porotic hyperostosis was seen.

Figure A65. *Perimortem rib fractures*

Other notes: A slight interparietal groove and slight inferior frontal eminence was seen. Mons temperosphenoidalis was also present.

Conclusion: The remains were that of an adult female individual, about 147 cm tall.

S109

Country/place of origin: Gamopedi, North West, South Africa.

Preservation: Fair. All skeletal elements were present, except for the hand bones, foot bones and cervical vertebrae.

Age: Sternal rib phase analysis indicated an age between 38 and 46 years. Cranial suture closure suggested that the individual had been between the ages of 30 and 60 years. A final estimate of 35 to 50 years was made.

Sex: A narrow greater sciatic notch, prominent glabella, robust mandible and medium to large mastoids suggested male. Records confirmed male.

Stature: The physiological length of the femur was used to calculate a stature of 161.453 ± 2.777 cm.

Dentition: The only tooth present was the upper left canine. The following teeth were lost antemortem: upper right M3 and M1, upper left P2, M1 and M3, as well as the lower right M2, M1, P2, and lower left P2, M2 and M3. The rest were lost postmortem. Abscesses were present in the upper right and left central and lateral incisors, as well as in the upper left M1. Periodontal disease was evident around the upper and lower molars. The individual could not be scored for attrition, caries or enamel hypoplasia.

Pathology and trauma: Osteoarthritis and eburnation could be seen in the left knee. The right knee showed some osteophytic activity, but only slightly and no eburnation was present. The patellae also displayed some osteoarthritis. The left humeral shaft presented some osteoblastic bone formation. No cribra orbitalia or porotic hyperostosis was seen.

Figure A66. *Osteoarthritis of the left knee*

Other notes: A slight interparietal groove and inferior frontal eminence could be seen. No mons temperosphenoidalis was present.

Conclusion: The remains belonged to an adult male individual, about 161 cm tall that presented with several dental pathologies.

S110

Country/place of origin: Tsineng, Northern Cape, South Africa.

Preservation: Good. All skeletal elements were present, except the atlas.

Age: The medial end of the clavicle, first segment of the sacrum and spheno-occipitalis synchondrosis was closed. Sternal rib end analysis indicated phase 4 (30-37 years). Cranial suture closure suggested that the individual had been between 15 and 40 years of age. A final estimate of 30 to 40 years was made.

Sex: A narrow greater sciatic notch, narrow subpubic angle, medium glabella and gonial flare of the mandible indicated male. Records also stated male.

Stature: Using the physiological length of the femur, a stature of 153.763 ± 2.777 cm was calculated.

Dentition: The upper right and left third molars were lost antemortem. The upper central and lateral incisors, as well as canines were lost postmortem. All lower molars were present, but the rest of the teeth were also lost postmortem. No caries, abscesses or enamel hypoplasia was seen. Slight to medium wear was present on all teeth.

Pathology and trauma: Cribra orbitalia was present, although no porotic hyperostosis was seen. No trauma was observed.

Other notes: No inferior frontal eminence or interparietal groove could be seen, but mons temperosphenoidalis was present.

Conclusion: The remains belonged to an adult male, about 153 cm tall.

S111

Country/place of origin: Tsineng, Northern Cape, South Africa.

Preservation: Fair. No skull or mandible was available. All postcranials were present, except the atlas, C3 to C7 cervical vertebrae, the lumbar and thoracic vertebrae.

Age: The medial end of the clavicle and the first three segments of the sacrum were open. The iliac crests were fused, but the lines were still visible. An estimate of 20 to 30 years was made.

Sex: A narrow subpubic angle, rectangular pubis and intermediate greater sciatic notch suggested male. The pubic symphysis and sternal rib ends were too damaged to use in the determination of sex. Records also stated male.

Stature: The physiololgical length of the femur was used to calculate a stature of 156.647 ± 2.777 cm.

Dentition: No teeth were available for analysis.

Pathology and trauma: No visible trauma or pathology was present.

Conclusion: The remains were that of a young adult male, about 156 cm tall.

S112

Country/place of origin: Tsineng, Northern Cape, South Africa.

Preservation: Fairly good. All skeletal elements were present, except the cervical vertebrae.

Age: Advanced wear was present on all teeth. The medial end of the clavicle was closed. Sternal rib end analysis suggested phase 5 (33 to 43 years). Cranial suture closure indicated an age between 30 and 60 years. A final estimate of 35 to 50 years was made.

Sex: A wide subpubic angle, preauricular sulcus, smooth brow ridge and small mastoids indicated female. Records confirmed female.

Stature: The physiological length of the femur suggested a stature of 149.845 ± 2.789 cm.

Dentition: The upper third molars, upper left second molar, upper left first premolar and upper left central incisor, as well as the lower second molars were lost antemortem. All other teeth were present. Abscesses were present in the lower right second premolar, lower left M1, upper right central incisor and upper right first premolar. All teeth present were loose and in total 13 caries was counted. Periodontal disease was seen around the upper molars. Severe wear was present on all teeth.

Pathology and trauma: No cribra orbitalia or porotic hyperostosis was present. A healed fracture of the right ulna was observed.

Other notes: No interparietal groove was seen, but slight mons temperosphenoidalis and inferior frontal eminence was present.

Conclusion: The remains were that of an adult female, about 149 cm tall.

S113

Country/place of origin: Tsineng, Northern Cape, South Africa.

Preservation: Fairly good. All skeletal elements were present, except the atlas and patellae.

Age: Advance wear was present on all teeth. Sternal rib phase analysis suggested an individual between the ages of 44 and 59 years (phase 6). Cranial suture closure indicated an age between 30 and 60 years. A final estimate of 45 to 60 years was made.

Sex: A wide greater sciatic notch, wide subpubic angle, preauricular sulcus and delicate skull indicated female. Records also stated female.

Stature: The physiological length of the femur suggested a stature of 144 cm.

Dentition: The following teeth were lost antemortem: upper right third molar, upper second molars, upper left P1, upper canines, upper right I2, upper central incisors, lower right M2, lower left M1 and lower left P2. The lower first premolars and right second premolar were lost postmortem. All other teeth were present, but loose. Severe periodontal disease was present around all molars, premolars and the upper incisors. In total, two caries were present. Abscesses were present in the upper left M2 and lower right M1. Severe attrition was present.

Pathology and trauma: Osteoarthritis and eburnation was present on the axis and knees. Severe osteophytic lipping was found on the shoulders, elbows, knees, patellae, cervical vertebrae and L3 to L5 of the lumbar vertebrae.

Figure A67. *Osteoarthritis of the left distal femur*

Other notes: Slight inferior frontal eminence and mons temperosphenoidalis was present, but no interparietal groove was seen.

Conclusion: The remains belonged to an adult female, about 144 cm tall.

S114

Country/place of origin: Tsineng, Northern Cape, South Africa.

Preservation: Fair. No skull or mandible was present. All postcranials were present, except the atlas, C5 of the cervical vertebrae, T1 to T7 of the thoracic vertebrae, left radius, left ulna, left patella, left os coxa, tibiae and fibulae.

Age: The pelvis was unfused. All vertebral arches were fused to the bodies. The sacrum was also fused. A final estimate of 6 to 12 years was made.

Sex: Determination of sex could not be done due to the young age of the individual.

Dentition: No teeth were available for analysis.

Pathology and trauma: No trauma or pathology was observed.

Conclusion: The remains belonged to a child between the ages of 6 and 12 years.

S115

Country/place of origin: Tsineng, Northern Cape, South Africa.

Preservation: Fairly good. All skeletal elements were present except for the C1 and C3 to C7 of the cervical vertebrae.

Age: Severe wear could be seen on all teeth. The medial end of the clavicle, first segment of the sacrum and spheno-occipitalis synchondrosis was fused. The iliac crests were fused, but the lines were still visible. Sternal rib phase analysis suggested phase 4 (28 to 32 years). Cranial suture closure indicated that the individual had been between the ages of 30 to 60 years. A final estimate of 25 to 40 years was made.

Sex: A wide greater sciatic notch, wide subpubic angle, smooth brow ridge, small mastoids and a delicate looking skull suggested female. Records confirmed female.

Stature: The physiological length of the femur suggested a stature of 144.031 ± 2.789 cm.

Dentition: The upper right second and third molars, upper left central incisor, lower right first and second molars were lost antemortem. The upper left lateral incisor, upper left first and third molars, as well as the lower right first premolar, lower central incisors and lower left lateral incisor were lost postmortem. All other teeth were intact. Caries were present in the lower left M1,M2 and M3, lower left P1 and P2, lower right M3, as well as the upper left M1 and P2, upper right canine and upper right M1. Abscesses could be seen in the upper left P2 and upper right M2. Periodontal disease was present around the lower and upper molars. Advanced attrition was present on all teeth.

Figure A68. *Caries of the upper left second molar*

Pathology and trauma: No cribra orbitalia or porotic hyperostosis was present. Osteophytic lipping was present on L2 to L5 of the lumbar vertebrae. No trauma was observed.

Other notes: An inferior frontal eminence and mons temperosphenoidalis was present. A slight interparietal groove could also be seen.

Conclusion: The remains belonged to an adult female, about 144 cm tall.

S116

Country/place of origin: Southern Africa.

Preservation: The only bones that remained were a few unfused epiphyses and 6 unfused vertebrae.

Age: The vertebrae had been completely unfused, which indicates that the child had been between the ages of 0 and 2 years.

Sex: Sex determination could not be performed due to the young age of the individual and the preservation of the remains.

Dentition: No teeth were available for analysis.

Pathology and trauma: No pathology or trauma could be observed.

Conclusion: The remains were that of a child between 0 and 2 years of age.

S117

Country/place of origin: Southern Africa.

Preservation: Fairly good. All skeletal elements were present.

Age: The upper and lower incisors were just starting to erupt. None of the other deciduous teeth were erupted. The two halves of the mandible were fused. An estimate of 6 to 12 months was made.

Sex: Determination of sex could not be performed due to the young age of the individual.

Dentition: The incisors were just starting to erupt. None of the other deciduous teeth had erupted yet, although the tooth crowns were developed and situated in the tooth sockets. The incisors did not show signs of enamel hypoplasia.

