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An odontological analysis of $18^{th}$and 19^{th}century burial sites from in and around Cape Town.

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Declaration

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Abstract

The development of the city of Cape Town in the last 20 years has led to the discovery of burial sites not sufficiently documented in the city's archival records. Human remains under study were recovered from three different locations namely Cobern Street (n=28) mid 18^{th} century; Marina Residence (n=40) and Polyoak (n=9) both late 18^{th} to early 19^{th} century. The aim of this study is to investigate oral hygiene; dental pathologies; behaviour; lifestyle aspects and geographic origins as seen on the dentition using standard osteoscopic methods. Calculus deposition which is an indicator of poor oral hygiene was found in 98.7% of the individuals. Pathologies such as caries at 4.3, abscesses at 2.5 and teeth lost antemortem at 8.8 per mouth, the Cape Poor were found to be similar to 18^{th} century poor communities. The evidence points more towards a difference in oral hygiene practices but similar diets between the three communities. The seemingly shared social class does not, at least in the earlier times of the colony, mask the diverse cultural heritage as evidenced in the dental behaviour through intentional, unintentional dental modification as well as habitual dental markers. Cobern Street which is an earlier community showed mesio/distal filing (14.3%) as well as buccal filing (21.4%) while the later Marina Residence community only had mesio/distal filing (5.6%). Polyoak community does not show any of these dental modifications. As all societies evolve, the communities of Cobern Street, Marina Residence and Polyoak become merged as the Cape Poor, a new society, which has abandoned certain unique cultural attributes with the traces of their varied geographic origins only left in the heritable dental traits. The diverse geographic origins are confirmed through the non metric traits.

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Chapter 1 Introduction

Odontology is the study of the dentition and all the factors that bear influence upon teeth. These factors can be intrinsic, meaning that they are susceptible to influences that are physiological or genetic; or they can be extrinsic, in which case they relate to congenital or post-formation influences determined by the external environment, time and usage. Teeth are assigned their own branch of detailed study largely due to the fact that teeth have very little remodelling capabilities as a result of their unique structure (Hillson, 1986; 1996) (see chapter 2). This property allows for teeth to act as a reservoir for storing a person's life history because whatever morphological or chemical changes made on teeth, they can be observed for as long as teeth are intact even if the individual is long deceased (Larsen, 1997; Hinton, 1981).

Teeth do not only bear witness to the diet but also to lifestyles and behavioural practices of a people. The dentition like other body parts are highly susceptible to grooming and cultural modifications as seen throughout the ethnographic and archaeological records (Molnar, 1972; Milner and Larsen, 1991; Hillson, 1996; Larsen 1997).

The process of reconstructing this odontological record and history is inextricable from the general life of the communities whose remains form the basis of this study. The study of human remains recovered from an archaeological site or burial ground is fundamental to physical anthropology and archaeology. These disciplines are following on the human quest to want to explain human origins and how humans have adapted to their environments since their existence. This quest has been in existence probably since the beginning of complex thought but it is speculated that it had been pushed to the fore by the course of evolutionary science (Ridley, 1993).

Most of the literature on the study of human burial grounds comes from European and American studies where access to the remains was in archaeological finds, land development projects and relocation of human remains from cemeteries especially war cemeteries. This is so because the disciplines of physical anthropology and archaeology have since their infancy been based in Europe and North America.

The studies of burial grounds focus on two aspects especially in regions of the World where colonialism has taken place in the recent historical period. The first aspect is the study of burial grounds of the colonisers and the second is that of burial grounds of the colonised (Deetz, 1977). The latter is a more recent move mainly motivated by some archaeologists to try correct what they perceived an inherent flaw in history reporting wherein history is biased and to a great extent ignores those who had little political or economic power (Deetz, 1977; Blakey and Rankin-Hill, 2004). In the above mentioned cases, the reference is to the history of the African slaves' experiences in North America where the history is mainly reported from what these authors believe to be a biased view of the colonisers and slave masters. The analysis of the human skeletal material from a burial ground dating back to the slavery periods or just after emancipation would in a sense give a more objective interpretation of life, death and disease of the Africans in that time period (Rose, 1985; Blakey and Rankin-Hill, 2004).

1.1 Previous South African dental studies

There is a general paucity of dental studies on South African 18^{th} and 19^{th} century samples. The limitations are largely due to lack of availability of archaeological samples within this time frame, but there have been a range of studies who have worked with teeth of both living and archaeological peoples in South Africa.

The available literature (Drennan, 1929; 1949; Shaw, 1931; Singer, 1953; Van Reenen, 1964; 1966; 1977; 1978; 1992; Grine, 1978; 1981; 1990; Kieser, 1985; 1986a; 1986b; 1987; 1988; Van Wyk *et al*, 1990; Morris, 1988; 1989; 1998; Apollonio, 1998; Cox, 1999; Friedling and Morris, 2007; Friedling and Morris 2005) is not specific to but broadly covers the dental health aspects including occlusal wear patterns as well as dental modification in both prehistoric and modern Southern African populations.

Earlier researchers Drennan (1929) and Van Reenen (1964; 1966; 1992) studies' mainly focused on the dentition of the Bushmen (now known as the San). This group was observed to have dental features such as extensive occlusal wear and low caries frequencies, consistent with the 'primitive' populations elsewhere in the world (Pederson, 1949; Molnar, 1971). Also noted was how the 'farm' Bushmen had more caries compared to the 'field' Bushmen (Van Reenen, 1964). This was attributed to a change from forager to sedentary lifestyles and the consumption of less fibrous food. The anthropological work of the early 20th century was still very much influenced by the typological thinking at the turn of the century hence the Drennan (1949) attempt to study the new 'racial group' emerging in the form of the Cape Coloureds. This group's occlusal wear severity was observed to be more than the South African European and Negro groups but less severe compared to the Bushmen. Also noted was the high caries rates which were expected seen as this group was of the poor communities (Drennan, 1949).

The Bantu- speaking populations on the other hand exhibited dental wear comparable to other modern populations (Dlamini, 2006) but have dental modification not seen in groups from Europe. This dental modification is generally accepted to be aesthetic in the form of extraction (Shaw, 1931; Singer, 1953; Morris 1988; 1989; 1998) and filing (Van Reenen, 1978; 1986).

West and Central Africans are documented to have cultural practices which involve filing of anterior teeth (Van Reenen, 1986), a practice which has not been observed in South African hunter –gatherer populations (Singer, 1953; Morris 1998; Manyaapelo, 2004) but has been documented in the Iron Age populations of Mapungubwe and K2 (Steyn, 1994) as well as the Soutpansberg district of in the then Northern Transvaal province of South Africa (Steyn *et al*, 1994). Another form of dental modification most recently studied in contemporary Cape Town populations is the removal of maxillary central incisors (Jappie, 1998; Morris, 1998; Friedling and Morris, 2005). Although there is evidence of this form of dental modification in Bantu speakers of Southern African Early Iron Age (Morris, 1998), it doesn't seem like there is a connection between that and the contemporary practice.

Dental studies in Southern African populations not only reconstruct life ways but also give insight into e.g. dentistry practices in 19th and 20th century South Africa (van Wyk *et al*, 1990). A documented cemetery in Wynberg, Cape Town, had to be exhumed to make way for urban development. The analysis of the dental material from the 181 individuals buried during the period 1848-1984 showed that dental reparative work in South Africa was relatively advanced at the turn of the 18th century when compared to Europe and North America where some of these practices originated. The van Wyk *et al* (1990) study adds to the South African history of dentistry in particular and also sheds light into the 'pink teeth' phenomenon which is widely believed to be caused by violent or unnatural death wherein the victim's head usually ends up positioned in a manner that would facilitate blood, through gravity, flowing to the head. The individual found with this condition at this cemetery had a death certificate listing the cause of death as a complication of meningitis therefore suggesting that the phenomenon could occur without violent death.

More recent work (Sealy *et al*, 1995; Cox, 1999; Cox *et al*, 2001) employed stable isotope analysis to reconstruct geographic origins of South African populations both historical and pre historical. The principle used in stable isotope analysis employs the known skeletal and dental development as well as the maturation patterns to track the presence of the stable isotopic indices of the elements carbon, nitrogen and strontium found in nature (Lee-Thorp *et al*, 1993; Sealy, 1995). The guiding rule is that stable isotopic indices follow a predictable geographic signature specific to a geographic location and from nature these isotopes find their way into body tissues (van der Merwe, 1982). Cox (1999) was able to determine that certain individuals from the Cobern Street sample spent their childhood in tropical climates but died subsisting on a diet consistent with life at the Cape. A shift from a typological approach as seen with the earlier works to a more clinal view to physical anthropological works on Southern African populations was pioneered by Tobias (1977; 1978; 1985). His works influenced mainly Grine (1978; 1981; 1990); Kieser (1985; 1986a; 1986b; 1987; 1988) and Kieser *et al,* (1987) who applied this approach which partly gives insight into the genetic/biological composition of the different Southern African populations (see chapter 2).

1.2 Comparative dental studies elsewhere

In a study that attempted to 'reconstruct the social and cultural life of Barbados island slaves from the middle of the seventeenth century to emancipation in 1834', Corruccini *et al,* (1982, pg 443) examined remains from a slave cemetery from one of the sugar plantations called Newton. This plantation slave cemetery according to the authors is well documented and whatever could be learned from the physical analysis of the skeleton and teeth would also be corroborated by the ethnohistorical data (Corruccini *et al*, 1982; Handler and Corruccini, 1983).

Dental analysis of the slave remains from the plantation Newton included the frequency and extent of the following variables: eruption sequences, caries, tooth loss, periodontal disease, root hypercementosis, enamel hypoplasia, malocclusions, crown length and breadth, non metric traits like Carabelli's cusp as well as dental 'mutilation' (Handler *et al,* 1982; Corruccini, 1982). With these data the investigators were able to make inferences on life expectancy of the population (which they estimated to 29 years); identified a relatively late weaning and a comparatively lengthy lactation period; noted a case of malnutrition or arrested nutritional episode and prenatal developmental stress; identified some level of population admixture and found evidence of social behaviours like pipe smoking. One of the major limitations with this study was not being able to establish place of birth of these people with a reasonable certainty (Handler and Corruccini, 1983).

In a study with a similar sample including skeletal remains of enslaved African Americans, Blakey *et al,* (1994) set out to prove if indeed the ethnohistorical data about weaning ages of enslaved children was true. Using frequencies and chronological distribution of dental enamel hypoplasia this study concluded that the enamel growth disturbances amongst enslaved African Americans are among the highest recorded in human populations. The high frequency was likely to have been caused by a combination of multiple environmental stresses, differences in hypoplastic susceptibility in enamel and random factors. This is in contrast to the school of thought that attributes peak hypoplasia frequencies to age at weaning or post weaning stresses (Blakey *et al.* 1994).

In his doctoral thesis Khudabux (1991) investigated the effects of life conditions on the health of a Negro slave community in Suriname. This research first highlights the contradictory accounts of the living conditions of the slaves in the plantations in Suriname. The study informs us that positive or negative accounts about slavery and the life conditions of slaves were dependent on the observer's standing in that society where some authors had emphasised that slaves were treated justly while others gave an opposite view. This study's results however confirmed what the old archives had documented about the slaves in the Caribbean living in worse of conditions as compared to slaves in the future USA (Khudabux, 1991). This is noted in the evidence of higher incidence of disease, both pathological bone changes and dental anomalies (occlusal caries).

The New York African Burial Ground (NYABG) project is a well described research that endeavours to use skeletal biology as a means investigate the origins of these Africans. The investigators wanted to narrow their origins to a local and regional group and thus have the data make an important contribution to the anthropological genetics, African Diaspora history, USA colonial history and the understanding of the peopling of 18th century New York (Blakey and Rankin-Hill, 2004).

The enslaved Africans found in New York City showed higher rates of dental pathologies compared to other groups of the same period. This the authors attribute directly to their circumstances and life conditions under slavery. This NYABG project has a similar context to the present study, which is of a burial ground that did not appear in historical records thereby leading researchers to conclude that the people buried there could have only belonged to the poor marginalised people of that time including slaves and ex-slaves.

1.3 Aims and objectives of this project

The aim of this project is to reconstruct life histories of the human remains found at Cobern Street, Marina residence and Polyoak using an odontological approach. The project will attempt to answer questions about dental health and behavioural practices which have left their signatures on the dentition of these people. Dental health includes evidence of diseases or pathological processes that involve dentition as well as general dental hygiene. Lifestyle practices are aspects of a people that give a clue about the diet or mode of subsistence while behaviour is witnessed through, e.g. evidence of dental decorative practices or evidence of pipe smoking.

In an attempt to reconstruct the dental history of these three samples, this study will try answer the following questions:

1. Do the three samples constitute one population when talking about dental health?
2. What are the differences between these Cape samples and other similar samples elsewhere in terms of dental health?
3. What can we learn about behaviour and lifestyle activities as witnessed on the dentition?
4. Can geographic origins be interpreted odontologically from these samples?

Chapter 2 Background

2.1 Anatomy of teeth

The structure of a tooth is composed of a part visible above the gum line called the crown and the part below the gum line called the root (see Figure 1). The tissues which form most of the tooth mass in the crown are enamel and dentine while dentine, cement and pulp are the tissues in the root area (Stevens and Lowe, 1997). Dentine is covered by the enamel in the crown area and by cement in the root area (Scott, 1974). The three tissues namely enamel, dentine and cement are all calcified. There is only one delicate specialised connective tissue called the pulp. Pulp is the tissue through which blood vessels and the myelinated nerve fibres enter the apical foramen and divide into numerous branches to supply the tooth. These nerve fibres are sensitive to pain, the only sensory modality recognised by teeth (Junqueira *et al*, 1992).

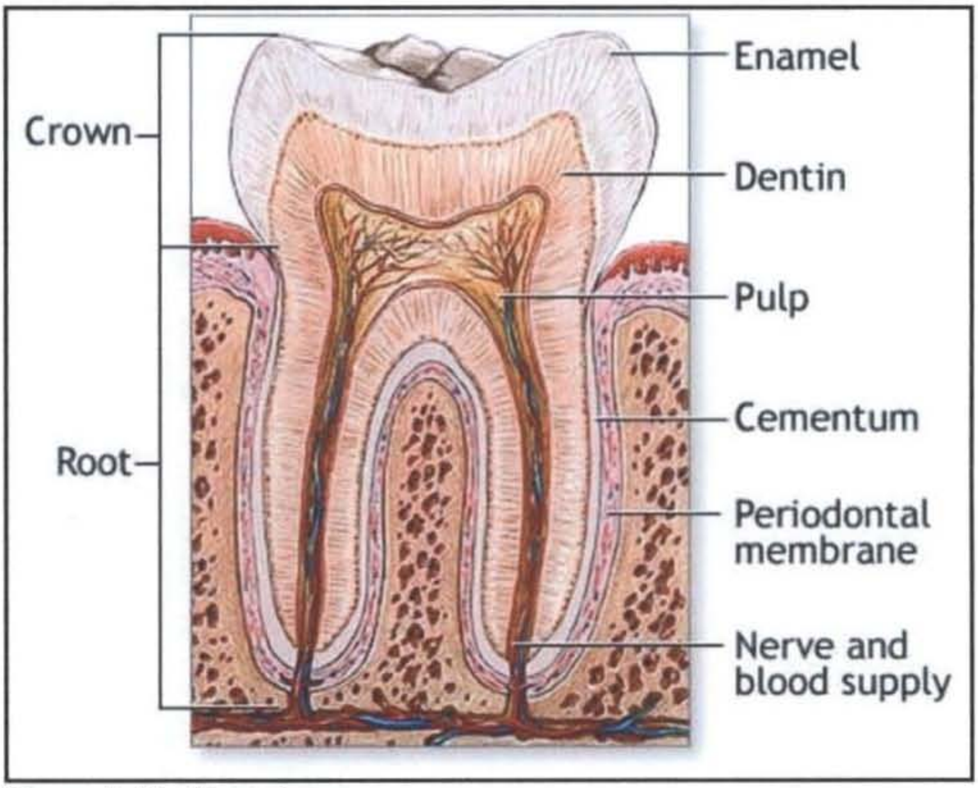

Figure 1: Tooth anatomy
(http://www.nlm.nih.gov/medlineplus/ency/imagepages/8974.htm)

Enamel is derived from the embryological tissue ectoderm while dentine, pulp, cementum and periodontal fibres, which anchor the tooth to bone, are of mesodermal origin (Carlson, 2004; Scott and Turner, 1997). The dental lamina and the surrounding mesenchymal cells which together eventually form the tooth components (tooth germ) start aggregating at six weeks after fertilization for the deciduous teeth and at sixteen weeks for the permanent teeth (Hillson, 1996). The developmental process of the tooth is essentially divided into three stages namely: the bud, the cap and the bell stages (Carlson, 2004). The secretion and mineralization of the hard tissues (enamel, dentine and cementum) only occurs in the late bell stage (see Figure 2) of development after the inner epithelium cells of the tooth germ have differentiated into ameloblasts (enamel producing) and the dental papilla cells into odontoblasts (dentine producing) (Gartner and Hiatt, 1990). The deposition of enamel matrix which is ultimately responsible for crown form occurs in a wave-like manner or perikymata and imbrication lines (Hillson, 1986). It is when there is a disruption in amelogenesis that the perikymata and imbrication zones are exaggerated with a greater than normal perikymata groove spacing resulting in linear enamel hypoplasias (Hillson, 1996). The significance of these in interpreting archaeological population health is explained in 2.2 below.

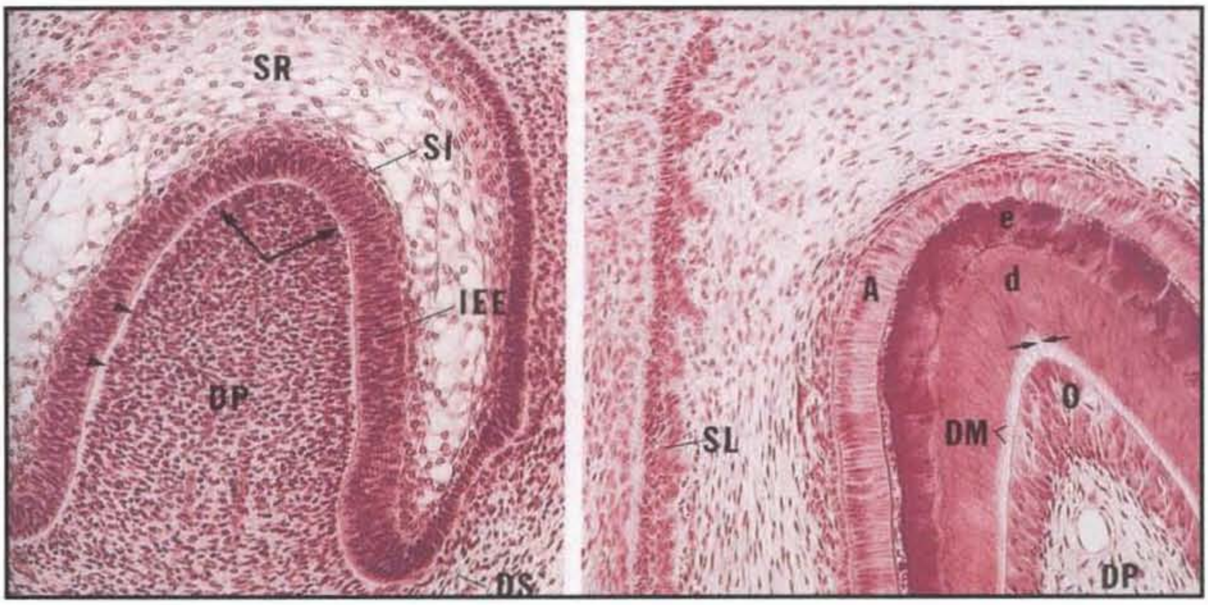

Figure 2: Histological sections showing tooth development stages (Gartner and Hiatt, 1990). IEE = inner enamel epithelium, **DP** = dental papilla, **SR** = stellate reticulum, **A** = ameloblasts, **e** = enamel, **d** = dentine, **DM** = dental matrix, **O** = odontoblast

Chapter 3 MATERIALS

Figure 3: Map of South Africa (www.places.co.za), showing Cape Town in the marked area (magnified on the next page).

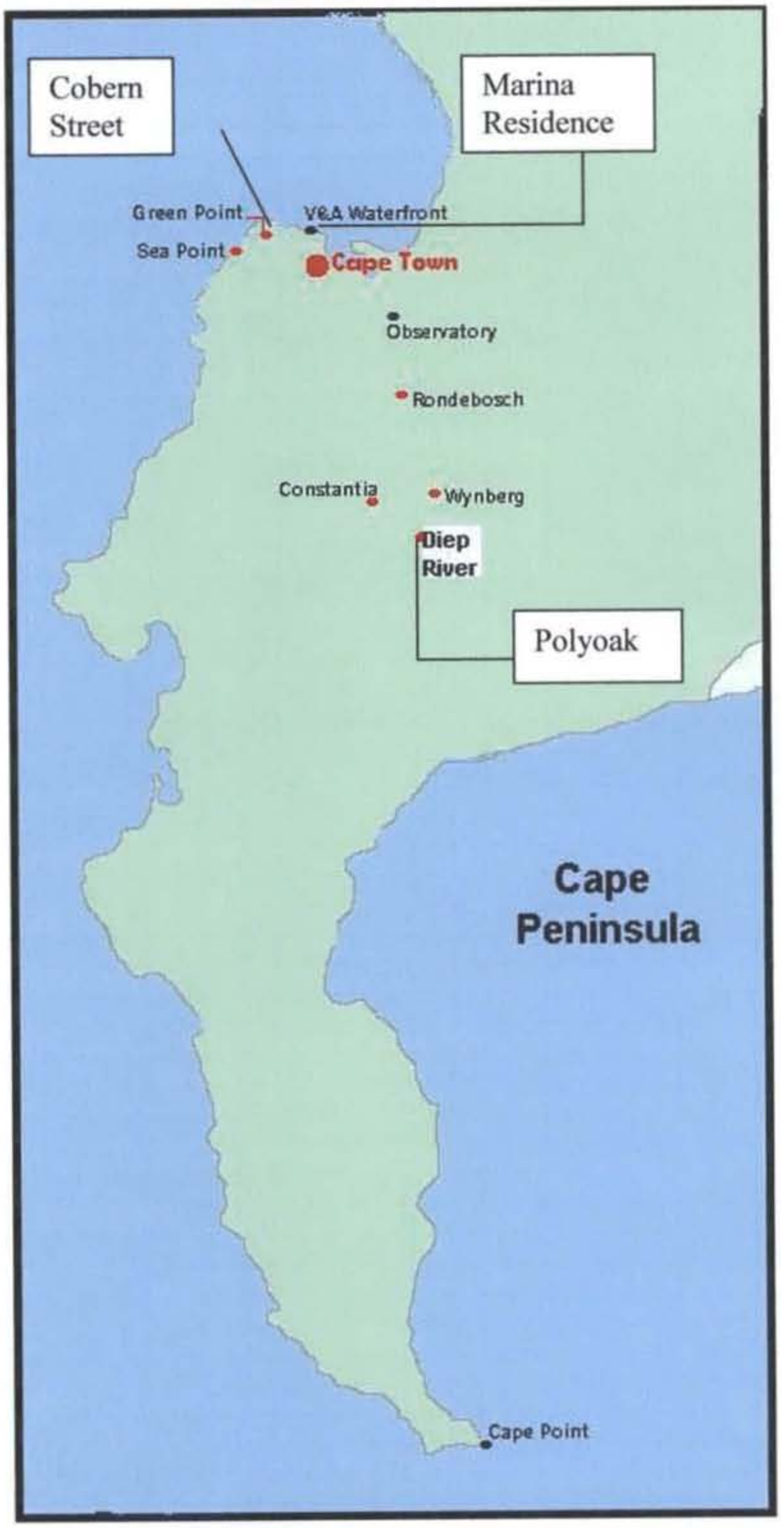

Figure 4: Map showing location of burial sites including some of the better known Cape Town suburbs for general orientation.

Both enamel and dentine have an organic and an inorganic part, the inorganic part is made up of hydroxyapatite crystals. Enamel has the largest component of hydroxyapatite crystals at more than 96% (Hillson, 1986). This property of enamel is very important because between the two calcified tissues enamel and dentine, enamel is the one with an almost non-existent capacity to remodel once laid down. Any impressions made on the enamel post formation usually survive long after the individual has died and it is from these impressions whether physiological, intentional or unintentional that anthropologists are able to reconstruct past peoples' life ways.

The complete permanent dentition in humans consists of the posterior teeth (three molars, two premolars) and the anterior teeth (one canine, two incisors) per quadrant making a total of 32 teeth. The surface area of the molars and premolars facing the cheeks is referred to as buccal while the surface area of the canines and incisors facing the lips is labial. The opposite side facing the tongue for all the teeth is called lingual. If the oral cavity is divided in a sagittal plane any direction or surface of any given tooth towards the midline is designated mesial while the direction or surface away from the midline is distal.

2.2 Diet, dental health and environmental impacts

Diet reconstruction is known to be a central factor in the determination of an archaeological population's dental health and lifestyle patterns (Lukacs, 1992; Turner and Machado, 1983; Smith, 1972; Wols and Baker, 2004). The distinction between hunter gatherer and agricultural modes of subsistence can be determined by the relative frequencies of caries and severity of occlusal wear in these populations (Larsen, 1997; Hillson 1986; 1996). Teeth with extensive caries and low to moderate occlusal wear are found in agriculturalists while severe occlusal wear and very low caries rates characterize hunter-gatherer populations. Like other body tissues teeth are susceptible to diseases processes which could be either as a result of invasion by exogenous agents or failure in the physiological systems to maintain a metabolic, homeostatic balance. Most of these diseases (e.g. caries, periodontal disease, apical abscessing) of teeth are related to dental plaque (Hillson, 1996).

These dental disease processes are interrelated with dental calculus (mineralized plaque), which together with dental caries are implicated in the development of both alveolar abscesses (Lukacs, 1996) and periodontal diseases (Hildebolt and Molnar, 1991).

Under 'normal' conditions the mouth is colonized by bacteria, fungi, viruses and other microbes (Hillson, 1996). Normal here refers to a lack of dysfunction either in the anatomy or physiological states in the oral cavity, as well as the absence of disease processes. These microbes' ability to adhere is constantly interrupted by the shedding of the mucosa (Hillson, 1996). Since teeth do not have a shedding surface, they allow the microbes to build up especially in between the fissures and crevices which are protected from the rinsing activities of saliva (Hillson, 1996). Saliva and gingival crevice fluid coat the crown surface with an organic layer called the pellicle and the predominant plaque microbes are bacteria with specialist mechanisms for adhering to it (Roitt and Lehner, 1980; Hillson, 1996). Dental plaque is the accumulation of these oral microbes which consist of aerobic and anaerobic organisms on the tooth surface (Hillson, 1979; 1986; 1996; Patterson, 1984; Roitt and Lehner, 1980).

Calculus is the product of a process which mineralizes bacterial plaque (Patterson, 1984). The process of how this mineralisation comes about is still unclear (Hillson, 1996). There are two types of calculus, supragingival and subgingival, which have clear different locations within the mouth (Patterson, 1984). Supragingival calculus is mainly found on the lingual aspects of the mandibular anterior teeth and the buccal aspect of maxillary molars, near the openings of the major salivary glands, while subgingival calculus is found on any or all of the teeth (Cawson, 1968; Alexander, 1971 as appears in Patterson, 1984).

Calculus deposition is mainly due to a lack of oral hygiene and less to do with diet even though the two processes both play a role (Anerud, 1991). Less self cleaning and more food stagnation in the mouth can lead to calculus formation (Patterson, 1984) but according to Hillson (1979) calculus deposition is heavily reliant on the oral chemical environment – meaning that it is more prone to an alkaline than an acidic environment. Hillson (1979) emphasizes that the formation of caries or dental plaque (calculus is mineralized plaque) is dependent on the delicate balance between the products of carbohydrate or protein digestion in the mouth. Protein products are said to be alkaline in nature while carbohydrate products are acidic. Both the formation of dental calculus and caries elicit an immune response (Roitt and Lehner, 1980; Burnett and Schuster, 1978) but it should be noted that the immune response to caries is at the level of the bacteria, Streptococcus mutans, which breaks down sugars to produce acids which in turn demineralise the enamel (Hillson, 1979). The immune response to dental calculus starts a cascade of events which ultimately has the host body defence cells attacking the periodontal ligament (Roitt and Lehner, 1980; Burnett and Schuster, 1978) which anchors the tooth in place.

