AN ANALYSIS OF DENTAL HEALTH IN RELATION TO SEX AND SOCIAL STATUS AT ROMAN WINCHESTER

AN ANALYSIS OF DENTAL HEALTH IN RELATION TO SEX AND SOCIAL STATUS AT ROMAN WINCHESTER

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ABSTRACT

Inequalities in society, past and present, are influenced by a number of aspects of identity. The purpose of this study is to investigate dental health differences at a Romano-British site as they relate to (1) sex, (2) social status, and the (3) confluence of sex and social status, using the theoretical frameworks of Embodiment and Intersectionality.

Dental health data for 342 adults from Roman Winchester (4-5th century CE) were compared between sex and social status groups. Statistical analyses showed that males exhibited higher rates of anterior antemortem tooth loss (AMTL) and higher rates of dental wear than females; additionally, the Lower Social Status group had higher rates of posterior and total AMTL than the Higher Social Status group. When analyzing sex *and* social status, the Higher Social Status group exhibited no statistically significant differences. Within the Lower Social Status group, however, males and females exhibited differences in anterior AMTL, anterior dental wear, and posterior dental wear. No differences in dental caries rates were found for any subgroups.

Results show that in this skeletal sample, dental health between the sexes was not drastically different, suggesting, at least with respect to diet, that women were not fundamentally inferior to men, contrary to surviving literary evidence. By analyzing the confluence of sex and social status, analysis shows that the Higher Social Status group was defined by more equality between sexes, while minor differences were found in the Lower Social Status group. This may suggest that in families where resources were strained, men and women consumed slightly different diets, while in families where resources were plentiful, women and men consumed similar foods.

The results of this thesis provide new insights into the lives of women and lower social status groups, and contributes to a greater understanding of inequalities and dietary variation in Roman Britain.

ACKNOWLEDGEMENTS

Throughout this process, I have come to learn that a thesis is not an individual effort, but is only accomplished through the support of many people. Some of those people are listed below, but not listed are the many people who read drafts, listened to my ramblings, and feigned interest in Romano-British diet and inequalities. Without these people, this thesis would not be complete today. Thank you.

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Lastly, a final thank you goes to Nika, for pulling me away from the computer from time to time, and reminding me that there is more to life than Romano-British teeth.

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DECLARATION OF ACADEMIC ACHIEVEMENT

The research contained in this thesis dissertation was completed by L. Creighton Avery, under the supervision of Dr. Megan Brickley and Dr. Tracy Prowse. Research questions and methodology were developed in consultation with Dr. Brickley and Dr. Prowse. Permission to access the skeletal collection was obtained by Dr. Brickley from Helen Rees of the Hampshire Cultural Trust (previously known as the Winchester City Council), Katherine Barclay of the Winchester Excavations Committee, and Louise Loe of Oxford Archaeology. Osteological age and sex data were collected by L. Creighton Avery and Xuan Wei for the Social Sciences of Humanities Research Council (SSHRC) of Canada Insight Grant, File number 435-2013-1006 (ID# 169793). Written agreement between L. Creighton Avery and Dr. Megan Brickley (SSHRC Project Principal Investigator) regarding the use of data was drawn up, and allows for the use of the data within this thesis. Dental data collection and analysis of data were independently completed by L. Creighton Avery. Dr. Brickley graciously provided additional funding for this project through the aforementioned SSHRC project.

CHAPTER 1: INTRODUCTION

1.1 Introduction

In Roman society, it is well understood that women were not politically or socially equal to men (Fuller *et al.*, 2006; Bonsall, 2014; Garnsey, 1999). In Roman Britain, much of the ancient literature maintains that women were collectively inferior to men (Redfern, 2005). However, ethnographic, clinical, and archaeological evidence has shown that gender and sex-based differences are not consistent within a single society, but that inequalities can be influenced by numerous aspects of identity, including social status (Meskell, 2007; Arantes *et al.*, 2009; Walker and Hewlett, 1990). Bioarchaeological and modern clinical research have highlighted that benefits related to sex and social status can be clearly identified through the analysis of dental health (*e.g.*, Bonsall, 2014; Borrell and Crawford, 2008; Cucina and Tiesler, 2003; Lopez and Baelum, 2006; Lukacs, 1996; Walker and Hewlett, 1990).

The aim of this thesis, therefore, is to explore dental health in relation to (1) sex, (2) social status, and (3) the confluence of sex and social status, to better understand sex and status inequalities, or lack thereof, at the Late Romano-British site of Winchester (c. 4-5th century CE), specifically as it relates to diet and access to food resources. The theoretical framework of Embodiment is used throughout, which emphasizes that social and cultural experiences can become manifested in physical remains. The concept of Intersectionality is also used to analyze the confluence of sex and social status in relation to dental health. Intersectionality is a feminist framework, which emphasizes that inequality and marginalization do not only occur due to individual systems of oppression, such as sexism, racism, or classism, but that these systems are interlinked and cannot be examined, understood, or solved in isolation (Crenshaw, 1989). McKinnon (2013) describes Intersectionality as the points of overlap in a Venn diagram, areas that are routinely neglected, or at best, 'sped through'. Therefore, this thesis uses dental health to explore the Venn diagram of inequalities as related to sex and status, and takes a detailed look at each aspect, as well as the convergence of these aspects of identity.

The skeletal remains used in this thesis come from four sites in the Northern Cemetery from Winchester, UK, associated with the Roman city of *Venta Belgarum.* Three hundred and forty-two (342) individuals were analyzed, representing all individuals aged 16 years and older with dental remains. Dental remains were examined macroscopically and differences were compared between groups created around sex, social status group, and age, and are contextualized through the use of historical, archaeological, and clinical evidence.

1.2 Thesis Organization

The thesis is organized into six chapters with additional appendices. Beyond the current chapter, Chapter two introduces the theoretical frameworks incorporated in this thesis, and provides information related to gender in bioarchaeology, and determining social status. It also discusses Roman Winchester, diet and dental care in the Roman world, as well as clinical background on the etiology of dental health conditions examined in the scope of this thesis. Chapter three reviews the materials, methodology used for recording, and subsequent statistical analysis, while Chapter four presents the results and statistical analyses of the sample and sub-samples. The results are then contextualized in Chapter five with the use of historical, archaeological, and clinical evidence. Chapter six concludes the thesis, summarizing the key findings of the study, as well as providing recommendations for future bioarchaeological research.

CHAPTER 2: BACKGROUND

2.1 Theoretical Frameworks

Theory is the lens through which researchers interpret and ascribe value to their data. While many researchers find it difficult to fully incorporate theory within their work, others argue that theory is imperative to any anthropological analysis, and without it we are left with data that have no meaning or sense associated with them (Layton, 1997). Theoretical approaches in bioarchaeology are numerous and diverse, but perhaps the most prominent of these theoretical frameworks is the biocultural approach, articulated in the medical anthropology literature by Goodman and Leatherman (1998).

The biocultural approach seeks to break the dichotomy between biology and culture, and places the emphasis on how sociocultural and political-economic processes affect and influence the biology of people (Goodman and Leatherman, 1998). The biocultural approach is unique, as it crosses sub-disciplines to discern experiences that affect the human body but can otherwise remain archaeologically or historically invisible (Zuckerman and Armelagos, 2011). For example, while paleobotany may be able to distinguish the types of food available at a site, by studying the human remains researchers can explore rates of dental disease, and through the lens of the biocultural approach, better understand the various social, political, and economic variables that influenced access to material resources.

Within the biocultural approach, there are numerous theoretical frameworks, including the theory of Embodiment, which forms the basis of this thesis. The feminist framework of Intersectionality will also be employed in this thesis, which stresses that inequalities are never due to singular and distinct factors, but are the outcome of the intersections of different power relations and experiences (Hankivsky, 2014).

2.1.1 Embodiment

The skeleton is often viewed as two separate entities: (1) the physical remains that are analyzed and quantified, and (2) the representation of cultural ideas (Joyce, 2005). The theory of Embodiment emphasizes that these two bodies are not distinct, but suggests that cultural ideas are expressed within the physical remains (Jimenez *et al.,* 2009). According to Krieger (2005), using the eco-social framework of Embodiment, researchers may be able to use bodies to uncover stories that people cannot, or will not, tell. The approach is often seen as an extension of the biocultural approach, and is considered vital for epidemiological studies (Krieger, 2005; Martin *et al.*, 2013).

The framework of Embodiment was largely influenced by phenomenology and feminist theory, however, explicit discussion of Embodiment in bioarchaeology has only developed within the past decade (Joyce, 2005). Working definitions of Embodiment differ between sub-disciplines, however, this thesis uses Embodiment as described by Krieger (2005), as a conceptual tool for understanding the biological effects of social and cultural actions (Zuckerman *et al.*, 2013). Perhaps the most prominent or obvious of these biological manifestations of cultural actions in bioarchaeology is through the use of body modification; however, Krieger (2005) stresses that Embodiment of social and cultural actions is not always consciously done. Social and cultural experiences may leave markers unknowingly on the individual, such as indicators of inequalities due to occupation, activities, and diet.