Pathology and trauma: Active porotic hyperostosis was present on the parietal bones. No other signs of pathology or trauma were noted.

Figure A69. *Porotic hyperostosis of the right parietal bone*

Conclusion: The remains were that of a child between the ages of 6 to 12 months that presented with porotic hyperostosis.

S118

Country/place of origin: Steenbokkloof (October 1909), Northern Cape, South Africa.

Preservation: Fairly good. All skeletal elements were present, except for the vertebrae.

Age: The permanent incisors had already erupted, as well as the permanent first molars. The permanent second molars had not yet erupted. An estimate of 7 to 9 years was made. Records confirmed that the child had been 7 to 8 years of age.

Sex: Determination of sex could not be performed as the child was too young, although records stated that the child had been male.

Dentition: The permanent upper and lower central and lateral incisors were intact, as well as the all permanent first molars. The deciduous upper and lower canines, first molars and second molars were still intact. No enamel hypoplasia, caries or abscesses was evident.

Pathology and trauma: No signs of pathology or trauma were observed.

Conclusion: The remains belonged to a child (male), about 7 years old.

S119

Country/place of origin: Top Dog farm, Northern Cape, South Africa.

Preservation: Fairly good. All skeletal elements were present, except the mandible, atlas, C3-C7 of the cervical vertebrae and the tibiae. The individual had an extra thoracic vertebra (13 instead of 12).

Age: Slight to medium wear could be seen on all teeth. The spheno-occipitalis synchondrosis was fused. The medial end of the clavicle and first segment of the sacrum was open. The iliac crests were fused, but the lines were still visible. Sternal rib phase analysis suggested that the individual had been between the ages of 25 and 37 years (phase 3 to 4). Cranial suture closure indicated an age range of 30 to 60 years. A final estimate of 25 to 40 years was made.

Sex: A narrow greater sciatic notch, narrow subpubic angle, pronounced glabella and medium mastoids suggested male. Records also stated male.

Stature: Using the physiological length of the femur, a stature of 154.004 ± 2.777 cm was calculated.

Dentition: No mandibular teeth were available for analysis. The upper right second premolar, upper right lateral incisor and the upper left first premolar had been lost postmortem. All other maxillary teeth were present and intact. No enamel hypoplasia, caries or abscesses was present.

Pathology and trauma: No signs of trauma or pathology were noticed.

Other notes: An inferior frontal eminence and mons temperosphenoidalis was present, as well as a slight interparietal groove.

Conclusion: The remains belonged to an adult male, about 154 cm tall.

S120

Country/place of origin: Top Dog farm, Northern Cape, South Africa.

Preservation: Fairly good. All skeletal elements were present, except the cervical vertebrae.

Age: The medial end of the clavicle was partly fused, while the spheno-occipitalis synchondrosis was completely fused. The first segment of the sacrum was unfused. Some osteophytic lipping could be seen on the fourth lumbar vertebra. An estimate of 25 to 40 years was made.

Sex: An intermediate greater sciatic notch, narrow subpubic angle, pronounced glabella and brow ridge, medium mastoids, robust mandible and gonial flare suggested male. Records also stated male.

Stature: Using the femur, an antemortem stature of 156.647 ± 2.777 cm was calculated.

Dentition: All teeth were present and intact. No caries, abscesses or enamel hypoplasia could be seen. Slight to medium wear was present on all teeth.

Pathology and trauma: No cribra orbitalia or porotic hyperostosis was observed. No visible signs of trauma were present.

Other notes: An inferior frontal eminence was present, however, no interparietal groove or mons temperosphenoidalis could be seen.

Conclusion: The remains possible belonged to an adult male, about 156 cm tall.

S121

Country/place of origin: Top Dog farm, Northern Cape, South Africa.

Preservation: Fair. All skeletal elements were present, except the atlas, axis, left scapula, right humerus, left ulna, left radius, right patella, fibulae, hand and foot bones.

Age: The spheno-occipitalis synchondrosis and iliac crests were completely fused. The first segment of the sacrum was open. Cranial suture closure indicated that the individual had been between the ages of 15 and 40 years. Sternal rib phase analysis suggested an age between 25 and 29 years (phase 3). A final estimate of 25 to 35 years was made.

Sex: A narrow greater sciatic notch, narrow subpubic angle, medium glabella, robust mandible and gonial flare suggested male. Records also stated male.

Stature: A stature of 159.290 ± 2.777 cm was calculated using the femur.

Dentition: The upper and lower left lateral incisors were lost postmortem. All other teeth were present and intact. No caries, abscesses or enamel hypoplasia were seen. Slight wear could be seen on all teeth.

Pathology and trauma: Remodelled cribra orbitalia was present, although no porotic hyperostosis could be seen. No trauma was present.

Other notes: An inferior frontal eminence and mons temperosphenoidalis could be seen, although no interparietal groove was present.

Conclusion: The remains were that of an adult male individual, about 159 cm tall. Cribra orbitalia was present bilaterally.

S122

Country/place of origin: Top Dog farm, Northern Cape, South Africa.

Preservation: Fair. All skeletal elements were present, except the left clavicle, atlas, radii, ulnae, right os coxa, right tibia, right fibula, hand and foot bones.

Age: The medial end of the clavicle, as well as the spheno-occipitalis synchondrosis was fused. The first segment of the sacrum was almost completely fused. Cranial suture closure suggested an age between 30 and 60 years. An estimate of 30 to 60 years was made.

Sex: A wide greater sciatic notch, broad sacrum, smooth glabella and brow ridge and sharp supra-orbital margins indicated female. Records confirmed female.

Stature: The physiological length of the femur was used to calculate a stature of 147.076 ± 2.789 cm.

Dentition: No teeth were available for analysis. All incisors, canines and premolars had been lost postmortem. The upper right and left molars had been lost antemortem. The lower left molars, as well as the lower right M1 were also lost antemortem. The lower right M2 and M3 was lost postmortem. Periodontal disease was seen around the upper and lower molars. The individual was not scorable for caries or enamel hypoplasia. No abscesses were evident.

Pathology and trauma: No signs of pathology or trauma were observed.

Other notes: An inferior frontal eminence and interparietal groove was present, although only slight mons temperosphenoidalis could be seen.

Conclusion: The remains were possibly that of an adult female, about 147 cm tall.

S123

Country/place of origin: Southern Africa (December 1909).

Preservation: Poor. All skeletal elements were present, except the atlas and humerii.

Age: Medium to advanced wear was present on all teeth. The first segment of the sacrum had recently started to close. The medial end of the clavicle and the spheno-occipitalis synchondrosis was fused. Cranial suture closure indicated that the individual had been between the ages of 15 and 40 years. A final estimate of 25 to 40 years was made.

Sex: A narrow greater sciatic notch, narrow subpubic angle, medium glabella and rounded supra-orbital margins suggested male. Records confirmed that it had been a male.

Stature: The physiological length of the femur was used to calculate a stature of 149.919 ± 2.777 cm.

Dentition: All teeth, except the lower left first molar that had been lost antemortem, were present, although not intact. In total, 13 caries were present. Abscesses could be seen in the lower right M1 and upper left M2. Periodontal disease was evident around the upper molars. Medium was seen on the molars, where as medium to advanced wear could be seen on the incisors, canines and premolars. No enamel hypoplasia was observed.

Pathology and trauma: No cribra orbitalia or porotic hyperostosis was present. The left radius had severe periosteal bone growth with cloaca formation on the lateral side indicating non-specific osteomyelitis. The ulna, however, appeared normal. All hand and foot bones also appeared normal.

Figure A70. *Osteomyelitis with cloaca formation of the left radius*

Other notes: Slight inferior frontal eminence and interparietal groove could be seen. No mons temperosphenoidalis was present.

Conclusion: The remains belonged to an adult female, about 149 cm tall.

S124

Country/place of origin: Southern Africa (October 1909).

Preservation: Poor. All skeletal remains was present, except the atlas, left clavicle, left scapula, a few ribs, right radius, ulnae and right fibula. The pelvis, sacrum and tibiae were fragmented. There were also an extra set of cervical vertebrae in the box not belonging to the individual.

Age: The spheno-occipitalis synchondrosis and medial end of the clavicle were fused. Cranial suture closure indicated that the individual had been between the ages of 45 and 75 years of age. A final estimate of 45 yo 75 years were made.

Sex: A wide greater sciatic notch, smooth brow, pointed chin and very small mastoids suggested female. Records also stated female.

Stature: The physiological length of the femur was used to calculate a stature of 148.461 ± 2.789 cm.

Dentition: No teeth were available for analysis. The maxilla was fragmented and dental analysis was not possible. The lower left molars, premolars and right first and third molars were lost antemortem. The rest of the lower teeth were lost postmortem. No abscesses were observed. The individual was not scorable for enamel hypoplasia, caries or attrition.

Pathology and trauma: No visible signs of pathology or trauma were present, partly due to the poor preservation of the skeleton.

Other notes: Slight inferior frontal eminence and mons temperosphenoidalis was present. An interparietal groove could also be seen.

Conclusion: The remains were possible that of an adult female, about 148 cm tall.

S125

Country/place of origin: Southern Africa (December 1909).

Preservation: Poor. All skeletal elements were present, except the right scapula, atlas, C3 to C7 of the cervical vertebrae, right humerus, radii, ribs, left tibia, patellae and foot bones. The pelvis, ulnae, sacrum and tibia were fragmented.

Age: The medial end of the clavicle, first segment of the sacrum and spheno-occipitalis synchondrosis was fused. Cranial suture closure suggested that the individual had been between the ages of 30 and 60 years. An estimate of 30 to 60 was made.

Sex: A medium glabella and intermediate greater sciatic notch possibly reflected male. Records stated that the individual had been male.

Stature: The physiological length of the femur was used to calculate a stature of 141.268 ± 2.777 cm.

Dentition: No teeth were available for analysis, as all had been lost antemortem. The individual was thus not scorable for caries or enamel hypoplasia. No abscesses were evident.

Pathology and trauma: Cribra orbitalia could be seen bilaterally and had been remodelled. No porotic hyperostosis, however, was seen. No signs of trauma could be detected.

Other notes: Slight inferior frontal eminence and mons temperosphenoidalis was present, although no interparietal groove could be seen.