As much as enamel does not remodel in the same manner that bone does, it is still susceptible to disease processes like other tissues in the body. The delicate balance of alkalinity and acidity within the oral cavity is vital for microbial metabolic processes and determines whether the disease dental caries occurs (Hillson, 1979). Dental caries is the disease process characterized by the focal demineralization of dental hard tissues by organic acids produce by bacterial fermentation of dietary carbohydrates, especially sugars (Hillson, 1986; 1998; Larsen, 1997).

The pathology of caries is characterized by four stages namely: the early lesion; phase of nonbacterial enamel crystal destruction; cavity formation and bacterial invasion of enamel (Cawson *et al*, 2002). The early lesion is seen as a white opaque spot that has an area of demineralization (only microscopically visible) below the surface of the intact enamel (Cawson *et al*, 2002). Due to action of food, saliva and bacterial activity, this white opaque spot can get heavily stained or darkened (personal comm. Phillips, 2006). Once cavitation of the carious lesion occurs it usually progresses until the entire tooth is affected and if the caries is not arrested the tooth will be shed. This process of carious tooth cavitation cannot be reversed.

A number of dental conditions including caries and periodontal disease can cause an inflammation of the pulp cavity which can progress to a pathological destruction of alveolar bone to form an alveolar abscess (Patterson, 1984). It is important to note that only when the integrity of the oral tissue is breached by a bacterial infection does it progress to form an abscess (Burnett and Schuster, 1978).A bacterial inflammatory reaction of the pulp cavity in teeth or pulpitis (Hillson, 1996) is only the beginning stage of an abscess formation which can present as any one of the following lesions; apical granuloma, apical periodontal cyst and apical abscess (Patterson, 1984).

Apical abscess is characterised by tissue damage coupled with pus formation and because of the space limitation within the pulp cavity, the exudate if left untreated will eventually form a fistula through the alveolar bone. The apical granuloma is an inflammatory overgrowth of granulation cells together with fibrous tissue which both replace the existing bone while the apical periodontal cyst presents with a fluid filled sac lined by epithelium and surrounded by connective tissue (Patterson, 1984). In archaeological samples the alveolar abscess is seen as a buccal or lingual fistula whose margins have been remodelled (Larsen, 1997; Hillson, 1996) and it is difficult to diagnose which of the processes mentioned above is responsible (Clarke and Hirsch, 1991).

The infectious processes which can be a product of dental disease conditions can often involve the periodontal ligament which anchors the tooth in place resulting in antemortem loss of teeth (Tal and Tau, 1986; Clarke and Hirsch 1991; Hildebolt and Molnar, 1991). The microbes which form components and products of dental plaque play an important role in the pathogenesis of periodontal disease (Burnett and Schuster, 1978). The proteolytic enzymes of dental plaque stimulate an immune cascade, which ends in a destructive inflammatory response involving the periodontal ligament (Burnett and Schuster, 1978). The resultant tooth loss is brought about mainly through two mechanisms with one being direct destruction of the periodontal ligament and the other being direct destruction or resorption of the alveolar bone (Burnett and Schuster, 1978). The site of carious lesions on the other hand can be in the fissures on teeth, the smooth surfaces or even the root surface (Hillson, 1996) with the commonality being the chronic nature of caries formation. Once a cavity is formed progression of the disease ultimately destroys the periodontal ligament to result in tooth loss. The carious cavity can sometimes be arrested (Hillson, 1979) when the conditions favourable for cariogenesis change but remineralisation does not occur especially in enamel. It is not easy to reconstruct the aetiology of antemortem tooth loss from archaeological samples (Hillson, 1996).

Archaeological records to date provide a substantial document of past peoples' dentition from the different geographical spheres. Among some of the earlier records (Drennan, 1929; Pedersen, 1949; Begg, 1954; Pedersen & Davies, 1955) dental wear is noted as the most distinguishing feature between foraging and agricultural peoples. This the researchers attributed directly to the type of diet which was 'coarse, hard and gritty foods' for prehistoric people and more refined foods for historic populations hence the notable reduction in occlusal wear severity. Tooth wear is defined as the general loss of surface detail which is a normal physiological process brought about through masticatory and non masticatory activities, (Hillson, 1996).

There are three types of tooth wear namely abrasion, attrition and erosion. Abrasion is tooth contact with exogenous material introduced to the mouth through the eating process while attrition is tooth on tooth contact (Smith 1975). Erosion which makes teeth susceptible to both abrasion and attrition is 'the loss of surface detail due to chemical dissolution' (Larsen, 1997). On a macroscopic level one can assess how much enamel has worn off therefore how much dentine is exposed (Molnar, 1971). This wear can be graded to quantify occlusal wear which generally refers to all type of wear or any combinations thereof since it is difficult to make a distinction between them (Wallace, 1974 in Larsen, 1997).

Teeth essentially have two stages of development namely the formation of crowns and roots and the eruption of teeth (Smith, 1991; Larsen 1997). A large component of this development is heritable and the environment accounts for roughly 10% especially in tooth size (Larsen, 1997).

Even though the environmental influence is small it can be very significant as seen in how ameloblasts are very sensitive to the slightest disruptions in the physiology (Goodman and Rose, 1990; Smith 1991). Linear enamel hypoplasias form as part of these physiological disruptions. Enamel hypoplasias are most commonly characterized by furrow form (usually linear furrows or pits) defects around the crown and visible to the naked eye (Hillson, 1990). The aetiology can be dietary deficiencies (Goodman and Rose, 1990) and/or infectious diseases especially in childhood when dental development occurs (Hillson, 1990). The crowns of the anterior teeth as well as both premolars where hypoplastic lesions are usually seen are completely formed at the end of the age of seven (Schour and Massler, 1940).

2.3 Behavioural traces on teeth

2.3.1 Dental Modification

As stated above because of the resilient nature of the tooth anatomy and lack of remodelling capacity, impressions made on teeth are usually permanent. Mastication by nature will result in normal 'wear and tear' of the dentition. This normal process of mastication involves the introduction of food particles which through their interaction with teeth leave wear facets. Tooth wear can also be as a result of non masticatory activities which usually see the introduction of foreign objects into the oral cavity. Any activity which results with extended contact between teeth themselves or with foreign objects will result in wear facets. These activities are broadly divided into those that were consciously manifested (intentional) and those that were indirectly borne from certain activities (unintentional).

Occlusal tooth wear (discussed above), pipe smoke wear facets and a host of occupational related wear patterns are part of unintentional dental modification. In earlier populations, teeth were used both in food preparation as well as some crafts (Molnar, 1972). A lot of food reduction was still inside the mouth as opposed to after the advent of agriculture when a shift to the use of mechanical methods of food preparation allowed food reduction to begin outside of the mouth (Molnar, 1972). This using of 'teeth as a tool' is ubiquitous among the hunter-gatherer people of Greenland, the Inuit (Pedersen, 1949), the Australian Aborigines (Campbell, 1925 as seen in Molnar, 1972) and the prehistoric populations of North America (Larsen, 1985).

The Inuit teeth showed transversely orientated grooves on the occlusal surface of worn anterior teeth, which was believed to be from actions of women pulling sinews across their teeth (Milner and Larsen, 1991). The Australian Aborigines are believed to have a similar practice in addition to which they used teeth to remove flakes from tools therefore causing them to present with chipping (Milner and Larsen, 1991).

Pipe smokers wear facets on teeth are a result of habitual clenching of pipe stems in the smoking of tobacco (Corruccini *et al*, 1982; Morris, 1988; Van der Merwe, 2005). Even though there is evidence of pipe smoking in prehistoric Sub-Saharan Africa (Van der Merwe 2005), this activity was made popular only after the introduction of tobacco by the Europeans in the 17th, 18th and 19th centuries. The lesions seen at some of the South African archaeological samples were at the junction of C/P2 or I1/12 (Morris, 1988).

Dental modification usually involves the anterior teeth mainly on the maxilla although the mandibular anterior teeth also do get modified (Milner and Larsen, 1991). Evidence of this form of tooth wear has been seen in Africa (Singer, 1953; Morris, Van Reenen, 1978; Morris 1989), in prehistoric North America (Molnar, 1971), historic North America (Handler *et al*, 1982; Corruccini *et al*, 1982; Blakey, 2004), South America (Romero, 1970 as seen in Milner and Larsen, 1991). One of the more comprehensive reviews on dental mutilation is that by Romero which was based on a collection of 1212 teeth (Milner and Larsen, 1991).

From this study a classification table applicable to the present study was drawn. It is generally accepted in the ethnographic literature that intentional dental modification can well be linked to act of social distinction or cultural integration for the given population (Blakey, 2004). The African slaves imported to the New World in the Americas seem to have easily abandoned this practice mainly to avoid recognition in the case of run away slaves being recaptured (Handler et al. 1982). Dental filing also followed the same fate for the West African slaves at the Cape (Cox, 1999).

2.4 Genetic aspect of dentition

Despite the lack of simple genetic markers in the dentition, it is evident that tooth development and dental morphology in particular are both under strong hereditary control (Scott and Turner, 1997). This evidence is mainly demonstrated by the patterned geographic variation in crown and root traits which could only mean there is some genetic basis. Essentially tooth morphology is part of the biological heritage in the same manner as are blood group genes and fingerprint patterns (Scott and Turner, 1997).

Dental metric traits are continuous variables obtained from linear measurement or indices derived from measurements which are used to describe shape of dental elements (Larsen, 1997). It is generally accepted that these elements (breadth and width) are a measure of biological affinity (Corruccini, 1974; Harris and Rathbun, 1991; Hanihara and Ishida, 2005). The dental patterning among the major geographic populations is more or less consistent with the ones from genetic and craniometric data (Hanihara and Ishida, 2005; Blakey and Rankin-Hill, 2004). Dental non metric traits are discrete or quasi – continuous morphological entities often expressed as gradations from absence to full expression (Irish, 1998; Larsen, 1997).

Pioneering studies on the genetic probability of discreet cranial and dental traits (Schultz, 1932; Dahlberg, 1937; Kraus and Furr, 1953; Berry and Berry, 1967; Sofaer *et al*, 1970; Berry, 1976) attempted to establish the mode of inheritance responsible while later studies (Sjovold, 1973; 1977; Green and Suchey, 1976; Konigsberg, 1990; Relethford and Blangero, 1990; Relethford, 1991; Greene, 1982) employed an array of statistical analysis to map out biological divergence of populations as effected by temporal and spatial divergence.

The studies on the genetic aspect of the dentition in Southern African populations by Grine (1981; 1990) were primarily on deciduous teeth. Using the mesiodistal canine-incisor index Grine (1981) was able to show that the Kalahari San have a lower canine-incisor index while the South African Negro have a higher index, comparable to Caucasoid samples who also have a higher index. The non-metrics traits however exhibit a different picture whereby there are similarities in the dental morphological features between the San and South African Blacks (Grine, 1990). These similarities were also observed by Kieser (1985) in an odontometric comparison of Griqua, San, Negro and Caucasoid samples.

Kieser and Groeneveld (1987) found that arcadal length is positively correlated to tooth size especially so for adjacent teeth. If a tooth develops and is larger than usual, the adjacent tooth developing later will be smaller than usual (Kieser *et al*, 1986) and molars positive for Carabelli's cusp tend to be on average larger in size (Reid *et al*, 1991). The fluctuating odontometric asymmetry of South African Caucasoids has equivalent patterns to those shown by American Caucasoids (Kieser and Groeneveld, 1986) but interestingly fluctuating asymmetry is shown to be an individual specific trait and not population specific. The more recent odontometric studies by L'Abbe (2005) suggest that the Venda are more similar to the general South African Negroid populations further supporting the view that the Venda did not migrate from East Africa as held elsewhere (Stayt, 1931). Steyn and Henneberg (1997) were also able to demonstrate that the K2 Iron Age population of the Sashi - Limpopo confluence is too more similar to the South African Negro populations. The Steyn and Henneberg (1997) study was able to confirm the craniometric data by Rightmire (1970) that had previously shown that the K2 people were related to the South African Negro not the Khoisan.

Based on the dental cast scoring plaques developed by Dahlberg, Turner *et al* (1991) made the Arizona State University Dental Anthropology System (ASUDAS) (see chapter 4), which has been the template for the more recent studies on Southern African dental genetics studies (Haeussler *et al*, 1989; Irish, 1997; 1998; Irish and Guatelli – Steinberg, 2002) as well Asia (Hanihara, 1967; 1992; Turner, 1990) and the Americas (Turner, 1984). This has made it possible to map of geographic origins for major populations worldwide.

3.1 Archaeological samples under study

The archaeological samples of study for this research project include Cobern Street, Marina Residence and Polyoak burial grounds. These sites represent unmarked, 'forgotten' and very scarcely documented burial grounds found in and around the city of Cape Town (see Figure 3 and 4) in the past 15 years. The discovery of these human remains was all accidental during construction in the fore mentioned areas. Cobern Street and Marina Residence burial sites' historical background will be treated as one because of their close proximity (see Figure 4) therefore shared history while Polyoak is looked at separately. In this chapter a brief summary of the excavation as well as the number of individuals found will given. It should be duly noted at this point that the total number of individuals uncovered at the excavation is not the same number of individuals selected for the purpose of this study. This number was subsequently reduced because not all of the individuals excavated had preserved teeth and were therefore excluded. The location of Cobern Street and Marina Residence samples is possibly closely associated to the cemeteries shown in the top left corner of Figure 5.

3.1.1 Cobern Street

3.1.1.1 Excavation

While digging the foundations of a new building complex on the North West outskirts of Cape Town City in Cobern Street, in September of 1994, the contractor exposed human remains (Morris, 1997). The contractor was unfortunately told by the police that since the remains are not recent; there was no need for concern so this resulted in at least three more weeks of digging which further disturbed the burial ground (Apollonio, 1998). It was only after the request from Alan G. Morris of the University of Cape Town that construction was halted temporarily and the relevant parties consulted to commence with a controlled excavation (Morris, 1997). The parties concerned included, the South African Police, National Monuments Council, Cape Town City Council, University of Cape Town Department of Anatomy and Cell Biology and the Archaeology

Contracts Office also from the University of Cape Town. The excavation was carried out under the supervision of Alan G. Morris from mid December 1994, with the break over Christmas holidays, and completed in January of 1995 (Morris, 1997).

When the excavation was completed, a total of 63 burials were uncovered (Apollonio, 1998) representing 121 individuals (Constant and Louw, 1997) with 88 adults and 33 sub adults (Cox, 1999). From this total, only the 28 adult individuals were selected for this study according to the method of selection specified in Chapter 4: Methods.

3.1.2 Marina Residence

3.1.2.1 Excavation

The Victoria and Alfred (V and A) Waterfront in Cape Town forms part of what was the original port to the city whose beginnings were largely influenced by the establishment of a refreshment stop by the then *Verenigde Oostindische Compagnie* (VOC) or Dutch East India Company in April of 1652. Towards the end of 1999 during construction of a residential part of the V and A Waterfront called Marina Residence, a human skull was discovered lying next to a fence surrounding the construction site by the police during a routine patrol (Halkett, 2000). A proper inspection was carried out on the 26th December by representatives from the South African Police, National Monuments Council, State Pathologists Office, the Archaeology Contracts Office from the University of Cape Town and the V&A Waterfront Company and from this initial assessment aided by the presence of historical copper items, it was suggested that the cemetery dated to the 18th and 19th centuries (Halkett, 2000). Permission for the exhumation from the relevant authorities was sought by the archaeological team appointed but unfortunately it had not been granted by the time work commenced. Getting the necessary permission to excavate is in line with Exhumation Ordinance No. 12 of 1980 which falls under the National Monuments Council and protects human remains post-dating AD 1652.

After the excavation was completed, a total of 57 burials were uncovered representing 69 individuals with 56 adults, 5 sub adults and 8 individuals who could not be positively aged (Friedling, pers comm). From this total, only the 40 adult individuals were selected for this study according to the method of selection specified in Chapter 4: Methods.

3.1.3 Polyoak Site

3.1.3.1 Excavation

In March 2000 human remains were discovered during construction on a site belonging to Polyoak Properties (Pty) Ltd, in the suburb of Diep River south-east of Cape Town city centre (see Fig 3) and subsequently reported to the authorities (Morris 2000). Permission was granted by the National Monuments Council and the developer stopped construction work until the excavation was completed by the team from the University of Cape Town (Morris 2000). From the remains recovered it was estimated that the sample represents a minimum of 34 individuals, 15 of whom are adults, 16 being children under 15 years of age and 3 around 16 years of age. All show evidence of being buried in a coffin (Morris 2000). Only nine adult individuals were selected for the purpose of this study according to the method of selection specified in Chapter 4: Methods)

3.1.4 History of Cobern Street and Marina Residence Sites

Cobern Street and Marina Residence burial sites are located in the Green Point suburb of the city of Cape Town and the Victoria and Alfred Waterfront respectively (see Fig 3). The latter is an exclusive upmarket residential complex associated with the harbour which is one of the city's leading tourist destinations and both these sites are situated between 1.0 and 1.5 kilometres North West of the Cape Town City centre, an area which was the burial ground during early colonial settlement (see top left corner of map in Figure 5).

Towards the end of the 16th century and early 17th century, the main route of trade between Europe and East India was through Holland and Zeeland (Israel, 1995), an area which had been incorporated into the Dutch empire since 1256 and had followed the same fate as Holland in terms of development and governance (Israel,1995). This trade in 1601 exceeded that of Portugal and England with East India (Israel, 1995). An amalgamation of sea merchant companies which were the backbone of this unprecedented trade in 1602 gave birth to the *Verenigde Oostindische Compagnie* (VOC) or Dutch East India Company. The VOC after being formed was soon given autonomy by the then States General of 'sovereign rights to maintain troops and garrisons; fit out warships; impose governors upon Asian populations; as well as sign treaties and make alliances' (Israel, 1995). It was only after a Dutch ship, the Haarlem, was wrecked on the sands of Table Bay in 1647 and the crew stranded there for nearly a year that the VOC decided to make the Cape a refreshment stop for the voyages between Europe and the East (Hunt, 2005). The availability of refreshments on route to the East was to later reduce the very high mortality rates on their ships.

Under the leadership of a surgeon in the service of the VOC, Jan Van Riebeeck, the Cape of Good Hope was officially set up as a refreshment stop for the VOC voyages in April of 1652 (Hunt, 2005). Upon arrival the Dutch were introduced to the hunter-gatherer San and pastorialist Khoikhoi peoples of the Cape occupying the area bordering what is now the Western Cape and Northern Cape provinces (see map). Almost immediately the Dutch set forth on bartering with the natives to acquire livestock for both their own consumption and a meat supply for the passing fleets (Penn, 2005). The livestock of the natives soon dwindled under a strenuous demand and this resulted in Khoikhoi – Dutch War wherein resisting camps of natives engaged in violent attempts to regain their livestock (Penn, 2005). Some Khoikhoi migrated north while other natives were captured and incorporated into the Dutch Colonial settlement as slaves or 'unfree labour' although not explicitly (Penn, 2005).

European settlers who contracted to work for the VOC were granted 'free burgher' status, allocated land to farm on and to sell their produce back to the Company as set prices. The offer of land and a free trip to the Cape soon attracted immigrants from other European countries who also came to settle at the Cape (Penn, 2005). The source of labour for the colony and this newly established refreshment stop came from the 'enslaved' natives, the few slaves in the Company's keep upon arrival and the Companies employees now practicing as 'free burgher' contractors. Since these three groups could not meet the growing demands for labour a request was made by the Cape Dutch administrators to import more slaves (Boeseken, 1977). Slaves were therefore imported for work in the Dutch Cape colony from mainly in the East (Java, Indonesia, Madagascar) and parts of West and East Africa (Angola and Mozambique) (Boeseken, 1977). The diversity of people resulted in a multiculturally stratified society by the turn of the 17^{th} century consisting of people of KhoiSan, African Negro, European and Asian ancestry coexisting as master and slave, indentured labourers and 'free burghers'.

Between 1652 and 1657, Governor Van Riebeeck erected a small fort and established the Company gardens not very far from the fort. More gardens were started for the Company with the help of the 'free burghers' as far as Rondebosch and a hospital was built close to the beach (Mentzel, 1925). The exact present day location of this early hospital structure is difficult to discern from the literature. Disease and death of sailors from the passing ships was a common occurrence (Laidler and Gelfand, 1971) hence the location of the hospital close to the beach. It is likely that these sailors were interred in the small burial plot within the fort because by April of 1677 there was need for a bigger ground for a cemetery (Pearse, 1956). The population of the Cape in April of 1679 stood at 480 (Pearse, 1956), not a figure that would warrant a bigger cemetery.

Mentzel (1925) makes mention of corpses from the hospital being carried 'to the Duunen, a place along the Bay outside the Town where the dead are buried and graves were dug by slaves'. Mentzel (1925) further noted that 'there was a cemetery for foreigners and people who could not afford to be buried in the church yard and it was situated on the west side facing the Bay near to the big battery'. The reference to this 'big battery' is most likely to Chavonne Battery (Halkett, 2000) which was constructed in the period 1715 until 1726 and this reference excludes Amsterdam Battery which was only constructed between 1784 and 1787 and also excludes Fort Knokke (Burman, 1969) whose location is not consistent with the burial grounds in this study. Mentzel's travels and documentation of the Cape was from about 1732 to 1741 (Mentzel, 1925). In 1755, an outbreak of smallpox occurred and the large number of deaths rapidly filled the Church cemetery making it necessary to use 'a tract of ground between Lion's Rump and the shores of the Bay' for the purpose of burials' (Pearse, 1956) even though its documented that the churchyard cemetery was not entirely closed until 1770 (Pearse, 1956). These descriptions cover an area which the author believes include Marina Residence, Cobern Street and Prestwitch Street burial sites. The Prestwitch Street burial site does not form part of this study. This site was uncovered in 2003 and yielded the biggest find of historical human remain in Cape Town thus far (Shepherd, 2007).

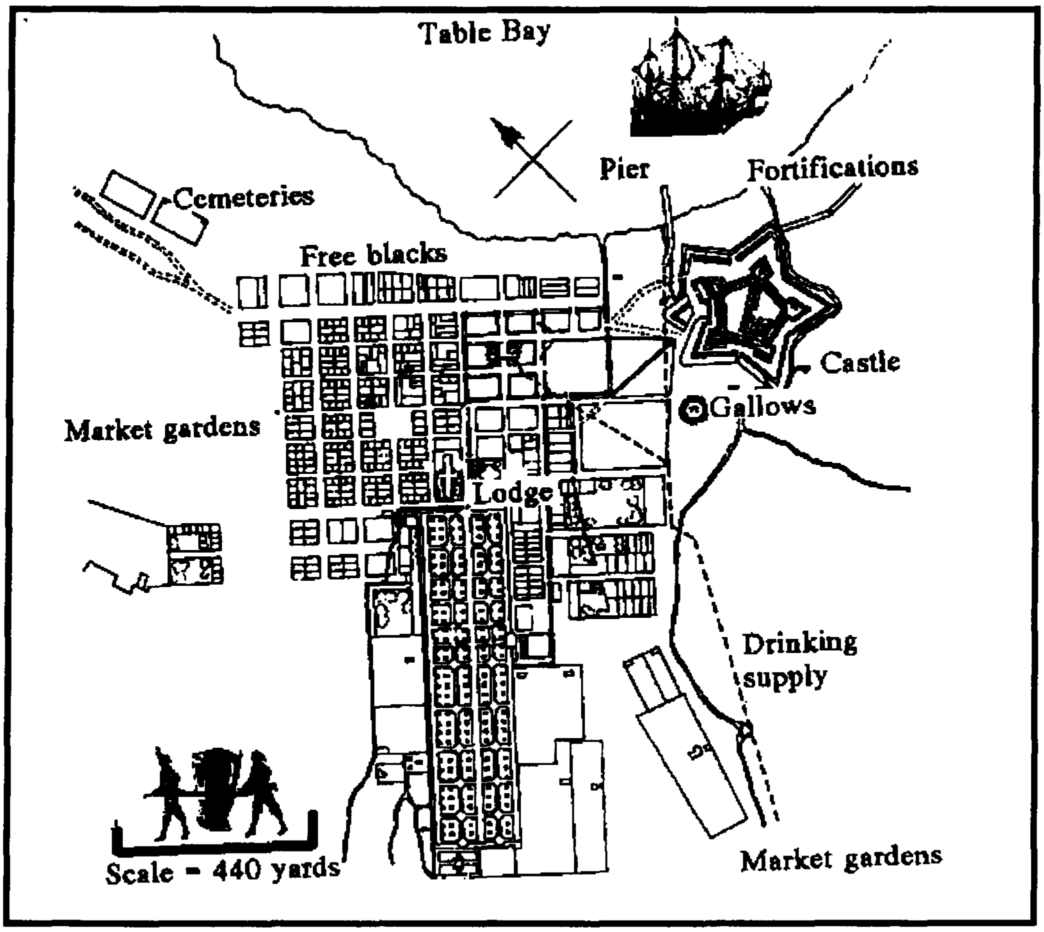

Figure 5: 1767 Map of Cape of Good Hope showing the burial grounds in the top left corner (Shell, 1994).

3.1.5 History of Polyoak Site

The land the VOC utilized to grow the produce needed to replenish the passing ships' supplies included the Company gardens near the fort in the town as well as land leased out to the 'free burghers' some of which occupied a vast area situated south of the town and is now known as the Southern Suburbs. The suburbs include Rondebosch (6.5 km from present day Cape Town CBD) where the Company had a farm, Wynberg (11 km from present day Cape Town CBD), where the Company had a vineyard (Pearse, 1956) and Constantia (14 km from present day Cape Town CBD) amongst others with Constantia having became the home of Governor Simon Van der Stel and later his son Willem Adriaan (Schutte, 1989). The Polyoak site is in Diep River (14 km from present day Cape Town CBD) which is about 5 kilometres from Constantia. This background briefly demonstrates that the land these human remains were discovered on was in the beginning stages of the colony occupied by the European settler farmers and whatever labour force they had acquired, be it imported slaves or indigenous people or a combination of the two.

Morris (2000) contends that this burial plot pre-date 1880's when all the modern southern suburb cemeteries were opened and also pre-dates 1896 when a survey of Cape cemeteries was conducted by Gregory (1896). It is possible that the date for these burials ranges from late 1600s till mid 1800s. There is no evidence to suggest that the demographic profile of this area changed drastically in the period from when it was first occupied by the European settlers (1650s) until early 1800s. Occupation of the Polyoak site is inferred from the occupation of the surrounding areas since there is no evidence that this particular area was occupied prior to the early 1800s.

3.2 Samples

The individuals listed in the tables below reflect only the selected section of the demography of Cobern Street, Marina Residence, and Polyoak sites as clearly defined in Chapter 4. The ageing and sexing was carried out by Friedling (per comm. 2006) for Marina Residence and Polyoak while Cobern Street had been previously investigated by Morris (1997); Ledger (1997); Apollonio (1998) and Cox (1999). The age and sex as determined by previous authors was accepted and not contested as this was not within the scope of this research. The number of teeth per individual was calculated by the author and this figure is representative of the total number of teeth per mouth. In two cases from Marina Residence (MR 56 and MR 58) the total number of *erupted teeth* was found to be 33 even though the actual number of teeth found was only 26 and 24 respectively. The total teeth count marked with an asterisk indicates a total tooth count per mouth exceeding 32. Accompanying the general demographic tables for the populations under study is the calendar age groupings of 17 to 40 and 41 + which have also been labelled young adult and older adult individuals respectively to facilitate analysis of age dependant variables. The rationale for dividing the samples into two age groups is explained in Chapter 4: Methods.

3.2.1 Cobern Street

The group from Cobern Street site fitting the criteria outlined in Chapter 4 Methods for this study consists of a total of 29 individuals with 18 males and 11 females. Their ages range from 20 to over 50 years old with the largest group being of young adults (17 – 40) standing at 20 individuals while the older adults consist of 9 people. The tooth count per mouth ranges from a minimum of 4 (UCT 551) to expected 32 in UCT 500, UCT 552, UCT 562, UCT 504 and UCT 508 with a total of 764 teeth for this site.