Although beneficial to understand that cultural experiences may become written on our bones, it is important for researchers to understand the limitations of this method as well. Perhaps most obvious is that not all cultural and social experiences will leave permanent marks on skeletal remains. Short term or low impact activities may have no effect on skeletal remains, while experiences that happen continuously or very drastically do, bu this is not always the case. Important social and emotional experiences may occur over a long period, but do not necessarily leave markers for bioarchaeologists to discern. Furthermore, individuals may assume multiple identities throughout their lifetime, and as identities change, so do cultural and social experiences (Martin *et al.*, 2013). Markers of activities will therefore also change, but not always in known or expected ways.

Krieger (2005) also emphasizes that the body does not partition experiences into neat packages to be read by bioarchaeologists, but that our bodies experience cumulative impressions from a variety of experiences and exposures. When considering that our identities are also not neatly packaged, but blend together and intersect with one another, it makes sense that physical manifestations of lived experiences would also follow this pattern. By incorporating the feminist framework of Intersectionality (see section 2.1.2) into the theory of Embodiment, we may be able to see that this blending and convergence of experiences and physical manifestations is not a limitation, but an exciting possibility for understanding how multiple aspects of identity influence social and cultural experiences, and therefore, their physical manifestations on the skeleton.

2.1.2 Intersectionality

In today's society, we are increasingly aware that human lives are multi-dimensional, and cannot be fully explained or understood through only one facet of our identity (Hankivsky *et al.,* 2012). However, within bioarchaeology, studies tend to focus on inequalities of sex, age, or social status individually, and rarely consider multiple aspects of identity concurrently (Thedeen, 2012; Meskell, 2007). Intersectionality works to incorporate multiple aspects of identity simultaneously, and offers a unique framework- especially within bioarchaeology- for understanding inequalities and diversity within the human experience (Hankivsky, 2014).

Since the term was first defined and used over 25 years ago by Crenshaw (1989), Intersectionality has been employed by social activists (Doetsch-Kidder, 2012), feminist scholars (McCall, 2005), legal representatives (Green, 2002), and public health officials (Bowleg, 2012), among others, to address inequalities and human rights issues. In this approach, inequalities and marginalization are not the result of individual systems of oppression, but are due to multiple systems interacting and influencing one another. These intersections of oppression can result in increased marginalization, depriving individuals of resources and power within a particular society, and can increase their likelihood of experiencing poor health, violence, and additional injustices. When first using the term, Crenshaw (1989) discusses that the work experiences of black women cannot be boiled down to sex discrimination or racial discrimination, but is the result of both of these systems of oppression working synergistically. As a result, the injustices and inequalities experienced by black women cannot be solved in isolation (Crenshaw, 1989). In an Intersectional approach, this is true for all inequalities experienced by individuals today, and in the past.

While this approach has been widely used in academic disciplines such as gender studies, health sciences, sociology, and cultural anthropology, it has not yet been widely employed by bioarchaeologists (Preucel and Mrozowski, 2010). Inspired by current social challenges and the ways in which we address them, bioarchaeological investigations utilizing an Intersectional approach set out to better understand past peoples, and see them as complex and diverse human beings, as opposed to categories represented in binaries such as male or female, adult or child, higher or lower social status (Zakrzewski, 2015). By considering multiple aspects of identity, researchers will more closely understand the "complexity, contradiction, and plurality of lived experiences" in Roman Britain and elsewhere in the world (Geller, 2009: 70). In an Intersectional approach, the few and uniform categories often used in bioarchaeological studies (*e.g*., male and female OR higher and lower social status) become diverse and many (*e.g.,* higher social status males, lower social status females, *etc*.) allowing for a more nuanced understanding of inequalities in the past (McKinnon, 2013).

Perhaps the main reason Intersectionality has not been utilized by bioarchaeoloigsts is because it has been seen as too daunting a challenge, and too complicated to approach, especially considering everything cannot be studied at the same time (Meskell, 2007; Nelson, 1997). However, by constantly limiting interpretations to one facet of life, we oversimplify lived experiences, and risk interpretive violence of those in the past, and by extension, those facing inequalities today (Allason-Jones, 2005; Meskell, 2007). By using an Intersectional approach, researchers may be able to understand inequalities in a more accountable and comprehensive way than current methodologies allow.

2.2 Gender in Bioarchaeology

In this thesis, the terms ‘sex’ and ‘gender’ are not synonymous, but refer to two different aspects of identity. Sex (male, female, *etc.*) is seen as a biological construct and refers to differences in genitalia and secondary sexual characteristics; gender (man, woman, *etc.*), however, is seen as a cultural construct, and often refers to how individuals should and/or choose to behave, or are treated within society (Claassen, 1992; Lukacs, 2011). The sex/gender division arose from the Social Sciences, acknowledging that lives of men and women, specifically relationships and behaviours, are not solely dependent on biological differences (Sofaer, 2006). While sex is considered to be set or ‘coded’, gender is a process that changes over the life course, as individuals negotiate their position within society, and as it intersects with other aspects of identity such as age or status (Sofaer, 2006). As a result, gender is often composed of categories that are numerous, diverse, and mutable. In Roman society, a variety of gender roles most likely existed, but literary evidence indicates two primary gender categories of men and women (Grubbs, 2002).

For osteologists, reliable methods to estimate sex based on morphological features of the pelvis and cranium allow for investigations of sex-based differences, but examinations based on gender are far more challenging (Brumfiel, 2006; Buikstra and Ubelaker, 1994). Archaeologically, gender is typically inferred through the use of funerary archaeology, which has been described as crucial to the exploration of gender-systems in the past (Arnold, 2006). However, this approach can be problematic, as the ways in which people use material cultural and ascribe meaning to objects is anything but straightforward (Cool, 2010).

Theoretically, researchers are now exploring gender through the framework of Embodiment, where the body is viewed as material culture (Sofaer, 2006; Brumfiel, 2006). The main premise of this approach is, since gender is socially and culturally constructed, it is performative, and as a result, these gendered actions may leave marks on the skeleton (Brumfiel, 2006). While mortuary analyses may look for *representations* of gender, Embodiment and analysis utilizing human remains looks at the *enactment* of gender (Brumfiel, 2006). Sofaer (2006) states that skeletal changes can relate to the ways that the social construction of gender impacts the body, whether that is done deliberately or unconsciously, through a lifetime of gendered activities. Naturally, not all activities will leave marks on skeletal remains, and activities that do would be indicators of severe or prolonged actions that were carried out repeatedly throughout the life course. Instead of assigning individuals to gender categories, this approach explores the ways in which gender is enacted and lived within a sample (Brumfiel, 2006). Analysis of gender through theoretical frameworks has successfully been used by other researchers studying dental health, to explore gendered patterns of food consumption (*e.g.,* Cucina and Tiesler, 2003; Bonsall, 2014; White, 2005; Somerville *et al*., 2015). In doing so, viewing the body as material culture alleviates some of the tensions between sex and gender, and allows for sample-wide analysis of gender and its impacts on individuals as a group.

2.3 Social Status

In order to explore or consider social status differences in the past, archaeologists and bioarchaeologists often look to mortuary profiles and funerary evidence, as these are believed to have the greatest potential for holistic insights into social status differences (Tainter, 1975; Griffin *et al.*, 2011). Within the mortuary profile, analysis of grave construction, quantity and/or quality of grave goods, grave location, or a multi-variable analysis are often used. However, using mortuary profiles can also be highly problematic due to issues of preservation, manipulation, and improper contextual readings (see Binford, 1971; Pearson, 1982; Cannon *et al.,* 1989; Robb *et al.,* 2001).

As well as these limitations, using mortuary evidence to determine social status is problematic as it represents status at the moment of interment. However, social status, even if ascribed, is not static throughout an individual's life, but can change based on occupation, marriage, family size, accomplishments, criminality, and more (Pechenkina and Delgado, 2006). In contrast, pathological conditions of the teeth are typically age-progressive and accumulate over the life of an individual. As a result, a change in social status towards the end of an individual's life may not be reflected in their dental health status, thus complicating results.

These are complications that researchers must keep in mind when forming their analyses, but should not altogether prevent analyses of this type. In the following sections, methods utilizing mortuary profiles will be outlined, and their application to Roman Winchester will be discussed.

2.3.1 Grave construction

Within a cemetery context, determining social status based on grave construction is employed with the assumption that more time, money, and energy would be invested in the burials of higher social status individuals, while individuals of the lower social status group would have a more simplified structure or no structure at all (Kinaston *et al.,* 2013). Roman texts suggested that the wealthy would be buried in coffins made of wood, terracotta, stone and lead, while the lower social status individuals were simply placed in the ground (Redfern and DeWitte, 2011). However, variation certainly existed and grave constructions were influenced by other aspects of identity including spiritual and religious beliefs (*e.g.,* simple and undecorated burials for Christians), membership in burial societies, and familial ties (*e.g.,* family mausoleums).