Conclusion: The remains possibly belonged to an adult male, about 141 cm tall.

S127

Country/place of origin: Middledrift, Eastern Cape, South Africa.

Preservation: Good. All skeletal elements were present.

Age: All teeth were deciduous and the first permanent molar had not yet erupted. All long bone epiphyses were unfused. The pelvis was also unfused. An estimate of 4 to 6 years was made.

Sex: Determination of sex could not be performed due to the young age of the individual.

Dentition: All deciduous teeth were present and intact. No enamel hypoplasia could be seen. The crown of the first permanent molar had already formed, but it had not yet erupted.

Pathology and trauma: Active lesions of cribra orbitalia were present. No other pathology or trauma was observed.

Conclusion: The remains possibly belonged to a child between the ages of 4 and 6 years, displaying active cribra orbitalia.

S133

Country/place of origin: Southern Africa.

Preservation: The only bones that remained were a few unfused epiphyses, 3 unfused vertebrae and 2 ribs.

Age: The unfused vertebrae indicated that the individual had been between the ages of 0 and 2 years.

Sex: Determination of sex could not be performed due to the young age of the individual.

Dentition: No teeth were available for analysis.

Pathology and trauma: No pathology or trauma could be observed.

Conclusion: The remains possibly belonged to a child aged 0 to 2 years.

S134

Country/place of origin: Belmont, Northern Cape, South Africa.

Preservation: Poor. Only fragments of the skull remained. No mandible was present. The only post-cranial remains present were the left os coxa (fragmented), the femora, left humerus, right tibia and hand bones.

Age: All long bone epiphyses were fused. It was determined that the individual had been older than 20 years.

Sex: Very small mastoids could be seen. Records stated female.

Stature: Using the maximum length of the humerus, a stature of 140.472 ± 3.715 cm was calculated.

Dentition: No teeth were available for analysis. The mandible was absent and the maxilla fractured.

Pathology and trauma: No visible signs of pathology or trauma were present.

Conclusion: The remains were possibly that of a female, older than 20 years and about 140 cm tall.

S140

Country/place of origin: Griqua area, South Africa.

Preservation: Fair. All skeletal elements were present, except for the left radius, vertebrae, left patella and tibiae. The scapulae were fragmented.

Age: Slight to medium wear could be seen on all teeth. The medial end of the clavicle and spheno-occipitalis synchondrosis was fused. The first segment of the sacrum was almost completely fused. Cranial suture closure suggested that the individual had been between the ages of 30 and 60 years. A final estimate of 30 to 45 years was made.

Sex: A narrow greater sciatic notch, prominent glabella and robust cranium suggested male. Records also stated male.

Stature: The physiological length of the femur was used to calculate an antemortem stature of 156.166 ± 2.777 cm.

Dentition: All teeth were present and intact. No enamel hypoplasia, caries or abscesses were present. Slight to medium wear was seen on all teeth.

Pathology and trauma: Cribra orbitalia was seen unilaterally in the left orbit. The lesions were remodelled and lightly scattered. Porotic hyperostosis was absent. No signs of trauma were present.

Conclusion: The remains were possibly that of an adult male, about 156 cm tall.

S141

Country/place of origin: Belmont, Northern Cape, South Africa.

Preservation: Fairly poor. The skull and mandible were fragmented. The only postcranials present were the right clavicle, right scapula, distal half of the right humerus, proximal half of the left ulna, left ilium, left ischium, femora, the first and second segment of the sacrum, 5 vertebrae, foot bones and unfused epiphyses.

Age: The permanent first molars had erupted, but the second permanent molars had not yet erupted. The knee, hip, shoulder, elbow and pelvis were unfused. An estimate of 6 to 8 years was made. Records stated that it had been a child of about 7 years of age.

Sex: Determination of sex could not be performed due to the young age of the individual.

Dentition: No maxillary teeth were available. The lower permanent first molars were intact. The left incisors and canine had been lost postmortem. The rest of the teeth were deciduous and intact. No dental pathology was noted.

Pathology and trauma: No cribra orbitalia or porotic hyperostosis was visible. No signs of trauma could be seen either.

Conclusion: The remains were possibly that of a 7 years old child.

S142

Country/place of origin: Southern Africa (December 1909).

Preservation: Fair. All skeletal elements were present, except the ribs, vertebrae, left tibia and a few of the foot bones. The scapulae were fragmented.

Age: Slight wear was present on all teeth. The medial end of the clavicle, as well as the first segment of the sacrum was open. The iliac crests were recently fused. An estimate of 20 to 30 years was made.

Sex: A wide greater sciatic notch, wide subpubic angle, smooth brow and small mastoids suggested female. Records also stated female.

Stature: The physiological length of the femur was used to calculate a stature of 158.153 ± 2.789 cm.

Dentition: All teeth were present and intact, except for the upper left second premolar and third molar. Caries were present in the upper right first premolar and first molar, as well as in the upper left canine and lower left first molar. No abscesses were present. Slight wear could be seen on the molars and premolars. Moderate wear, however, was present on the incisors and canines. Enamel hypoplasia was also evident.

Pathology and trauma: Cribra orbitalia (remodelled) was observed. No porotic hyperostosis was present. Enamel hypoplasia was also recorded for this individual. No trauma could be seen.

Figure A71. *Cribra orbitalia of the right orbit*

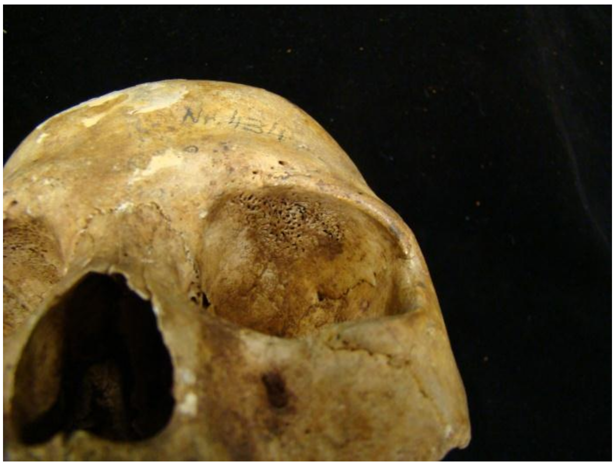

Figure A72. *Cribra orbitalia of the left orbit*

Conclusion: The remains were possibly that of a female adult, about 158 cm tall. The individual portrayed cribra orbitalia and enamel hypoplasia.

S143

Country/place of origin: Griqua Town, Northern Cape, South Africa.

Preservation: Fairly poor. The only skeletal elements present were the occipital bone, right scapula, right humerus, right radius, right ulna, os coxae, sacrum, femora, patellae, tibiae, fibulae, bones of one hand, bones of one foot, 2 rib fragments and 12 vertebrae.

Age: All long bones were fused. The first segment of the sacrum was open. An estimate of 20 to 30 years was made.

Sex: A narrow greater sciatic notch, narrow subpubic angle and overall robusticity suggested male. Records also stated male.

Stature: Using the physiological length of the femur, an antemortem stature of 169.162 ± 2.777 cm was calculated.

Dentition: No teeth were available for analysis.

Pathology and trauma: No pathology or trauma was observed.

Conclusion: The remains possibly belonged to an adult male individual, about 169 cm tall.

S144

Country/place of origin: Griqua Town, Northern Cape, South Africa.

Preservation: Fairly poor. The only skeletal elements present were the vertebrae, os coxa fragments, left humerus, left radius, left femur, distal part of the right femur, tibiae (fragmented) and unfused epiphyses.

Age: The vertebral arches were not yet fused to the vertebral bodies. Almost all of the arches were fused together, except for that of 4 vertebrae. An estimate of 1 to 2 years was made.

Sex: Sex determination could not be performed due to the young age of the individual.

Dentition: No teeth were available for analysis.

Pathology and trauma: No visible signs of pathology or trauma were observed.

Conclusion: The remains were possibly that of a child between the ages of 1 and 2 years.

MMM131

Country/place of origin: Griqualand, South Africa.

Preservation: Only the skull was available. No mandible or post-cranials was present.

Age: The spheno-occipitalis synchondrosis was fused. Cranial suture closure suggested that the individual had been between the ages of 30 and 60 years. An estimate of 30 to 60 years was made.

Sex: A medium brow ridge, rounded supra-orbital margins and large mastoids suggested male. Records confirmed that the individual had been male.

Dentition: No teeth were available for analysis.

Pathology and trauma: No pathology or trauma could be seen.

Other notes: No mons temperosphenoidalis, interparietal groove or inferior frontal eminence was seen.

Conclusion: The cranium possibly belonged to a male, between the ages of 30 and 60 years.

MMM134

Country/place of origin: Griqualand West, South Africa.

Preservation: No post-cranials were present. Only the skull and mandible were preserved.

Age: Slight wear was present on all teeth. The spheno-occipitalis synchondrosis was fused. The sagittal suture had closed prematurely, thus cranial suture closure could not be used to estimate age. It was concluded that the individual had been older than 20 years of age.

Sex: A medium brow ridge and very robust mandible suggested male. Records also stated male.

Dentition: The upper and lower incisors, canines and premolars had all been lost postmortem. The upper right and left second and third molars had also been lost postmortem. The upper first molars, as well as all lower molars were present and intact. Caries were found in the lower right M2 and M3, lower left M1 and the lower left M2. No abscesses could be seen. Slight wear was present on all molars.

Pathology and trauma: Cribra orbitalia (remodelled) was present bilaterally. No porotic hyperostosis was seen. No signs of pathology were present.

Other notes: An inferior frontal eminence could be seen, however, no mons temperosphenoidalis or interparietal groove was present.

Conclusion: The remains were possibly that of an adult male. Cribra orbitalia was evident.

MMM135

Country/place of origin: Griqualand West, South Africa.

Preservation: No post-cranial material was present. The skull and mandible were available for analysis.

Age: The third molars were erupted and in occlusion. The spheno-occipitalis synchondrosis was open. Cranial suture closure suggested that the individual had been between 15 and 40 years of age. An estimate of 15 to 20 years was made (records stated "juvenile").

Sex: A medium glabella and robust mandible suggested male. Records also stated male.