Table 1: Age and sex estimates for Cobern Street (Morris, 1997)

Accession number	Sex	Age	Midpoint of age range	Number of teeth
UCT 460	Male	20	20	26
UCT 517	Male	20 - 25	22.5	15
UCT 504	Male	25	25	32
UCT 510	Male	25 - 30	27.5	29
UCT 552	Male	30 - 35	32.5	32
UCT 554	Male	35	35	31
UCT 562	Male	35 - 40	37.5	32
UCT 551	Male	35 - 40	37.5	4
UCT 549	Male	35 - 40	37.5	26
UCT 500	Male	35 - 45	40	32
UCT 557	Male	40	40	20
UCT 547	Male	40	40	30
UCT 536	Male	35 - 50	42.5	23
UCT 548	Male	35 - 50	42.5	32
UCT 521	Male	40 - 50	45	26
UCT 543	Male	50 +	60	12
UCT 526	Male	50 - 60	55	22
UCT 559	Female	20	20	31
UCT 563	Female	22 -25	23.5	30
UCT 555	Female	20 - 30	25	27
UCT 556	Female	30	30	26
UCT 514	Female	25 - 35	30	27
UCT 558	Female	30	30	31
UCT 498	Female	35 - 40	37.5	30
UCT 544	Female	35 - 50	42.5	24
UCT 508	Female	40 - 50	45	28
UCT 542	Female	40 - 50	45	27
UCT 502	Female	45 - 55	50	29

Table 2: Age groups Cobern Street.

Age	Total	Sex		Total no. of teeth
17 – 40	20	Male	12	**309**
		Female	7	**202**
41 +	9	Male	5	**115**
		Female	4	**108**
Total	**29**		**28**	**734**

3.2.2 Marina Residence:

The group from Marina Residence site consistent with the criteria outlined for this study consists of a total of 40 individuals with 23 males, 13 females and 4 people who could not be positively sexed. Their ages range from a minimum of 18 to over 50 years old with the largest group being of young adults (17 – 40) standing at 19 individuals while the older adults and unknown age groups consist of 15 and 6 people respectively. The tooth count per mouth ranges from a minimum of 2 (MR 9) to 33 erupted teeth although not all of them present in at least 2 individuals (MR 56 and MR 58), with a total of 795 teeth for this site.

Table 3: Age and sex estimates by Friedling (per comm.)

Accession number	Sex	Age as estimated	Midpoint of age range	Number of teeth
MR 39	Male	18	18	27
MR 31	Male	20-30	25	30
MR 34	Male	20-30	25	28
MR 25	Male	18-35	26.5	30
MR 10	Male	18-35	26.5	8
MR 46	Male	25-35	30	28

Table 3(cont.): Age and sex estimates by Friedling (per comm.)

Accession number	Sex	Age as estimated	Midpoint of age range	Number of teeth
MR 33	Male	25-40	32.5	26
shaft MR 56	Male	30-35	32.5	10
MR 56	Male	25-40	32.5	26*
MR 58	Male	30-40	35	24*
MR 51	Male	30-40	35	13
MR 28	Male	30-40	35	28
MR 48	Male	35-45	40	31
MR 5	Male	35-45	40	25
MR 13	Male	35-50	42.5	26
MR 49	Male	35-50	42.5	26
MR 14	Male	35-50	42.5	22
MR 43(B)	Male	40-60	50	31
MR 29	Male	40-60	50	13
MR 26	Male	50+	60	23
MR 32	Male	50-60	55	20
MR 63(ii)	Male	Unknown		15
MR 17	Male	Unknown		13
MR 20	Female	20-25	22.5	28
MR 24	Female	20-25	22.5	7
MR 7	Female	18-35	26.5	32
MR 43A	Female	30-50	40	7
MR 6	Female	35-50	42.5	17
MR 38	Female	35-50	42.5	29
MR 3	Female	40-50	45	16
MR 45	Unknown	40-55	47.5	19
MR 61	Female	40-60	50	32
MR 57	Unknown	40+	55	10
MR 4	Female	50+	60	18
MR 21	Female	50+	60	8
MR 8	Female	45-55	50	27
shaft MR 53	Female	Unknown		5
shaft MR 33	Female	Unknown		10
shaft MR 10	Unknown	Unknown		5
MR 9	Unknown	Unknown		2

* = MR 56 has an extra upper right incisor, MR 58 has an extra upper left incisor

Table 4: Age groups Marina Residence

Age	Total	Sex		Total no. of teeth
17 – 40	19	Male	14	**324**
		Female	4	**94**
41 +	15	Male	7	**161**
		Female	7	**147**
		Unknown	2	**19**
Unknown age	6	Male	2	**28**
		Female	2	**15**
		Unknown	2	**7**
Total	**40**		**40**	**795**

3.2.3 Polyoak:

The group from Polyoak site fitting the criteria outlined for this study consists of a total of 9 individuals with 2 males and 7 females. Their ages range from 18.5 to over 50 years old with the largest group being of young adults (17 – 35) standing at 5 individuals while the mature adults and old individuals consist of 1 and 3 people respectively. The tooth count per mouth ranges from a minimum of 12 to 30 with a total of 210 teeth for this site.

Table 5: Age and sex estimates by Friedling (per comm.)

Accession number	Sex	Age	Midpoint of age range	Number of teeth
ISOLATED REMAINS # 13	Female	- /+ 20	20	26
BURIAL # 8	Female	17 - 20	18.5	31
ISOLATED REMAINS # 7 (a)	Female	Late 20's	27	25
ISOLATED REMAINS # 1&5?	Female	20 - 25	22.5	30
BURIAL # 12	Female	35	35	28
BURIAL # 15	Female	50 +	60	12
BURIAL # 14	Female	40 - 60	50	30
ISOLATED REMAINS # 8	Male	35 - 40	37.5	16
BURIAL # 19	Male	50 +	60	12

Table 6: Age groups Polyoak Site

Age	Total	Sex		Total no. of teeth
17 – 40	6	Male	1	**16**
		Female	5	**140**
41 +	3	Male	1	**12**
		Female	2	**42**
Total	**9**		**9**	**210**

Chapter 4 METHODS

Archaeological excavations rarely yield complete human skeletal remains therefore the analysis of any given samples is always limited to whichever state the remains are found in. In the majority of cases fragmentary remains are all that can be salvaged. Teeth are made up of one of the hardest materials in the body, hydroxyapatite crystals (Hillson, 1996), making them highly resistant to adverse burial conditions therefore generally well recovered from archaeological sites. The surrounding maxilla and mandible as characteristic of bone are more susceptible to adverse burial conditions than teeth are, and therefore do not always survive. **Individuals for this study were selected on the following criteria:**

1. **Presence of at least one tooth, which can be associated with a specific burial or individual. Isolated loose teeth that could not be linked to any specific burial or individual were excluded from the calculations**

2. **All individuals were aged and sexed from osteological features. Individuals too fragmentary to age and sex were still included in the data set where ages and sexes were pooled.**

3. **Broken teeth were included for metric analysis only if the mesiodistal and buccolingual diameters were intact.**

4.1 Demographic analysis

4.1.1 Determination of age and sex

Age and sex had been determined previously for the Cobern Street sample (Apollonio 1998, Morris 1997, Cox 1999) as well as Marina Residence sample (Friedling, per comm. 2006) and the Polyoak sample (Morris, 2000). For this study the sample age range was limited to only adult individuals, with the skeletal maturity age as defined by the union of epiphysis of the proximal and distal humerus; distal radius; proximal and distal femur and medial clavicle (Ubelaker, 1989). Individuals whose assessment for both the skeleton and dentition fit the criterion of juveniles as defined by lack of union of epiphyseal centres, the presence of deciduous dentition and/or lack of eruption of permanent teeth except for M3 which is treated with caution (Krogman and Iscan, 1986; Schour and Massler, 1940) were excluded from the samples.

The choice of which part was used to age varied for each individual because it relied heavily on what was recovered from the excavation and how well it was preserved. The criteria for ageing adults include age related morphological changes of the pubic symphyseal face, auricular surface of the os coxae, sternal extremity of ribs (Loth and Iscan, 1989), union of epiphyses in the post-cranial skeleton (Ubelaker, 1989) and cranial suture closure. To facilitate analysis as well as a standard for comparative purposes with similar archaeological samples the age groups are divided into two broad groups, young adults and older adults. This is a classification adopted by Morris (1992) which basically uses osteological age landmarks whereby younger adults do not yet show skeletal degenerative changes while older adults do. Morris' (1992) age categories were 21 – 40 and 41+ respectively while this study will extend young adults to include calendar ages 17, 18, 19 and 20 to compensate for the younger ages as previously determined by earlier authors.

The author has set 70 years as the maximum age for all individuals in this study. For example in cases where individuals were aged by previous authors as just 40+, 50+ and 60+ respectively, the author would add that number to the given maximum of 70 years and divide by 2 to get the midpoint age which was then used in the analysis of the data.

Sex was assessed using sexual dimorphism in the pelvis: the subpubic region, greater sciatic notch, preauricular sulcus, and pubic symphysis, as well as the morphological differences in the skull; nuchal crest, mastoid process, supra-orbital margin, glabella and the mental eminence (Buikstra and Ubelaker, 1994). Where individual's sex and/or age could not be positively assessed but some teeth were present, dental hygiene, pathologies, dental metric traits, dental non-metric traits, aesthetic and unintentional dental modifications were still observed with the aim of making inferences with regards to the greater population under study.

4.2 Dental health

4.2.1 Dental/Oral Hygiene

The presence of dental calculus on the teeth of human remains found in an archaeological setting is often attributed to poor oral/ dental hygiene (Hillson, 1996; Patterson, 1984). The interaction of proteins, amino acids and carbohydrates together with 'normal' oral microbes facilitates the formation of dental plaque (Hillson, 1986; 1996; Larsen, 1997). The mineralization of this dental plaque is termed dental calculus (Hillson, 1996). This study accepts the presence of dental calculus as an indication of poor oral/dental hygiene. The standard set out by (Buikstra and Ubelaker, 1994) for recording calculus presence is used with the following grades:

- 0 = absent,
- 1 = small quantity,
- 2 = moderate quantity
- 3 = large quantity

No distinction is made between supra-gingival and sub-gingival types of calculus. Where there is no visible calculus on a given tooth no attempt is made to reconstruct its presence in relation to presence of calculus on adjacent teeth and the score given is 0.

4.2.2 Dental Pathologies

Dental caries and alveolar abscessing are the pathological variables assessed in this study. Dental caries is defined as the progressive demineralisation of dental tissue (Hillson, 1996). "It is characterised by acid demineralisation, proteolysis and microbial invasion and results in the destruction of hard tissue to form a cavity" (Patterson, 1984 pg 62). Buikstra and Ubelaker (1994) contend that reliability of recording caries incidence is dramatically increased if only cases where enamel is penetrated are recorded however some investigators (Hillson, 1986; 1996; Larsen, 1997) do not highlight this point in detail in their respective methodologies. Morris' (1984) caries observation criterion is much more specific in that he only considers lesions with a definite break in the enamel in which one can insert a probe (personal comm. October 2006).

The pathology of caries is characterized by four stages namely: the early lesion; phase of nonbacterial enamel crystal destruction; cavity formation and bacterial invasion of enamel (Cawson *et al*, 2002). The early lesion is seen as a white opaque spot that has an area of demineralization (only microscopically visible) below the surface of the intact enamel (Cawson *et al*, 2002). Due to action of food, saliva and bacterial activity, this white opaque spot can get heavily stained or darkened (personal comm. Phillips, 2006). The present investigator found that cavities in the enamel are extremely difficult to discern macroscopically especially if the given tooth (usually molars) has fissure caries whereby the lesion is already positioned within the surface folds. In the light of this discovery and also because early carious lesions do present with enamel demineralization below intact surface enamel, the present study resolved to record the caries presence in a similar manner to Morris (1992) although no probe was used and the observations were only visual. Carious lesions without a break in the enamel were excluded. It should be noted that this method of recording just cavities is seen by the current investigator as inherently under reporting of caries incidence. It has been observed in the present study that early stages of caries with darkened lesions form a substantial area of dental surface landscape. Cavitations in the crown were only visually assessed and very deeply darkened lesions on the teeth which represent early carious lesions were excluded. The standards by Buikstra and Ubelaker (1994) were used to record presence of caries incidence and severity.

The '*percentage of carious teeth*' which is used as the comparative tool within the Cape samples as well as for inter-sample comparisons is calculated as the total number of teeth observed to have caries (as defined above) divided by the total number of observed teeth multiplied by 100. The use of this rather conservative calculation was mainly influenced by the comparative samples (Morris, 1984; Steyn, 1994; Maat *et al*, 2002; Onisto *et al*, 1998; Khudabux, 1991 and Van Der Merwe, 2006) used in this study, which do not have the correction recalibrations. The caries recalibrations (Lukacs, 1995; Erdal and Duyar, 1999) attempt to incorporate firstly: the ante mortem tooth loss possibly due to caries and attrition and secondly: the disproportional post mortem losses between anterior and posterior teeth respectively. The correction factor by Lukacs (1995) does not take into account teeth lost due to periodontal disease, deliberate extraction and trauma, with the first two variables as factors to consider in an 18th and 19th century African context. Erdal and Duyar (1999) recommended that their proportional correction factor be used in conjunction with the Lukacs (1995) caries correction factor. The author holds the view that the Lukas (1995) correction factor is not suitable for the current study given the reasons above and as a result thereof, the Erdal and Duyar (1999) correction factor too cannot be used.

Alveolar abscessing is a pathological condition which usually results from dental caries, periodontal disease and spontaneous idiopathic phenomena (Buikstra and Ubelaker, 1994) or in some cases results from dental trauma and occlusal attrition (Patterson, 1984). Alveolar abscessing is the end product of an inflammatory process characterized by tissue necrosis and pus formation

(Patterson, 1984). With the build-up of inflammatory exudates, there is a tendency for untreated abscesses to form a fistula through the buccal plate of the alveolar bone, although other routes are possible (Spounge (1973) as quoted by Patterson (1984 pg 76). Alveolar abscessing is recorded here in this study as outlined by Buikstra and Ubelaker (1994).

- 1 = buccal/labial channel
- 2 = lingual perforation

4.2.3 Growth Disruption

Enamel hypoplasia is a developmental abnormality where the episodic layering of enamel is disrupted. It is characterised by macroscopic defects on the enamel ranging from small pits on the surface, a linear row of pits to a linear furrow or groove (Patterson, 1984). These defects are believed to be caused by a variety of systemic stresses such as malnutrition or infectious diseases (Buikstra and Ubelaker, 1994; Handler *et al*, 1982). Although there is a great variation in hypoplastic lesions, this study limited its observations to linear enamel hypoplasia type of lesions set out in Buikstra and Ubelaker (1994). Absence or presence of macroscopically visible linear enamel hypoplasias as listed above were recorded on all tooth types. No attempt was made to record the position or exact location of the linear enamel hypoplasia on the given tooth. This was all done with the aide of an illuminating magnifying glass.

4.3 Occlusal wear

Occlusal wear occurs due to normal physiological attrition and abrasion (Hillson, 1986). Occlusal wear was scored on an 8 point system by Molnar (1971) for all tooth types. In this system 'various degrees of wear were assigned categories on the basis of the criteria on dentine exposure' (Molnar, 1971).

Table 7: Molnar Occlusal Wear Score Categories (1971)

Wear Category	Incisor and Canine	Premolar	Molar
1	unworn	unworn	unworn
2	Wear facet minimal in size	Wear facet, no observable dentine	Wear facet, no observable dentine
3	Cusp pattern obliterated, small dentine patch maybe be present	Cusp pattern partially or completely obliterated, small dentine patches maybe be present	Cusp pattern partially or completely obliterated, small dentine patches maybe be present
4	Dentine patch (minimal)	Two or more dentine patches, one of large size	Three or more small dentine patches
5	Dentine patch (extensive)	Two or more dentine patches, secondary dentine may be slight	Three or more large dentine patches, secondary dentine, none to slight
6	Secondary dentine(moderate to extensive)	Entire tooth still surrounded by enamel, secondary dentine moderate to heavy	Secondary dentine moderate to extensive, entire tooth surrounded by enamel,
7	Crown (enamel) worn away on at least one side, extensive secondary dentine	Crown (enamel) worn away on at least one side, extensive secondary dentine	Crown (enamel) worn away on at least one side, extensive secondary dentine
8	Roots functioning in occlusal surface	Roots functioning in occlusal surface	Roots functioning in occlusal surface

This system of scoring occlusal wear on an 8 point scale as opposed to the 4 point scale previously used by Morris (1984); Smith (1984) and Brothwell (1989) is more varied and highly reliable in scoring premolars which are more problematic to score. No attempt was made to distinguish between attrition and abrasion or score the direction of wear. Where possible all the teeth present were assigned occlusal wear scores. The average wear score for the individual will be sum of all the wear scores on all the teeth present for that individual divided by the total number of teeth present for that individual. The same system is applied to get averages for the following:

- Maxillary average = M_{-max}
- Mandibulary average = M_{-man}
- Average for anterior dentition (incisors + canines) = M_{-ant}
- Average for posterior dentition (premolars + molars) = M_{-post}

No attempt was made to assign occlusal wear scores to missing teeth.

4.4 Behaviours

4.3.1 Aesthetic Modification

Each of the tooth types was thoroughly examined under the illuminating magnifying glass for any form of aesthetic modification and marked present or absent. The position and type of the modification was also noted whether, mesial and/or distal edge; labial and/or lingual surface or the combination of these to make it possible to group similar forms of modification. The classification of aesthetic modification in the literature is specific for the given population under study (Handler *et al*, 1982; Larsen, 1985; Cox and Sealy 1997; Morris, 1998; Blakey and Rankin-Hill, 2004) since this phenomenon has been described as a bio cultural attribute possibly linked to social distinction and cultural integration (Tieslerbos and Frausto, 2001).

4.3.2 Unintentional Modification

The form of unintentional modification observed is pipe smokers wear which is sometimes classified as habitual wear (Buikstra and Ubelaker, 1994).The exact location of pipe smoker's modification and tooth type involved were recorded. Where the teeth were out of their sockets an attempt was made to reconstruct the groove for the pipe smokers wear. A minimum of three adjacent or opposing teeth were used to positively identify pipe smokers wear:

1. Two adjacent teeth in maxilla with pipe smoke grooves plus a corresponding mandibulary tooth also exhibiting a corresponding groove or
2. Two adjacent mandibulary teeth with a pipe smokers groove plus a corresponding maxillary tooth also exhibiting a corresponding groove.

4.5 Geographic origins/population affinities

4.5.1 Dental Metric Traits

The metric traits observed include mesiodistal and buccolingual dimensions. These measurements were recorded using a digital calliper with the aid of an illuminating magnifying glass. For each tooth observed, three measurements were taken for the buccolingual as well as for the mesiodistal diameters and the average used as the true value to reduce observer error (Perez Perez *et al*, 1990). Mesiodistal and buccolingual diameters have been utilised in the literature to 'investigate diversity of local and regional population groups (Brace and Hinton, 1981; Hanihara and Ishida, 2005) as well as give a systematic analysis of world wide geographic variation (Hanihara and Ishida, 2005). The two variables, mesiodistal and buccolingual diameters, best describe tooth size and shape (Mayhall, 2000).

The mesiodistal length in this study is measured as the maximum crown width of the tooth crown in the mesiodistal plane (Buikstra and Ubelaker, 1994).

The buccolingual diameter was measured as the 'widest diameter of the tooth, measured perpendicular to the mesiodistal plane (Buikstra and Ubelaker, 1994). Both the mesiodistal and buccolingual diameters can be impacted on by occlusal and interproximal wear respectively (Larsen, 1997; Mayhall, 2000). Teeth with an occlusal wear score 6 according to the Molnar, 1971 scale were excluded.

4.5.2 Dental Non-Metric Traits

The Arizona State University Dental Anthropology System (ASUDAS) (Turner *et al*, 1991) was used. This system uses a set of graded dental casts for the permanent dentition for morphological variants which are commonly observed within archaeological samples, have low sexual dimorphism and are readily observable (Turner *et al*, 1991; Buikstra and Ubelaker, 1994). A total of 22 variables were observed for the maxilla and 20 for the mandible. To maximise sample size, if only one side was present, that side is scored and assumed to represent the highest expression (Irish, 2006). In the case where only one tooth was present, symmetry was assumed; all the traits observable were measured and assumed to be representative of the highest expression. The traits were dichotomized into present or absent using the Turner *et al* (1991) standardized system. Any visible expression of the trait, albeit faint, was recorded as present. This was all done with the aide of an illuminating magnifying glass. For analysis only 16 traits as defined by (Haeussler *et al* 1989) were considered even though more were measured. The aim was to measure as many traits as possible given that the remains are scheduled for reburial in the near future. It should be noted that the paucity in Southern African dental non metric morphological literature has confined this study to comparative reference by Haeussler *et al*, 1989 even though the latter study dichotomized their present or absent traits using 'criteria by Turner (1985) and Zubov (1979)' (Haeussler *et al*, 1989 page 116). The criteria used by Turner (1985) and Zubov (1979) recorded minimal expression of certain traits as absent whereas the present study recorded any noticeable expression as present. This means that the current study will have a higher frequency of expression for the traits: shovel-shaped upper first incisor; double-shovel upper first incisor; shovel-shaped upper second incisor; Carabelli's cusp; hypocone reduction; six-cusped first lower molar and the deflecting wrinkle on lower second molar.

4.6 Description/definition of maxillary non-metric variables measured (Turner *et al*, 1991)

4.6.1 Anterior dentition non-metric traits

(i) Winging

It is observed on the central incisors. This feature is the rotation of the incisors usually in the mesiolingual direction with respect to the dental arcade. In certain instances the incisors are rotated distolingually. It was recorded as present or absent.

(ii) Labial curve

It is observed on the incisors. The labial surface of the upper incisors, when viewed from the occlusal aspect, can range from being essentially flat to showing a marked degree of convexity. It was recorded as present or absent.

(iii) Shovel

It is observed on incisors and canines. It is the presence of ***lingual*** margin ridges. It was recorded as present or absent.

(iv) Double shovel

It is observed on the incisors and canines. It is the presence of ***labial*** marginal ridges. It was recorded as present or absent.

(v) Interrupt groove

It is observed on the incisors. It is a groove that crosses the cingulum and often continues down the root and is more frequent on the lateral than on the central incisors. It was recorded as present or absent.

(vi) Tuberculum dentale

It is observed on the incisors and canines. It occurs in the cingular region of the lingual surface. It takes the form of either ridges referred to as mediolingual ridges or takes the form of various degrees of expression of a cusp known as canine tubercle. It was recorded as present or absent.

(vii) Canine mesial ridge (Bushmen canine)

This trait is seen on the canines. It is characterised by the mesial ridge being larger than the distal and in pronounced cases, it possesses a distal deflection approximately two-thirds of the way down from the occlusal surface due to its attachment to the Tuberculum Dentale. The extreme form occurs with higher frequency among Africans especially the San. It was recorded as present or absent.

(viii) Canine distal accessory ridge

It is observed on the canines and is characterised by a ridge of varying expressions that occurs in the distolingual fossa between the tooth apex and the distolingual marginal ridge. It was recorded as present or absent.

(ix) Peg incisor

It is commonly found to be the upper lateral incisor. This tooth has a much reduced size and is lacking the 'normal' crown morphology. It was recorded as absent ('normal' incisor) or present (a peg incisor).

4.6.2 Posterior dentition non-metric traits

(x) Tricuspid premolar

The premolars usually have two cusps but in certain rare cases (south-western U.S Indians) a third cusp is present with varying sizes. It was recorded as present or absent.

(xi) Accessory cusps

This trait is seen in the form of small accessory cusps seen at the mesial and/or distal ends of the sagittal grooves of the upper premolars. It was recorded as present or absent.

(xii) Distosagittal ridge (Uto – Aztecan premolar)

This trait is seen on the first premolar in the form of a pronounced ridge from the apex of the buccal cusp extending to the distal occlusal border at or near the sagittal sulcus. There is also a medial rotation of the buccal surface and a buccolingual expansion of the buccal cusp. It was recorded as present or absent.

(xiii) Odontome

This trait presents as any pin-sized, spike-shaped enamel and dentine projection that occurs on the premolar occlusal surface. It was recorded as present or absent.

(xiv) Metacone

This is the distobuccal cusp or cusp 3 seen on the molars. Absence and weaker forms of expression are rare for M1 and M2. It was recorded as present or absent.

(xv) Hypocone

This is the distolingual cusp or cusp 4 seen on the molars. Absence and weaker forms of expression are more common on M1 and M2. It was recorded as present or absent.

(xvi) Cusp 5

A fifth cusp, metaconule, may occasionally be present in the distal fovea of the upper molars between the metacone and hypocone. It was recorded as present or absent.

(xvii) Carabelli's Trait

This trait is usually seen on the lingual surface of the mesiolingual cusp (protocone or cusp 1) of the upper molars in varying degrees of expression from a pit to a large free cusp. It was recorded as present or absent.

(xviii) Parastyle

This trait is most common on the buccal surface of the mesiobuccal cusp (the paracone or cusp 2) of the third molar but also may occur on other molars in the same location. It was recorded as present or absent.

(xix) Enamel extension

This is projections of the enamel border in the apical direction in seen in both premolars and molars. It was recorded as present or absent.

(xx) Root number

The root number for both the premolars and molars are assessed. The premolars usually have only one root, when two are present these will usually have a buccal root and a lingual root. Three roots usually result from the bifurcation of the buccal root. The first molar usually has three roots with the second molar having the greatest variation. The third molar usually has one or two roots, rarely five. The root number was recorded as one, two and three etc depending on what the tooth being observed presented with.

(xxi) Peg molar

It is commonly associated with the third molar, as in the case of the incisor the tooth is small and lacks normal crown morphology. It was recorded as absent ('normal' molar) or present (a peg molar).

4.6.3 General non-metric traits

(xxii) Radical number

This can be seen on all the teeth types. The trait is characterised by developmental grooves which run along the length of the root and partition the cross-sectional area of e.g. a single-rooted tooth into two or more 'unseparated' root-like divisions. The radical number was recorded as one, two and three etc depending on what the tooth being observed presented with.

(xxiii) Congenital absence

This feature can be evident in the absence of upper lateral incisors, upper second premolar and the third molar. It was recorded as present or absent (when the tooth observed is present).

4.7 Description/definition of mandibulary non-metric variables measured (Turner *et al*, 1991)

4.7.1 Anterior dentition non-metric traits

(i) Shovel

It is observed on incisors and canines. It is the presence of ***lingual*** margin ridges. It was recorded as present or absent.

(ii) Double shovel

It is observed on the incisors and canines. It is the presence of ***labial*** marginal ridges. It was recorded as present or absent.

(iii) Canine distal accessory ridge

It is observed on the canines and is characterised by a ridge of varying expressions that occurs in the distolingual fossa between the tooth apex and the distolingual marginal ridge. It was recorded as present or absent.

(iv) Canine root number

Mandibular canine can have one or two roots. This trait is scored as one or two.

4.7.2 Posterior dentition non-metric traits

(v) Premolar lingual cusp variation

There is considerable variation in the crowns of lower premolars. This ASU system only considers the number of lingual cusps and their relative size. It was recorded as present or absent. If cusp variation was present, the size of the cusps relative to each other was recorded i.e. if mesial cusp is larger than distal and vice versa.

(vi) Odontome

See above.

(vii) Anterior fovea

It is observed on the lower first molar and is located on the anterior occlusal surface; this feature is a precuspidal fossa. It was recorded as present or absent.

(viii) Cusp number

The number of cusps for each molar is observed regardless of size. The score given is the actual number of cusps observed.

(ix) Groove pattern

This is the actual groove on the occlusal surface of the molars. The scoring is a 'Y', '+' or 'X' groove pattern.

(x) Deflecting wrinkle

This trait is observed on the lower first molar. It is the form of variation of the medial ridge on cusp 2. It was recorded as present or absent.

(xi) Distal trigonid crest

This is observed on the lower molars. It is the ridge that bridges cusps 1 and 2. It was recorded as present or absent.

(xii) Mid trigonid crest

This trait is observed on the lower molars. This is the enamel bridge that joins the protoconid and metaconid. It was recorded as present or absent.

(xiii) Cusp 5

A fifth cusp, hypoconulid, occurs on the distal occlusal aspect of the lower molars. It is graded in terms of size only in the absence of cusp 6. It was recorded as present or absent. If present then it was graded according to the ASU reference plaque: 1= present and very small; 2 = small; 3 = medium-sized; 4 = large; 5 = very large

(xiv) Cusp 6

This trait is observed on the lower molars. Cusp 6, the entoconulid or tuberculum sextum, occurs in the distal fovea of the lower molars lingual to cusp 5. It is scored by size relative to cusp 5. It was recorded as present or absent. If present then it was graded according to the ASU reference plaque: 1= much smaller than cusp 5; 2 = smaller than cusp 5; 3 = equal in size to cusp 5; 4 = larger than cusp 5; 5 = much than cusp 5.