Researchers at Roman Dorset, UK, based determination of social status simply on the presence or absence of coffins (Redfern and DeWitte, 2011). However, the majority of individuals in the Northern Cemetery of Roman Winchester were buried in coffins, thus, presence or absence of a coffin may not be an appropriate method for determining social status within this sample. Rather, excavators at Lankhills state that stepped burials and burials with enclosures may serve to distinguish the wealthy from others within the cemetery, as these constructions suggest a higher degree of provisions and extra expenditure; conversely, those without coffins may indicate individuals of lower social status (Powell, 2010). Those buried in simple coffins with no additional structures do not immediately suggest higher or lower social status, but may be an equivalent to a middle class.

2.3.2 Grave goods

Correlations are often made between the quantity and/or quality of items within a grave and the wealth of an individual. However, this connection has been highly criticised for its simple translation of material cultural into economic capital (Pearson, 1982; Peck, 2013). Additionally, differential preservation and the durability of various materials may mean that particular items (*i.e.,* those made of wood or textiles) may not survive for archaeologists to examine and interpret. Thus, researchers have argued for a more contextual analysis of material culture, and what it may tell us about an individual's occupation or activities (Linderholm *et al.,* 2008). For example, a stylus, used for writing, may indicate literacy and therefore special or higher social status within a sample where literacy was uncommon (Quensel-von-Kalben, 2000). Another concern with using grave goods to determine social status is the manipulation by the surviving family members, who may include elaborate displays of wealth that were unobtainable in life, for their own social advancement or to honour the deceased (Pearson, 1999; Cannon *et al.,* 1989). In these cases, grave goods may be gifts from mourners and have no relevance to the deceased. These items may be to support a journey to the afterlife, be apotropaic (*i.e.,* believed to ward off evil spirits and bad luck), or serve as a method of social advancement (Cannon *et al.,* 1989). However, Cool (2010) believes this was not the case within the Northern Cemetery of Roman Winchester, as the majority of the grave goods were of little financial value, and were instead comprised of low denomination coins, well-worn ceramics, and repurposed jewellery made of bronze, bone, and shale rather than precious metals.

2.3.3 Grave location

A third approach for determining social status from mortuary contexts is examining the location of an individual's grave. This approach operates under the assumption that individuals with more power, wealth or prestige within a community would have preferential access to better areas within a cemetery or burial location (Pearson, 1999). The use of grave location to determine status is often used in archaeological studies of medieval churches, where noble families and clergy were buried closest to the altar, and the poor were buried around the church instead of within it (Vercellotti *et al.,* 2011). However, processes beyond social status may influence where an individual was buried, including circumstances of death (*e.g*., criminals, the unbaptized, those who died of acute infectious diseases), occupational groupings, religious affiliation, and other reasons that have not yet been considered (Binford, 1971).

Within the Northern Cemetery, determining social status based on grave location was not possible, as much of the cemetery is still unexcavated, and as a result, the full boundaries are unknown, as are the 'more desirable' locations within the Northern Cemetery. As there are four cemeteries surrounding *Venta Belgarum*, with some overlap in use through time, it is possible that the entire Northern Cemetery was a preferred burial location, but no thorough analysis on this has yet been completed. As a result, grave location was not a factor used to determine social status standing within the Northern Cemetery sample.

2.3.4 Multi-variable analysis of social status

Using multiple lines of evidence (*e.g*., grave construction, grave goods, grave location) to determine social status helps minimize issues of preservation, manipulation and burial practices that may limit expression of status in one way or another. Jorkov and colleagues (2010) believe that using a multi-variable approach helps to add subtle nuances to understanding social organization, especially when single lines of evidence, such as grave goods, can be complicated by a wide range of cultural factors. However, using multiple lines of evidence does not eliminate these complications. Additionally, the amount of data needed for multi-variable analysis can be difficult to obtain, especially in disturbed graves, or those excavated with minimal burial records.

Using mortuary profiles to determine social status certainly has its challenges and limitations, which may be partially mitigated by supplementing standard methodologies (*e.g*., grave goods, grave constructions) with contextualized information regarding how the living buried the dead within particular samples. In the Roman Empire, surviving literary and epigraphic information allows researchers to make connections between status and funerary practice, however, little remains from Roman Britain (Griffin *et al.,* 2011; Redfern *et al*., 2015; Philpott, 1991). Ottaway and colleagues (2012: 358) support this, stating there is a "scarcity of data" in Roman Britain to help understand the relationship between status and mortuary profiles. Studying burial practices throughout Roman Britain (43-410 CE) by using the burials themselves, Philpott (1991) concludes that burial practices in Roman Britain were both dynamic and regionally varied, but four features may indicate status in Romano-British burials, specifically:

(1) Quality and quantity of grave furnishings;

(2) Special markings of graves (*e.g.,* monumental tombs, a grave with enclosure);

(3) Use of special containers (*e.g.,* lead-lined or stone coffins); and

(4) Special treatment of the body (*e.g.,* embalming or plaster-packing).

Without direct literary evidence as to how individuals in Roman Britain buried their dead and indicated social status, it is important to consider that the results of these methodologies do not determine who was high or low social status, but finds groups that operate in relation to one another. As a result, the groups defined by these methods are viewed as higher and lower social status groups, indicating their comparison to each other, and not their positions in absolutes.

2.4 Roman Winchester

Winchester is a modern city in Hampshire, England (Fig 2.1A, B). Evidence of human occupation in the area dates back to the late Neolithic and early Bronze Age (circa 2500 BCE) with evidence of farming, flint knapping and ceremonial activities (Ottaway *et al.*, 2012). Occupation of the area continued into the Iron Age (750 BCE- 43 CE), with construction of earthworks, fortifications, and expansion of trade, which made the location a tribal and religious centre for the surrounding areas (Ottaway *et al.,* 2012).

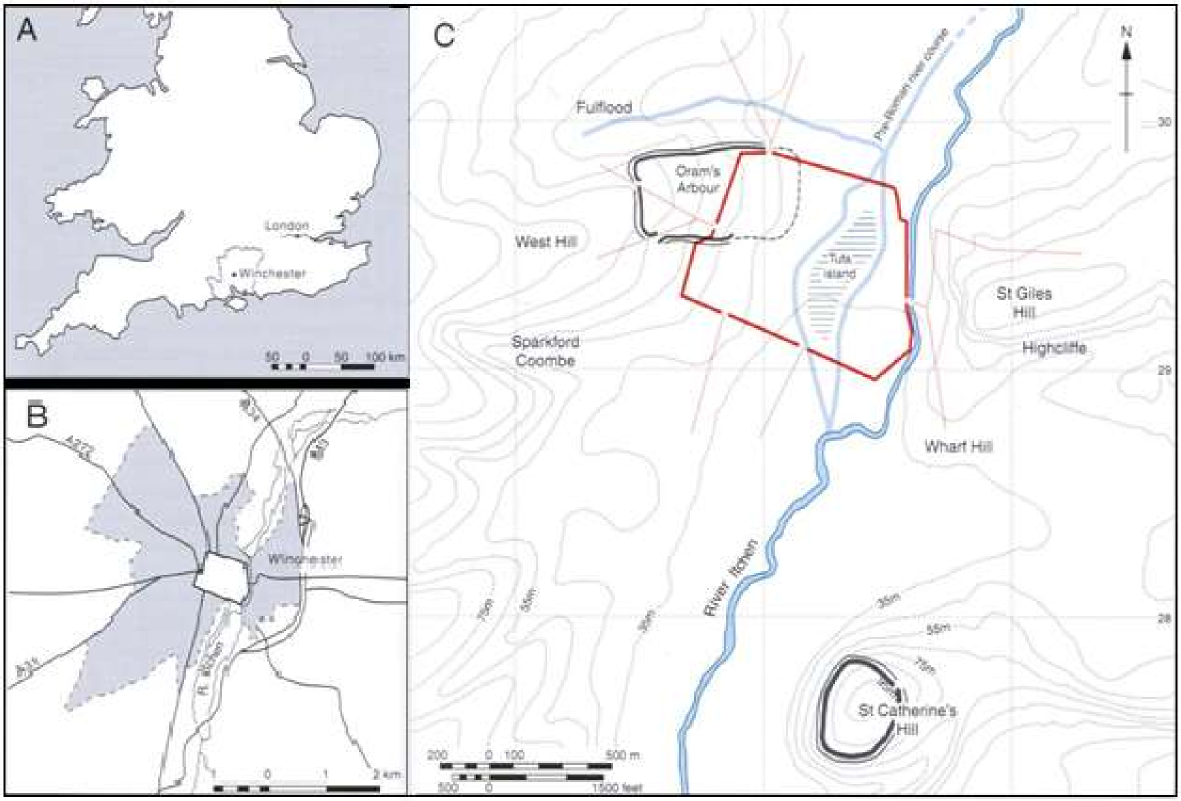


Figure 2.1. Winchester, Hampshire, UK, with geographical and topographical setting. (A) Location of Winchester, Hamphsire, UK. (B) Showing areas of the modern city (shaded grey) and Roman town (white, centrally located). (C) Geography and topography of the Iron Age earthworks (double black line, labeled "Oram's Arbour") and of Roman Winchester; *Venta Belgarum* (red lines). (Adapted from Ottaway *et al*., 2012: 3).