Dentition: The upper right M3, all upper incisors, upper left canine, lower premolars, canines and incisors were lost postmortem. The upper left premolars were broken. All other teeth were present and intact. Caries were present in the lower left and right first molars. No abscesses were present. The individual was not scorable for enamel hypoplasia as the enamel had been chipped. Slight to medium wear was present on all teeth.

Pathology and trauma: No signs of pathology or trauma were present.

Other notes: Slight inferior frontal eminence and interparietal groove could be seen. No mons temperosphenoidalis was present.

Conclusion: The skull and mandible possibly belonged to an adolescent male.

C1

Country/place of origin: Southern Africa.

Preservation: Only the skull was available. No mandible or post-cranials were present.

Age: The spheno-occipitalis synchondrosis was fused. Cranial suture closure suggested that the individual had been between the ages of 30 and 60 years, which was also the final estimate.

Sex: Sharp supra-orbital margins, a smooth brow ridge and small mastoids indicated female. Records also stated female.

Dentition: No mandibular teeth were available for analysis. The upper central incisors, as well as the upper right lateral incisor had been lost antemortem. The upper right P2, upper left I2 and C was lost postmortem. No caries or enamel hypoplasia was evident. Abscesses were present in the upper right central and lateral incisors, as well as in the upper left central incisor.

Figure A73. *Abscessing of the maxillary central and lateral incisors*

Pathology and trauma: No signs of pathology or trauma were noted.

Other notes: A slight inferior frontal eminence was present, as well as a noticeable interparietal groove. No mons temperosphenoidalis could be seen.

Conclusion: The cranium possibly belonged to a female individual between the ages of 30 and 60 years.

C3

Country/place of origin: Southern Africa.

Preservation: Only the cranium was available. No mandible or postcranials were present.

Age: Medium wear could be seen on the molars. The spheno-occipitalis synchondrosis was fused. It was estimated that the individual had been older than 25 years of age.

Sex: A smooth brow ridge, small mastoids and sharp supra-orbital margins suggested female. Records confirmed that the individual had been female.

Dentition: No mandibular teeth were available. The upper right molars were intact, but the rest of the upper teeth had been lost postmortem. No caries, abscesses or enamel hypoplasia was present on the molars. Medium attrition could be seen.

Pathology and trauma: There weren't any signs of pathology or trauma.

Other notes: No mons temperosphenoidalis was present, but a slight inferior frontal eminence and interparietal groove could be seen.

Conclusion: The remains were possibly that of a female older than 25 years.

C5

Country/place of origin: Southern Africa.

Preservation: No mandible or postcranials were present, only the cranium was available.

Age: Cranial suture closure suggested that the individual had been between the ages of 30 and 60 years, which were used as the final estimate.

Sex: A smooth brow ridge, small mastoids and sharp supra-orbital margins suggested female. Records confirmed female.

Dentition: No mandibular teeth were available. The upper second and third molars, as well as the upper left central and lateral incisors were lost antemortem. The rest of the teeth were lost postmortem. The individual was not scorable for attrition, enamel hypoplasia or caries. Abscesses were evident in the upper left central and lateral incisors.

Pathology and trauma: There weren't any signs of pathology or trauma.

Other notes: A prominent interparietal groove could be seen. A slight inferior frontal eminence was present, but no mons temperosphenoidalis was evident.

Conclusion: The cranium possibly belonged to a female individual between the ages of 30 and 60 years.

C13

Country/place of origin: Southern Africa.

Preservation: No mandible or postcranials were present. Only the cranium remained.

Age: Cranial suture closure indicated that the individual had been between the ages of 30 and 60 years of age, which was also accepted as the final estimate.

Sex: Sharp supra-orbital margins, smooth brow ridge and small mastoids suggested female. Records also stated female.

Dentition: No teeth were available for analysis. No abscesses could be seen. The individual was not scorable for caries, enamel hypoplasia or attrition.

Pathology and trauma: Cribra orbitalia (remodelled) was observed, although no porotic hyperostosis could be seen. No trauma was evident.

Other notes: An inferior frontal eminence was present. A slight interparietal groove and mons temperosphenoidalis could be seen.

Conclusion: The cranium possibly belonged to a female between the ages of 30 and 60 years, with cribra orbitalia.

C14

Country/place of origin: Southern Africa.

Preservation: The cranium and mandible were present. No postcranials were available.

Age: The third molars had not yet erupted, although the second permanent molars were fully erupted. The spheno-occipitalis synchondrosis was still open. An estimate of 12 to 20 years was made.

Sex: Sex determination could not be performed due to the skeleton being incomplete and of a subadult age.

Pathology and trauma: No signs of pathology or trauma were present.

Other notes: An inferior frontal eminence and mons temperosphenoidalis was present, however, no interparietal groove could be seen.

Conclusion: The remains were possibly that of an individual between the ages of 12 and 20 years.

C15

Country/place of origin: Southern Africa.

Preservation: The cranium and mandible were available. No postcranials were present.

Age: Medium wear could be seen on the molars. Cranial suture closure indicated that the individual had been between the ages of 30 and 60 years; this was also considered to be the final estimate.

Sex: Small mastoids, a medium brow ridge, sharp supra-orbital margins and a pointed chin suggested female. Records also stated female.

Dentition: The upper second and third molars were lost antemortem. The only upper tooth present was the right first premolar. All other upper teeth had been lost postmortem. The lower incisors, left canine and left premolars were lost antemortem. The lower right molars, right canine and lower left third molar were present and intact. The rest of the lower teeth were lost postmortem. Abscesses were present in the lower left P1, C, lower right M1 and upper left M2. The lower left canine was also impacted. Periodontal disease was evident around the upper right molars. Medium wear could be seen on the molars.

Figure A74. *Impacted lower left canine and antemortem tooth loss of the lower incisors*

Pathology and trauma: No signs of pathology or trauma were noted.

Other notes: An inferior frontal eminence was present. Slight mons temperosphenoidalis and interparietal groove could also be seen.

Conclusion: The remains were possibly that of a female individual between the ages of 30 and 60 years.

C16

Country/place of origin: Marydale, Northern Cape, South Africa.

Preservation: Only the cranium remained, no mandible or postcranials were available.

Age: Cranial suture closure indicated that the individual had been between the ages of 35 and 65 years, which were also considered to be the final estimate.

Sex: A pronounced glabella, medium to large mastoids and rounded supra-orbital margins suggested male. Records also stated male.

Dentition: No mandibular teeth were available. The upper first molars and the upper left second molar were the only teeth present. The upper right third molar was lost antemortem. All other upper teeth were lost postmortem. Abscesses were present in the upper right second and third molars. No caries could be seen on the three remaining molars. Medium to severe wear was present on the molars.

Pathology and trauma: Remodelled cribra orbitalia was observed bilaterally. Porotic hyperostosis was present on the frontal bone. A healed gummatous lesion was present on the left parietal bone.

Figure A75. *Healed gummatous lesion on the left parietal bone*

Other notes: An inferior frontal eminence, mons temperosphenoidalis and interparietal groove was present.

Conclusion: The cranium possibly belonged to a male individual between the ages of 35 and 65 with bilateral cribra orbitalia.

C17

Country/place of origin: Koranna area, Kalahari, South Africa.

Preservation: Only a fragmented cranium remained. No mandible or postcranials were present.

Age: The spheno-occipitalis synchondrosis was fused. Cranial suture closure could not be used to estimate age due to the skull being fragmented. It was concluded that it had been an adult individual, possibly older than 20 years of age.

Sex: Small mastoids, a medium glabella and a delicate cranium suggested female. Records confirmed female.

Dentition: No teeth were available for analysis.

Pathology and trauma: No signs of pathology or trauma could be seen.

Other notes: An inferior frontal eminence was present, however, no mons temperosphenoidalis or interparietal groove could be seen.

Conclusion: The cranium possibly belonged to an adult female individual.

C21

Country/place of origin: Southern Africa.

Preservation: The skull and mandible were available, but the mandible was glued to the skull. No postcranials were present.

Age: Cranial suture closure suggested that the individual had been between the ages of 35 and 65 years, which was also the final estimate.

Sex: A prominent brow ridge, robust mandible and cranium, as well as medium mastoids suggested male. Records also stated male.

Dentition: All upper teeth were lost antemortem. The lower incisors were lost postmortem, but all other lower teeth were lost antemortem. No teeth were available for analysis. The individual was not scorable for enamel hypoplasia, attrition or caries.

Pathology and trauma: No signs of pathology and trauma were noticed.

Other notes: A slight inferior frontal eminence and interparietal groove was present. No mons temperosphenoidalis could be seen.

Conclusion: The remains were possibly that of a male between the ages of 35 and 65 years.

C22

Country/place of origin: Southern Africa.

Preservation: The only skeletal element that remained was the cranium.

Age: The spheno-occipitalis synchondrosis was fused. Cranial suture closure suggested that the individual had been between the ages of 15 and 40 years. A final estimate of 25 to 40 years was made.

Sex: A medium brow ridge, small mastoids and sharp supra-orbital margins suggested female. Records confirmed female.

Dentition: No mandibular teeth were present. The upper first and second molars, as well as the upper right third molar were present. All other teeth were lost postmortem. The canines were severely damaged postmortem. No abscesses or caries could be seen. Slight wear could be seen on the molars.

Pathology and trauma: No signs of pathology or trauma were noticed.

Conclusion: The remains were possibly that of an adult female individual.

C25

Country/place of origin: Southern Africa.

Preservation: The cranium was the only skeletal element that remained and had a bleached appearance.

Age: Cranial suture closure suggested that the individual had been between the ages of 35 and 65 years, which were considered to be the final estimate.

Sex: A medium brow ridge, small mastoids and sharp supra-orbital margins suggested female. The skull also had a delicate apprearance. Records confirmed that it had been female.

Dentition: No mandibular teeth were present. The upper second and third, as well as the upper right first molar were present. The rest of the teeth had been lost postmortem. No abscesses or caries was noticed. Slight to medium wear could be seen on the molars.

Pathology and trauma: No pathology or trauma was observed.

Other notes: A pronounced mons temperosphenoidalis was present. A slight interparietal groove and inferior frontal eminence was also observed.