(xv) Cusp 7

This trait is observed on the lower molars. Cusp 7, the metaconulid or tuberculum intermedium occurs in the lingual groove between cusp 2 and 4 of the lower molars, most commonly on the first molar. It was recorded as present or absent.

(xvi) Protostylid

This trait is observed on the lower molars. It is a paramolar cusp found on the buccal surface of cusp 1. It is normally associated with the buccal groove separating cusps 1 and 3. This trait is most common on the first and third molars. It was recorded as present or absent.

(xvii) Molar root number

Lower molars have one to three roots. This trait is scored as one, two or three.

4.7.3 General non-metric traits

(xviii) Radical number

See above.

(xix) Congenital absence

See above.

4.8 Statistical analysis

Analysis of data using Microsoft Office Excel 2003, SPSS 11.0 for Windows and Statistica version 7.0 and 8.0

1. Graphical methods: histogram, box plots etc

These illustrations check for 'normality' i.e. if data is normally distributed and which statistical analyses are appropriate. If data is not normally distributed it will have to be transformed.

2. Descriptive measures

Calculate the mean, standard deviation, median, range and frequency distributions.

3. Hypothesis testing

Hypothesis testing is to determine how likely it is that observed differences between different sample estimates are entirely due to sampling error (chance) rather than underlying population differences.

Significance testing using Statistica version 8 as well as the Preacher (2001) chi square adjusted with a Yate's correction factor for values equal to 5 and below.

F- tests and T-tests using Microsoft Office Excel 2003

4. Measure of association

Index of similarity = the sum of the absolute values of the differences between the frequencies of each trait in the two groups under comparison, dividing by the number of traits, and subtracting from 100. The closer a value to 100 the more the two samples are alike (Haeussler *et al*, 1989). The index of similarity between the native North and South Americans is a high 95.5 with a separation time of 10 000 years. The index of similarity between Asians and Europeans is a low 72.9 (Haeussler *et al*, 1989).

Chapter 5 RESULTS

The first part of this chapter shows the dental health, which in this study includes the presence and frequencies of calculus, caries, antemortem tooth loss and abscesses. Growth disruption markers such as enamel hypoplasias conclude the dental health section. Part two gives the results of occlusal wear investigation while part three deals with behaviours as evident on the dentition and lastly part four gives the indicators of population affinities in the form of metric and non metric traits.

Health in the general sense is defined as being in a state free from disease. The state of ill health can be either intrinsic (a malfunction of the bodies own physiological processes) or extrinsic (initiated by an exogenous agent) or the combination of both these modalities. Age has been shown to be one of the factors that can play a very important role in the body's ability to maintain a healthy state. It is for this reason that the author starts every part by attempting to correlate the variables under investigation with age thereby aiding in the analysis especially of variables, which are found to be age dependant.

Each part attempts to show the differences within the given sample as well as similarities and differences for the given variables between the three populations under study. The rationale here being that if there is evidence to support it then these three groups with be treated as a homogenous entity, which can in turn be compared to other archaeological samples with similar and different histories.

5.1 Dental health

5.1.1 Dental/Oral hygiene

a. Calculus

Table 8: Cobern Street males: Calculus frequency (ranked by increasing calculus percentage)

Accession number	Age	Number of teeth	No. teeth with calculus	% Calculus
UCT 557	40	20	6	30.0
UCT 504	25	32	13	40.6
UCT 460	20	26	15	57.7
UCT 543	60	12	8	66.7
UCT 500	40	32	22	68.8
UCT 521	45	26	18	69.2
UCT 510	27.5	29	23	79.3
UCT 549	37.5	26	24	92.3
UCT 547	40	30	28	93.3
UCT 517	22.5	15	14	93.3
UCT 554	35	31	29	93.5
UCT 562	37.5	32	30	93.8
UCT 552	32.5	32	31	96.9
UCT 548	42.5	32	31	96.9
UCT 551	37.5	4	4	100
UCT 526	55	22	22	100
UCT 536	42.5	23	23	100
Totals		**424**	**341**	
Average	**37.6**	**25.2**	**20.5**	**80.4***

* = (341 ÷ 424) × 100

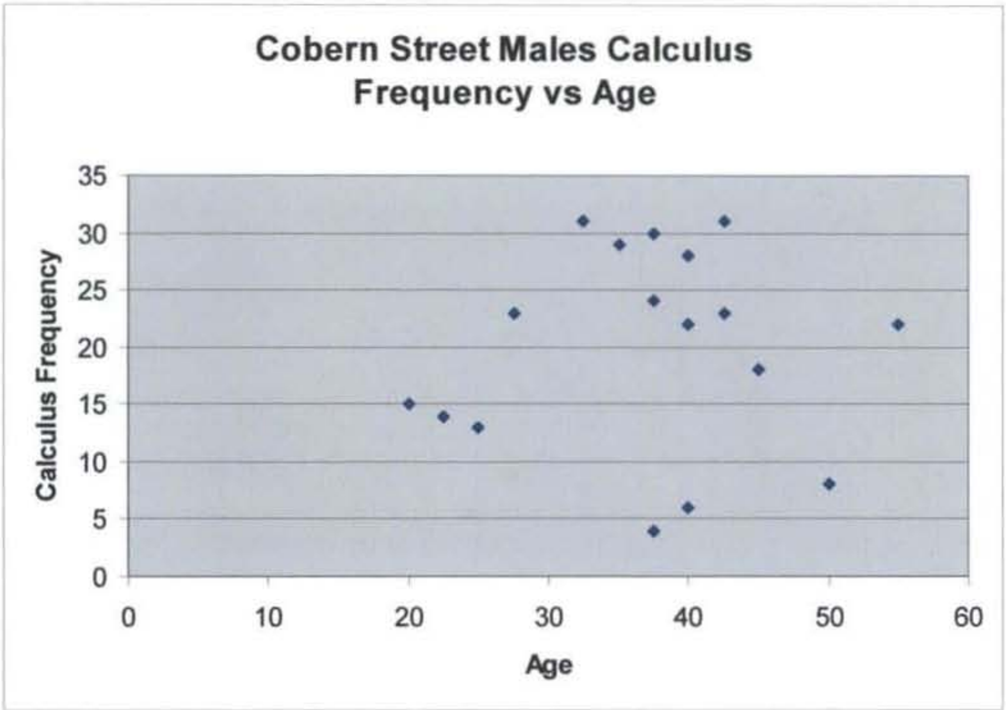

Figure 6: Cobern Street males: Calculus frequency against age

Sample size n = 17 for Cobern Street Males. The correlation coefficient is r = 0.081. The critical value for n=17 at 95% confidence interval = 0.482 (Rohlf and Sokal, 1969) therefore there is **NO SIGNIFICANT CORRELATION**

Table 9: Cobern Street females: Calculus frequency (ranked by increasing calculus percentage)

Accession number	Age	Number of teeth	No. teeth with calculus	% Calculus
UCT 498	37.5	30	15	50.0
UCT 514	30	27	15	55.5
UCT 563	23.5	30	18	60.0
UCT 559	20	31	19	61.3
UCT 542	45	27	22	81.5
UCT 508	45	28	23	82.1

Table 9 (cont.): Cobern Street females: Calculus frequency (ranked by increasing calculus percentage)

Accession number	Age	Number of teeth	No. teeth with calculus	% Calculus
UCT 558	30	31	26	83.9
UCT 556	30	26	22	84.6
UCT 502	50	29	25	86.2
UCT 555	25	27	25	92.6
UCT 544	42.5	24	24	100
Totals		**310**	**234**	
Average	**34.4**	**28.2**	**21.3**	**75.5***

* = (234 ÷ 310) × 100

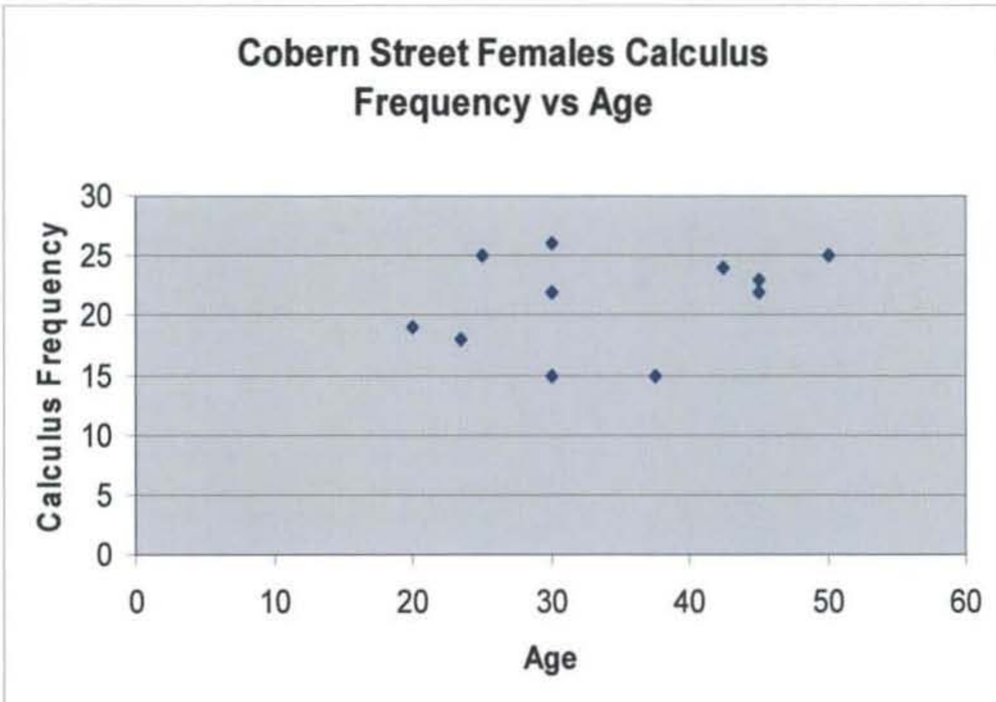

Figure 7: Cobern Street females: Calculus frequency against age

Sample size n = 11 for Cobern Street Females. The correlation coefficient is r = 0.311. The critical value for n=11 at 95% confidence interval = 0.602 (Rohlf and Sokal, 1969) therefore there is **NO SIGNIFICANT CORRELATION**. The lack of significant correlations between Cobern Street males and females calculus frequency with age suggests that the young and older adults in this sample **should be pooled.**

Table 10: Cobern Street calculus sex differences (young and older adults pooled) using a chi square test.

	Teeth with calculus	Teeth without calculus	Total	
CS Males	341	83	424	
CS Females	234	76	310	$x^2 = 2.576$
Total	575	159	734	P= 0.108

*P > 0.05 therefore there is **NO SIGNIFICANT** difference between calculus frequencies in males and females of Cobern Street.

Table 11: Marina Residence males: Calculus frequency (ranked by increasing calculus percentage)

Accession number	Age	Number of teeth	No. teeth with calculus	% Calculus
MR 5	40	25	14	56.0
MR 31	25	30	17	56.7
MR 39	18	27	16	57.1
MR 17	unknown	13	8	61.5
MR 13	42.5	26	18	69.2
shaft MR 56	32.5	10	7	70.0
MR 43(B)	50	31	23	74.2
MR 33	32.5	26	21	80.7
MR 26	60	23	19	82.6
MR 51	35	13	11	84.6
MR 49	42.5	26	22	84.6
MR 10	26.5	8	7	87.5
MR 58	35	24*	21	87.5
MR 29	50	13	12	92.3
MR 56	32.5	26*	25	96.2
MR 46	30	28	27	96.4

Table 11 (cont.): Marina Residence males: Calculus frequency (ranked by increasing calculus percentage)

Accession number	Age	Number of teeth	No. teeth with calculus	% Calculus
MR 63(ii)	unknown	15	15	100
MR 32	55	20	20	100
MR 14	42.5	22	22	100
MR 34	25	28	28	100
MR 28	35	28	28	100
MR 25	26.5	30	30	100
MR 48	40	31	31	100
Total		**523**	**442**	
Average	**40.8**	**24.9**	**21**	**84.5***

* = *these individuals have supernumerary teeth (a total of 33 erupted teeth), MR 56 has an extra upper right incisor, MR 58 has an extra upper left incisor*

* = (442 ÷ 523) × 100

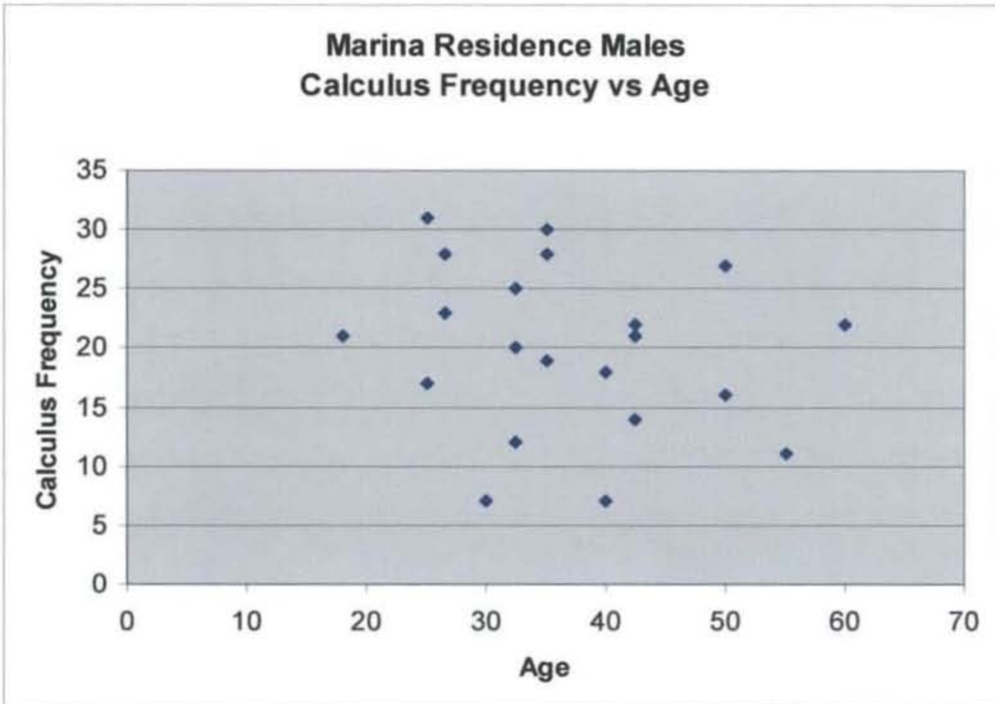

Figure 8: Marina Residence males: Calculus frequency against age

Table 10: Cobern Street calculus sex differences (young and older adults pooled) using a chi square test.

	Teeth with calculus	Teeth without calculus	Total	
CS Males	341	83	424	
CS Females	234	76	310	$x^2 = 2.576$
Total	575	159	734	P= 0.108

*P > 0.05 therefore there is **NO SIGNIFICANT** difference between calculus frequencies in males and females of Cobern Street.

Table 11: Marina Residence males: Calculus frequency (ranked by increasing calculus percentage)

Accession number	Age	Number of teeth	No. teeth with calculus	% Calculus
MR 5	40	25	14	56.0
MR 31	25	30	17	56.7
MR 39	18	27	16	57.1
MR 17	unknown	13	8	61.5
MR 13	42.5	26	18	69.2
shaft MR 56	32.5	10	7	70.0
MR 43(B)	50	31	23	74.2
MR 33	32.5	26	21	80.7
MR 26	60	23	19	82.6
MR 51	35	13	11	84.6
MR 49	42.5	26	22	84.6
MR 10	26.5	8	7	87.5
MR 58	35	24*	21	87.5
MR 29	50	13	12	92.3
MR 56	32.5	26*	25	96.2
MR 46	30	28	27	96.4

Sample size n = 21 for Marina Residence males. The correlation coefficient is r = -0.198. The critical value for n=21 at 95% confidence interval = 0.433 (Rohlf and Sokal, 1969) therefore there is **NO SIGNIFICANT CORRELATION**

Table 12: Marina Residence females: Calculus frequency (ranked by increasing calculus percentage)

Accession number	Age	Number of teeth	No. teeth with calculus	% Calculus
MR 7	26.5	32	16	50.0
shaft MR 53	unknown	5	3	60.0
MR 20	22.5	28	17	60.7
MR 4	60	18	15	83.3
MR 43A	40	7	6	85.7
MR 21	60	8	7	87.5
MR 38	42.5	29	26	89.7
MR 3	45	16	15	93.8
MR 6	42.5	17	16	94.1
MR 8	50	27	26	96.3
MR 24	22.5	7	7	100
shaft MR 33	unknown	10	10	100
MR 61	50	32	32	100
Total		**236**	**196**	
Average	**41.5**	**18.2**	**15.1**	**83.1***

* = $(196 \div 236) \times 100$

P > 0.05 therefore there is **NO SIGNIFICANT** difference between calculus frequencies in males and females of Marina Residence. This lack of significant difference between males and females makes it possible to include the four individuals with unknown sex listed in Table 11 below. Therefore with regards to calculus frequency Marina Residence has a sample of 36 (age and sex pooled).

Table 14: Marina Residence unknown sex: Calculus frequencies.

Accession number	Number of teeth	No. teeth with calculus	% Calculus
MR 45	19	19	100
MR 9	2	2	100
shaft MR 10	5	0	0
MR 57	10	9	90
Total	**36**	**30**	**83.3**

Table 15: Marina Residence calculus sex differences for all individuals

	Teeth with calculus	Teeth without calculus	Total
MR Males	442	81	523
MR Females	196	40	236
MR unknown sex	30	6	36
Total	668	127	795

Table 16: Cobern Street and Marina Residence: Calculus frequency comparison (sexes pooled)

	Teeth with calculus	Teeth without calculus	Total	
CS	575	159	734	
MR*	668	127	795	x^2=8.118
Total	1243	286	1529	P=0.0044

* = sexed, unsexed and ages pooled

P < 0.05 therefore there is **SIGNIFICANT** difference between Calculus Frequencies in Cobern Street and Marina Residence.

Table 17: Polyoak Calculus frequency:

Accession number	Sex	Age	Number of teeth	No. teeth with calculus	% Calculus
IR # 13	♀	20	26	21	80.0
BURIAL # 8	♀	18.5	31	10	32.2
IR # 7 (a)	♀	27.5	25	10	40.0
IR # 1&5?	♀	22.5	30	0	0
BURIAL # 12	♀	35	28	14	50.0
BURIAL # 15	♀	60	12	2	16.7
BURIAL # 14	♀	50	30	15	50.0
IR # 8	♂	37.5	16	12	75.0
BURIAL # 19	♂	60	12	1	8.3
Total			**210**	**85**	
Average		**36.8**	**23.3**	**9.4**	**40.5**

Table 18: Cobern Street, Marina Residence and Polyoak calculus frequency

	% individuals with calculus	Teeth with calculus	Teeth without calculus	% of teeth with calculus	Total
CS	**100**	**575**	**159**	**78.3**	**734**
MR	**100**	**668**	**127**	**84**	**795**
PO	**88.9**	**85**	**125**	**40.5**	**210**
Total	**100**	**1328**	**411**	**76.4**	**1739**
				x^2=177.293	**P = 0**

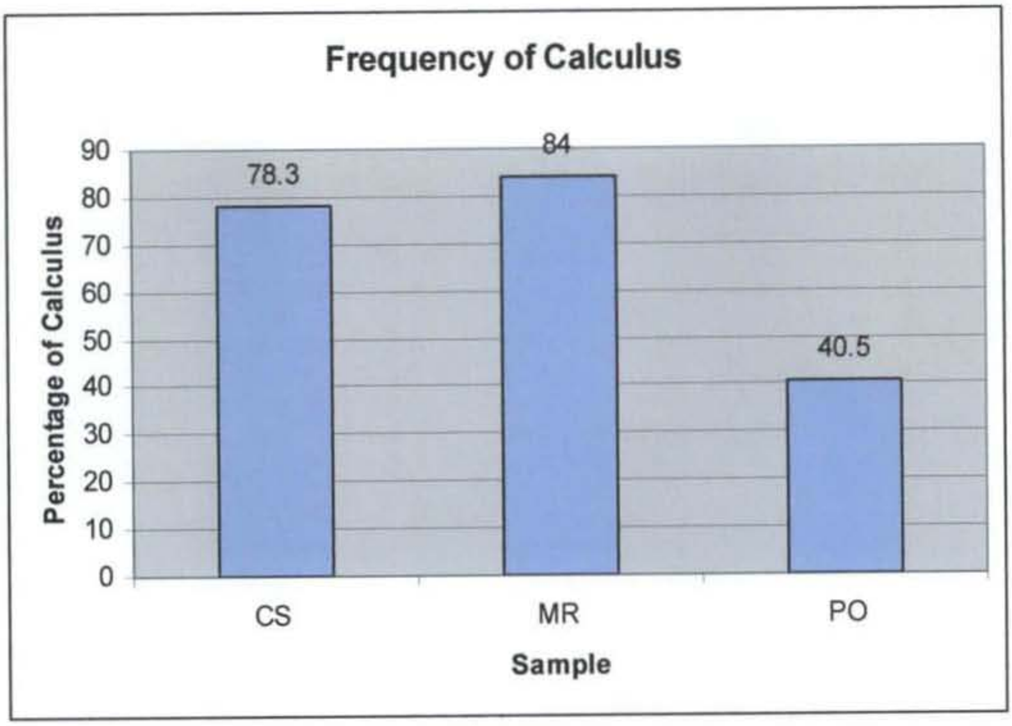

Figure 10: Cobern Street, Marina Residence and Polyoak calculus frequency

5.1.1.2 Calculus frequency summary

Calculus frequency is not significantly correlated to age for both Cobern Street and Marina Residence samples. The Polyoak calculus frequency cannot be tested for correlation with age because of the small sample size. Of the 1739 teeth examined, 76.4% show some calculus deposition. Nearly all the individuals with the exception of Polyoak have tartar deposits. There is no significant sex differences between the Cobern Street ($x^2 = 2.576$; P= 0.108) and Marina Residence ($x^2 = 0.259$; P= 0.611) samples. There is a significant difference ($x^2 = 8.118$; P = 0.0044) between the calculus frequencies of Cobern Street and Marina Residence. When all three samples are tested for chi square significance with regards to the calculus frequency there is a significant difference ($x^2 = 177.293$; P = 0)

5.1.2 Dental Pathologies

a. Caries

Table 19: Cobern Street males: Caries frequency (ranked by increasing caries percentage)

Accession number	Age	Number of teeth	No. teeth with caries	% Caries
UCT 554	35	31	0	0
UCT 562	37.5	32	0	0
UCT 526	55	22	0	0
UCT 504	25	32	0	0
UCT 548	42.5	32	0	0
UCT 510	27.5	29	2	6.9
UCT 460	20	26	2	7.7
UCT 547	40	30	3	10.0
UCT 552	32.5	32	4	12.5
UCT 517	22.5	15	2	13.3
UCT 543	60	12	2	16.7
UCT 536	42.5	23	4	17.4
UCT 500	40	32	6	18.8
UCT 521	45	26	6	23.1
UCT 549	37.5	26	9	34.6
UCT 551	37.5	4	2	50.0
UCT 557	40	20	17	85.0
Total		**424**	**59**	
Average	**37.6**	**24.9**	**3.5**	**13.9***

* = $(59 \div 424) \times 100$

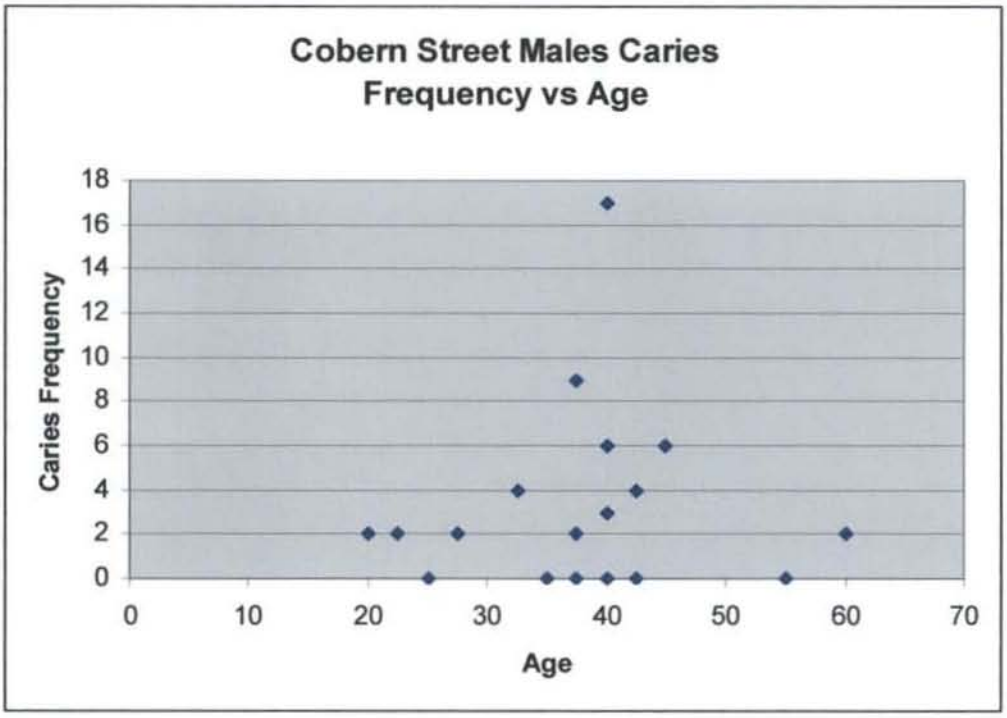

Figure 11: Cobern Street males: Caries frequency against age

Sample size n = 17 for Cobern Street males. The correlation coefficient is r = 0.073. The critical value for n=17 at 95% confidence interval = 0.482 (Rohlf and Sokal, 1969) therefore there is **NO SIGNIFICANT CORRELATION**

Table 20: Cobern Street females: Caries frequency (ranked by increasing caries percentage)

Accession number	Age	Number of teeth	No. teeth with caries	% Caries
UCT 563	42.5	30	0	0
UCT 559	20	31	0	0
UCT 558	30	31	1	3.2
UCT 555	25	27	2	7.4
UCT 544	42.5	24	2	8.3
UCT 514	30	27	3	11.1
UCT 498	37.5	30	5	16.7
UCT 542	45	27	5	18.5

Table 20 (cont.): Cobern Street females: Caries frequency (ranked by increasing caries percentage)

Accession number	Age	Number of teeth	No. teeth with caries	% Caries
UCT 508	45	28	9	32.1
UCT 556	30	26	15	57.7
UCT 502	50	29	17	58.6
Total		**310**	**59**	
Average	**36.1**	**28.2**	**5.4**	**19.0***

* = (59 ÷ 310) × 100

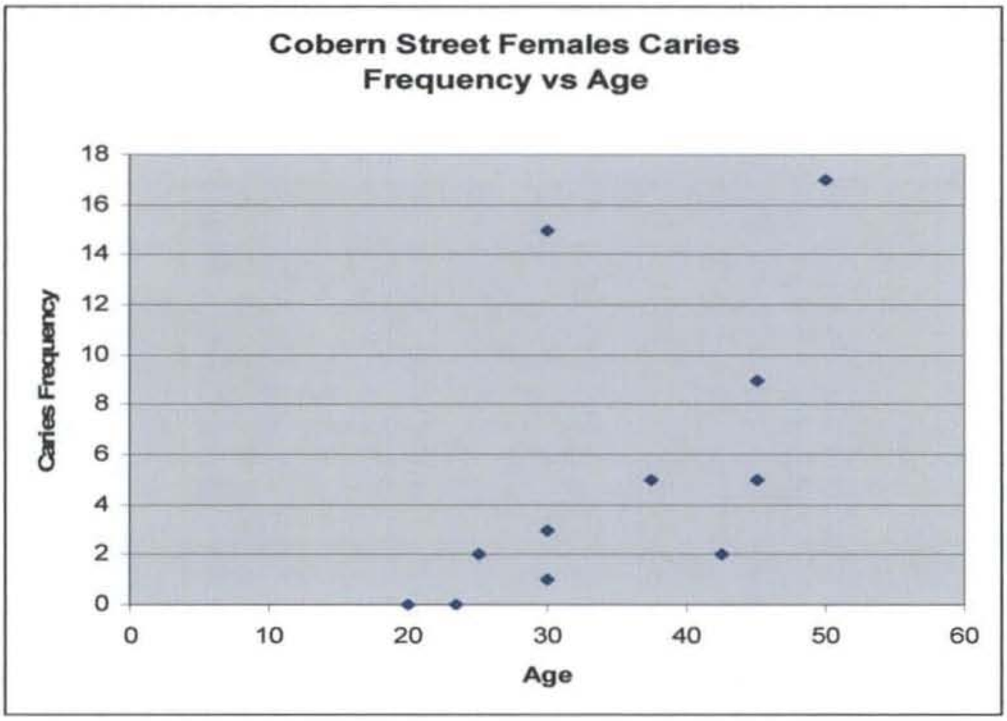

Figure 12: Cobern Street females: Caries frequency against age

Samples size n = 11 for Cobern Street females. The correlation coefficient is r = 0.577. The critical value for n=11 at 95% confidence interval = 0.602 (Rohlf and Sokal, 1969) therefore there is **NO SIGNIFICANT CORRELATION**. The lack of significant correlations between both Cobern Street males and females with age suggest that the caries frequencies for the young and older adults in this sample **should be pooled**.