The Roman town, *Venta Belgarum* ('the marketplace of the Belgae,' Fig 2.1B, C) most likely started as a military fort in 50 CE, making it one of the first Roman settlements following the Claudian invasion in 43 CE (James, 1997). Utilizing the Iron Age earthworks, the Romans were able to control communications and trade routes throughout the area from this location (Ottaway *et al.,* 2012). The first major constructions by the Romans occurred by 70 CE, with the addition of defences, and the diversion of the River Itchen to help control the flood plains for farming and the expansion of urban occupation (Ottaway *et al.,* 2012). Over the next century, further defensive walls and ramparts were built around Roman Winchester, as well as five (possibly six) long-distance roads, connecting *Venta Belgarum* to other important Roman centres in Britain (Ottaway *et al.,* 2012). By 100 CE, *Venta Belgarum* was designated as a *civitas* capital, serving as an administrative centre and unit of government for the surrounding conquered areas (Roberts and Cox, 2003). The restructuring of the area and new status of the town resulted in major building works including an administrative centre, grid-patterned streets, basilica, forum, shops, and offices (James, 1997). Due to its economic and administrative status as a *civitas,* Roman Winchester became the fifth largest town in Roman Britain, and the population grew to three or four thousand inhabitants (Stuckert and Kricun, 2011; James, 1997).

By the late third century CE, Roman Winchester was a typical major urban centre, with a wide range of commercial and craft productions (Bonsall, 2014). The community most likely consisted of traders or craftsmen, with a smaller ruling elite living in higher status houses within and around the community of *Venta Belgarum*. Initially, craft production was most likely for the community rather than for long-distance trade, but by the fourth century, a *gynaeceum* (imperial cloth production centre) may have been present. While no structures of the factory have been located, ancient texts mention a *gynaeceum* in '*Venta'*, which historians believe refers to *Venta Belgarum* (Ottaway *et al.,* 2012; Clarke, 1979).

The decline of *Venta Belgarum* coincided with the end of Roman rule in Britain in 410 CE, and while the individual towns and provinces were not entirely dependent on Rome's support, it may have been a contributing factor to the decline of the town. By the mid-fourth century, within the city limits, the larger houses of the ruling elite were slowly being dismantled, and smaller wooden structures began to take their place (Ottaway *et al.*, 2012; James, 1997). Literary evidence indicates that the textile factory, the *gynaeceum,* closed at the beginning of the fifth century, which would have resulted in economic decline and the loss of jobs for many inhabitants of *Venta Belgarum*. Outside the city walls, the cemeteries also experienced a decline, with no burials confidently dated after 410 CE (Eckardt *et al*., 2009). According to James (1997), by the middle of the fourth century, there were problems within the city and by the beginning of the fifth century there were only remnants of a city remaining. Ultimately, it is the decline in the number of burials in the various cemeteries surrounding *Venta Belgarum* that archaeologists have interpreted as the end of Roman Winchester (Ottaway *et al.,* 2012). It would be another 400 years until the Saxons and Alfred the Great made Winchester a regionally important town once again.

2.4.1 The Northern Cemetery

Consistent with Roman law, burial of the dead occurred outside the city walls of *Venta Belgarum*, alongside the main roads leading from the city (James, 1997). To date, three cemeteries have been identified outside the walls (Northern, South Gate, and East Gate) (Figure 2.2), which archaeologists believe were in use semi-contemporaneously, with no known distinction as to who was buried where (Ottaway *et al.*, 2012).

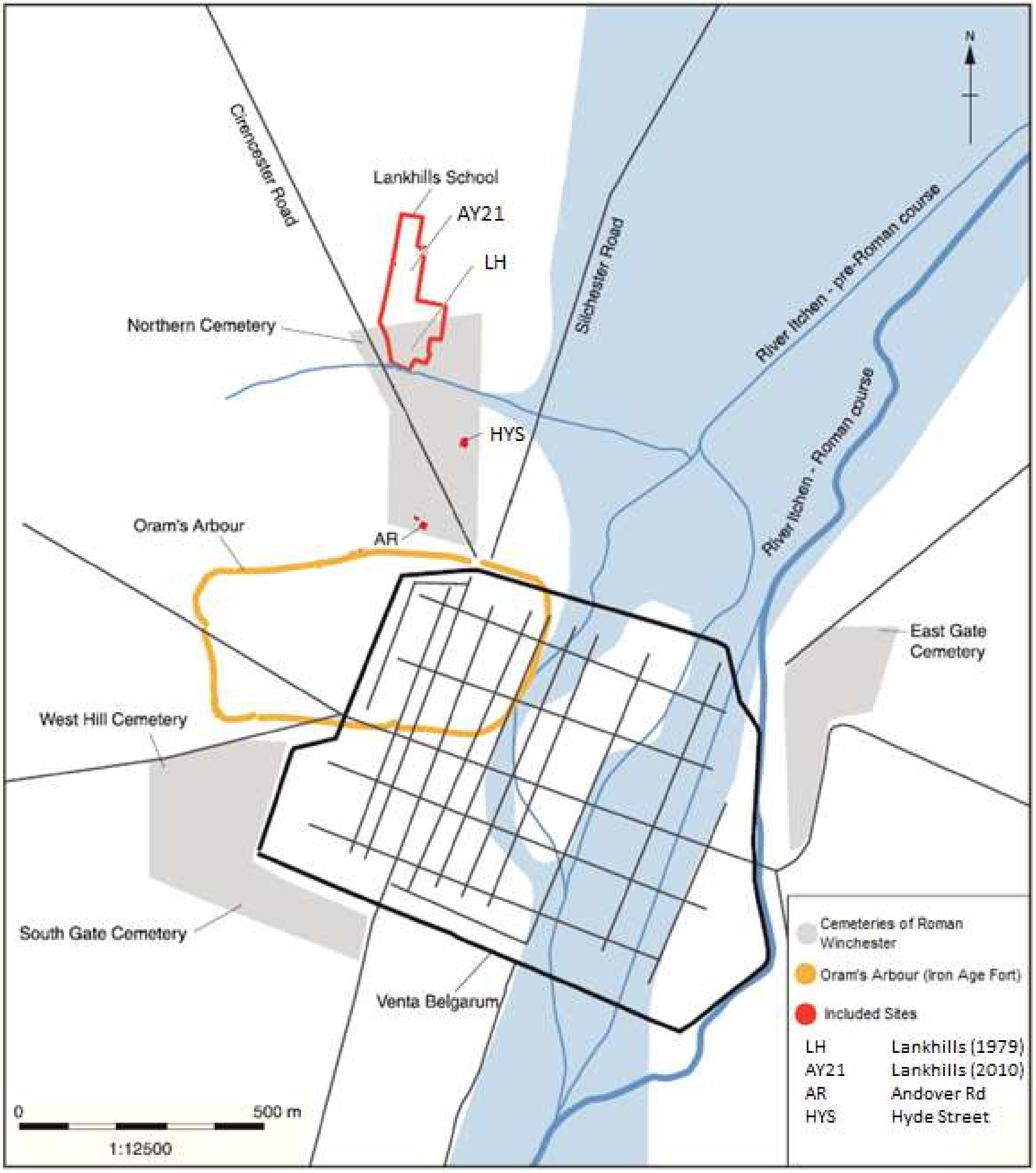


Figure 2.2. Roman Winchester and the surrounding cemeteries. Yellow indicates the extent of the Iron Age enclosure, and the thick black lines indicate the Roman city. Grey indicates the known cemeteries. Red indicates the four sites in the Northern Cemetery used within the context of this thesis. (Adapted from Booth *et al.,* 2010: 6).

According to Ottaway and colleagues (2012), the Northern Cemetery was most likely established circa 270 CE, and remained in constant use until the early fifth century. It is the largest of the known cemeteries at *Venta Belgarum*, and was most likely a managed cemetery, as evident by the well-defined area for burial and the semi-parallel rows of inhumations (Ottaway *et al.,* 2012). While Britain was largely Christian between the fourth and fifth century, evidence of a managed cemetery does not indicate management by the church; it is equally plausible that a municipal authority, landowners, or other third-party groups managed the cemetery (Ottaway *et al.,* 2012). In fact, variations in burial rites between body position (flexed, extended), burial type (inhumation, cremation) and inclusion of grave goods, reflect a certain amount of diversity which may include religious diversity; although the extent of this variation and the ways in which it is displayed is not fully understood (Baldwin, 1985).