Conclusion: The remains possibly belonged to a female individual between the ages of 35 and 65 years.

C26

Country/place of origin: Southern Africa.

Preservation: Only the skull and mandible remained. No postcranials were available.

Age: Cranial suture closure indicated that the individual had been between the ages of 30 and 60 years, which were also considered to be the final estimate.

Sex: A prominent brow ridge, medium mastoids, robust mandible and square chin suggested male. Records also stated male.

Dentition: The upper right molars, right second premolar, upper canines, all incisors, lower central incisors, left lateral incisor and lower left third molar had been lost antemortem. The upper right first premolar and lower left first and second molars were present. The rest of the teeth had been lost postmortem. Abscesses were present in the lower left M3, I2 and lower right P1, as well as in the upper right P1, C, I2 and upper left M1 and P2. Caries could be seen in the lower left M1 and M2. Severe wear was present on the three remaining teeth.

Figure A76. *Antemortem tooth loss and abscessing in the maxilla*

Pathology and trauma: No signs of trauma or pathology could be seen.

Other notes: No inferior frontal eminence or interparietal groove could be seen, however, a prominent mons temperosphenoidalis was present.

Conclusion: The remains were possibly that of a male individual between the ages of 30 and 60 years.

C28

Country/place of origin: Southern Africa.

Preservation: A fragmented cranium was present, but was preserved poorly. No mandible or postcranials were available.

Age: Cranial suture closure could not be used as a method for estimating age, since the cranium was fragmented, thus no age estimation could be done.

Sex: A smooth brow ridge, small mastoids and a delicate cranium suggested female. Records confirmed female.

Dentition: No teeth were available for analysis.

Pathology and trauma: No signs of pathology or trauma were observed.

Other notes: Only a slight interparietal groove could be seen.

Conclusion: The fragmented cranium was possibly that of a female individual. Age could not be determined.

C29

Country/place of origin: Southern Africa.

Preservation: The skull and mandible were available for analysis, although no postcranials were present. The preservation of the remains was fairly poor and it had a reddish-orange colour of unknown origin.

Age: The permanent first molars had erupted, but the permanent second molars had not yet erupted. The permanent incisors had also erupted, although the premolars and canines were unerupted. An estimate of 7 to 9 years was made.

Sex: Determination of sex could not be performed due to the young age of the individual.

Dentition: The permanent second and third molars were unerupted. The permanent first molars, as well as incisors were erupted, although the upper central incisors were lost postmortem. The deciduous first and second molars and canines were still intact. No visible enamel hypoplasia was present. Slight wear was seen on the permanent first molars.

Pathology and trauma: Bilateral cribra orbitalia and porotic hyperostosis were evident. Active lesions were seen in both conditions. No trauma was present.

Figure A77. *Cribra orbitalia of the right orbit*

Conclusion: The remains were possibly that of a child about 8 years old, with active cribra orbitalia and porotic hyperostosis.

C30

Country/place of origin: Southern Africa.

Preservation: Only the cranium remained and it had a bleached appearance. No mandible or postcranials were present.

Age: Cranial suture closure suggested that the individual had been between the ages of 35 and 65 years of age, which was also considered to be the final estimate.

Sex: A smooth brow ridge, sharp supra-orbital margins, small mastoids, smooth and delicate cranium indicated female. Records confirmed female.

Dentition: No teeth were available. All maxillary teeth were lost postmortem, thus the individual was not scorable for caries, enamel hypoplasia or attrition.

Pathology and trauma: No visible signs of pathology or trauma were noted.

Other notes: A slight inferior frontal eminence and interparietal groove could be seen. No mons temperosphenoidalis was present.

Conclusion: The cranium possibly belonged to a female individual between the ages of 35 and 65 years.

C32

Country/place of origin: Southern Africa.

Preservation: Condition of the remains was fair. Skull fragments, mandible, unfused epiphyses, vertebrae (unfused), os coxa (unfused), ribs, scapulae, humerii, femora and tibiae were present.

Age: No teeth had erupted yet. The mandible were unfused, as well as the vertebrae. It was estimated that the child had been 0 to 6 months of age.

Sex: Determination of sex could not be performed due to the young age of the individual.

Dentition: No teeth were available for analysis.

Pathology and trauma: No signs of pathology or trauma were observed.

Conclusion: The remains were possibly that of an infant child.

C33

Country/place of origin: Southern Africa.

Preservation: Fair. Skull fragments, ribs, vertebrae (unfused), unfused epiphyses, hand and foot bones were present.

Age: The mandible had not yet fused and no teeth had erupted yet. An estimate of 0 to 6 months was made.

Sex: Determination of sex could not be performed due to the young age of the individual.

Dentition: No teeth were available for analysis.

Pathology and trauma: No signs of trauma or pathology were observed.

Conclusion: The remains were most likely that of an infant child.

C34

Country/place of origin: Southern Africa.

Preservation: Fair. Skull fragments, unfused epiphyses, all long bones, clavicles, hand and foot bones were present.

Age: The mandible was not yet fused. An estimate of 0 to 6 months was made.

Sex: Determination of sex could not be performed due to the young age of the individual.

Dentition: No teeth were available for analysis.

Pathology and trauma: No signs of trauma or pathology were observed.

Conclusion: The remains were most likely that of an infant child.

C35

Country/place of origin: Southern Africa.

Preservation: Fairly good. The skull, mandible, ribs, vertebrae, scapulae, humerii, radii, ulnae, femora, tibiae, fibulae and unfused epiphyses were present.

Age: The two halves of the mandible were fused, suggesting that the child had been older than 6 months. The anterior fontanelle was open. All vertebral arches were fused together, but were not yet connected to the vertebral bodies. The upper and lower central incisors were erupted. An estimate of 6 to 12 months was made.

Sex: Determination of sex could not be performed due to the young age of the individual.

Dentition: The upper and lower central incisors were erupted, although the deciduous molars had not yet erupted. All deciduous incisors were present. The rest of the deciduous teeth were evident in the tooth sockets, but had not yet started to erupt.

Pathology and trauma: The radii and fibulae showed severe periosteal activity. The anterior fontanelle also appeared to be persistently open. No cribra orbitalia or porotic hyperostosis was present. No trauma was evident.

Figure A78. *Thickened appearance of the fibulae and radii*

Conclusion: The remains were possibly that of a child between 6 and 12 months.

C36

Country/place of origin: Southern Africa.

Preservation: Fair. The cranial bones, mandible, vertebrae, epiphyses (unfused), humerii, femora and tibiae were present.

Age: The deciduous incisors, canines and first molars were erupted. The deciduous second molars had not yet erupted. Based on dentition, an estimate of 15 to 21 months was made.

Sex: Determination of sex could not be performed, as the individual had been too young.

Dentition: The deciduous upper and lower incisors, canines and first molars were erupted and present. The second molars could be seen in the tooth sockets, but had not yet erupted. No enamel hypoplasia could be seen.

Pathology and trauma: Active lesions of cribra orbitalia could be seen. No porotic hyperostosis was present. The femora and tibiae showed significant curvature, suggesting Rickets. Periosteal bone reactions were present on the humerii. No trauma was observed.

Figure A79. *Periostitis of the humerii*

Figure A80. *Periostitis of the femora*

Conclusion: The remains possibly belonged to a child about 18 months of age with significant pathology visible on the humerii, femora and tibiae.

C37A

Country/place of origin: Southern Africa.

Preservation: Fair. The cranium (frontal bone absent), mandible, rib fragments, os coxae, scapulae, clavicles, foot bones, vertebrae and all long bones were present.

Age: All deciduous teeth were still intact. The permanent first molars were erupted. Based on dentition, an estimate of 6 to 8 years was made.

Sex: Determination of sex could not be performed due to the young age of the individual.

Dentition: All deciduous teeth were present and intact. The permanent first molars were also erupted and intact. No enamel hypoplasia was seen.

Pathology and trauma: There weren't any signs of pathology or trauma.

Conclusion: The remains were possible that of a child about 7 years of age.

C38

Country/place of origin: Southern Africa.

Preservation: Poor. Fragments of the skull, long bones and ribs were present. The two halves of the mandible were also present.

Age: None of the deciduous teeth had erupted yet. The two halves of the mandible were not yet fused. An estimate of younger than 6 months was made.

Sex: Determination of sex could not be performed due to the young age of the individual.

Dentition: No teeth had erupted yet, but the enamel crowns of the deciduous teeth were visible in the tooth sockets.

Pathology and trauma: The individual could not be scored for pathology as the remains were too poorly preserved.

Conclusion: The remains were possibly that of an infant younger than 6 months old.

C39

Country/place of origin: Southern Africa.

Preservation: Skull fragments, vertebrae, epiphyses (unfused), rib fragments, mandible, long bones fragments, hand and foot bones were present. Condition of the remains was fairly poor.

Age: The two halves of the mandible were fused. The central incisors were starting to erupt. The lateral incisors had not yet erupted. An estimate of 6 to 9 months was made.

Sex: Determination of sex could not be performed due to the young age of the individual.

Dentition: The central incisors were starting to erupt. No other deciduous teeth had erupted yet.

Pathology and trauma: There were signs of porotic hyperostosis on the parietal bones, but no cribra orbitalia could be seen. No trauma was present.

Conclusion: The remains were possibly that of a child between the ages of 6 and 9 months.

C40

Country/place of origin: Southern Africa.

Preservation: Fair. Skull fragments, mandible, vertebrae, unfused epiphyses and all long bones were present.

Age: No teeth had erupted yet. The two halves of the mandible were not yet fused. An estimate of 0 to 6 months was made.

Sex: Determination of sex could not be performed, as the individual was too young.

Dentition: No teeth had erupted yet.

Pathology and trauma: Porotic hyperostosis could be seen on the parietal bones. No cribra oribitalia was visible. No trauma was evident.

Figure A81. *Porotic hyperostosis on the left parietal bone*

Conclusion: The remains were possibly that of an infant between 0 and 6 months of age.

C42

Country/place of origin: Southern Africa.

Preservation: Only the cranium was available. No mandible or postcranials were present.

Age: Cranial suture closure suggested that the individual had been between the ages of 45 and 75 years, which were also considered to be the final estimate.

Sex: A prominent brow ridge and robust looking mandible suggested male. Records also stated male.