Table 21: Cobern Street caries sex differences (young and older adults pooled) using chi-square

	Teeth with caries	Teeth without caries	Total	
CS Males	**59**	**365**	**424**	
CS Females	**59**	**251**	**310**	**x^2=3.476**
Total	**118**	**616**	**734**	**P=0.062**

P > 0.05 therefore there is **NO SIGNIFICANT** difference between caries frequencies in males and females of Cobern Street. The lack of significance in the means of Cobern Street males and females caries frequencies suggests that the caries frequencies for the males and females in this sample **should be pooled**.

Table 22: Caries frequency summary Cobern Street

Tooth type	MALE			FEMALE			TOTAL			S
	N^1	N^2	%	N^1	N^2	%	N^1	N^2	%	
I1	52	3	12.00	38	2	5.26	90	5	5.56	p= 0.7134
I2	52	4	7.69	29	4	13.79	81	8	9.88	p=0.6822
C	59	6	10.17	44	8	18.18	103	14	13.59	p=0.3082
P1	61	3	4.92	41	8	19.5	102	11	10.78	p=0.0804
P2	60	6	10.00	41	7	19.5	101	13	12.87	p=0.3623
M1	58	10	17.24	36	10	27.78	94	20	21.28	p=0.3895
M2	59	15	25.42	37	8	21.62	96	23	23.96	p=0.7384
M3	52	12	23.08	34	12	35.29	86	24	27.91	p=0.3581
TOTAL	453	59		300	59		753	118		

N^1 = total number of teeth present per tooth type

N^2 = total number of teeth with caries per tooth type

S = p value for chi square test between men and women

Table 23: Marina Residence males: Caries frequencies (ranked by increasing caries percentage)

Accession number	Age	Number of teeth	No. teeth with caries	% Caries
MR 31	25	30	0	0
MR 34	25	28	0	0
MR 29	50	13	0	0
MR 25	26.5	30	0	0
MR 13	42.5	26	0	0
MR 10	26.5	8	0	0
MR 28	35	28	1	3.57
MR 33	32.5	26	2	7.7
MR 48	40	31	3	9.68
MR 43(B)	50	31	3	9.68
MR 63(ii)	Unknown	15	3	20
MR 56	32.5	26*	3	11.54
MR 39	18	27	3	11.11
MR 17	Unknown	13	3	23.08
shaft MR 56	32.5	10	3	30
MR 46	30	28	4	14.3
MR 14	42.5	22	5	22.8
MR 49	42.5	26	5	19.2
MR 32	55	20	6	30
MR 26	60	23	6	26.09
MR 58	35	24*	6	25
MR 51	35	13	6	46.15
MR 5	40	25	16	64
Total		**523**	**78**	
Average	**36.9**	**22.7**	**4.6**	**14.9***

* = (78 ÷ 523) × 100

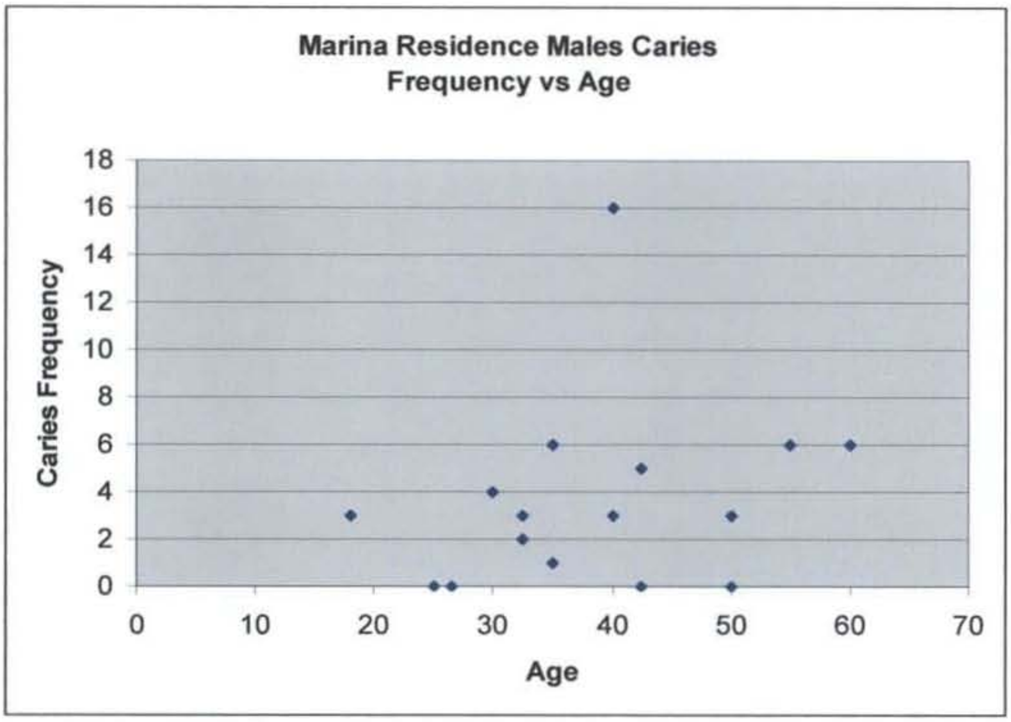

Figure 13: Marina Residence males: Caries frequency against age

Sample size n = 21 for Marina Residence males. The correlation coefficient is r = 0.323. The critical value for n =21 at 95% confidence interval = 0.433 (Rohlf and Sokal, 1969) therefore there is **NO SIGNIFICANT CORRELATION**

Table 24: Marina Residence females: Caries frequencies (ranked by increasing caries percentage)

Accession number	Age	Number of teeth	No. teeth with caries	% Caries
MR 20	22.5	28	0	0
MR 7	26.5	32	0	0
shaft MR 33	unknown	10	0	0
MR 43A	40	7	1	14.3
MR 24	22.5	7	1	14.3
MR 8	50	27	1	3.70
MR 61	50	32	2	6.25
MR 38	42.5	29	2	6.9

Table 24 (cont.): Marina Residence females: Caries frequencies (ranked by increasing caries percentage)

Accession number	Age	Number of teeth	No. teeth with caries	% Caries
shaft MR 53	unknown	5	3	60
MR 21	60	8	4	50.0
MR 6	42.5	17	8	47.06
MR 3	45	16	8	50
MR 4	60	18	12	66.67
Total		**236**	**42**	
Average	**41.9**	**18.2**	**4.2**	**17.8***

* = (42 ÷ 236) × 100

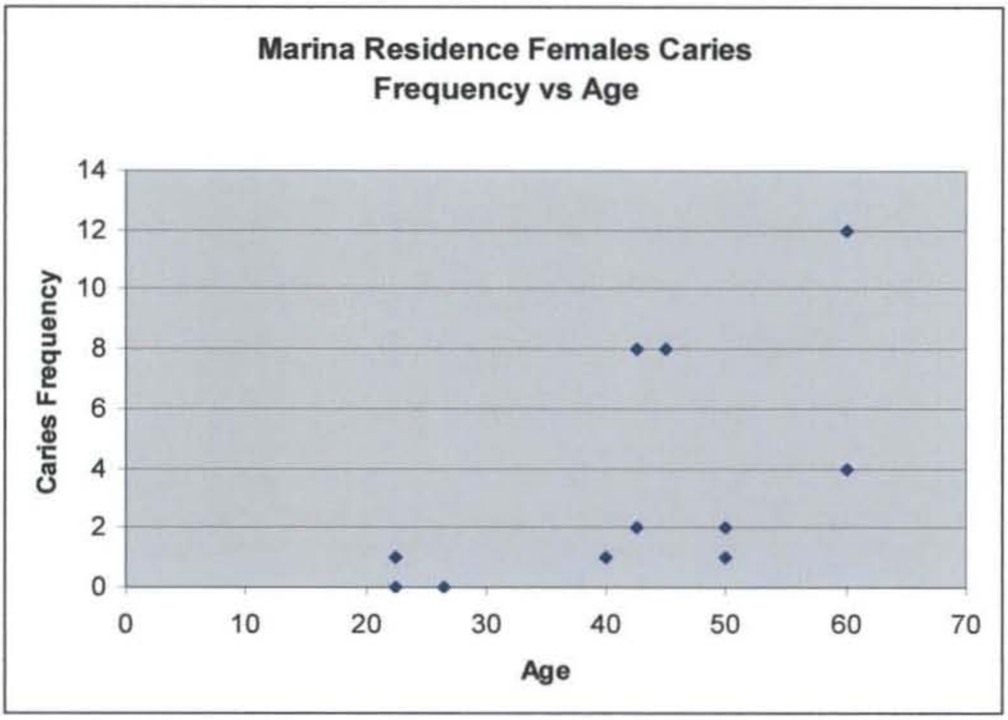

Figure 14: Marina Residence females: caries frequency against age

Sample size n = 11 for Marina Residence females. The correlation coefficient is r = 0.599. The critical value for n=11 at 95% confidence interval = 0.602 (Rohlf and Sokal, 1969) therefore there is **NO SIGNIFICANT CORRELATION**. The lack of significant correlations between Marina Residence males and females with age suggests that the caries frequencies for the young and older adults in this sample **should be pooled.**

Table 25: Marina Residence caries sex differences (young and older adults pooled) using chi-square

	Teeth with caries	Teeth without caries	Total	
MR Males	78	445	523	
MR Females	42	194	236	x^2=1.015
Total	120	639	759	P = 0.314

P > 0.05 therefore there is **NO SIGNIFICANT** difference between caries frequencies in males and females of Marina Residence. The lack of significance in the means of Marina Residence males and females caries frequencies suggests that the caries frequencies for the males and females in this sample **should be pooled.**

Table 26: Caries frequency summary Marina Residence

Tooth type	MALE			FEMALE			TOTAL			S
	N^1	N^2	%	N^1	N^2	%	N^1	N^2	%	
I1	53	4	7.55	31	3	9.68	84	7	8.33	p=0.9552
I2	65	3	4.62	30	5	1.50	95	8	8.42	p=0.1662
C	75	7	9.33	38	5	13.16	113	13	11.50	p=0.5773
P1	75	9	12.00	33	7	21.21	108	16	14.81	p=0.2920
P2	72	8	11.11	30	7	23.33	102	15	14.71	p=0.1797
M1	64	11	17.19	24	5	20.83	88	16	18.18	p=0.7442
M2	61	16	26.23	27	5	18.52	88	21	23.86	p=0.5344
M3	65	20	30.77	25	8	32	90	28	31.11	p=0.9349
TOTAL	530	78		238	45		768	125		

N^1 = total number of teeth present per tooth type

N^2 = total number of teeth with caries per tooth type

S = p value for chi square test between men and women

Table 27: Cobern Street and Marina Residence: Caries comparison (sexes pooled) using chi-square

	Teeth with caries	Teeth without caries	Total	
CS	118	616	734	
MR	120	639	759	x^2 = 0.02
Total	238	1255	1493	P = 0.888

P > 0.05 therefore there is **NO SIGNIFICANT** difference between the caries frequencies for Marina Residence and Cobern Street

Table 28: Polyoak caries frequency:

Accession number	Sex	Age	Number of teeth	No. teeth with caries	% Caries
IR # 13	♀	20	26	12	46.2
BURIAL # 8	♀	18.5	31	4	12.9
IR # 7 (a)	♀	27.5	25	7	28
IR # 1&5?	♀	22.5	30	23	76.7
BURIAL # 12	♀	35	28	8	28.6
BURIAL # 15	♀	60	12	0	0
BURIAL # 14	♀	50	30	2	6.7
IR # 8	♂	37.5	16	1	
BURIAL # 19	♂	60	12	0	0
Total			**210**	**57**	
Average		**36.8**	**23.3**		**27.1***

* = $(57 \div 210) \times 100$

Table 29: Caries frequency summary Polyoak

Tooth type	MALE			FEMALE			TOTAL			S
	N^1	N^2	%	N^1	N^2	%	N^1	N^2	%	
I1	2	0	0	19	2	10.53	21	2	9.52	-
I2	3	0	0	26	4	15.38	29	4	13.79	-
C	4	0	0	24	4	16.67	28	4	14.29	-
P1	2	1	50	26	8	30.77	28	9	32.14	-
P2	2	0	0	24	9	37.50	26	9	34.62	-
M1	2	0	0	19	11	57.89	21	11	52.38	-
M2	2	0	0	22	9	40.91	11	9	81.82	-
M3	2	0	0	23	8	34.78	10	8	80	-
TOTAL	19	1		183	55		202	56		

N^1 = total number of teeth present per tooth type

N^2 = total number of teeth with caries per tooth type

S = p value for chi square test between men and women

Table 30: Caries frequency summary (ages and sexes pooled)

Chi square test combining CS and MR against PO

	Teeth with caries	Teeth without caries	Total	
CS	**118**	**616**	**734**	
MR	**120**	**639**	**759**	
PO	**57**	**153**	**210**	**x^2 = 16.13**
Total	**295**	**1408**	**1703**	**P = 0.000059**

P < 0.05 therefore there is a **SIGNIFICANT** difference between the caries frequencies for Marina Residence and Cobern Street

Table 31: Caries frequency summary (ages and sexes pooled)

	Cobern Street	Marina Residence	Polyoak	Three sites combined
% Carious Teeth	16.1	15.8	30.8	17.3
Number of Carious Teeth per mouth	4.2	3.8	6.3	4.3
% of individuals with Caries	75	84.4	77.8	66.7

5.1.2.1 Caries frequency summary

Caries frequency is not significantly correlated to age for both Cobern Street and Marina Residence samples. The sex differences as well as the caries frequency cannot be tested for correlation with age in the Polyoak sample because of the small sample size. There is no significant sex difference in the caries frequencies of both Cobern Street and Marina Residence. This lack of sexual dimorphism is also evident when comparing the individual tooth types because all the tooth types do not show any significant differences. There is no significant difference (x^2=0.02; P=0.888) in the caries frequencies between the Cobern Street and Marina Residence samples. There is a significant difference (x^2=16.13; P=0.000059) when the caries frequencies of all three samples is compared with Polyoak being the outlier due to small sample size. Of the 1703 teeth examined, 17.3 % show signs of caries. There are a total of 4.3 carious teeth per mouth for 66.7% of the total number of individuals when the three sites are combined.

b. Antemortem tooth loss

Table 32: Cobern Street males: AMTL frequency (ranked by increasing AMTL percentage)

Accession number	Age	Number of tooth places	AMTL	% AMTL
UCT 500	40	32	0	0
UCT 552	32.5	32	0	0
UCT 554	35	32	0	0
UCT 562	37.5	32	0	0
UCT 517	22.5	16	0	0
UCT 504	25	32	0	0
UCT 551	37.5	16	0	0
UCT 548	42.5	32	0	0
UCT 510	27.5	32	1	3.44
UCT 460	20	27	1	3.70
UCT 547	40	32	2	6.25
UCT 549	37.5	32	3	9.38
UCT 536	42.5	30	3	10
UCT 526	55	32	7	21.88
UCT 521	45	32	6	23.08
UCT 557	40	32	9	28.13
UCT 543	60	28	10	35.71
Total		**501**	**42**	
Average	**37.8**	**29.5**	**4.7**	**8.4***

* = (42 ÷ 501) × 100

Table 25: Marina Residence caries sex differences (young and older adults pooled) using chi-square

	Teeth with caries	Teeth without caries	Total	
MR Males	78	445	523	
MR Females	42	194	236	x^2=1.015
Total	120	639	759	P = 0.314

P > 0.05 therefore there is **NO SIGNIFICANT** difference between caries frequencies in males and females of Marina Residence. The lack of significance in the means of Marina Residence males and females caries frequencies suggests that the caries frequencies for the males and females in this sample **should be pooled.**

Table 26: Caries frequency summary Marina Residence

Tooth type	MALE			FEMALE			TOTAL			S
	N^1	N^2	%	N^1	N^2	%	N^1	N^2	%	
I1	53	4	7.55	31	3	9.68	84	7	8.33	p=0.9552
I2	65	3	4.62	30	5	1.50	95	8	8.42	p=0.1662
C	75	7	9.33	38	5	13.16	113	13	11.50	p=0.5773
P1	75	9	12.00	33	7	21.21	108	16	14.81	p=0.2920
P2	72	8	11.11	30	7	23.33	102	15	14.71	p=0.1797
M1	64	11	17.19	24	5	20.83	88	16	18.18	p=0.7442
M2	61	16	26.23	27	5	18.52	88	21	23.86	p=0.5344
M3	65	20	30.77	25	8	32	90	28	31.11	p=0.9349
TOTAL	530	78		238	45		768	125		

N^1 = total number of teeth present per tooth type

N^2 = total number of teeth with caries per tooth type

S = p value for chi square test between men and women

Table 27: Cobern Street and Marina Residence: Caries comparison (sexes pooled) using chi-square

	Teeth with caries	Teeth without caries	Total	
CS	118	616	734	
MR	120	639	759	x^2 = 0.02
Total	238	1255	1493	P = 0.888

P > 0.05 therefore there is **NO SIGNIFICANT** difference between the caries frequencies for Marina Residence and Cobern Street

Table 28: Polyoak caries frequency:

Accession number	Sex	Age	Number of teeth	No. teeth with caries	% Caries
IR # 13	♀	20	26	12	46.2
BURIAL # 8	♀	18.5	31	4	12.9
IR # 7 (a)	♀	27.5	25	7	28
IR # 1&5?	♀	22.5	30	23	76.7
BURIAL # 12	♀	35	28	8	28.6
BURIAL # 15	♀	60	12	0	0
BURIAL # 14	♀	50	30	2	6.7
IR # 8	♂	37.5	16	1	
BURIAL # 19	♂	60	12	0	0
Total			**210**	**57**	
Average		**36.8**	**23.3**		**27.1***

* = (57 ÷ 210) × 100

Table 29: Caries frequency summary Polyoak

Tooth type	MALE			FEMALE			TOTAL			S
	N^1	N^2	%	N^1	N^2	%	N^1	N^2	%	
I1	2	0	0	19	2	10.53	21	2	9.52	-
I2	3	0	0	26	4	15.38	29	4	13.79	-
C	4	0	0	24	4	16.67	28	4	14.29	-
P1	2	1	50	26	8	30.77	28	9	32.14	-
P2	2	0	0	24	9	37.50	26	9	34.62	-
M1	2	0	0	19	11	57.89	21	11	52.38	-
M2	2	0	0	22	9	40.91	11	9	81.82	-
M3	2	0	0	23	8	34.78	10	8	80	-
TOTAL	19	1		183	55		202	56		

N^1 = total number of teeth present per tooth type

N^2 = total number of teeth with caries per tooth type

S = p value for chi square test between men and women

Table 30: Caries frequency summary (ages and sexes pooled)

Chi square test combining CS and MR against PO

	Teeth with caries	Teeth without caries	Total	
CS	**118**	**616**	**734**	
MR	**120**	**639**	**759**	
PO	**57**	**153**	**210**	**x^2 = 16.13**
Total	**295**	**1408**	**1703**	**P = 0.000059**

$P < 0.05$ therefore there is a **SIGNIFICANT** difference between the caries frequencies for Marina Residence and Cobern Street

Table 31: Caries frequency summary (ages and sexes pooled)

	Cobern Street	Marina Residence	Polyoak	Three sites combined
% Carious Teeth	16.1	15.8	30.8	17.3
Number of Carious Teeth per mouth	4.2	3.8	6.3	4.3
% of individuals with Caries	75	84.4	77.8	66.7

5.1.2.1 Caries frequency summary

Caries frequency is not significantly correlated to age for both Cobern Street and Marina Residence samples. The sex differences as well as the caries frequency cannot be tested for correlation with age in the Polyoak sample because of the small sample size. There is no significant sex difference in the caries frequencies of both Cobern Street and Marina Residence. This lack of sexual dimorphism is also evident when comparing the individual tooth types because all the tooth types do not show any significant differences. There is no significant difference (x^2=0.02; P=0.888) in the caries frequencies between the Cobern Street and Marina Residence samples. There is a significant difference (x^2=16.13; P=0.000059) when the caries frequencies of all three samples is compared with Polyoak being the outlier due to small sample size. Of the 1703 teeth examined, 17.3 % show signs of caries. There are a total of 4.3 carious teeth per mouth for 66.7% of the total number of individuals when the three sites are combined.

b. Antemortem tooth loss

Table 32: Cobern Street males: AMTL frequency (ranked by increasing AMTL percentage)

Accession number	Age	Number of tooth places	AMTL	% AMTL
UCT 500	40	32	0	0
UCT 552	32.5	32	0	0
UCT 554	35	32	0	0
UCT 562	37.5	32	0	0
UCT 517	22.5	16	0	0
UCT 504	25	32	0	0
UCT 551	37.5	16	0	0
UCT 548	42.5	32	0	0
UCT 510	27.5	32	1	3.44
UCT 460	20	27	1	3.70
UCT 547	40	32	2	6.25
UCT 549	37.5	32	3	9.38
UCT 536	42.5	30	3	10
UCT 526	55	32	7	21.88
UCT 521	45	32	6	23.08
UCT 557	40	32	9	28.13
UCT 543	60	28	10	35.71
Total		**501**	**42**	
Average	**37.8**	**29.5**	**4.7**	**8.4***

* = $(42 \div 501) \times 100$

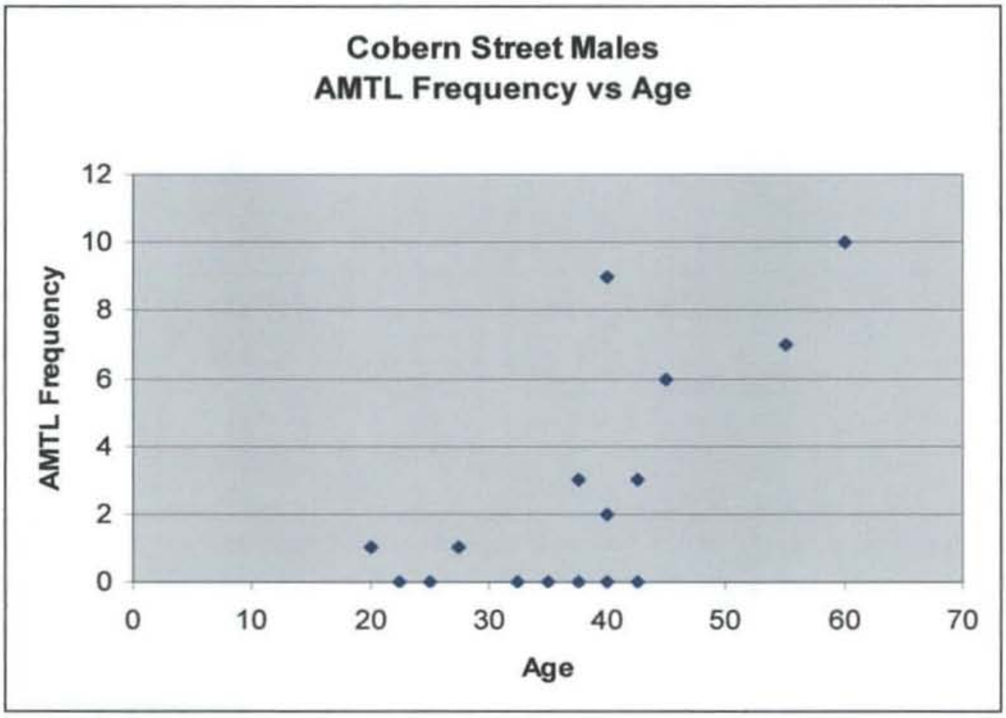

Figure 15: Cobern Street males: AMTL frequency against age

Sample size n = 17 for Cobern Street males. The correlation coefficient is r = 0.681. The critical value for n=17 at 95% confidence interval = 0.482 (Rohlf and Sokal, 1969). Therefore there is a **SIGNIFICANT CORRELATION** The significant correlation between Cobern Street males AMTL frequency and age suggests that the AMTL frequency for the young and older adults in this sample **should not be pooled.** In the light of this being the only **SIGNIFICANT CORRELATION** out of four correlation tests between age and AMTL, for the purpose of this study the ages for Cobern Street males AMTL frequencies **will be pooled.**

Table 33: Cobern Street females: AMTL frequency (ranked by increasing AMTL percentage)

Accession number	Age	Number of tooth places	AMTL	% AMTL
UCT 542	45	29	0	0
UCT 563	23.5	32	0	0
UCT 559	20	32	0	0
UCT 558	30	32	0	0
UCT 498	37.5	32	1	3.13
UCT 502	50	32	2	6.25
UCT 514	30	32	2	6.25
UCT 555	25	32	2	6.25
UCT 508	45	32	3	9.38
UCT 556	30	31	4	12.90
UCT 544	42.5	32	5	15.63
Total		**348**	**19**	
Average	**34.4**	**31.6**	**2.7**	**5.5***

* = (19 ÷ 348) × 100

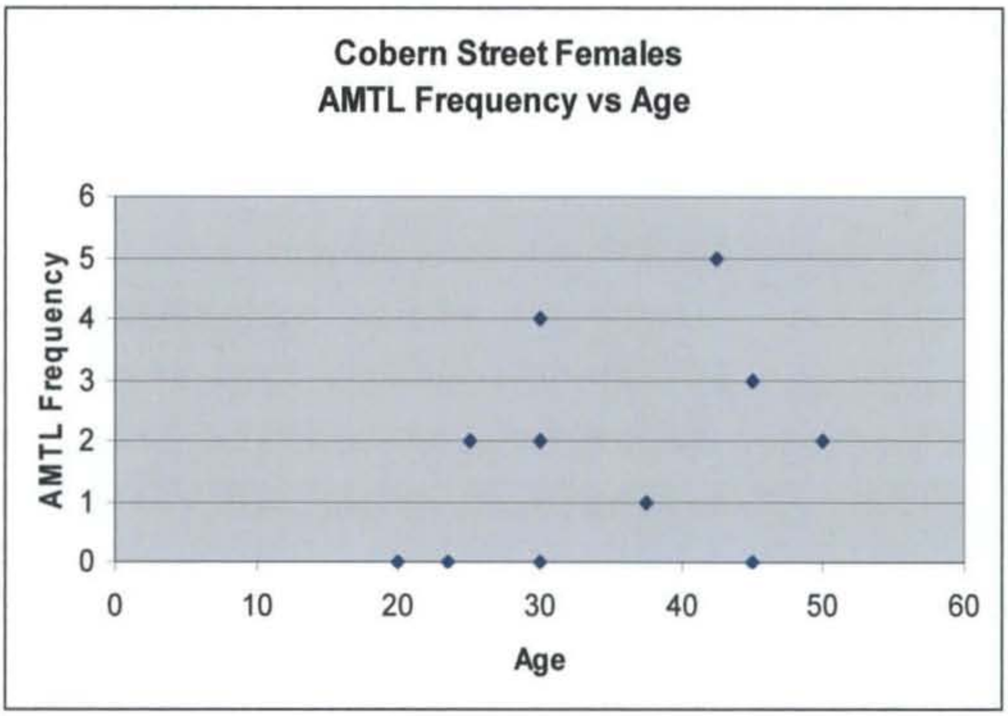

Figure 16: Cobern Street females AMTL frequency against age

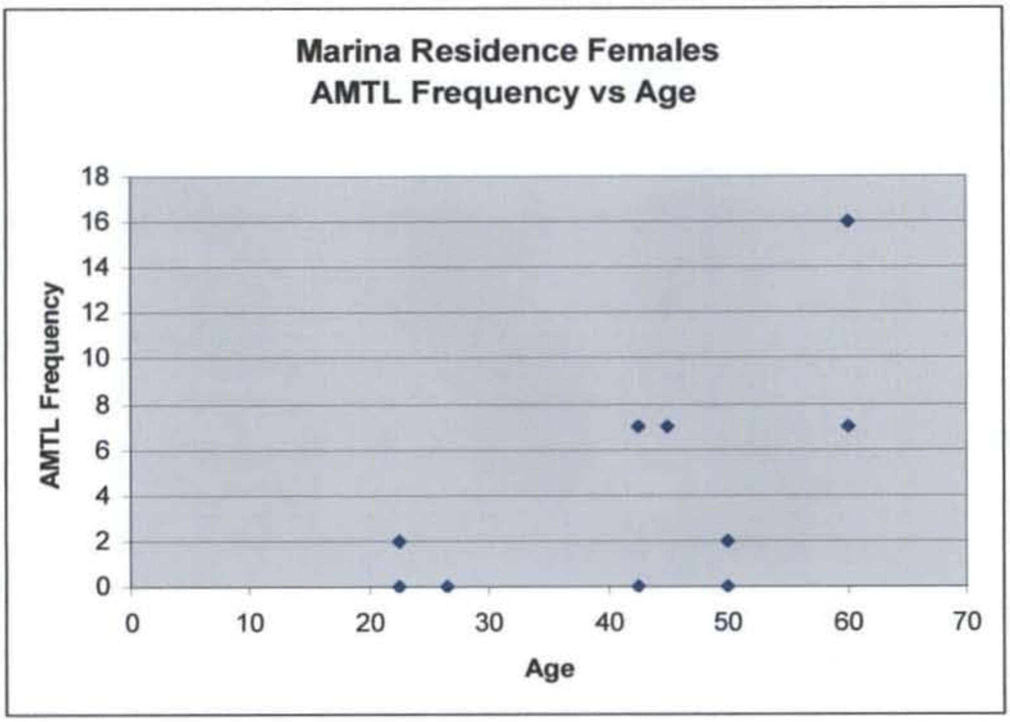

Figure 18: Marina Residence females AMTL frequency against age

Sample size n = 10 for Marina Residence females. The correlation coefficient is r = 0.621. The critical value for n=10 at 95% confidence interval = 0.632 (Rohlf and Sokal, 1969) therefore there is **NO SIGNIFICANT CORRELATION**. The lack of significant correlations between Marina Residence males and females with age suggests that the AMTL frequencies for the young and older adults in this sample **should be pooled.**

Table 37: Marina Residence AMTL sex differences (young and older adults pooled)

	AMTL places	No. tooth places	Total	
MR Males	**59**	**603**	**662**	
MR Females	**45**	**282**	**327**	**x^2 = 5.469**
Total	**104**	**885**	**989**	**P = 0.019**

P < 0.05 therefore there is a **SIGNIFICANT** difference between means of AMTL frequencies in males and females of Marina Residence.