2.5 Diet

Diet and dietary habits of an individual and of a community are formed by many factors, including environmental (*i.e.*, what is available to eat) and cultural (*i.e.,* what is appropriate to eat) influences. As a result, food choices can be heavily influenced by gender, ethnic affiliation, social status, religious beliefs, occupation, and more. Thus, by understanding the diets of past peoples, we may also be able to expose cultural dynamics between individuals and recognized sub-groups (Bonsall, 2014).

2.5.1 Diet of the Roman Empire

Current understandings of Roman diet are interpreted from multiple sources including ancient texts, art, paleobotany, and zooarchaeology. Ancient texts, such as Marcus Gabius Apicius' *Apicius de re Coquinaria,* provide recipes and cooking instructions, while medical writers such as Galen wrote about appropriate dietary intake for various groups of people (*e.g.*, men or women) (Prowse, 2001). While informative, these texts can also be highly problematic. For example, the recipes mentioned in Apicius' cookbook often call for the use of exotic foods, which may have only been accessible to higher social status individuals, and does not represent the foods that were accessible to the majority of the population (Prowse, 2001). Researchers must also consider that while Galen wrote about recommended dietary intakes, this does not mean these recommendations were followed by the population at large.

As a second line of evidence to determine diet in Roman society, art - including frescos and ceramics - often illustrates plants or animals that may have been consumed. However, these works only tell us what was available or existed in society at large, not necessarily if it was present at that particular site. A third line of evidence, paleobotany, has also been used to understand what plants or animals were present at particular sites. However, unless found in human coprolites, paleobotany only tells researchers what was present at the site, not necessarily what was consumed. Ancient texts, art, and paleobotany all indicate that cereals formed the main component of the Roman diet, although the types of cereals varied by region, social status, and popularity (Prowse, 2001). Finally, zooarchaeological analysis of large quantities of animal bone excavated at various sites indicate that animals were also a large part of the economy (Jackson, 1988).

Ancient texts, art, paleobotany, and zooarchaeology provide a basic understanding of the foods available, but not what everyone in the empire consumed. Some Roman texts emphasize dietary differences between sexes, due to nutritional requirements, expected energy expenditure, and beliefs regarding the way in which food influences behaviour. Food accessibility may have also been influenced by social and economic position, with ancient texts suggesting that individuals of lower social standing had limited access to fish, meat, wine and oil, and instead relied more heavily on grains such as barley and millet (Prowse, 2001). Prowse (2001) states that while ancient texts may present the Roman diet in one way, it does not take into consideration regional, societal or even familial variation. As a result, the typical ‘Roman diet’ may be more fiction than fact, or at least a very broad generalization.

2.5.2 Diet of Roman Britain

Researchers have noted that food practices were varied throughout the Roman Empire, including in Roman Britain (Bonsall, 2014; Cool, 2010; Redfern *et al*., 2012). In recent years, it has become more accepted and expected that the Romans did not force their ways of life on the local communities, but local traditional food-ways were allowed to continue (Redfern *et al.,* 2012). Leading up to the Claudian invasion, Britannia was inhabited by a diverse range of nationalities and ethnic groups and as a result, food choices would have been varied between communities and households (Cool, 2010).

To understand diet in Roman Britain, historians and archaeologists have turned to a range of sources (see section 2.5.1) as well as bioarchaeological data. The few ancient texts relating to diet in Roman Britain indicated that the staple diet consisted of porridge, bread, and pasta, supplemented with fish, meat, fruit and vegetables, while the wealthy consumed three course meals with wine or beer (Roberts and Cox, 2003). However, it is difficult to assess whether this diet was practiced by the general public, or was simply the ideal diet of a small group of people (Bonsall, 2014). For example, Allason-Jones (2005) points out that ancient texts suggest that the Romano-British diet was largely vegetarian with meat consumption limited to the wealthy, but the amount and variety of animal and fish remains at archaeological sites indicates otherwise. Paleobotanical research indicates that the diet in Roman Britain was high in fiber, with beans, lentils, figs, nuts, dates, and fruits found at many Romano-British sites (Summerton, 2007). Researchers have determined that the varieties of foods available in Great Britain drastically increased with the Roman conquest, especially in towns, with the introduction of foods such as figs, grapes, olives, lentils, cucumbers, almonds, peaches, and pomegranates (van der Veen *et al.,* 2008). These foods are typical of Mediterranean diets, and van der Veen and colleagues (2008) argue that individuals living in the major towns may have wanted to associate themselves more closely with Roman society and lifestyle, in part, by consuming a similar diet.

During the Roman period, there was also increased consumption of foods high in sugar, including the use of honey, fruits, figs, dates, and sweetened wine (Summerton, 2007; Roberts and Cox, 2003). Cruse (2005) notes that the extent of dental disease in the Roman Empire is relatively unknown. However, within Britain researchers have observed an increase in dental disease from the late Iron Age (*e.g.*, in Dorset, UK, 6.5% of teeth had a carious lesion) to the Roman period (*e.g.*, in Dorset, UK, 19.1% of teeth had a carious lesion) (Redfern, 2005; also see Roberts and Cox, 2003). The increase in caries rates is attributed to changes in diet, including the increased consumption of sugary food and drink, such as dates and wine (Cruse, 2005). Other bioarchaeological data, specifically related to pathological conditions, indicate that there was great variation in diet between individuals. Throughout sites in the Roman province, there is skeletal evidence of gout and diffuse idiopathic skeletal hyperostosis (DISH), a condition associated with diabetes and obesity (Allason-Jones, 2005). On the other hand, there is also a rise in the prevalence of metabolic diseases and evidence of malnourishment, suggesting that dietary intake was inadequate for some individuals (Allason-Jones, 2005).

Roman sources specified dietary differences between males and females; however, Bonsall (2014) suggests this may not be constant throughout Roman Britain. Analysis of carbon and nitrogen isotopes in skeletal remains from Dorchester-On-Thames, Oxfordshire and Gloucester, Gloucestershire, indicate that males had higher meat/fish protein consumption than females, while other studies have found no differences between the sexes (Bonsall, 2014; Eckardt *et al.,* 2014). Clearly, there was no common 'Romano-British diet' widely consumed by all members of society; rather, regional choice and variation was likely the norm.

2.5.3 Diet of Roman Winchester

Utilizing zooarchaeological analysis of the quantity and variety of animal remains at Roman Winchester, researchers suggest that the inhabitants of *Venta Belgarum* consumed higher than expected quantities of meat compared to literary evidence for diet in the Roman Empire (Booth *et al.,* 2010). This is supported by carbon and nitrogen isotopic analyses showing that humans had higher δ^{15}N (4‰) and δ^{13}C (2.5‰) values compared to herbivores from Roman Winchester; isotopic signals that are higher than expected for an agriculturally based society (Cummings and Hedges, 2010). Cummings and Hedges (2010) found that, while variation exists between individuals, the overall increase is significant, indicating that everyone sampled for isotopic analyses had at least some access to meat and other animal protein. Higher carbon ratios for some individuals suggest that at least part of society in *Venta Belgarum* had access to marine fish or shellfish on a consistent basis, on top of the high levels of meat in their diet (Cummings and Hedges, 2010). Comparisons of isotopic levels show that males had higher carbon values and significantly higher nitrogen values when compared to females (t= 2.371, df= 94, p=0.020); suggesting males consumed more marine resources, and foods that were positioned higher in the food chain than females (Cummings and Hedges, 2010).

Evidence for dietary differences between social status groups is also present, with trends found between individuals buried in coffins and those without. All individuals in the study sample showed high nitrogen and carbon values; however, the range of variation is pronounced (Cummings and Hedges, 2010). Some individuals had higher nitrogen values by more than one full tropic level, while the most depleted individuals exhibiting nitrogen values 2‰ higher when compared to herbivores (Cummings and Hedges, 2010). Statistical analysis shows that individuals buried in coffins are significantly higher in $\delta^{13}C$ compared to those buried without coffins (p=0.000, other statistical tests not provided), which is interpreted by Cummings and Hedges (2010) as status variation. Overall, the bioarchaeological and zooarchaeological analyses paint a picture of a community with consistent access to animal protein, and with a small section of the community, possibly males, having additional access to marine resources.

2.6 Roman Dental Care

According to written texts, Romans relied on a preventative approach to medical and dental care, often through the regulation of diet and liquids, activities, and baths (Roberts and Cox, 2003). The balance of these aspects of life was not universal, but depended on the individual, informed by their age and gender, as well as the time of year (King, 2001). Literary evidence mentions the use of toothpicks made of feather quills or splinters of wood (Roberts and Cox, 2003). This was perhaps the most common dental practice, as toothpicks have been found in many Roman burials as part of a pocket toiletry kit that was carried with the individual for easy access throughout the day (Jackson, 1988). Cruse (2005), however, cautions that this does not indicate toothpicks were used by the majority of the population on a regular basis, but is more likely an object associated with elite contexts.