Dentition: No mandibular teeth were present. All upper incisors and molars had been lost antemortem. The canines, first and second premolars had been lost postmortem. Abscesses were present in the upper right and left canines. The individual was not scorable for caries, enamel hypoplasia or attrition.

Pathology and trauma: No cribra orbitalia or porotic hyperostosis could be seen. Two button osteomas were present on the frontal bone.

Other notes: An inferior frontal eminence, interparietal groove and mons temperosphenoidalis were present.

Conclusion: The remains were possibly that of an adult male individual between the ages of 45 and 75 years.

C43

Country/place of origin: Southern Africa.

Preservation: Only the cranium was available, but the maxilla and occipital bone was absent. No mandible or postcranials were present.

Age: Age estimation could not be performed, due to the cranium being incomplete.

Sex: A prominent brow and rounded supra-orbital margins suggested male. Records confirmed that the individual had been male.

Dentition: No teeth were available for analysis.

Pathology and trauma: No cribra orbitalia or porotic hyperostosis could be seen. There were not any signs of trauma present.

Conclusion: The remains possibly belonged to a male of unknown age.

C47

Country/place of origin: Southern Africa.

Preservation: A complete cranium was available, but no mandible or postcranials remained.

Age: Cranial suture closure suggested that the individual had been between the ages of 30 and 60 years, which were also considered to be the final estimate.

Sex: A prominent brow, large mastoids and robust skull suggested male. Records also stated male.

Dentition: No mandibular teeth were available. The upper left third molar, upper right premolars and canine were lost postmortem. The rest of the teeth were present and intake. The enamel of the upper incisors showed postmortem damage. Caries could be seen in the upper right and left second molars. No abscesses were present. The individual was not scorable for enamel hypoplasia due to postmortem damage. Medium to severe wear could be seen on all teeth.

Pathology and trauma: No cribra orbitalia or porotic hyperostosis was present. A healed infectious lesion was present on the left parietal bone.

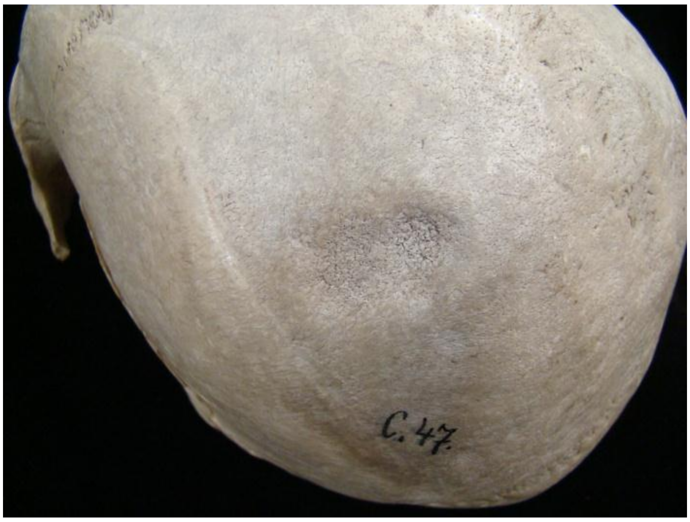

Figure A82. *Healed infectious lesion on the left parietal bone*

Other notes: No inferior frontal eminence or interparietal groove could be seen, although mons temperosphenoidalis was present.

Conclusion: The remains were possibly that of a male, between the ages of 30 and 60 years.

C91

Country/place of origin: Southern Africa.

Preservation: A complete cranium was present, but no mandible or post-cranials remained. The cranium had a bleached appearance.

Age: Cranial suture closure suggested that the individual had been between the ages of 30 and 60 years, which were also considered to be the final estimate.

Sex: A medium brow ridge, medium mastoids and robust cranium suggested male. Records also stated male.

Dentition: The upper incisors had been lost postmortem. The rest of the upper teeth were intact, but sustained significant postmortem damage and could not be scored for attrition, caries or enamel hypoplasia. No abscesses were seen.

Pathology and trauma: No signs of pathology or trauma were present.

Conclusion: The remains were possibly that of a male between the ages of 30 and 60 years.

C94

Country/place of origin: Southern Africa.

Preservation: The skull and mandible were present. No post-cranials, however, remained. The skull and mandible were stained black.

Age: Cranial suture closure indicated that the individual had been between the ages of 45 and 75 years of age, which were also considered to be the final estimate.

Sex: A smooth brow, delicate skull and small mastoids indicated female. Records confirmed that the individual had been female.

Dentition: The upper left and lower right third molars were lost antemortem. The upper right third molar, lower right first premolar and canine, lower central incisors, lower left canine and third molar were lost postmortem. All other teeth were present and intact. No abscesses or enamel hypoplasia could be seen. Caries were present in the upper right and lower left second molars. Medium wear could be seen on all teeth.

Pathology and trauma: No signs of trauma or pathology were noted.

Other notes: A slight inferior frontal eminence and interparietal groove could be seen, although no mons temperosphenoidalis was present.

Conclusion: The remains were possibly that of a female between the ages of 45 and 75 years.

Museé de l'Homme Skeletal Collection:

#1604

Country/place of origin: Southern Africa.

Preservation: Excellent. The complete skeleton was available. The skeleton was mounted on a stand and thus made analysis somewhat difficult.

Age: The iliac crests were fused, but the lines were still visible. The first segment of the sacrum was open. Cranial suture closure suggested that the individual had been between the ages of 15 and 40 years. A final estimate of 20 to 30 years was made.

Sex: A wide subpubic angle, smooth brow ridge and glabella, pointed chin and gracile cranium suggested female. The humeral head diameter was measured to be 37.7 mm, which fall within the range (37.7 ± 2.08mm) for black South African females according to Steyn & Işcan (1999). The epicondylar breadth of the humerus was measured to be 53.7 mm, which also falls within the range (53.2 ± 3.62 mm) for black South African females (Loth & Işcan, 2000; Steyn & Işcan, 1999).

Stature: Antemortem stature could not be calculated because the maximum lengths of the long bones could not be measured due to the mounting of the skeleton.

Dentition: The upper left lateral incisor and third molar, as well as the lower right canine were lost postmortem. All other teeth were present and intact. No abscesses were present. Caries could not be scored due to the skull and mandible being connected. Enamel hypoplasia was evident on all teeth. Slight wear appeared on all teeth.

Pathology and trauma: No cribra orbitalia or porotic hyperostosis was present. There weren't any signs of trauma.

Other notes: No mons temperosphenoidalis or inferior frontal eminence could be seen, but a slight interparietal groove was present.

Conclusion: The remains were possibly that of a female between the ages of 20 and 30 years.

#3582

Country/place of origin: Cape Colony, South Africa.

Preservation: The skull and mandible were available. No postcranials were present.

Age: All teeth were permanent, but the third molars had not erupted yet. The spheno-occipitalis synchondrosis was open. An estimate of 14 to 18 years was made.

Sex: Pronounced gonial flare and ramus flexure of the mandible, as well as rounded supra-orbital margins suggested male.

Dentition: The third molars had not yet erupted. The upper second molars, right premolars and left lateral incisor had been lost antemortem. The upper central incisors, upper right lateral incisor, lower central and lateral incisors, lower canines and lower right first premolar were lost postmortem. The rest of the teeth were present and intact. The upper canines were impacted in the maxilla. Periodontal disease was evident around the upper molars. No enamel hypoplasia, caries or abscesses were noticed.

Figure A83. *Impacted upper left canine*

Pathology and trauma: Cribra orbitalia (remodelled) was observed bilaterally. No porotic hyperostosis could be seen. Postmortem trauma was evident on the right parietal bone possibly caused by a shovel or similar object.

Figure A84. *Bilateral cribra orbitalia*

Other notes: A slight mons temperosphenoidalis and inferior frontal eminence was present, but no interparietal groove could be seen.

Conclusion: The remains were possibly that of an adolescent male.

#3584

Country/place of origin: Cape Colony, South Africa.

Preservation: The skull and mandible were available. No post-cranials were present.

Age: The third molars were in occlusion and slight wear could be seen on all teeth. The spheno-occipitalis synchondrosis was open. Cranial suture closure suggested that the individual had been between the ages of 15 and 40 years. A final estimate of 20 to 30 years was made.

Sex: Large mastoids, a square chin, sloping forehead and ramus flexure suggested male.

Dentition: The upper third molars, upper right second premolar and all lower incisors were lost postmortem. No enamel hypoplasia or abscesses could be seen. The individual could not be scored for attrition or caries, since the skull and mandible were connected to one another.

Pathology and trauma: No trauma or pathology was observed.

Other notes: A prominent inferior frontal eminence could be seen, as well as a slight interparietal groove. No mons temperosphenoidalis could be seen.

Conclusion: The remains possibly belonged to a young adult male individual.

#3587

Country/place of origin: Namaqua area, South Africa.

Preservation: The cranium and mandible were available. No postcranials were present.

Age: The spheno-occipitalis synchondrosis was fused. Cranial suture closure suggested that the individual had been between the ages of 30 and 60 years, which were also considered to be the final estimate.

Sex: The cranium was somewhat robust and the mandible showed pronounced gonial flare and a square chin. Large mastoids and a sloping forehead were also present. The individual was considered to be male.

Dentition: The upper left central incisor, second premolar and the lower central incisors were lost postmortem. The lower left M3 was lost antemortem. All other teeth were present and intact. An abscess was present in the upper right second molar. Caries could be seen in the upper right M2 and lower left M1 and M2. Extensive tartar was present on all teeth. No enamel hypoplasia could be seen.

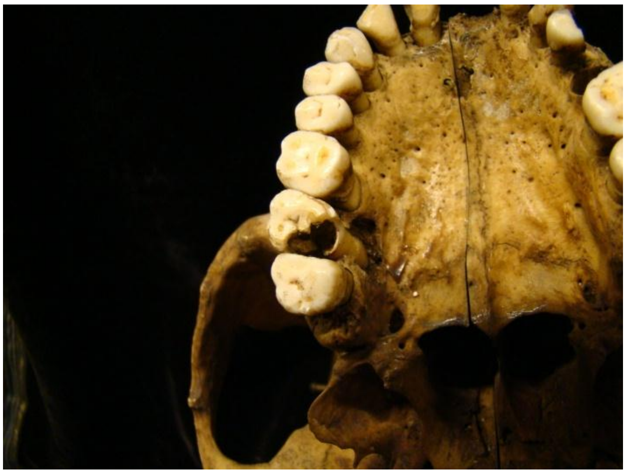

Figure A85. *Caries of the upper right second molar*

Pathology and trauma: No pathology or trauma was present.