Table 38: Polyoak AMTL Frequency:

Accession number	Sex	Age	Number of tooth places	No. teeth with AMTL	% AMTL
IR # 13	♀	20	32	0	0
Burial # 8	♀	18.5	32	1	3.1
IR # 7 (a)	♀	27.5	32	0	0
IR # 1&5?	♀	22.5	32	0	0
Burial # 12	♀	35	32	0	0
Burial # 15	♀	60	32	15	46.9
Burial # 14	♀	50	32	2	6.3
IR # 8	♂	37.5	16	0	0
Burial# 19	♂	60	23	9	39.1
Total			**263**	**27**	
Average		**36.8**	**23.3**		**12.9***

* = (27 ÷ 210) × 100

Table 39: Antemortem tooth loss frequency summary:

	Cobern Street			**Marina Residence**			**Polyoak**			
	No. tooth places	**No. teeth lost**	**%.**	**No. tooth places**	**No. teeth lost**	**%.**	**No. tooth places**	**No. teeth lost**	**%.**	
Young Adults	570	25	4.4	482	30	6.2	176	1	0.6	
Older Adults	279	36	12.9	403	57	14.1	87	26	29.9	**Total AMTL %**
Ages Pooled	849	61	7.2	885	87	9.8	263	27	10.3	8.8

Antemortem tooth loss frequency summary

There is no significant correlation with age for the antemortem tooth loss frequencies of Cobern Street and for Marina Residence. Males and females for Cobern Street do not show any significant differences (x^2=2.632; P=0.105) while the Marina Residence sexes are significantly different (x^2=5.469; P=0.019). The older adults in all three samples have more teeth lost antemortem than younger adults.

c. Abscesses

Table 40: Cobern Street abscess frequency

Males (n=17)		Females (n=11)	
Accession number	**Number of abscesses**	**Accession number**	**Number of abscesses**
UCT 500	0	UCT 498	0
UCT 460	0	UCT 556	0
UCT 552	0	UCT 514	0
UCT 554	0	UCT 542	0
UCT 562	0	UCT 544	0
UCT 517	0	UCT 563	0
UCT 510	0	UCT 559	0
UCT 504	0	UCT 555	0
UCT 551	0	UCT 558	1
UCT 536	0	UCT 502	3
UCT 548	0	UCT 508	3
UCT 521	1		
UCT 547	1		
UCT 526	2		
UCT 543	2		
UCT 557	2		
UCT 549	2		
Total	**10**		**7**

Table 41: Cobern Street abscess frequency comparison between males and females using chi square

	Males	Females	Total	
Number of Abscess	**10**	**7**	**17**	
Number of individuals	**17**	**11**	**28**	x^2 =0.016
Total	**27**	**18**	**45**	P =0.899

P > 0.05 therefore the abscess frequency for males and females is **NOT SIGNIFICANTLY** different

Table 42: Marina Residence males: Abscess frequencies

Males (n=23)		Females (n=13)	
Accession number	No of abscesses	Accession number	No of abscesses
MR 10	0	MR 43A	0
MR 33	0	MR 38	0
MR 31	0	MR 61	0
MR 48	0	MR 20	0
MR 34	0	MR 7	0
MR 32	0	MR 6	0
MR 56	0	MR 21	0
MR 28	0	MR 24	0
MR 25	0	shaft MR 53	0
MR 14	0	MR 8	3
MR 58	0	MR 4	3
MR 46	0	MR 3	2
MR 39	0	shaft MR 33	2
MR 17	0		
shaft MR 56	0		
MR 13	1		
MR 51	1		
MR 29	1		
MR 5	2		
MR 49	2		
MR 63(ii)	2		
MR 26	2		
MR 43(B)	3		
Total	**14**		**10**

Table 43: Marina Residence abscess frequency comparison between males and females using chi-square

	Males	Females	Total	
Number of Abscess	**14**	**10**	**24**	
Number of individuals	**23**	**13**	**36**	$x^2 = 0.188$
Total	**37**	**23**	**60**	P = 0.665

$P > 0.05$ therefore the abscess frequency for males and females is **NOT SIGNIFICANTLY** different

Table 44: Polyoak abscess frequency

Males (n=2)		Females (n=7)	
Accession number	**Number of abscesses**	**Accession number**	**Number of abscesses**
IR # 8	0	IR # 13	2
BURIAL#19	2	BURIAL # 8	0
		IR # 7 (a)	0
		IR # 1&5?	1
		BURIAL # 12	3
		BURIAL # 15	0
		BURIAL # 14	0
Total	**2**		**6**

Table 45: Abscess frequency summary:

	Cobern Street			Marina Residence			Polyoak			
	Males	**Females**	**Sexes pooled**	**Males**	**Females**	**Sexes pooled**	**Males**	**Females**	**Sexes pooled**	
No. of individuals	17	11	28	23	13	36	2	7	9	
% with abscess	35.3	27.3	32.1	34.8	30.8	33.3	50	42.9	44.4	
No. of abscess/mouth	0.59	0.64	0.60	0.61	0.77	0.67	1	0.85	0.89	**Total**
% abscess/tooth place	2.0	2.0	2.0	2.3	3.5	2.7	5.1	2.6	3.0	2.5*

* = Total percentage of abscess per tooth place for all samples combined = total number of abscesses divided by total number of tooth places

5.1.3 Growth disruption

a. Linear enamel hypoplasia

Table 46: Cobern Street males: Hypoplasia frequency (ranked by increasing hypoplasia percentage)

Accession number	Number of teeth	No. teeth with hypoplasia	% hypoplasia
UCT 526	22	unobservable	unobservable
UCT 536	23	unobservable	unobservable
UCT 500	32	unobservable	unobservable
UCT 554	31	0	0
UCT 504	32	0	0
UCT 460	26	0	0
UCT 543	12	0	0
UCT 521	26	0	0
UCT 551	4	0	0
UCT 557	20	0	0
UCT 562	32	2	6.3
UCT 549	26	2	7.7
UCT 548	32	3	9.3
UCT 547	30	4	13.3
UCT 517	15	3	20.0
UCT 552	32	7	21.9
UCT 510	29	12	41.4
Total	**347**	**33**	
Average	**24.9**		**9.5***

* = $(33 \div 347) \times 100$

Table 47: Cobern Street females: Hypoplasia frequency (ranked by increasing hypoplasia percentage)

Accession number	Age	Number of teeth	No. teeth with hypoplasia	% hypoplasia
UCT 559	20	31	0	0
UCT 558	30	31	0	0
UCT 544	42.5	24	0	0
UCT 508	45	28	0	0
UCT 502	50	29	0	0
UCT 542	45	27	1	3.7
UCT 556	30	26	1	3.9
UCT 563	23.5	30	2	6.7
UCT 555	25	27	2	7.4
UCT 514	30	27	2	7.4
UCT 498	37.5	30	4	13.3
Total		**310**	**12**	
Average	**34.4**	**28.2**	**2**	**3.9***

* = $(12 \div 310) \times 100$

Table 48: Cobern Street hypoplasia sex differences (Young and Older Adults pooled) using chi-square

	No. teeth with hypoplasia	No. teeth without hypoplasia	Total	
CS Males	**33**	**314**	**347**	
CS Females	**12**	**298**	**310**	$x^2 = 8.16$
Total	**45**	**612**	**657**	**P= 0.004**

$P < 0.05$ therefore there a **SIGNIFICANT** difference between hypoplasia frequencies in males and females from Cobern Street. The significance between Cobern Street males and females hypoplasia frequencies suggests that males and females in this sample **should not be pooled**.

Table 49: Marina Residence males: Hypoplasia frequency (ranked by increasing hypoplasia percentage)

Accession number	Number of teeth	No. teeth with hypoplasia	% hypoplasia
MR 28	28	unobservable	unobservable
MR 48	31	0	0
MR 43(B)	31	0	0
MR 17	13	0	0
shaft MR 56	10	0	0
MR 46	28	0	0
MR 26	23	1	4.35
MR 32	20	1	5
MR 31	30	2	6.67
MR 33	26	2	7.69
MR 51	13	1	7.69
MR 58	24*	2	8.33
MR 25	30	3	10
MR 13	26	3	11.54
MR 56	26*	3	11.54
MR 49	26	3	11.54
MR 14	22	3	13.64
MR 29	13	2	15.38
MR 39	27	6	22.2
MR 34	28	8	28.57
MR 5	25	9	36
MR 63(ii)	15	9	60
MR 10	8	5	62.5
Total	**495**	**63**	
Average	**22.5**	**3.7**	**12.0***

* = (63 ÷ 523) × 100

Table 50: Marina Residence females: Hypoplasia frequency (ranked by increasing hypoplasia percentage)

Accession number	Number of teeth	No. teeth with hypoplasia	% hypoplasia
MR 20	28	0	0
shaft MR 33	10	0	0
MR 8	27	0	0
MR 21	8	0	0
MR 38	29	1	3.45
MR 4	18	1	5.55
MR 61	32	2	6.25
MR 3	16	2	12.5
MR 43A	7	1	14.3
MR 24	7	1	14.3
shaft MR 53	5	1	20
MR 7	32	12	37.5
MR 6	17	10	58.8
Total	**236**	**31**	
Average	**18.2**	**3.4**	**13.1***

* = (31 ÷ 236) × 100

Table 51: Marina Residence hypoplasia sex differences (Young and Older Adults pooled)

	No. teeth with hypoplasia	No. teeth without hypoplasia	Total	
MR Males	**63**	**432**	**495**	
MR Females	**31**	**205**	**236**	**$x^2 = 0.024$**
Total	**94**	**637**	**731**	**P = 0.877**

*P > 0.05 therefore there is **NO SIGNIFICANT** difference between hypoplasia frequencies in males and females of Marina Residence. The lack of significance in the means of Marina Residence males and females hypoplasia frequencies suggests that males and females in this sample **should be pooled**.

Table 52: Polyoak linear enamel hypoplasia frequency:

Accession number	Number of teeth	No. teeth with LEH	% LEH
BURIAL # 15	12	0	0
BURIAL # 12	28	1	3.4
IR# 8	16	1	6.3
IR# 1&5?	30	3	10
IR# 13	26	3	11.5
IR# 7 (a)	25	3	12
BURIAL # 8	31	4	12.9
BURIAL # 19	12	2	16.7
BURIAL # 14	30	6	20
Total	**210**	**27**	
Average	**23.3**		**12.9***

* = $(27 \div 210) \times 100$

Table 53: Hypoplasia frequency summary:

	Cobern Street			**Marina Residence**			**Polyoak**		
	Males	**Females**	**Sexes pooled**	**Males**	**Females**	**Sexes pooled**	**Males**	**Females**	**Sexes pooled**
No. of individuals	14	11	25	22	13	35	2	7	9
% individuals with LEH	50	54.5	52	77.3	69.2	74.3	100	85.7	88.9
% teeth with LEH	9.5	3.9	6.8	12.0	13.1	12.9	10.7	13.2	12.9

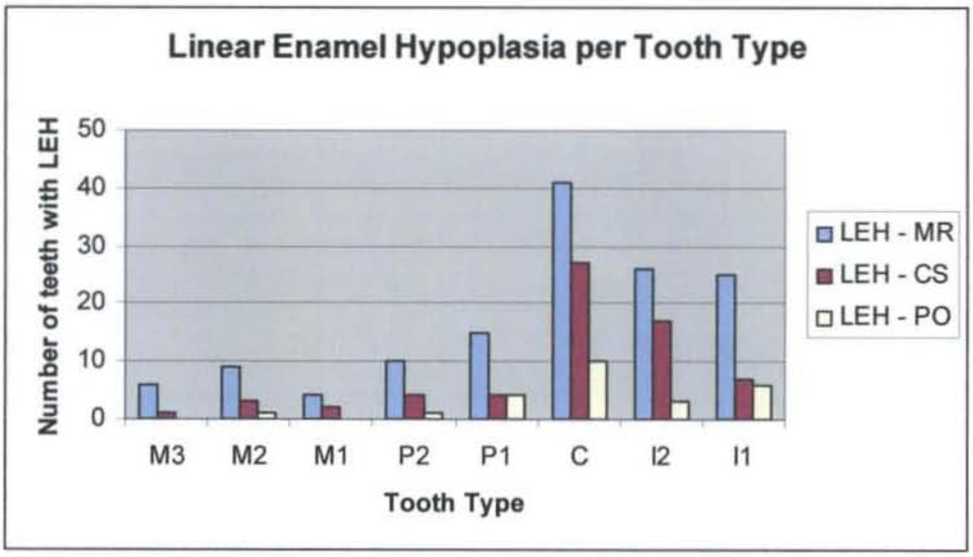

Figure 19: Linear enamel hypoplasia per tooth type

5.2 Occlusal wear

The following tables show the occlusal wear scores per individual in the three populations under study, Marina Residence; Cobern Street and Polyoak sites. These teeth were graded using the Molnar (1971) occlusal wear score scale which assigns wear scores from 1 to 8. The average values for the maxillary, mandibular, anterior, and posterior as well as the total sum of all the wear scores per given mouth is also given and calculated using guidelines explained in Chapter 4. Age is calculated as the mid-point of the range with an assumed maximum age of 70 years.

Table 54: Cobern Street males: Occlusal wear scores (ranked by increasing average wear)

Accession number	Age	M – ant	M - post	Average Wear	Number of teeth
UCT 552	32.5	2	2.3	2.2	32
UCT 460	20	3	2.4	2.7	26
UCT 554	35	2.7	2.6	2.7	31
UCT 562	37.5	3	2.8	2.8	32
UCT 510	27.5	3	3.1	2.9	29
UCT 517	22.5	3.8	2.9	3.2	15
UCT 504	25	3.5	3	3.3	32
UCT 548	42.5	3.8	3	3.3	32
UCT 557	40	3	3.4	3.4	20
UCT 549	37.5	3.7	3.4	3.5	26
UCT 500	40	3.9	3.4	3.6	32
UCT 521	45	4	3.3	3.6	26
UCT 536	42.5	4.3	3.3	3.6	23
UCT 551	37.5	4	4	4	4
UCT 526	55	4.7	4.1	4.3	22
UCT 547	40	4.4	4.5	4.5	30
UCT 543	60	6.8	6.7	6.8	12
Average	**37.6**	**3.7**	**3.4**	**3.6**	**24.9**
Standard Deviation		**1.05**	**1.03**	**1.02**	**8.19**

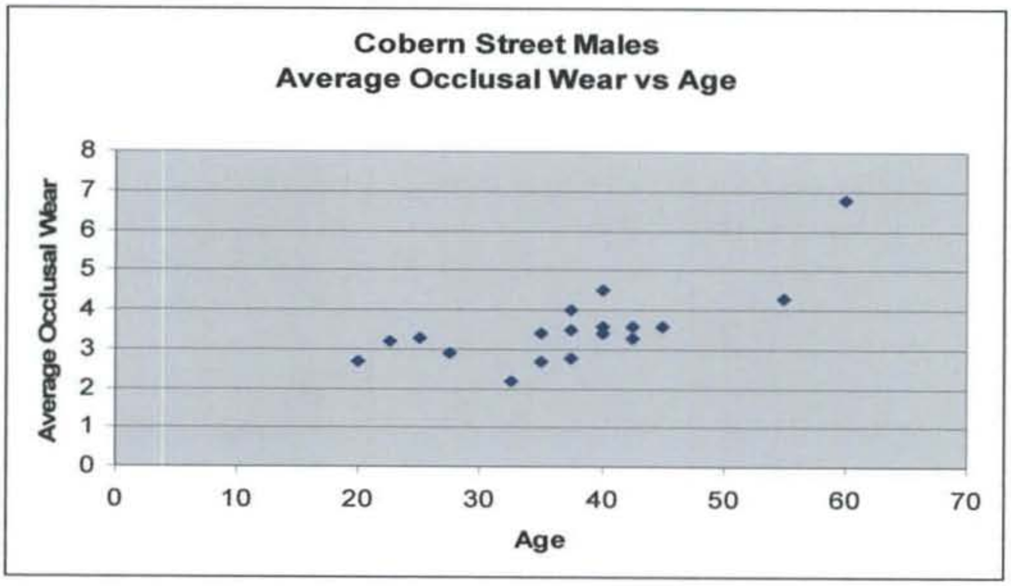

Figure 20: Cobern Street males: Average occlusal wear against age

Sample size n = 17 for Cobern Street males. The correlation coefficient is r = 0.737. The critical value for n= 17 at 95% confidence interval = 0.482 (Rohlf and Sokal, 1969) therefore there is a **SIGNIFICANT CORRELATION**

Table 55: Cobern Street females: Occlusal wear scores (ranked by increasing average wear)

Accession number	Age	M – ant	M - post	Average Wear	Number of teeth
UCT 559	20	3.1	2.9	3	31
UCT 556	30	3.3	2.9	3.1	26
UCT 514	30	3	3.2	3.1	27
UCT 555	25	3	3.1	3.1	27
UCT 563	23.5	4	2.7	3.2	30
UCT 558	30	3.5	3	3.2	31
UCT 498	37.5	3.4	3.2	3.3	30
UCT 502	50	3.6	3.4	3.4	29
UCT 508	45	3.5	3.7	3.6	28
UCT 544	42.5	4.5	4.1	4.3	24
UCT 542	45	5	3.9	4.4	27
Average	**34.4**	**3.6**	**3.3**	**3.4**	**28.2**
Standard Deviation	**10.07**	**0.64**	**0.45**	**0.49**	**2.23**

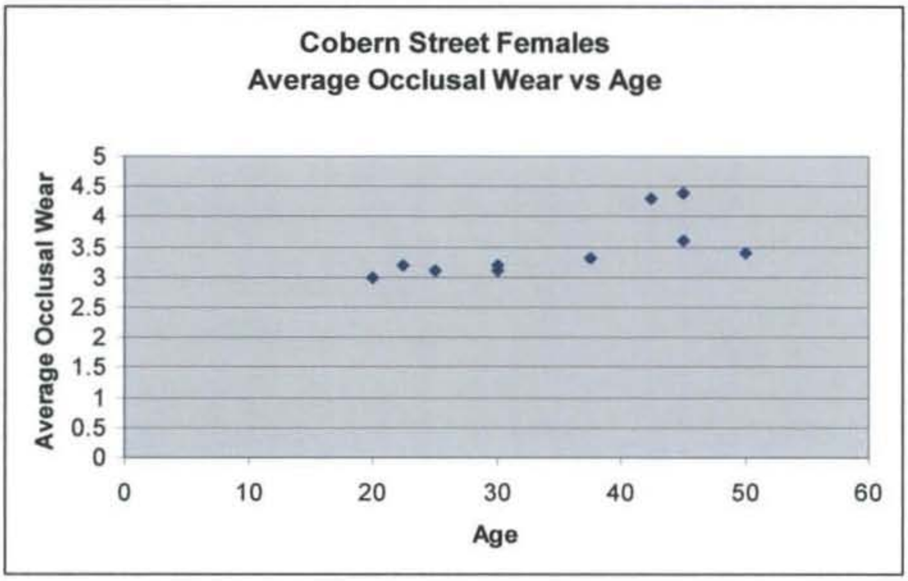

Figure 21: Cobern Street females: Average occlusal wear against age

Sample size n = 11 for Cobern Street females. The correlation coefficient is r = 0.691. The critical value for n= 11 at 95% confidence interval = 0.602 (Rohlf and Sokal, 1969) therefore there is a **SIGNIFICANT CORRELATION** The significant correlations between both Cobern Street males and females with age suggest that the average occlusal wear for the young and older adults in this sample **should not be pooled.**

Table 56: Cobern Street occlusal wear score sex differences:

Young adults:

t-Test: Two-Sample assuming unequal variances between young adults

	CS young males	CS young females
Mean	3.2	3.1
Variance	0.37	0.01
Observations	13	7
df	13	
P(T<=t) two-tail	0.558	

P > 0.05 at 0.558 therefore the average occlusal wear values for young adults in both males and females are **NOT SIGNIFICANTLY** different

Table 57: Cobern Street occlusal wear score sex differences:

Older Adults:

t-Test: Two-Sample assuming equal variances for older adults

	CS older males	CS older females
Mean	4.3	3.9
Variance	2.06	0.25
Observations	5	4
df	7	
P(T<=t) two-tail	0.619	

P > 0.05 at 0.619 therefore the average occlusal wear values for older adults in both males and females are **NOT SIGNIFICANTLY** different. The lack of significant differences in the occlusal wear means between Cobern Street males and females in young and older adults suggest that the sexes in this sample **can be pooled.**

Table 58: Marina Residence males: Occlusal wear scores (ranked by increasing average wear)

Accession number	Age	M – ant	M - post	Average Wear	Number of teeth
MR 58	35	2.1	2.2	2.1	24*
MR 25	26.5	2.1	2.1	2.2	30
Shaft MR 56	32.5	3	2.1	2.3	10
MR 34	25	2.6	2.2	2.4	28
MR 39	18	2.6	2.4	2.4	27
MR 46	30	3	2.6	2.8	28
MR 10	26.5	2	3	2.8	8
MR 31	25	3	2.9	2.9	30
MR 56	32.5	2.8	2.9	2.9	26*
MR 29	50	3	2.9	2.9	13
MR 33	32.5	3	3.1	3	26
MR 48	40	3.3	3.2	3.2	31
MR 14	42.5	3	3.4	3.2	22
MR 13	42.5	3.4	3.4	3.4	26
MR 17	Unknown	4	3.3	3.4	13
MR 49	42.5	4.6	3.1	3.7	26
MR 26	60	3.5	3.9	3.8	23
MR 51	35	4.7	3.6	3.9	13
MR 32	55	4.6	2.9	4	20
MR 63(ii)	Unknown	4.2	4.3	4.2	15
MR 28	35	4.5	4.3	4.4	28
MR 43(B)	50	4	4.8	4.5	31
MR 5	40	5.1	4.2	4.7	25
Average	**37**	**3.4**	**3.2**	**3.3**	**22.7**
Standard Deviation	**10.7**	**0.90**	**0.76**	**0.77**	**7.15**

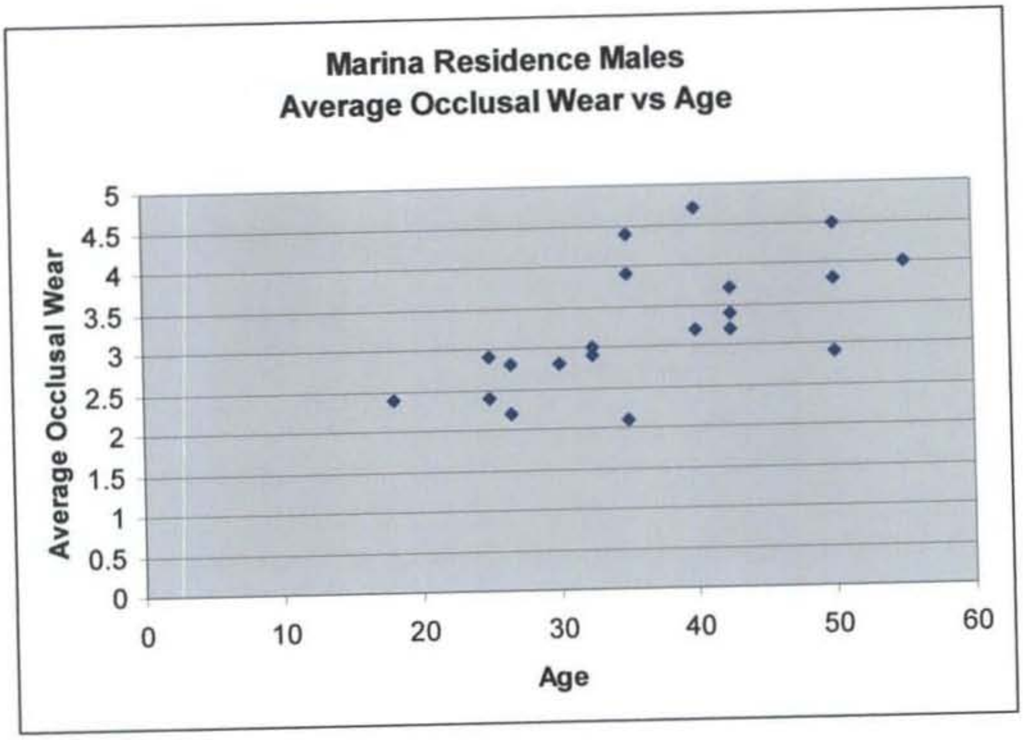

Figure 22: Marina Residence males: Average occlusal wear against age

Sample size n = 20 for Marina Residence males. The correlation coefficient is r = 0.601. The critical value for n= 20 at 95% confidence interval = 0.444 (Rohlf and Sokal, 1969) therefore there is a **SIGNIFICANT CORRELATION**

Table 59: Marina Residence females: Occlusal wear scores (ranked by increasing average wear)

Accession number	Age	M – ant	M - post	Average Wear	Number of teeth
MR 20	22.5	2	2.1	2.1	28
MR 43A	40	3	2	2.3	7
MR 7	26.5	3.2	2	2.4	32
MR 38	42.5	3	3.1	3.	29
MR 61	50	3	3.1	3.1	32
MR 6	42.5	3.5	2.9	3.2	17
MR 24	22.5	3	4	3.3	7
MR 4	60	5.1	3	4	18
Shaft MR 33	Unknown	4	4	4	10
MR 3	45	5.4	3.4	4.1	16

Table 59 (cont.): Marina Residence females: Occlusal wear scores (ranked by increasing average wear)

Accession number	Age	M – ant	M - post	Average Wear	Number of teeth
MR 8	50	4.9	4	4.3	27
Shaft MR 53	Unknown	4.5	7	5.8	5
MR 21	60	7.5	4.3	5.9	8
Average	**40.1**	**4.0**	**3.5**	**3.7**	**18.2**
Standard Deviation	**11.10**	**1.45**	**1.32**	**1.20**	**10.30**

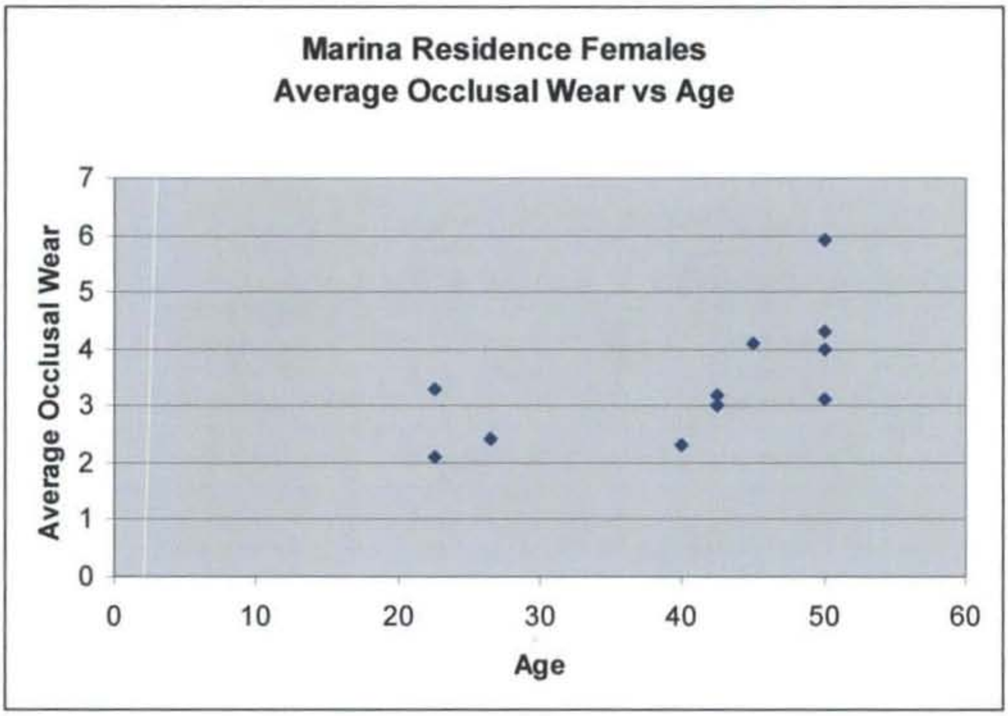

Figure 23: Marina Residence females: average occlusal wear against age

Samples size n = 11 for Marina Residence females. The correlation coefficient is r = 0.730. The critical value for n= 11 at 95% confidence interval is 0.602 (Rohlf and Sokal, 1969) therefore there is a **SIGNIFICANT CORRELATION** The significant correlations between both Marina Residence males and females with age suggest that the average occlusal wear for the young and older adults in this sample **should not be pooled**.