Dentifrices, a paste or powder for cleaning teeth, were recommended in medical texts, with recipes consisting of oyster and eggshell, or the ashes of dogs' teeth mixed with honey, among others (Roberts and Cox, 2003; Jackson, 1988). However, much like toothpicks, it is unlikely that the general public would have access to these dentifrices, or cared that much to use them. Some of the most elaborate recipes for dentifrices come from Scribonius Largus, when acting as a care provider for Emperor Claudius during the invasion of Britain:

> *"Gather pellitory which is in season and with many roots, then wash and dry it for one day; on the following day soak the hard parts in fresh brine; on the third day, after water has been pressed out, bring them together in a new earthenware pot; immediately afterwards they are to be placed between layers of salt and thoroughly cooked in the furnace of a both-house; then partially burned over charcoal. Afterwards, the remainder is mixed with spikenard, which is pleasing. This then makes the teeth white, and makes them firm"* (Scribonius *Compositiones,* as cited by Cruse, 2005: 183).

The mixture for Claudius' wife, Messalina, was much simpler, consisting of stag's horns burned in an earthenware pot until ash and two additional ingredients (Cruse, 2005). Thornton (1991) also noted the use of urine as a cleaning agent, which would be collected daily and used as a mouth wash; continuing that the 'morning urine' would be most effective, as the sample contained a higher concentration of ammonia, which acts as a cleaning agent.

If preventative measures were not enough, most of the population would have turned to family members for care, while the more affluent of society would turn to physicians for herbal remedies and minor surgeries (Roberts and Cox, 2003). Within the Roman period, dentistry was not practiced separately from general medicine, but fell under the responsibilities of the Roman physician or apothecary/pharmacist (Cruse, 2005; Becker, 2014). Examining evidence from the Temple of Castor and Pollux in the Roman Forum, Becker (2014) suggests one business stall was used by an apothecary-dentist, as evident, in part, by the number and variety of carious teeth found within a drain in the archaeological ruins. In Roman Britain, sets of physicians' tools have been found that may have had dental and medical applications, making interpretation of more local dental practices difficult (Jackson, 1988). Occasionally, Roman medical texts refer to treatments for teeth that have fallen out, mirroring the work of the Etruscans. In this practice, the loose teeth were riveted to a small gold band, and the ends of the gold band were then looped around the adjacent teeth (Jackson, 1988). However, Becker (1998; 2014) states that dental implants were improbable in the Roman Empire, and more evidence is required before being considered a regular Roman practice.

If home care was not successful in curing or alleviating pain caused by dental disorders, herbal rinses were recommended to alleviate tooth aches (Cruse, 2005; Jackson, 1988). At the time, it was believed that tooth decay was caused by small worms, and that fumigation of the mouth would kill the worms and end decay. Scribonius (*Compositiones LIII,* as cited by Cruse, 2005: 183) wrote: "…It is necessary to fumigate the open mouth with the seed of hyoscyamus, scattered over charcoal, and to repeatedly rinse the mouth with hot water; for sometimes, as it were, little worms are expelled. And fumigations of warmed bitumen relieve the ache…". Celsus (*De Medicina* VI:9) echoed many of the same concerns, stating the tooth ache was among the greatest torments of life, and recommended fasting, eating soft foods, and applying a sponge soaked in Cyprus or iris oil for the treatment of tooth decay (*De Medicina* VI:9). As a last resort, and only if absolutely necessary, was the tooth extracted, which Celsus (*De Medicine* VII.12) also discusses with disturbingly detailed instructions.

Much of our current knowledge regarding Roman medical practices and dental treatments come from Greco-Roman writing, which can be problematic. These sources were predominately written by literate males of Roman society, and may not be reflective of life in the provinces, life of the non-upper classes, life of women, or what was actually practiced by physicians at the time. Without considering the written texts, the widespread evidence of dental disease suggests that poor dental health was a fact of life (Roberts and Cox, 2003). In fact, the Roman poet, Ovid, wrote that the solution for those with bad teeth was not to seek medical treatment, but to not laugh, indicating the widespread and normalized problem within society at the time (Jackson, 1988).

2.7 Dental Pathology

Modern clinical and ethnographic evidence has demonstrated a clear link between dietary habits and dental health variables such as caries, dental wear, and antemortem tooth loss (Hillson, 2005; 1996; Walker and Hewlett, 1990). In populations with minimal oral health care, there is a direct correlation between carious lesion frequencies and proportion of carbohydrates and sugars in the diet; specifically, that diets high in carbohydrates and sugars will result in higher frequencies of carious lesions, while diets high in protein and fat will have lower caries rates (Hillson, 2005). Dental wear is understood to be closely related to the consistency of foods and culinary practices, with more abrasive foods leading to higher rates of dental attrition and soft and sticky foods producing lower levels of wear (Walker and Hewlett, 1990). Antemortem tooth loss is slightly more complicated and can be due to severe carious lesions, advanced dental wear, or other factors (*e.g.*, trauma, aesthetic ablation) (see section 2.7.1).

In clinical and ethnographic studies, researchers explore dental health as it relates to social and cultural factors such as socioeconomic status, literacy, and access to dental care (*e.g.,* Astrom and Rise, 2001; Corraini *et al.*, 2009; Lopez and Baelum, 2006). Researchers investigating past communities have used dental health to understand past dietary habits, including transitions to agriculture or other subsistence practices (Temple and Larsen, 2007), lifestyles (Erdal and Duyar, 1999), and differences in dental health according to age, sex, gender, and socio-economic status (Keenleyside, 2008; Lopez *et al.,* 2012). These latter explorations are often conducted to learn about social stratification and access to resources within a particular community or sample (Lopez *et al.,* 2012).

2.7.1 Antemortem tooth loss

Antemortem tooth loss (AMTL) is often used as an indicator of overall oral health, and can be caused by both social and environmental influences (Lopez *et al.,* 2012; Hunter and Arbona, 1995). By definition, AMTL is tooth loss occurring prior to death, and is characterized by the resorption of the alveolar bone. Many researchers agree that dental caries, periodontal disease, and severe dental wear are the primary causes of AMTL (Hunter and Arbona, 1995; Keenleyside, 2008; Lopez *et al.,* 2012; Lukacs, 2007; Neely *et al.*, 2005; Prowse, 2011; Taguchi *et al.,* 2004; Susain *et al.*, 2005; Hunter and Arbona, 1995). However, a multitude of other factors can influence or participate in tooth loss, including periapical abscesses, trauma, extraction (surgical, aesthetic, and/or ritual), socio-economic status and gender, absence of fluoride, among others. Determining exactly why tooth loss has occurred can be very challenging, and instead, AMTL is typically employed as a nonspecific indicator of pathology, resulting from a variety of different social and biological factors (Lukacs, 1995; Belcastro *et al.*, 2007).

Antemortem and post-mortem tooth loss are differentiated by observing the degree of resorption of the associated alveolar bone. For teeth lost antemortem, the tooth sockets may be completely resorbed, slightly resorbed, or may appear enlarged with the edges of the socket smooth, indicating remodeling has begun. Sockets that are completely remodeled may also be confused with congenital absence of teeth; in these scenarios, factors including observable space for the missing tooth within the dental arcade, wear on occlusal partners, and the presence (or absence) of wear facets on surrounding teeth may clarify if the tooth was congenitally absent or was lost prior to death (Mant and Roberts, 2015). There is also the possibility that tooth loss occurred immediately prior to death, and resorption had not begun or was not advanced enough to be identifiable by the researcher. While this may result in the socket being incorrectly identified as ante- or post-mortem tooth loss in these scenarios, Lukacs (1995) states that this type of error is negligible, and is not a great concern in bioarchaeological studies.

Moderate to high rates of tooth loss (both antemortem and post-mortem) can have significant influence on the rate and prevalence of other dental conditions, especially dental caries (Lukacs, 1995). Therefore, to have a better understanding of dental caries, it is important to have a thorough understanding of AMTL. For people living with moderate to severe AMTL, the main concern is the effect on diet. With few teeth, individuals may adapt their diet to consuming softer foods, which, depending on the food sources available, has the possibility of leaving the individual undernourished, malnourished, and prone to other metabolic diseases (Russell *et al.*, 2013). This may then increase susceptibility to other diseases due to a compromised immune system.

2.7.2 Caries

Dental caries is one of the most widely studied pathological conditions for archaeologists and biological anthropologists (Hillson, 2008; Wasterlain *et al.,* 2009).

This is largely due to the breadth of clinical research regarding the etiology and mechanisms causing carious lesions, as well as the frequency with which dental caries is found in archaeological contexts (Hillson, 2008; Keenleyside, 2008; Mant and Roberts, 2015; Thornton, 1991).