Conclusion: The remains were possibly that of a male individual between the ages of 30 and 60 years.

#3591

Country/place of origin: Southern Africa.

Preservation: Only the cranium remained. No mandible or postcranials were available.

Age: The spheno-occipitalis synchondrosis was fused and slight wear was present on all teeth. Cranial suture closure indicated an age between 15 and 40 years. A final estimate of 25 to 40 years was made.

Sex: A sloping forehead, medium to large mastoids, rounded supra-orbital margins and slight glabella suggested male.

Dentition: No mandibular teeth were available. The upper central incisors, right lateral incisor and left premolars were lost postmortem. All other teeth were present and intact. No abscesses were present. Caries was evident in the upper right M3, left canine and left M3. Enamel hypoplasia was also observed. Slight wear was present on all teeth.

Pathology and trauma: Remodelled cribra orbitalia, as well as enamel hypoplasia could be seen. No porotic hyperostosis was present. No trauma could be seen.

Figure A86. *Bilateral cribra orbitalia*

Other notes: An inferior frontal eminence and slight interparietal groove was present. No mons temperosphenoidalis could be seen.

Conclusion: The remains possibly belonged to a male between the ages of 25 and 40 years.

#3592

Country/place of origin: Southern Africa.

Preservation: The skull and mandible (fractured) were present. No postcranials were available.

Age: The third molars had not yet erupted. The spheno-occipitalis synchondrosis was open. Cranial suture closure indicated that the individual had been between the ages of 15 and 40 years. A final estimate of 15 to 20 years was made.

Sex: A pronounced glabella and rounded supra-orbital margins suggested male, whereas small mastoids and a pointed chin suggested female. Determination of sex was inconclusive.

Dentition: Very little wear could be seen. No abscesses were present. The upper right premolars, right canine and upper right lateral incisor, as well as the upper left first premolar, all lower incisors and lower left canine were lost postmortem. The third molars had not erupted yet. All other teeth were present and intact. Caries could be seen in the lower left M1 and upper left I1. Enamel hypoplasia was also evident.

Pathology and trauma: Enamel hypoplasia could be seen. No cribra orbitalia could be seen, but porotic hyperostosis was present. A healed infectious/gummatous lesion was present on the left parietal bone that might suggest treponematosis. No trauma was present.

Other notes: An interparietal groove and inferior frontal eminence, as well as a slight mons temperosphenoidalis were present.

Conclusion: The remains were possibly that of an adolescent individual of unknown sex.

#3593

Country/place of origin: Southern Africa.

Preservation: The skull and mandible were present. No postcranials were available.

Age: The third molars had not erupted yet, although all other permanent teeth were erupted and intact. The spheno-occipitalis synchondrosis was open. It was estimated that the individual had been older than 12, but younger than 18 years of age.

Sex: A smooth brow ridge, sharp supra-orbital margins, a pointed chin and delicate cranium suggested female.

Dentition: All permanent teeth, except the third molars had erupted. The upper incisors, right premolars, left canine and left first premolar, as well as the lower incisors and left canine were lost postmortem. All other teeth were intact. Caries could be seen in the lower right second premolar. No abscesses were present. Enamel hypoplasia was also evident. Slight wear could be seen on all teeth.

Pathology and trauma: Cribra orbitalia (active), as well as enamel hypoplasia could be seen. No porotic hyperostosis or trauma was present.

Figure A87. *Bilateral cribra orbitalia*

Other notes: A slight interparietal groove, inferior frontal eminence and mons temperosphenoidalis was observed.

Conclusion: The remains were possibly that of an adolescent female with cribra orbitalia and enamel hypoplasia.

#3594

Country/place of origin: Southern Africa.

Preservation: Only the cranium was available. No mandible of postcranials remained.

Age: The third molars had not erupted yet. The spheno-occipitalis synchondrosis was open. It was estimated that the individual had been between 12 and 18 years of age.

Sex: Sharp supra-orbital margins, a smooth brow ridge and small mastoids suggested female.

Dentition: No mandibular teeth were available. The upper right premolars, central incisor, as well as the left incisors, canine, first premolar and second molar were lost postmortem. No caries or abscesses were seen. Enamel hypoplasia was evident.

Pathology and trauma: Only enamel hypopolasia could be seen; no other pathology or trauma was evident.

Other notes: An inferior frontal eminence and mons temperopsphenoidalis were present. No interparietal groove could be seen.

Conclusion: The cranium possibly was that of an adolescent female individual.

#3596

Country/place of origin: Southern Africa.

Preservation: Only the cranium was available. No mandible or post-cranials were present.

Age: The third molars had not yet erupted. All other teeth were permanent. It was estimated that the individual had been older than 12 years, but younger than 18 years of age.

Sex: Small mastoids, smooth brow ridge and delicate cranium suggested female.

Dentition: No mandibular teeth were present. The upper incisors, canines, right premolars, and second molars had been lost postmortem. The third molars were not yet erupted. The upper first molars and left premolars were the only teeth present and intact. No caries or abscesses were present. Slight wear could be seen on all teeth.

Pathology and trauma: No signs of pathology or trauma were present.

Other notes: A slight interparietal groove could be seen, but no mons temperosphenoidalis or inferior frontal eminence was present.

Conclusion: The cranium were most likely that of an adolescent female individual.

#3597

Country/place of origin: Southern Africa.

Preservation: Only the cranium remained. The box contained a mandible that did not belong to the skull. No postcranials were present.

Age: The upper right M3 were erupted, although the left M3 had not erupted yet. The spheno-occipitalis synchondrosis was fused. It was estimated that the individual had been younger than 20 years, but older than 15 years of age.

Sex: A smooth brow ridge, sharp supra-orbital margins, very small mastoids and a delicate cranium indicated female.

Dentition: The only teeth present were the upper right molars, as well as the upper left M1 and M3. No abscesses were present, but caries were seen in the upper right M1. Enamel hypoplasia was also evident. Slight wear could be seen on the molars.

Pathology and trauma: Enamel hypoplasia and cribra orbitalia (remodelled) were present. No porotic hyperostosis or trauma could be seen.

Figure A88. *Cribra orbitalia of the right orbit*

Figure A89. *Cribra orbitalia of the left orbit*

Other notes: An inferior frontal eminence was observed, although no mons temperosphenoidalis or interparietal groove was present.

Conclusion: The cranium were most likely that of a female adolescent individual.

#3599

Country/place of origin: Southern Africa.

Preservation: The cranium and mandible were present. No postcranials were available.

Age: The third molars were erupted and in occlusion. The spheno-occipitalis synchondrosis was fused. Cranial suture closure could not be used for age estimation due to the sagittal suture being completely obliterated. It was concluded that the individual had been older than 18 years of age.

Sex: Small mastoids, sharp supra-orbital margins, gracile cranium and pointed chin suggested female.

Dentition: The upper incisors, canines and left premolars had been lost postmortem. The lower left central incisor and left second premolar had also been lost postmortem. All other teeth were present and intact. No abscesses were present. Caries were present in the lower right M2. Slight wear could be seen on all teeth.

Pathology and trauma: No signs of trauma were noticed. Sagittal synostosis was present.

Other notes: No mons temperosphenoidalis or inferior frontal eminence could be seen, but a slight interparietal groove was present.

Conclusion: The remains were possibly that of a female older than 18 years.

#3600

Country/place of origin: Southern Africa.

Preservation: The skull and mandible remained. No postcranials were present.

Age: The permanent M1 had erupted and the permanent first premolars were just starting to erupt. The deciduous second molars were still intact. An estimation of 9 to 11 years was made.

Sex: Determination of sex could not be performed due to the young age of the individual.

Dentition: All teeth had been lost postmortem, except for the mandibular deciduous second molars and the upper permanent canines. The permanent incisors and first molars had erupted. The permanent second molars had not yet erupted. The individual was not scorable for enamel hypoplasia. No caries or abscesses could be seen.

Pathology and trauma: There were no signs of trauma or pathology.

Other notes: A prominent inferior frontal eminence and mons temperosphenoidalis was present, but only a slight interparietal groove could be seen.

Conclusion: The remains were most likely that of a child between 9 and 11 years of age.

#5563

Country/place of origin: Southern Africa.

Preservation: Only the cranium remained; no mandible was present. No post-cranials were present either.

Age: The spheno-occipitalis synchondrosis was closed. Cranial suture closure suggested that the individual had been between the ages of 45 and 75 years of age, which was also taken as the final estimate.

Sex: A robust cranium, slight brow ridge and glabella might have indicated male.

Dentition: No teeth or mandible was available. The upper right M3, M1, C and upper left I1 and M1 had been lost postmortem. The rest of the teeth were lost antemortem. Periodontal disease was evident around almost all teeth. An abscess could be seen in the upper right second molars. The individual was not scorable for enamel hypoplasia or caries.

Pathology and trauma: No cribra orbitalia or porotic hyperostosis was observed. The cranium had an uneven and porotic appearance with gummatous lesions, suggesting treponemal disease. No trauma could be seen.

Figure A90. *Porotic area above the right orbit on the cranium*

Other notes: No inferior frontal eminence or mons temperosphenoidalis could be seen, although a slight interparietal groove was present.

Conclusion: The cranium most likely belonged to a male individual between 45 and 75 years of age.

#23590

Country/place of origin: Cave in Humansdorp, South Africa.

Preservation: The skull and mandible were available, but no postcranials were present.

Age: The third molars were not yet fully erupted. Slight to medium wear could be seen on all teeth except the third molars. The spheno-occipitalis synchondrosis had recently fused. An estimate of 15 to 18 years of age was made.

Sex: A smooth brow ridge, small mastoids, sharp supra-orbital margins and a pointed chin suggested female.