Table 60: Marina Residence occlusal wear score sex differences

Young Adults:

t-Test: Two-Sample assuming equal variances between young adults

	MR Males Average Wear	MR Females Average Wear
Mean	3.1	2.5
Variance	0.66	0.28
Observations	13	4
df	15	
P(T<=t) two-tail	0.245	

P > 0.05 at 0.245 therefore the average occlusal wear values for young adult males and females is **NOT SIGNIFICANTLY** different

Table 61: Marina Residence occlusal wear score sex differences

Older Adults:

t-Test: Two-Sample assuming equal variances for older adults

	MR Males Average Wear	MR Females Average Wear
Mean	3.6	3.9
Variance	0.28	1.02
Observations	7	7
df	12	
P(T<=t) two-tail	0.501	

P > 0.05 at 0.250 therefore the average occlusal wear values for older adults in both males and females are **NOT SIGNIFICANTLY** different. The lack of significant differences in the occlusal wear means between Marina Residence males and females in young and older adults suggest that the sexes in this sample **can be pooled**. Therefore Marina Residence sexes are pooled but age separated.

Table 62: Polyoak males: Occlusal wear scores (ranked by increasing average wear)

Accession number	Age	M – ant	M - post	Average Wear	Number of teeth
IR # 8	37.5	3	3.2	3.2	16
BURIAL # 19	60	6.9	5	6.7	12
Average	**48.8**	**5.0**	**4.1**	**4.9**	**14.0**
Standard Deviation	**15.9**	**2.75**	**1.27**	**2.49**	**2.83**

Polyoak males average occlusal wear against age

The correlation coefficient cannot be calculated on a sample n = 2 since the equation t = r/√ (1- r2)/ (n-2) = r√ (n-2)/ (1- r2) v = n – 2 cannot be satisfied (Rohlf and Sokal, 1969).

Table 63: Polyoak females: Occlusal wear scores (ranked by increasing average wear)

Accession number	Age	M – ant	M - post	Average Wear	Number of teeth
IR # 13	20	2	1.9	1.9	26
BURIAL # 8	18.5	2	2	2	31
IR # 7 (a)	27	2.3	3.3	2.3	25
BURIAL # 12	35	3	3	3	28
IR # 1&5?	22.5	3.3	3.2	3.3	30
BURIAL # 15	60	4.6	4.6	4.6	12
BURIAL # 14	50	5.3	4.4	4.8	30
Average	**33.3**	**3.2**	**3.2**	**3.1**	**26.0**
Standard Deviation	**16.06**	**1.31**	**1.06**	**1.19**	**6.56**

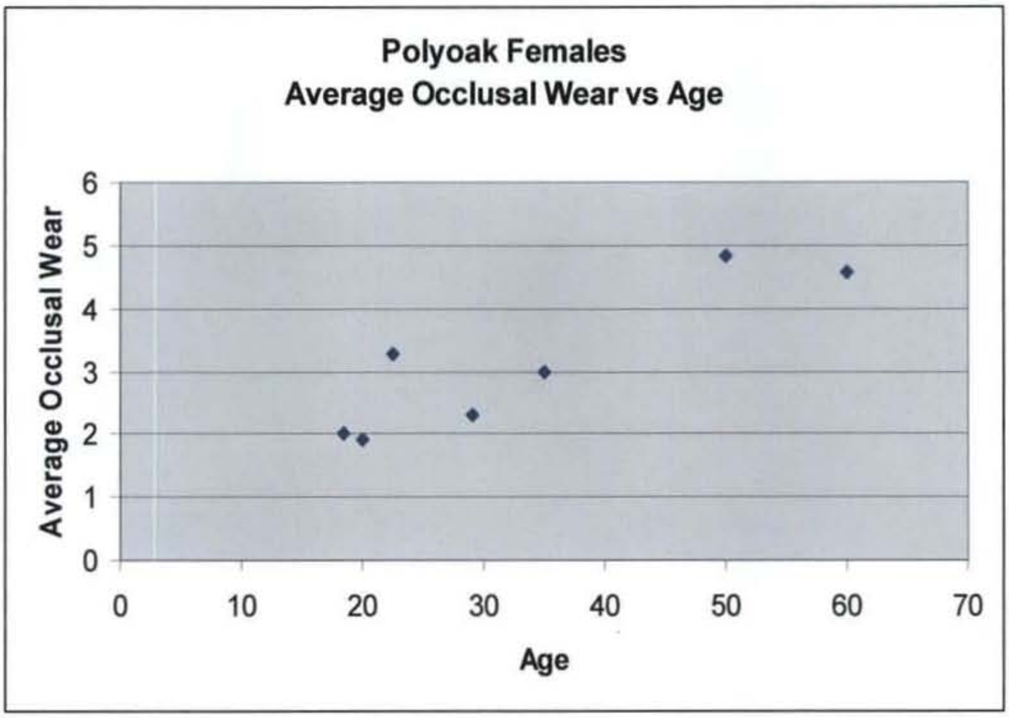

Figure 24: Polyoak females: Average wear against age

Sample size n = 7 for Polyoak females. The correlation coefficient is r = 0.896. The critical value for n= 7 at 95% confidence interval = 0.754 (Rohlf and Sokal, 1969) therefore there is a **SIGNIFICANT CORRELATION** The significant correlations between both Polyoak females with age suggest that the average occlusal wear for the young and older adults in this sample **should not be pooled.**

Table 64: Cobern Street and Marina Residence occlusal wear comparison (sexes pooled)

Young Adults:

t-Test: Two-Sample assuming unequal variances

	MR Young Adults	CS Young Adults
Mean	2.9	3.2
Variance	0.60	0.24
Observations	17	20
df	26	
t Stat	-1.29068	
P(T<=t) two-tail	0.208*	

*P > 0.05 therefore there is **NO SIGNIFICANT** difference between means of occlusal wear in Young Adults of Marina Residence and Cobern Street.

Table 65: Cobern Street and Marina Residence Occlusal Wear Comparison (sexes pooled)

Older Adult

t-Test: Two-Sample assuming equal variances

	MR Older Adults	CS Older Adults
Mean	3.8	4.1
Variance	0.63	1.17
Observations	14	9
df	21	
t Stat	-0.90219	
P(T<=t) two-tail	0.377*	

*P > 0.05 therefore there is **NO SIGNIFICANT** difference between means of occlusal wear in Older Adults of Marina Residence and Cobern Street.

Table 66: Occlusal wear summary

	Cobern Street			Marina Residence			Polyoak		
	n	**wear**	**Std dev.**	**n**	**wear**	**Std dev.**	**n**	**wear**	**Std dev.**
Young Adults	19	3.2	0.50	17	2.9	0.78	6	2.6	0.61
Older Adults	9	4.1	1.08	14	3.8	0.79	3	5.4	1.16
Ages Pooled	28	3.5	0.84	31	3.3	0.89	9	3.5	1.57

Table 67: Occlusal wear significance testing

		Chi ^{2} values		
		CO	**MR**	**PO**
	CO	-	0.039	1.908
p-values	**MR**	0.843	-	2.492
	PO	0.167	0.114	-

5.3 Behaviours

5.3.1 Aesthetic Modification

Two forms of aesthetic modification were observed. One involves filing either on the mesial or distal or both these margins of the tooth while the other form is a filing of the buccal surface.

i. Mesial and distal filing:

Table 68: Marina Residence:

Accession number	Sex	Age	Filing
MR 33	Male	32.5	LI1 & RI1 filed to a point
MR 48	Male	40	Diamond shaped file

Table 69: Cobern Street

Accession number	Sex	Age	Filing
UCT 510	Male	27.5	RI2 distal,RI1 mesial,LI1 mesial
UCT 558	Female	30	RI2,RI1,LI1,LI2 filed to a point
UCT 548	Male	42.5	RI2 mesial,RI1 distal,LI1 distal,LI2 mesial
UCT 547	Male		File to a point I1,I2,I1,I2

ii. Buccal filing

Table 70: Cobern Street

Accession number	Sex	Age	Filing
UCT 563	Female	23.5	ULC; ULI2; ULI1;URI1;URI2;URC;LRI2;LRI1;LLI1;LLI2;C
UCT 504	Male	25	ULI2;ULI1;URI1;URI2
UCT 562	Male	37.5	ULC; ULI2; ULI1;URI1;URI2;URC
UCT 500	Male	40	ULC; ULI2; ULI1;URI1;URI2;URC
UCT 544	Female	42.5	ULI2; ULI1;URI1;URI2
UCT 526	Male	55	ULC; ULI2; ULI1;URI1;URI2;URC

5.3.2 Unintentional Modification

Table 71: Marina Residence:

Accession number	Sex	Age
MR 25	Male	26.5
MR 33	Male	32.5
MR 38	Female	42.5
MR 61	Female	50
MR 43 (B)	Male	50
MR 26	Male	60

Table 72: Cobern Street:

Accession number	Sex	Age
UCT 508	Female	40 - 50

The two above tables show all the individuals with unintentional modification for both Cobern Street and Marina Residence. All of them are as a result of pipe smokers wear.

Figure 25: UCT 510 showing mesial filing on both maxillary incisors

Figure 26: UCT 548 showing mesial and distal filing of maxillary incisors

Figure 27: MR 33 maxillary incisors filed to a point

Figure 28: UCT 558 maxillary incisors filed to a point

Figure 29: MR 33 showing pipe smokers wear

Figure 30: UCT 562 showing buccal filing on maxillary anterior teeth

Table 73: Dental modification summary:

	Cobern Street			Marina Residence			Polyoak		
	Males	Females	Sexes pooled	Males	Females	Sexes pooled	Males	Females	Sexes pooled
Number of individuals	17	11	28	23	13	36	2	7	9
% with mesio/distal filing	17.6	9.1	14.3	8.7	0	5.6	0	0	0
% with buccal filing	23.5	18.2	21.4	0	0	0	0	0	0
% Pipe wear	0	9.1	3.6	17.3	15.4	16.6	0	0	0

5.4 Geographic origins/population affinities

5.4.1 Dental Metric Traits

Polyoak is not included in the analysis of dental metric and non –metrics traits because of the small sample size.

Table 74: Cobern Street (left maxillary quadrant buccolingual and mesiodistal diameters in millimetres)

		CS Males (n=17)				CS Females (n=11)		
		M-D	B-L	AREA		M-D	B-D	AREA
I1	Mean	8.8	7.5	50.2		8.6	7.2	56.3
	SD	0.75	0.48	27.65		0.56	0.40	17.10
I2	Mean	7.2	6.9	46.1		6.7	6.4	40.2
	SD	0.54	0.56	15.24		0.49	0.34	12.04
C	Mean	8.0	8.6	59.0		7.7	8.3	58.8
	SD	0.34	0.67	24.60		0.30	0.31	17.15
P1	Mean	7.5	9.7	68.1		7.1	9.4	67.5
	SD	0.33	0.34	18.81		0.46	0.47	6.52
P2	Mean	7.0	9.6	62.9		6.5	9.1	59.2
	SD	0.50	0.58	17.52		0.36	0.55	6.24
M1	Mean	10.8	11.5	108.3		10.3	11.3	105.7
	SD	0.53	0.41	42.46		0.53	0.61	34.82
M2	Mean	9.9	11.5	96.2		9.6	11.0	83.5
	SD	0.61	0.77	42.09		0.55	0.53	42.40
M3	Mean	9.3	11.2	104.5		8.5	10.7	91.1
	SD	0.48	0.85	11.43		0.82	1.00	13.23

Table 75: T- test values for Cobern Street: males compared to females

Tooth	Mesiodistal			Buccolingual		
	Male	Female	P-value	Male	Female	P-value
I1	8.8	8.6	0.595	7.5	7.2	0.164
I2	7.2	6.7	0.041*	6.9	6.4	0.045*
C	8.0	7.7	0.046*	8.6	8.3	0.210
P1	7.5	7.1	0.035*	9.7	9.4	0.122
P2	7.0	6.5	0.014*	9.6	9.1	0.036*
M1	10.8	10.3	0.069	11.5	11.3	0.321
M2	9.9	9.6	0.257	11.5	11.0	0.151
M3	9.3	8.5	0.014*	11.2	10.7	0.236

* = significant P-values

Table 76: Marina Residence (left maxillary quadrant buccolingual and mesiodistal diameters in millimetres)

		MR Males (n=23)				CS Females (n=13)		
		M-D	B-L	AREA		M-D	B-D	AREA
I1	Mean	8.8	7.2	63.9		8.6	6.9	59.5
	SD	0.44	0.55	7.35		0.51	0.64	8.88
I2	Mean	7.0	6.4	43.6		6.9	6.3	43.8
	SD	1.03	0.70	13.83		0.48	0.67	6.94
C	Mean	7.7	8.7	63.7		7.5	8.2	61.9
	SD	0.66	0.65	15.88		0.67	0.64	10.57
P1	Mean	7.1	9.5	67.0		7.2	9.2	65.9
	SD	0.61	0.60	9.00		0.27	0.77	7.50
P2	Mean	6.8	9.6	65.4		6.7	9.0	60.7
	SD	0.51	0.72	8.88		0.47	0.64	7.22
M1	Mean	10.6	11.4	120.2		10.4	11.1	116.5
	SD	0.63	0.62	11.82		0.66	0.66	13.30
M2	Mean	10.3	11.7	108.9		10.5	11.4	120.6
	SD	0.97	0.60	39.80		1.28	0.55	18.27
M3	Mean	9.3	11.2	104.2		8.6	10.7	92.5
	SD	1.02	1.06	19.10		0.79	0.85	9.57

Table 77: T- test values for Marina Residence: males compared to females

Tooth	Mesiodistal			Buccolingual		
	Male	Female	P-value	Male	Female	P-value
I1	8.8	8.6	0.393	7.2	6.9	0.180
I2	7.0	6.9	0.795	6.4	6.3	0.617
C	7.7	7.5	0.652	8.7	8.2	0.084
P1	7.1	7.2	0.499	9.5	9.2	0.319
P2	6.8	6.7	0.855	9.6	9.0	0.053
M1	10.6	10.4	0.665	11.4	11.1	0.464
M2	10.3	10.5	0.709	11.7	11.4	0.323
M3	9.3	8.6	0.200	11.2	10.7	0.349

Table 78: T- test values for Cobern Street and Marina Residence: Males compared

Tooth	Mesiodistal			Buccolingual		
	CS Male	MR Male	P-value	CS Male	MR Male	P-value
I1	8.8	8.8	0.986	7.5	7.2	0.228
I2	7.2	7.0	0.519	6.9	6.4	0.102
C	8.0	7.7	0.052	8.6	8.7	0.780
P1	7.5	7.1	0.008*	9.7	9.5	0.120
P2	7.0	6.8	0.253	9.6	9.6	0.938
M1	10.8	10.6	0.357	11.5	11.4	0.520
M2	9.9	10.3	0.145	11.5	11.7	0.507
M3	9.3	9.3	0.933	11.2	11.2	0.921

Table 79: T- test values for Cobern Street and Marina Residence: Females compared

Tooth	Mesiodistal			Buccolingual		
	CS Female	MR Female	P-value	CS Female	MR Female	P-value
I1	8.6	8.6	0.932	7.2	6.9	0.210
I2	6.7	6.9	0.368	6.3	6.4	0.602
C	7.7	7.5	0.453	8.3	8.2	0.634
P1	7.1	7.2	0.860	9.4	9.2	0.382
P2	6.5	6.7	0.236	9.1	9.0	0.698
M1	10.3	10.4	0.759	11.3	11.1	0.713
M2	9.6	10.5	0.081	11.0	11.4	0.144
M3	8.5	8.6	0.703	10.7	10.7	0.994

5.4.2 Dental Non-Metric Traits

Table 80: Cobern Street and Marina Residence non metric trait significance tests

	Cobern Street			Marina Residence			x^2	P
Trait	**N**	**K**	**Percent**	**N**	**K**	**Percent**		
Shovel - shaped UI1	23	6	26.1	20	8	40	0.943	0.332
Double-shovel UI1	16	3	18.8	21	7	33.3	0.379*	0.538*
Winging UI1	14	0	0	11	2	18.2	-	-
Shovel - shaped UI2	21	9	42.9	26	15	57.7	1.023	0.312
Peg-shaped UI2	19	0	0	30	1	3.3	-	-
Bushman canine	15	3	20	16	4	25	0.009*	0.924*
Carabelli's cups UM1	23	8	34.8	21	4	19.1	0.692*	0.405*
Hypocone reduction UM2	21	6	28.6	23	8	34.8	0.195	0.659
Cusp 5 UM2	21	0	0	24	1	4.2	-	-
Shovel-shaped LI1	19	0	0	18	4	22.2	-	-
Distal Trigonid crest LM1	14	0	0	10	2	20	-	-
Cusp 7 LM1	20	0	0	15	0	0	-	-
Six - cusped LM1	20	6	30	14	1	7.1	-	-
Four-cusped LM2	21	19	90.5	17	13	76.5	0.533*	0.465*
Deflecting wrinkle LM2(LM1)	15	0	0	4	0	0	-	-
Y-groove LM2	17	2	11.8	18	4	22.2	0.138*	0.710*

N =number of observable teeth

K = number of positive observations

* = In the 2 x 2 case of the chi-square test of independence, expected frequencies less than 5 are usually considered acceptable if Yates' correction is employed (Preacher, 2001).

Index of similarity = the sum of the absolute values of the differences between the frequencies of each trait in the two groups under comparison, dividing by the number of traits, and subtracting from 100. A higher index of similarity means that the two samples are more alike (Haeussler *et al*, 1989).

Index of similarity between Cobern Street and Marina Residence = 91.5

Chapter 6 DISCUSSION: Reconstructing the dental history of the samples

There are three skeletal samples that represent the poor communities of 18th and 19th century Cape colony; Cobern Street, Marina Residence and Polyoak. Cobern Street has been dated middle to late 18th century; Marina Residence is early 19th century while Polyoak is late 19th century. The classification of these communities as poor is largely supported by the fact that the burial grounds are scantly documented in the literature of first Dutch and then British rule of the Cape. Cobern Street and Marina Residence are located close to each other in the vicinity of the city and harbour while Polyoak is at least 14km or so south-east of present day Cape Town city centre.

6.1 Can these three samples be combined?

The question being posed here is whether these Cape Town samples represent similar dental profiles and is it possible to lump them into one group which would represent the poor of 18th and 19th century Cape in first, the Dutch and then the British period of colonial rule. The combined product would be referred to as the Cape Poor.

6.1.1 Dental Health

Dental health in this study is assessed by the frequencies of calculus, caries, AMTL, abscesses as well as the occlusal wear states. These variables are all to a large extent dependant on diet and oral behaviour, and all five factors are inter-related. For example, extensive caries or extensive occlusal wear may render the pulp cavity compromised leading to abscess formations (Hillson, 1986). None of the five factors had any significant difference between the sexes for both Cobern Street and Marina Residence therefore the sexes are pooled.

The frequency of calculus at Cobern Street is 78.3% compared to 84% at Marina Residence and 40.5% at Polyoak (Table 13a). The three samples, Cobern Street, Marina Residence and Polyoak have significantly different frequencies in calculus which could mean a different diet between the three sites and/or a difference in oral hygiene practices, although the comparatively low frequency at Polyoak could be due to the small sample size. Diet and oral hygiene are the major factors which contribute to the deposition of calculus on teeth (Lehner, 1992; Hillson 1979, 1986, 1996) and the probable cause for the differential frequency rates of calculus between the three samples.

Table 81: Calculus comparison significance tests

Samples comparing calculus	Chi-Square Value	P – Value
Cobern Street and Marina Residence	8.118	0.004*
Cobern Street and Polyoak	111.282	0*
Marina Residence and Polyoak	167.692	0*

* = significantly different

There are no significant differences (see table 20) in the frequencies of caries when Cobern Street (16.1%) is compared to Marina Residence (15.8%) but highly significant (see table 22) when Polyoak caries frequencies are introduced. Polyoak has almost double the caries frequencies at 30.8%. This is largely due to the high caries count of just one Polyoak individual, IR 1&5. This individual distorts the Polyoak frequency because there are so few individuals. Despite this, the Polyoak data will be included when discussing the Cape Poor's caries frequencies, as the small sample is unlikely to skew the overall caries percentage by very much.

There are also no significant differences between Cobern Street (32.1%), Marina Residence (33.3%) and Polyoak (44.4%) in abscess frequencies (see table 71 below). AMTL and abscessing are heavily influenced by caries. Although abscesses are as a result of an inflammatory process, caries are usually the needed trigger (Patterson, 1984). The similar caries and abscesses rates between Cobern

Street and Marina Residence suggest a similar diet between these two samples but there is a significant difference in AMTL frequencies between the three samples (see table 72 below). The main difference for AMTL frequencies is between Cobern Street and Marina Residence samples while there are no significant differences when Polyoak is compared to both Cobern Street and Marina Residence.

Table 82: Abscessing comparison significance tests

Samples comparing abscessing	Chi-Square Value	P – Value
Cobern Street and Marina Residence	0.053	0.818
Cobern Street and Polyoak	0.442	0.506
Marina Residence and Polyoak	0.272	0.602

Table 83: AMTL comparison significance tests

Samples comparing AMTL	Chi-Square Value	P – Value
Cobern Street and Marina Residence	4.858	0.0275*
Cobern Street and Polyoak	3.186	0.0743
Marina Residence and Polyoak	0.043	0.8357

* = significant

There are no significant differences ($p = 0.234$) in the occlusal wear states between the three samples. The very similar occlusal wear scores, Cobern Street 3.5; Marina Residence 3.3 and Polyoak 3.5 also support the likelihood of a similar diet between the three samples at least as far is abrasion on the teeth is concerned. When the occlusal wear scores are analysed further into posterior and anterior teeth, there appears to be no significant difference ($p = 0.242$) between the anterior teeth of Cobern Street men and women. Posterior teeth of Cobern Street men and women too show no significant differences ($p = 0.261$). Marina Residence sexes follow a similar pattern with no significant differences ($p = 0.960$ for anterior teeth and $p = 0.279$ for posterior teeth. Polyoak on the other hand shows a significant difference ($p < 0.05$) between its men and women for anterior teeth but a non significant difference ($p = 0.310$) for posterior teeth. The results from Polyoak should be treated with caution given the overall small sample size. The similarities in occlusal wear for both Cobern Street and Marina Residence sexes suggest that they ate similar foods.

The lack of significant frequencies in caries, abscesses frequencies and occlusal wear states suggest that there was to a greater extent a similar diet linking the samples. Despite this, the significant differences found in the frequency of AMTL and calculus suggests that the dental health profiles of the three samples are not the same. How can this mixed signal of information be resolved? As stated in Chapter 2, calculus deposition is influenced by lack of oral hygiene as well as an alkaline oral environment (Hillson. 1979). The deposition of calculus can be a trigger for an immune response which leads to periodontal disease (Burnett and Schuster, 1978).

Calculus, especially the sub-gingival form can often lead to periodontal disease which in turn can lead to teeth falling out (Patterson, 1984). Cobern Street (7.2%) has slightly less AMTL frequency than Marina Residence (9.8%) and Polyoak (10.3%). It is also evident that the calculus frequencies are different between Cobern Street and Marina Residence. These differences in calculus and AMTL cannot be explained by diet alone so they are probably due to difference oral hygiene practices more than a dietary difference. It has been shown that a combination of smoking and chewing of betel in the absence of proper oral hygiene often leads to an increased calculus deposition (Anerud, 1991). There is evidence of some level of oral hygiene, the use of *miswak*, a tooth cleaning twig, at Cobern Street as explained by the dental modification below.

Cobern Street, Marina Residence and Polyoak samples could have had similar dietary practices and similar food supplies as evident the similar frequency distributions of caries, abscessing and occlusal wear, but oral hygiene was different. The multi-factorial immune responses triggered by calculus leading to AMTL are also very specific to the individual.

6.1.2 Physiological disruption during growth

LEH is caused by physiological upsets (Hillson, 1986, 1996; Goodman *et al*, 1988) while metric and non-metric dental traits have a large heritable component (Irish 2006, Scott and Turner, 1997). There is a significant difference in the LEH frequencies of Cobern Street males (n = 17) and females (n = 11), but the same sex difference is not present in the Marina Residence sample. There is a significant difference in the LEH frequency between the three samples. LEH frequencies per total tooth count CS (6.8%), MR (12.9%) and PO (12.9%) are significantly different with Cobern Street as the outlier. The percentages of individuals affected by LEH is 52% for Cobern Street, 77.3% for Marina Residence and 88.9% for Polyoak.

Comparing the present study's LEH frequencies against Cox's (1999) identification of Cape Born and Immigrants for individuals with LEH, it seems the Immigrants into the Cape have on average a higher LEH frequency, 68.8.% while the Cape Born have 22.2% (see table below). It should be noted that the Cox (1999) data are only for Cobern Street. Testing the differences in the Cox data for frequency of LEH between the Cape Born and Immigrants with a chi square adjusted with a Yates' correction for values below 5 (Preacher, 2001), there are no significant differences between the two. (Chi-square value = 3.306, P value = 0.069). When the two frequencies are tested without the correction factor for values below 5, we see a significant difference (Chi-square value = 4.996, P value = 0.025).

The non significant value is only so by a small margin which demonstrates that the small sample size of the Cox (1999) Cape Born with LEH (n=2) is still a major factor. From the frequencies and the percentages 68.8% and 22.2% shown this study will adopt that there is a significant difference between the prevalence of LEH in Cape Born and Immigrant groups.

Table 84: LEH frequency comparison

Geographic Origin	No. individuals with LEH	No. individuals without LEH	Total	% of Individuals Affected
Cobern Street Cape born (Cox, 1999)	2	7	9	22.2%
Cobern Street Origin not Cape (Cox, 1999)	11	5	16	68.8%
Marina Residence (most Cape born)	26	9	35	74.3%
Polyoak (Cape born)	8	1	9	88.9%

Cape society was from 1652 until 1834 a slave owning society and the individuals born and brought up at the Cape, most into slavery, seem to have lived under less childhood stresses compared to individuals who immigrated into the Cape from their native places where they were probably not born into slavery. Why would this be so? Could life have been less harsh under slavery than in freedom in the original homelands? Although we can only speculate about these questions, it seems unlikely that the urban poor of Cape Town had such ideal lives that they were relatively unaffected by LEH. Perhaps the answer lies in the nature of the stresses. The stress of poverty in Cape Town would have been a constant presence, whereas the life in the respective homelands may have been affected by episodic stress. LEH may better reflect these episodic stresses.