Dental caries is the destruction of tooth structures (enamel, dentine and cement), due to the acidic environment created by bacteria within the biofilm, possibly leading to the formation of a cavity (Hillson, 1996). As individuals consume food and water, bacteria adhere to the tooth surfaces, creating a biofilm. While many of these bacteria are beneficial for the oral environment, some bacteria within this biofilm, particularly *Streptococcus mutans* and *Lactobacillus spp.*, metabolize sugars, and in doing so produce acids that lower local pH levels, creating an acidic environment (Selwitz *et al*., 2007). Within the acidic environment, tooth structures soften, and demineralization of the tooth tissues occurs. When cleared of the acid-producing bacteria (*e.g*., rinsing with water and/or natural buffering by saliva), the local pH levels return to neutral, and the dental tissues remineralize (Hillson, 2008). Demineralization in the early phases of cavity production is reversible, through the intake of calcium, phosphate and fluoride, but if low pH levels dominate over time there is a net loss of dental tissues and a carious lesion may form (Selwitz *et al*., 2007; Hillson, 2008).

The formation of caries is multifactorial and can be caused, or influenced by, a number of other aspects. These factors can be biological (*e.g*., inadequate salivary flow and composition), behavioural (*e.g*., poor oral hygiene, chewing gum), or due to other personal factors (*e.g*., social status, occupation) (Fig 2.3; Selwitz *et al.*, 2007).

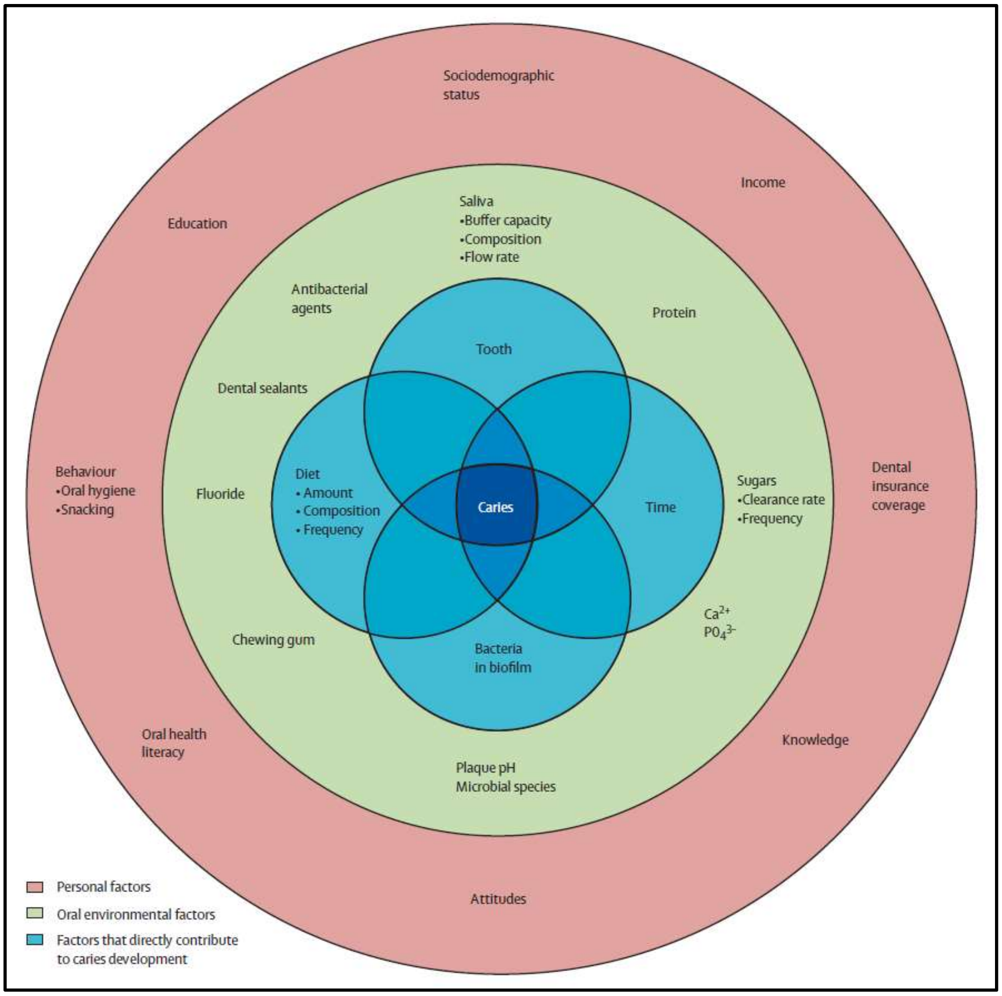


Figure 2.3. Illustration of the factors involved in the development of a carious lesion. (Selwitz *et al*., 2007: 54, Fig 3).

Clinical, experimental and archaeological evidence suggest that diet is the most important contributing factor to the development of carious lesions, including the types and textures of foods, as well as the frequency of eating (Wasterlain *et al.,* 2009). Specifically, diets high in carbohydrates (sugars and starches) produce higher rates of carious lesions than diets high in protein (Hillson, 2008; Dawes, 2008). Hillson (1996) notes that foods high in carbohydrates contain high levels of easily-digested sugars, which *Streptococcus mutans* and other cavity-causing bacteria metabolize rapidly, producing more acid, dropping pH levels, and delaying the return of a neutral pH environment once again. On the other hand, when proteins and fats from the diet are metabolized by plaque bacteria, alkaline waste products are produced, raising pH levels, which may offer some protection from dental caries by coating the tooth surfaces, preventing demineralization by acids (Khan *et al.,* 2008; Hillson, 1979). These strong links between caries rates and types of foods ingested have made the analysis of dental caries rates in archaeological populations important for the reconstruction of diet and dietary change over time (Wasterlain *et al.,* 2009).

Caries rates can also be influenced by the texture of the food. Foods that are soft and sticky will more easily adhere to the biofilm and attach to dental surfaces, promoting bacterial activity that favours cavity formation (Keenleyside, 2008). Alternatively, Prowse (2010) notes that more abrasive foods may help to clean teeth as particles are dislodged from the tooth surfaces, and may help to prevent carious lesions.

The third dietary factor that has an influence on the development of carious lesions is the frequency of food consumption. When food is consumed, the pH level falls within minutes and takes an hour or more to return to neutral (Hillson, 1996). Consuming additional foods before pH neutrality has been met keeps the oral environmental acidic for longer periods. This results in an overall pH imbalance, which benefits the formation of carious lesions. In cases where diets are similar, individuals with the ability and opportunity to snack between meals exhibit higher caries rates than individuals who only eat a few times a day (Lopez *et al.,* 2012).

Due to extensive clinical and ethnographic research, much is known about the etiology and causes of dental caries, and now more research is being devoted to the consequences of poor dental health. At the most basic level, individuals with carious lesions experience localized pain, and if the bacteria penetrate the pulp chamber, it can enter the circulatory system and cause further complications (Cucina and Tiesler, 2003). With carious lesions, there is also increased risk of antemortem tooth loss, as the demineralization of supporting structure (*e.g.*, roots) makes teeth more susceptible to loss. If the pain is severe, individuals may also choose to have the tooth manually extracted. Recent clinical studies are also illustrating that oral health is a fundamental component of general health (Jackson *et al.*, 2011). Studies have shown that chronic caries in young children can affect body weight, growth, quality of life, and can contribute to failure to thrive (FTT) (Sheiham, 2006). In adults, studies have established connections between poor oral health and coronary heart disease (Bahekar *et al.*, 2007), stroke (Haraszthy *et al.*, 2000), diabetes (Melaley and Oates, 2006), and mortality (DeStefano *et al.*, 1993) among other conditions.

Researchers studying caries rates in archaeological samples need to be aware of the impact ante- and post-mortem tooth loss may have on caries rates. In both instances, teeth are no longer available for analysis to determine if carious lesions were present. Without a full dentition, the proportion of carious lesions may be over- or under-estimated within an individual or sample. Lukacs (1995) argues that teeth lost antemortem are often a direct result of severe carious lesions, and if these teeth are not considered, we do not have a true understanding of caries rates within the sample. Differential rates of post mortem loss between anterior and posterior teeth (due to root morphology and susceptibility to loss) can also skew overall results (Erdal and Duyar, 1999). While numerous equations for determining caries rates have been created to correct for ante- and post-mortem loss (see section 3.3), no equation will be able to determine true caries rates within a sample.

Many studies, whether paleopathological or clinical in nature, have shown that women often have higher rates of carious lesions than men (*e.g.,* Ferraro and Vieira, 2010; Lopez *et al.,* 2012; Lukacs and Largaespada, 2006; Prowse, 2011; Temple and Larsen, 2007). These differences are often attributed to social and behavioural factors (*e.g*., differences in diet, different patterns of food consumption), however, biological factors must also be considered, specifically, earlier eruption of teeth in females, and the effect of pregnancy on the oral environment.