Dentition: All incisors, the upper right first premolar, upper left premolars, lower incisors, canines, premolars and lower right second molar had been lost postmortem. All other teeth were present and intact. Caries could be seen in the lower left M2, as well as in the upper left M2. No abscesse of enamel hypoplasia could be seen.

Pathology and trauma: Remodelled cribra orbitalia could be seen. No porotic hyperostosis or trauma was observed.

Figure A91. *Bilateral cribra orbitalia*

Other notes: An inferior frontal eminence was seen, but no interparietal groove or mons temperosphenoidalis was present.

Conclusion: The cranium most likely belonged to an adolescent female individual.

#24893

Country/place of origin: Southern Africa.

Preservation: Only the cranium remained. No postcranials or mandible was present.

Age: Cranial suture closure suggested that the individual had been between the ages of 30 and 60 years, which were also taken as the final estimate.

Sex: A smooth brow ridge, sharp supra-orbital margins, small mastoids and a delicate cranium suggested female.

Dentition: No mandibular teeth were present. The upper left premolar, first and second molars were the only teeth present. The upper left third molar had been lost antemortem. The resto of the teeth had been lost postmortem. Caries could be seen in the upper left second premolar and first molar. Abscesses were evident in the upper left canine, first and second premolars. Severe attrition could be seen on the upper premolars.

Pathology and trauma: Remodelled cribra orbitalia could be seen. No porotic hyperostosis was present. Postmortem fire damage was present on the right side of the cranium, affecting the occipital bone and mastoid process.

Other notes: No inferior frontal eminence could be seen, but an interparietal groove and mons temperosphenoidalis could be seen.

Conclusion: The cranium most likely belonged to a female individual between the ages of 30 and 60 years.

Appendix 2

Table A2.1 List of grave goods associated with each individual.

Case #	Associated grave goods
S3	Clothing fragments
S25	Iron arm bangles and OES beads
S37	Green glass beads
S40	Blue glass beads
S44	Iron arm bangle
S45	Iron arm bangles
S48	Two clothing buttons
S52	Iron arm bangle
S55 skull/S56 post-cranials	OES beads
S59 skull/S62 post-cranials	OES beads and blue glass beads
S62 skull/S59 post-cranials	Iron arm bangle
S63	Iron arm bangle and black wool
S71	Iron arm bangle and blue glass beads
S95	Two “dolosse”
S99	Iron arm bangles

OES – ostrich egg shell

Appendix 3

Table A3.1 Summary of the cranial and mandibular measurements for adult males and females.

	Male				Female			
	n	range	mean	SD	n	range	mean	SD
Cranium								
Maximum length	39	166-194	181.1	7.4	49	166-187	176.5	6.0
Maximum breadth	40	118-143	128.7	4.9	49	113-136	127.4	4.9
Bizygomatic breadth	29	114-132	122.6	5.0	41	105-129	119.2	4.9
Basion-bregma	40	116-138	125.9	6.4	46	111-131	121.2	4.8
Cranial base length	39	87-110	95.7	5.8	46	84-98	91.7	3.7
Basion-prosthion	30	84-146	96.8	11.6	35	80-103	91.9	5.3
Maximum alveolar breadth	29	55-65	60.0	3.3	33	51-62	57.4	2.9
Maximum alveolar length	29	43-65	52.9	5.1	35	45-101	53.2	9.2
Upper facial height	30	50-75	60.9	6.1	38	51-67	59.4	4.5
Total facial height	24	89-120	104.9	7.4	27	82-120	102.2	7.7
Minimum frontal breadth	39	83-105	94.7	5.0	49	56-102	91.3	6.6
Nasal height	38	39-54	44.9	3.6	48	40-49	43.9	2.4
Nasal breadth	38	23-43	27.0	3.4	48	21-30	25.3	2.0
Orbital breadth	37	33-43	38.8	2.1	48	35-43	38.0	1.4
Orbital height	38	26-40	31.2	3.2	48	27-37	31.2	2.0
Biorbital breadth	37	84-106	97.2	5.1	47	90-103	95.3	3.2
Interorbital breadth	37	18-33	24.3	3.0	48	19-28	23.4	2.3
Total sagittal arch	38	338-395	363.9	14.5	45	239-384	352.5	22.0
Circumference	39	464-530	501.4	16.4	48	461-525	490.6	15.0
Frontal arch	39	118-150	128.9	7.7	45	105-135	123.0	6.9
Parietal arch	39	105-140	121.4	8.0	45	101-130	117.7	7.8
Occipital arch	38	98-125	111.3	6.3	45	98-126	110.7	7.2
Frontal chord	39	103-128	111.3	6.2	45	94-117	106.7	4.9
Parietal chord	39	95-123	110.5	6.0	45	94-120	107.5	6.4
Occipital chord	38	82-102	90.6	4.6	45	80-103	90.1	5.2
Foramen magnum length	37	30-41	36.3	2.9	45	30-39	34.7	2.3
Foramen magnum breadth	38	25-33	29.3	2.3	44	24-34	28.7	2.2
Mastoid length	36	23-38	30.5	4.4	46	13-35	27.1	3.9
Biasterionic breadth	37	90-119	106.7	5.9	46	95-115	103.6	4.3
Mandible								
Symphyseal height	23	26-36	30.0	2.6	28	21-37	28.3	3.7
Body height at ment for	25	22-31	27.3	2.1	22	21-31	25.9	2.6
Body thickness at ment for	25	9-16	12.2	1.8	23	7-15	11.2	1.9
Bigonial diameter	28	79-106	89.9	6.5	31	74-96	84.7	5.7
Bicondylar breadth	23	94-118	107.4	6.6	28	88-113	104.5	6.6
Minimum ramus breadth	26	28-44	35.7	3.5	29	28-41	33.7	2.8
Maximum length	24	96-116	104.8	4.5	30	91-113	100.3	5.0

ment for - mental foramen

Table A3.2 Summary of the measurements of the upper limb for adult males and females.

	Male				Female			
	n	**range**	**mean**	**SD**	**n**	**range**	**mean**	**SD**
Clavicle								
Max length	30	109-164	139.0	13.3	35	114-156	131.9	8.3
Sagittal diam midshaft	31	8-15	11.0	1.5	36	8-11	9.6	0.9
Vertical diam midshaft	31	6-14	9.0	1.7	36	5-11	7.6	1.2
Scapula								
Height	29	112-158	132.7	11.5	30	96-143	119.3	9.4
Breadth	29	89-109	97.1	6.3	31	77-109	89.6	7.1
Humerus								
Max length	31	190-348	288.9	28.9	36	233-319	274.5	17.6
Epicondylar breadth	32	49-61	54.0	3.3	38	39-59	48.7	3.8
Max vertical diam head	32	29-47	37.6	3.8	36	30-41	34.5	2.6
Max diam midshaft	33	16-25	18.9	2.2	39	14-21	16.9	1.6
Min diam midshaft	33	12-20	15.2	1.6	39	11-17	13.1	1.3
Radius								
Max length	32	199-272	229.0	16.9	36	123-250	208.6	20.9
Sagittal diam midshaft	33	8-13	10.5	1.1	38	8-11	9.0	0.9
Transverse diam midshaft	33	10-17	12.4	1.5	38	8-15	11.0	1.3
Ulna								
Max length	31	214-299	244.3	18.1	34	185-271	227.8	16.1
Dorso-volar diam	32	9-14	11.8	1.3	35	8-15	10.1	1.5
Transverse diam	32	10-17	13.0	1.7	35	10-14	11.5	1.2
Min circumference	31	22-36	29.7	3.5	35	19-39	27.1	3.9

max – maximum
min – minimum
diam – diameter

Table A3.3 Summary of the measurement of the lower limb for adult males and females.

	Male				Female			
	n	**range**	**mean**	**SD**	**n**	**range**	**mean**	**SD**
Sacrum								
Anterior straight length	27	77-117	99.2	10.3	31	88-122	100.1	9.4
Anterior straight breadth	29	68-109	90.5	8.4	35	82-117	97.2	6.8
Os coxa								
Height	29	162-200	181.1	10.0	35	155-203	174.9	10.4
Iliac breadth	29	86-140	126.2	10.5	34	113-140	126.7	7.7
Pubis length	27	66-88	75.6	6.6	33	62-90	77.1	6.1
Ischium length	30	78-102	90.1	5.5	34	75-102	84.6	5.6
Acetabulum	27	43-52	47.4	2.3	32	40-53	44.4	2.5
Femur								
Max length	33	358-476	426.0	23.8	38	350-465	407.5	22.0
Bicondylar length	33	356-474	422.9	23.7	37	346-461	404.1	21.4
Epicondylar breadth	31	65-82	71.5	3.8	34	58-77	66.0	4.0
Max diam head	33	30-45	39.9	2.9	37	33-43	37.1	2.4
A-P subtroch diam	33	20-29	22.7	1.9	38	13-24	20.4	2.1
Transverse subtroch diam	33	22-34	27.6	2.4	38	22-30	25.3	1.9
A-P diam midshaft	33	22-33	27.5	2.5	38	20-29	24.4	2.3
Transverse diam midshaft	33	19-28	23.2	2.0	38	19-25	21.9	1.6
Circumference midshaft	33	69-93	80.0	5.8	38	65-85	73.7	4.8
Tibia								
Max length	27	300-404	358.3	26.5	36	303-396	339.6	21.1
Max prox epiph breadth	26	59-85	68.6	5.5	35	48-71	60.5	5.1
Max dist epiph breadth	27	36-52	43.9	3.5	35	36-63	41.5	4.6
Max diam nut for	27	25-53	32.6	5.2	37	23-39	28.0	2.9
Transverse diam nut for	27	16-25	21.0	2.4	37	15-23	18.9	2.0
Circumference at nut for	27	72-98	84.6	7.1	37	65-91	75.5	6.8
Physiological length	28	288-389	346.4	25.5	35	289-383	328.3	21.0
Fibula								
Max length	29	303-389	344.6	24.2	32	290-384	325.4	20.7
Max diam midshaft	28	11-17	13.9	1.7	37	10-15	12.4	1.1

max – maximum
diam – diameter
A-P – anterior-posterior
subtroch – subtrochanteric
prox – proximal
dist – distal
epiph – epiphyseal
nut for – nutrient foramen