Blakey *et al*, (1994) in contrast found that enslaved 18th century African Americans showed some of the highest LEH frequencies in historical populations at 89% (n = 27). This they suspect is closely related to early weaning among enslaved women. Life under slavery would have offered some level of stability for children in terms of food supply (Shell, 1994) but other potential stressors like disease are unpredictable. Instability in the form of a change of life ways from a forager to agricultural society resulted in increased LEH frequency in a North American prehistoric population (Goodman *et al*, 1988).

The timeline of our three samples suggests that Cobern Street could have had a predominance of individuals who could have come into the Cape as slaves, as opposed to Marina Residence and Polyoak samples who probably had individuals who were born at the Cape, some into slavery and others into very poor, harsh living conditions. The Polyoak site especially given its inland location and late timeframe probably has individuals who were all born at the Cape and were practicing agriculture in the surrounding areas of Wynberg and Constantia. The frequencies show that LEH incidence increases in both Marina Residence and Polyoak when the timeline includes a post slavery emancipation period. Could this suggest that conditions were better for the Cape Born under slavery meaning that local born Capetonians were more stressed when they were free than under slavery?

A varied view of the life conditions under slavery is given in the literature (Goodman *et al*, 1988; Khudabux 1991; Blakey *et al* 1994; Shell, 1994) and Khudabux (1991) observed that this view is highly subjective. He noted that a person's position in society as well as their affiliation to slaves influenced their view greatly. He makes mention of a military captain in 18th century Suriname who lived in concubinage with a female slave speaking of very 'harsh conditions' slaves lived under as opposed to a medical doctor who viewed the slaves conditions as favourable. The 'harsh conditions' the Suriname slaves lived under is also supported by Francois Le Vaillant, an 18th century traveller through the Cape, who describes the life conditions under slavery at the Cape being more humane than any other place he had been with particular reference to his native Suriname (Glenn, 2007).

6.1.3 Behaviour

Cobern Street has 14.3% of its individuals showing mesial and/or distal filing while Marina Residence and Polyoak show 5.6% and 0% respectively. For pipe smoke's wear Cobern Street has 9.1% incidence which is only confined to females and Marina Residence has 16.6% incidence which is roughly evenly represented between males and females at 17.3% males and 15.4% females. Cobern Street has 23.5% males and 18.2% females presenting with buccal filing.

The samples clearly show differences in behavioural features. Mesial and distal margin filing patterns (see Figures 25 to 28) as well as pipe smoker's wear are seen at Cobern Street and Marina Residence sites only with no filing or pipe smoker's wear at Polyoak site. Cobern Street sample also shows a distinct type of buccal filing not seen at the other two sites. These differences do not allow these samples to be lumped for behavioural aspects as represented by dental modification.

6.1.4 Genetic Differences between the Samples

With regards to dental metric traits there is a greater sexual dimorphism within the Cobern Street sample compared to the Marina Residence sample. The mesiodistal diameters of second incisor, canine, first premolar, second premolar as well as the third molars of Cobern Street are significantly different (Table 75). With the buccolingual diameters it is the second incisor and the second premolar that are significantly different for Cobern Street while for Marina Residence none of the metric traits show any significant sexual dimorphism. There are no obvious reasons for the sexual dimorphism seen at Cobern Street. When comparing Cobern Street sample to Marina Residence sample, there is very little difference between the 32 dental metric trait variables but it should be borne in mind that these samples potentially have individuals from many different places as documented in the literature from the 18^{th} and 19^{th} Cape (Pearse, 1956; Boeseken, 1977; Penn, 2005; Hunt 2005).

There are no significant differences between Cobern Street and Marina Residence dental non-metric traits. Only 8 of the 16 traits investigated are directly comparable because the rest do not have values testable for significance. These are: Shovel - shaped UI1, Double-shovel UI1, Shovel - shaped UI2, Bushman canine, Carabelli's cups UM1, Hypocone reduction UM2, Four-cusped LM2 and Y-groove LM2. A high index of similarity means that the two samples are more alike i.e. a value closer to 100 (Haeussler *et al*, 1989).

6.1.5 Summary

Although the dental health indicators for abscessing, occlusal wear and caries are similar for Cobern Street and Marina Residence, Polyoak does differ in caries, and all of the samples differ for calculus and AMTL frequencies. The caries figures for Polyoak are almost certainly caused by sample size problems because there are so few individuals from Polyoak. In addition, the calculus differences may very well reflect oral hygiene rather than diet and this may also be a factor in the one significant difference in antemortem losses. It is for these reasons that it is proposed that the samples be fused for the dental health discussion.

Metric and non-metric traits also suggest that the origin of each sample is similar. This does not imply that the samples are homogeneous, but simply that all of the samples have similar ranges of variation. This not true when it comes to the presence of linear enamel hypoplasia and behavioural differences in tooth modification, and the samples will need to be seen as separate units for these occurrences.

Because five (caries, abscessing, occlusal wear, metric and non metric traits) of the nine variables are similar Cobern Street, Marina Residence and Polyoak will for the purpose of this study be lumped as representing the poor communities of 18th and 19th century Cape Town (Cape Poor).

6.2 How does dental health compare to other samples?

The Non-African comparative samples are firstly from Early and Late Delft which were drawn from a medieval infirmary which ran from 1265 to 1652 AD. This institution housed the sick and the poor homeless of the town of Delft at the time. The second sample is the Sint Jans Cathedral sample, which belongs to people of a lower social economic class and lastly are the two slave samples, one from Suriname and the other from New York City in North America. All these comparative samples except for the New York African Burial Ground (NYABG) are Dutch, in the form of Dutch citizens in Delft and Sint Jans and a Dutch colony as represented by the Suriname sample. The choice of these samples is based on the thinking that Dutch society of the 18th and 19th century should be fairly similar both in the colonies and the motherland therefore what is regarded as poor social conditions in Cape Town should not be too far from 'Dutch poor social conditions'.

How do the historic samples from Cape Town compare to other poor populations and what are the similarities in diet and oral hygiene between these populations since diet and oral hygiene are the major contributors to dental health?

The dental health of forager populations is characterised by high occlusal attrition scores where dentine and secondary dentine exposures are common, caries frequencies, AMTL and abscessing are low (Molnar, 1972; Turner, 1979; Lukacs, 1990, 1996; Larsen 1997). This is attributed to a diet of coarse, fibrous and gritty foods. The evolution of more refined food preparation techniques, a shift to more sedentary, agricultural life ways and the adoption/taming of more food products resulted in less occlusal attrition and increased caries rates. Although hunter-gatherers have a wider range of foodstuffs than agriculturalists, the more limited range of domesticated food species tends to be less fibrous but richer in carbohydrates, which promotes cariogenesis. This is why in general a distinction can be made between forager and agricultural populations based mainly on dental health alone.

Table 85: Caries Comparison

Sample	Source	Date	Percentage of carious teeth
Early Delft (Netherlands)	Onisto *et al* 1998	1265 - 1433 AD	7.6
Late Delft (Netherlands)	Onisto *et al* 1998	1433 - 1652 AD	12.3
Suriname	Khudabux 1991	1793 – 1861 AD	16.2
18th – 19th century Cape Town	Present Study	18th- 19th century	17.3
New York African Burial Ground	Blakely and Rankin-Hill 2004	17th - 18th century	20.0
Sint Jans (Netherlands)	Maat *et al* 2002.	1830 – 1858 AD	20.7

Table 86: Caries Comparison African samples

Sample	Source	Date	Percentage of carious teeth
Kakamas	Morris 1992	18th – 19th century	1.3
Colesberg	Peckmann 2002	19th century	3.8
Riet River	Morris 1992	11th – 19th century	4.3
Gladstone	Van der Merwe 2006	1897 – 1900 AD	4.3
Griqua	Morris 1992	19th century	5.2
18th – 19th century Cape Town	Present Study	18th- 19th century	17.3
K2 and Mapungubwe	Steyn 1994	Iron Age	18.3

The Cape Poor's caries frequency at 17.3 % is consistent with 18th/19th century sample from Suriname (16.2%), and a bit lower than the NYABG (20.0%) and Sint Jans (20.7%) which also date between 17th and 19th centuries. The AMTL at the Cape (8.6%) is lower than Suriname and Sint Jans. The two Delft samples represent the poor of the 'developing countries of the Netherlands', the transition period during which the formerly agrarian village turned into a fully developed town with specialized trades such as beer making. An increase in the caries frequency from the Early to the Late Period was due to the decrease in food coarseness with the introduction of cloth sieves for flour products (Onisto *et al*, 1998). The caries frequency of the Cape Poor is consistent with the frequencies experienced by other poor societies including that of the Dutch citizens and slaves in Suriname.

Table 87: Abscessing Comparison

Sample	Source	Date	Percentage of tooth places with abscesses
18th – 19th century Cape Town	Present Study	18th- 19th century	2.5
New York African Burial Ground	Blakely and Rankin-Hill 2004	17th - 18th century	5.6
Late Delft (Netherlands)	Onisto *et al* 1998	1433 - 1652 AD	5.9
Sint Jans (Netherlands)	Maat *et al* 2002	1830 – 1858 AD	5.9
Early Delft (Netherlands)	Onisto *et al* 1998	1265 - 1433 AD	7.1

Table 88: Abscessing Comparison African sample

Sample	Source	Date	Percentage of tooth places with abscesses
Colesberg	Peckmann 2002	19th century	6.6
18th – 19th century Cape Town	Present Study	18th- 19th century	2.5

Although the AMTL and abscessing frequencies are on the lower end comparatively they are to a large extent influenced by caries therefore suggesting some level of similarity in dental health. Was the diet between these populations the same? The slaves in Suriname had very little access to protein and only occasionally received rations of salted fish or meat. They mainly subsisted on bananas, yams, cassava and rice (Khudabux, 1991). The slaves at the Cape consumed rice, bread, fish, meat, peas, beans, wine, sugar and herbs, with the last four foodstuffs being less common and often only consumed as a treat (Cox, 1999). The Cape Poor also had very limited access to meat which was to a large degree in the control of the VOC.

Table 89: Calculus Comparison

Sample	Source	Date	Percentage of individuals with calculus
18^{th} – 19^{th} century Cape Town	Present Study	18^{th}- 19^{th} century	98.7 %
Suriname	Khudabux 1991	1793 – 1861 AD	100 %

The Cape slaves had limited access to animal protein but consumed large amounts of marine products (Cox, 1999), which have a high protein content. High carbohydrate diets with low protein intake have been shown to correlate with high calculus deposition (Patterson, 1984).

The Cape Poor have high calculus levels with over 70% of teeth affected with a moderate to high score. Onisto *et al*, 1998 and Maat *et al*, 2002 recorded 'slight to moderate' for Delft and Sint Jans samples respectively. The consumption of protein rich marine foods does not explain the high calculus levels, so perhaps the answer could be in food preparation methods such as the use of spices and perhaps certain oral behaviours that have not been recorded. Some studies have shown certain Asian populations to have more prevalence of dental calculus (Anerud *et al*, 1991; Roberts- Harry and Clerehugh, 2000) mainly influenced by poor oral hygiene and betel chewing. Betel and areca chewing are known to offer some protection against caries (Trivedy *et al*, 2002) hence the moderate caries despite a high carbohydrate diet as explained by the high calculus?

Table 90: AMTL Comparison

Sample	Source	Date	Percentage of teeth lost antemortem
18th – 19th century Cape Town	Present Study	18th- 19th century	8.8
Early Delft (Netherlands)	Onisto *et al* 1998	1265 - 1433 AD	16.2
Sint Jans (Netherlands)	Maat *et al* 2002	1830 – 1858 AD	16.5
Suriname	Khudabux 1991	1793 – 1861 AD	18.1
Late Delft (Netherlands)	Onisto *et al* 1998	1433 - 1652 AD	19.1

Table 91: AMTL Comparison African samples

Sample	Source	Date	Percentage of teeth lost antemortem
Gladstone	Van der Merwe 2006	1897 – 1900 AD	2.3
Kakamas	Morris 1992	18th – 19th century	4.1
Riet River	Morris 1992	11th – 19th century	6.1
18th – 19th century Cape Town	Present Study	18th- 19th century	8.8
Colesberg	Peckmann 2002	19th century	15.1
Griqua	Morris 1992	19th century	17.0

Comparing contemporaneous South African samples to the Cape Poor reveals the high caries and AMTL among the Cape Poor. This could be due to better access to refined sugars considering that the Cape was a port of entry for many varied foodstuffs. Did caries necessarily arise from Cape diet? Since the Cape community consisted of immigrants in the earlier years with a continual inflow over the succeeding years it is possible that some of the individuals could have developed caries before they arrived at the Cape. The land of origin, in case of Africans had more access to maize which is shown to be cariogenic (Turner, 1979, Larsen, 1995). There is evidence of maize being grown in West Africa (where some of the slaves are believed to have originated) as early as the 16th century (Willet, 1962). The only South African sample that has caries rates similar to the Cape Poor is Mapungubwe at 18.3% a group who definitely did not have access to maize. Steyn (1994) acknowledges that this could be a sample size error and also due to the fact that there is very low fluoride content in the water around the given area. Cape Town also has very low levels of fluoride in the water (Ockerse, 1943) whereas most of the other South African samples are drawn from the Karoo and Bushveld where fluorine is present in the water (Ockerse, 1941) and caries are known to be lower incidence even in modern times (Morris 1992, Peckmann 2002).

6.3 Dental Modifications

The Polyoak sample does not show any dental modification, whether the aesthetic type or unintentional. Mesial and distal filing pattern are seen in Cobern Street and Marina Residence. The common pattern between the two sites is maxillary incisors filed to a point (UCT 547, UCT 558 and MR 33). This pattern is believed to originate from the Congo and Gold Coast (Handler *et al*, 1982; Handler, 1994; 1997; Apollonio, 1998; Cox, 1995; Blakey and Rankin-Hill, 2004). UCT 547 and 558 have an isotopic signature of an early tropical life with UCT 547 'probably having spent at least 15 years at the Cape' (Cox, 1999). UCT 510 and UCT 548 also show isotopic signatures consistent with C4 diet devoid of marine foods therefore less likely to have been bred at the Cape suggesting that they possibly arrived at the Cape as slaves (Cox, 1999). This is confirmed by the dental modifications commonly found in West Africa at the time (Handler *et al*, 1982; Handler, 1994; 1997; Apollonio, 1998).

All these Cobern Street individuals with mesial and distal filing pattern have type B burial styles, which is the common style found in most colonial cemeteries (Apollonio, 1998, Cox, 1999) and is linked to Christian burial patterns. Whether this conversion to Christianity pre-dated the individuals' arrival at the Cape is unknown, but missionaries were certainly active amongst the slaves in Cape Town during the latter 18th and early 19th centuries. There is currently no evidence to suggest that this kind of dental modification was practiced at the Cape at any point. The only modification possibly indigenous to the Cape involved removal of maxillary central incisors (Friedling and Morris, 2005), but the lack of this modification in the Polyoak sample suggests that it is a later occurrence unrelated to these earlier forms of dental modification.

The Cobern Street sample also has second kind of buccal filing (see Figure 30) not found at either the Marina Residence or the Polyoak sites. A total of six individuals at Cobern Street have this peculiar filing, four males and two females. Three of the individuals have Type C burials which are described as Muslim type burials and the other three have Type B burials, general Christian type burial with coffins (Apollonio 1998; Cox 1999). This filing is only seen on the anterior dentition (central, lateral incisors and canines) mainly but sometimes involves mesial parts of the premolars. The fact that in some individuals only one half of the buccal surface (mesial buccal surface) of the canine is filed suggests that the motion could possible be side to side as opposed to up and down. Evidence of this kind of filing is seen Renaissance Italy on the dentition of a Noblewoman Isabella d'Aragona 1470 – 1524 AD, where the filing was in an attempt to remove a black patina left by a mercury based medication for syphilis (d'Errico, *et al* 1988). No evidence of syphilis was found from these six individuals with buccal filing at Cobern Street (Friedling pers comm.2007) although there was evidence of syphilis in some individuals at Cobern Street, but none of whom included the six individuals under discussion here. No attempt was made to test for mercury on the teeth and there was generally no black staining in any of the individuals.

Lukacs and Pastor (1988) also provide evidence of a similar kind of filing in Neolithic Pakistan. They cite five possible causes of this facial abrasion 1) wearing lip plugs or labrets; 2) retouching stone tools; 3) stuff and cut method of eating meat; 4) grasping the mouthpiece or bit of a bow drill and 5) splitting reed or bamboo stalks. Lukacs and Pastor (1988) accept that 'four of five potential sources of facial abrasion are plausible' but are reluctant to make any conclusion in the light of no ethnographic data to support these findings.

Another study by Fine and Craig (1981) examined the buccal wear found on the posterior teeth of 19th century native Greenland Eskimos, Asiatic Indians and Australian Aborigines. This study concluded that the kind of buccal filing seen here was due to normal masticatory practices. This was attributed to the amount of horizontal striations compared to vertical striations in relation to the occlusal plane. A high index of vertical to horizontal striations was indicative of a predominantly meat-eating diet (Fine and Craig, 1981). Between the two studies, the Lukacs's and Pastor's (1988) is more similar to the filing seen at the Cape (there are individuals exhibiting the same mesial buccal wear on the canines), therefore the evidence points to this practice being of a more general Asian origin that predates Islam (Fischman, 1997).

A much more likely explanation of this type of buccal filing could be due to the use of *miswak* for dental hygiene purposes. *Miswak* is an ancient 'toothbrush' used mainly in the East by followers of the Islam religion although not exclusively (Fischman, 1997). This chewing stick is generally restricted to men and more in the older than the younger generation. In Cobern Street however, there is one female with a Type C burial showing this kind of buccal filing. If indeed this is a Muslim practice, it might have evolved to include women among the people at the Cape who were far from their native lands where the practice was predominantly amongst men. The motion described by Fischman (1997) is usually up and down which is not consistent with what was seen at Cobern Street therefore is it possible that this motion was up and down for the incisors and side to side for the posterior teeth distally? Only further work using scanning electronic micrographs will help to solve this problem.

Pipe wear facets (see Figure 29) are only seen at Cobern Street and Marina Residence and none at Polyoak. Cobern Street has just one individual showing this unintentional tooth modification while Marina Residence has a total of six individuals (2 females, 4 males). Suriname slave plantation has a 100% prevalence (n = 17), 12 male, 4 females (Khudabux, 1991). Sint Jans has 28% of adults with wear facets, 44% males, 12% females (Maat, 2002). Corruccini *et al* (1982) shows pipe wear at 25 out of 60 individuals examined. The pipe wear on tooth surfaces is made by habitual positioning of a pipe in the act of smoking tobacco and the pipes with clay stems had been mass imported by the Europeans into the Cape in the 17th and 18th centuries.

Tobacco was used as early as 1658 by the Dutch at the Cape to induce the Khoikhoi to be 'more attentive' when being given Dutch and Christian teachings (Shell, 1994). In some instances European 'husbands' would barter off their Khoi 'wives' for tobacco (Shell, 1994), which Khudabux (1991) and Morris (1988) note that tobacco was expensive in Europe initially but became more readily available throughout Europe in later times. Morris (pers comm. 2007) also supports the view that tobacco was readily available to the poor at the time but acknowledges that there could have been a vast difference between what more affluent European enjoyed compared to what the slaves and poor had access to with regards to the type of tobacco consumed. This then suggests that pipe smoking was widely practiced throughout the colony with no class or race distinction therefore filtering to even the very poor who could be represented by these samples. There is archaeological evidence of pipe smoking in pre European, pre tobacco Southern Africa (Shaw, 1938) where Van der Merwe (2005) confirmed that mainly cannabis was used but in also used was a variety of aromatic materials. An interesting case is that of UCT 547 who shows both intentional maxillary incisor filing together with pipe wear facets. It reinforces the view that slaves imported to the Cape readily adopted practices not common in their native homes.

6.4 What can be learnt about geographic origins from these samples?

The Cobern Street and Marina Residence burial grounds went largely undocumented in the city's historical archives and are closely associated to a location marked 'slaven begrafnis' (slave burial ground) in the archives (Gordon Brown, 1970). It is for this reason it is believed that these burial grounds belonged to the poor of the city at the time. This designation of the 'city's poor' should encompass a myriad of people making the Cape a multicultural hub considering that fact that the Cape served as a refreshment stop for the VOC from 1652. The 'city's poor' would have consisted of sailors, from Europe, Asia, the Americas and West Africa; slaves from the VOC and those owned privately by the free burghers, free Blacks, the nomadic Khoikhoi populations indigenous to the Cape but who had become incorporated into Cape society and a combination of any of the above unions (Pearse, 1956; Boeseken, 1977; Penn, 2005; Hunt 2005).

The historical information about the arrival of slaves and others to the Cape and the intriguing evidence of the dental modification suggest that many, if not most, of the people buried at the three sites had their genetic origins from outside of South Africa.

'Assuming that non metric dental phenetic similarities give a reasonable estimate of genetic relatedness' (Irish 2006) and that the patterning of metric dental variation among geographic populations is more or less consistent with those obtained from genetic and craniometric data (Hanihara and Ishida, 2005) then teeth provide the near perfect tool to learn about geographic origins of a people. Sixteen non – metric traits and two metric traits were scored for Cobern Street and Marina Residence samples. Polyoak has a very small sample and the general preservation of the dentition was not satisfactory, so this discussion does not include the Polyoak data.

Although the differences are not statistically significant, the shovelling of both maxillary incisors, mandibullary central incisor and double shovelling of central maxillary incisors of Marina Residence sample are consistently higher than the frequencies seen in Cobern Street sample. Marina Residence upper central incisor shovelling frequency is 40% against Cobern Street 26.1%; 57.7 % against 42.9% for lateral incisor shovelling; 22.2% against 0% for lower central incisor shovelling and 33.3% against 18.8% for upper central incisor double shovelling respectively. Shovelling and double shovelling both add mass to the tooth crown and are not entirely independent of one another (Scott and Turner, 1997). The world wide frequency distribution of shovelling sees Sub Saharan Africa with lower frequencies (below 15%). Haeussler *et al* (1989) reported very low frequencies in both the San (2.0%) and Sotho (0.0%) samples. Western Europe and central parts of Asia with intermediate frequencies (20 – 50%) and East and North Asia as well as the Americas show the highest frequencies of shovelling (Scott and Turner, 1997). It should be noted that there is some level of overlap in between the frequencies of the major world populations (Turner *et al*, 1991). The winging frequencies follow the shovelling pattern closely.

The Mesial Canine Ridge (Bushmen canine) is very rare in other world populations but present in moderate (12 – 35%) frequencies in Sub-Saharan Africa (Morris, 1975). Cobern Street shows a 20 % frequency while Marina Residence shows a 25% frequency. This trait suggests a strong African origin to the individuals displaying it. Carabelli's cusp on the other hand, previously believed to be a 'European / Caucasoid' trait is shown to be found at frequencies of between 15 – 20 % in Sub Saharan Africa and higher frequencies of 20 – 30% in Western Eurasia (Western and Northern Europe, and North Africa) (Scott and Turner, 1997); groups which are traditionally classified as Caucasoid.

Cobern Street and Marina Residence samples show frequencies of 34.8% and 19.1% respectively. Cusp 6 on the lower molars is found in low frequencies (0 – 10%) in Western Eurasia; 10 – 20% in Sub-Saharan Africa and between 30 and 50% in North and East Asia (Scott and Turner, 1997). Cobern Street and Marina Residence samples show 30 % and 7.1% respectively.

The deflecting wrinkle and cusp 7 traits found on the lower first molar were not found in the Cobern Street and Marina Residence samples. Both these traits have moderate frequencies in Sub-Saharan African population of 25 – 40% for cusp 7 and 20 – 35% for deflecting wrinkle (Scott and Turner, 1997). Cusp 7 has a frequency of less than 10% in Western Eurasia and Southeast Asia while deflecting wrinkle has a frequency of less than 15% in Western Eurasia and a 20 – 35% frequency in East and Southeast Asia. The distal trigonid crest is absent in Cobern Street sample but present at Marina Residence at 20.0% frequency. This trait is seen in frequencies of below 10% in Sub-Saharan Africa and Western Eurasia while East Asia exhibits frequencies of between 10 and 20%.

Of the 16 dental non – metric traits observed, only 11 best describe geographic population patterning and from this 11 traits, 9 suggest a Western Eurasian, East and North Asian origin while only one is very strongly suggestive of an African origin. This means that from both Cobern Street and Marina Residence discrete dental traits support more of an Asian and European geographic origin and Africa is only marginally represented. The minimal African admixture is also supported by low frequencies of traits such as upper first molar Carabelli's trait, lower second molar Y-groove pattern, lower first molar cusp 7, which best describe the Sub-Saharan Dental Complex as defined by Irish, (1997; 1998). If however both Cobern Street and Marina Residence frequencies of quasi continuous traits are subjected to the Turner (1990) 'Asian Complex' definition previously discovered by Hanihara (1967), both samples fall short. This further supports a multicultural composition of the individuals buried at both Cobern Street and Marina Residence.

Cobern has less shovelling, but its presence at both sites confirms Asian origins for at least some of the individuals. The relatively high incidence of Carabelli's cusp and Cusp 6 add to this Asian confirmation, but also suggest the possibility of European ancestry as well, also this is less dramatic at Marina Residence than Cobern Street.

Bird (1966) gives the Cape Town 1821 census as: Europeans at 9 761; slaves including those working as freed apprentices at 7 999. Since Europeans had their own designated burial grounds according to their religious denominations (Laidler and Gelfand, 1971) it is consistent that their representation especially at Cobern Street would be minimal comparatively if the number given by Bird (1966) is likely to include any who could be classified as Cape Poor. The mesial canine ridge indicates the importance of the African presence in the burial grounds. This is absolutely consistent with the styles of dental modification and dietary data (Sealy, 1996; Cox, 1999; Apollonio, 1998).

For dental metric traits there is a greater sexual dimorphism within the Cobern Street sample compared to the Marina Residence sample. The mesiodistal diameters of I2, C, P1, P2 and M3 are significantly different between Cobern Street sexes and for the buccolingual diameters only I2 and P2 are significantly different. There are no significant differences in the mesiodistal and buccolingual diameters of Marina Residence. When comparing Cobern Street sample to Marina Residence only one (male mesiodistal diameter of P1) of 32 variables is significant suggesting some homogeneity between the two samples assuming that dental metric trait are heritable. The homogeneity referred to between these two samples takes into account the variability within each sample and does not imply homogeneity of heritable characteristics. Further analysis (not covered in this study) of metric and non metric traits using principal component analysis will better explain inter-sample variation and distances between the two samples in terms of genetic variability as well as possibly list those traits that vary most among the samples.

Chapter 7 Conclusion

The skeletal samples from Cobern Street burial site represent the poor of 18th and 19th century Cape Town based both on the undocumented nature of the burial sites (Cox, 1999) as well as the dental health as shown in this study. The Marina Residence and Polyoak burial sites follow a similar trajectory. The dental health of the Cape Poor of 18th and 19th century Cape of Good Hope does not suggest that there was much difference in the diet of the local poor people but points more towards vastly different oral hygiene practices, more precisely the lack thereof.

Those among the Cape Poor who were slaves ate whatever their masters could afford to give them with fish having been the more abundant foodstuff. The differences in oral hygiene practices are to be expected given theses peoples' array of cultural backgrounds including West and East Africa, European, Asian as well as nomadic the KhoiKhoi people. Some of the other cultural traits evident include dental filing and buccal surface wear possibly due to the use of a tooth cleaning twig, Miswak. Both dental filing and the buccal surface filing are no longer practiced as there has been no evidence in contemporary or recent historical populations.

The Cape Poor's burial grounds represent people from very diverse backgrounds but there is a strong European and Asian presence as seen in the dental morphological traits. The cultural trademarks of some of these communities became absorbed in 18th and 19th century Cape life. Some examples are a slave showing dental filing also seen with pipe smokers wear, a young woman with buccal surface wear that may very well be caused by the use of Miswak, a practice that is normally associated with older/mature men.

The Cape Born individuals who were probably born into slavery seem to have had a relatively non stressful childhood compared to both the group of individuals who were born after emancipation and those who originated outside the Cape. This finding is contrary to the general perception that all aspects of slavery were bad. It shows that at least in as far as nutritional requirements and stability in childhood are concerned, slave children were better off. These results should be treated with caution since the samples are very small. The odontological analysis of the Cape Poor confirms previous studies' accounts of people who lived under harsh conditions, were multicultural in their origins but were ultimately absorbed into the formation of a 'South African identity'.

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