Hillson (1996) states that the permanent dentition of females often develops before males within the same population. As a result, a female's teeth are exposed to the bacteria within the oral environment for a longer length of time than a male's. This provides more opportunity for caries to develop and may explain the differences in caries rates between sexes (Ferraro and Vieira, 2010). Drawing together various published studies, Smith (1991, in White and Folkens, 2005) found that a female's teeth develop as much as fourteen (14) months earlier than the teeth of a male, as in the case of the first premolar (root apex half closed in females at 11.6 years and in males at 12.7 years). Ferraro and Vieira (2010) stress that earlier exposure to the oral environment should provide higher rates of caries in females; but contradictory information has been found in children, where males have higher caries rates than females, in a number of studies around the world. Ferraro and Vieria (2010) conclude that earlier exposure to the oral environment does not have enough substantial evidence to explain higher rates of carious lesions in females than males. Temple and Larsen (2007) support this, stating that in clinical research, the association is weak, and earlier tooth eruption in girls is not correlated with increased rates of carious lesions. Within the context of this thesis, individuals are examined by age category, and differences in tooth eruption by one year should not influence overall prevalence of dental caries between the sexes when examined by age category.

Clinical studies have recognized that the oral environment can also be affected by pregnancy, although the mechanisms of this relationship are not yet fully understood (Laine, 2002; Lukacs and Largaespada, 2006; Russell *et al.*, 2010). It is understood that increased levels of estrogen can lead to significant changes in the oral environment, specifically affecting the quantity and quality of saliva (Ferraro and Vieira, 2010). As saliva acts as a buffering mechanism, by rinsing caries-inducing bacteria from the mouth, a decrease in salivary production could result in a less effective washing process and increased rates of carious lesions. Lukacs and Largaespada (2006) argue that the effect of pregnancy on caries rates was once considered as folk knowledge, with the phrase ‘for every child a tooth is lost,’ connecting pregnancy and childbirth with antemortem tooth loss. Winkvist and colleagues’ (1992) work on redefining the Maternal Depletion Syndrome, demonstrates that women who experienced consecutive births in short time intervals are at a higher risk of nutrient depletion. While teeth were not included in the initial study, this syndrome has been extended to explain the process by which pregnancy causes nutrients (*e.g*., calcium) to be taken from bones or teeth (Lukacs and Largaespada, 2006). More recently, Lukacs (2011) stressed that pregnancy alone cannot explain sex-based differences in caries rates, as the idea that pregnancy leads to drastically poor dental health has no scientific basis as of yet.

2.7.3 Dental wear

Dental wear typically encompasses two separate processes: tooth-tooth contact (attrition) and tooth-food interaction (abrasion) (Hillson, 2005). Dental wear is not typically considered as a pathological condition or process, but much like caries and AMTL, it is typically age progressive. Studying dental wear can often provide information regarding the types of food consumed, specifically as it relates to texture and consistency (Keenleyside, 2008). For example, a diet consisting mainly of abrasive and hard foods can wear away dental enamel at increased rates, while soft and sticky foods will result in minimal wear. The amount of dental wear is often inversely related to the formation of dental caries, as dental wear will smooth or remove enamel pits, where bacteria often accumulates in the biofilm (Prowse *et al.,* 2008). However, as dental wear becomes severe, and exposes the dentin and/or pulp chamber, it can make the tooth more fragile and susceptible to other pathological conditions such as carious lesions, infections, and abscesses (Thornton, 1991). As well as contact with food and teeth, dental wear can be influenced by the use of teeth as tools, which can often have gendered differences related to occupation and production (Keenleyside, 2008). For this reason, it is important to analyze both anterior and posterior teeth, which may have differential rates of dental wear due to these activities.

CHAPTER 3: MATERIALS AND METHODS

3.1 Materials

Excavations of the Northern Cemetery of Roman Winchester began in 1967, and to date, over 1,000 burials have been recorded across many different sites (Fig 3.1). These sites range from small salvage excavations to multi-year endeavors, and the full extent of this cemetery is still unknown due to modern construction built on the area. Of the sites located in the Northern Cemetery, Lankhills School Site is the largest and most thoroughly documented. It was first excavated by Giles Clarke between 1967 and 1972, with a total of 444 inhumations and seven cremation burials reported. The site report, published in 1979, has been viewed as a landmark in Roman British cemetery studies and is considered the standard for the analysis of cemetery materials (Booth *et al.,* 2010; Philpott, 1991). Further excavations at the site of Lankhills were undertaken by Oxford Archaeology between 2000 and 2005. During this period of excavation, 307 inhumations and 25 cremations were documented.

Initially, only skeletal material from the excavations at Lankhills was planned to be recorded, but the speed of recording allowed for the inclusion of two additional sites: Andover Road (AR) and Hyde Street (HYS). These sites are also located in the Northern Cemetery, and are contemporaneous with Lankhills, being utilized between the fourth and fifth centuries CE (Table 3.1).

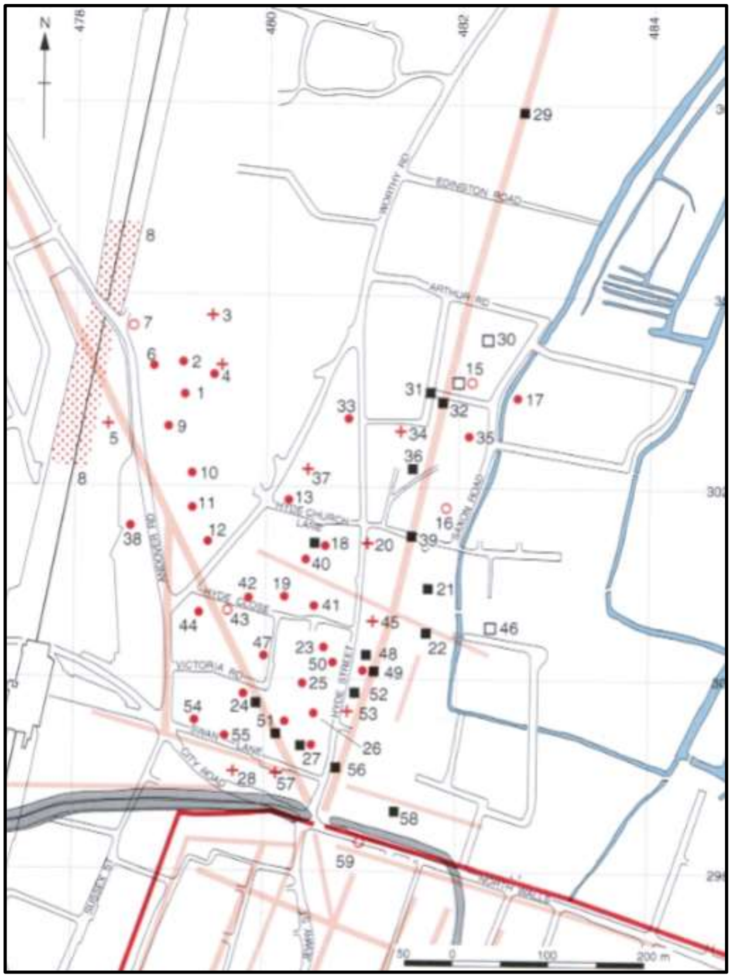


Figure 3.1. Salvage and full scale archaeological excavations relating to the Roman period in the Northern Cemetery of Winchester, UK (1971-1986). Red circles indicate the presence of human remains (open circles indicate that exact location is unknown), while red crosses indicate that no graves were found. Black squares indicate the presence of other Roman features (open squares indicate exact location is unknown). Red dotted area indicates that observations were limited due to cutting of railway lines. (Ottaway *et al*., 2012: 245).

TABLE 3.1. Summary data of the four sites included in this thesis

Site	Site Code	Dated	Excavated
Lankhills (Clarke, 1979)	LH	Early 4th- Early 5th century CE	1967-1972
Lankhills (Booth *et al.*, 2010)	WINCM:AY21	Early 4th- Early 5th century CE	2000-2005
Andover Road (Ottaway *et al.*, 2012)	AR	Early 4th- Early 5th century CE	1998
Hyde Street (Ottaway *et al.*, 2012)	HYS	Mid-4th- Early 5th century CE	1979

3.1.1 Lankhills (LH)

Initial excavations of the Lankhills School Site (Winchester, Hampshire, UK; Fig 3.2) were completed under the direction of Giles Clarke between 1967 and 1972. The excavation was prompted by the discovery of skeletal remains and Roman artefacts during construction in 1961, but the first test pits were not initiated until 1967. Excavations were largely completed on weekends, with participation of students from Winchester; in 1971, the Winchester Schools Archaeological Committee was formed and became the sponsor of the project, providing funds and professional archaeologists to complete the excavation of the site (Clarke, 1979).

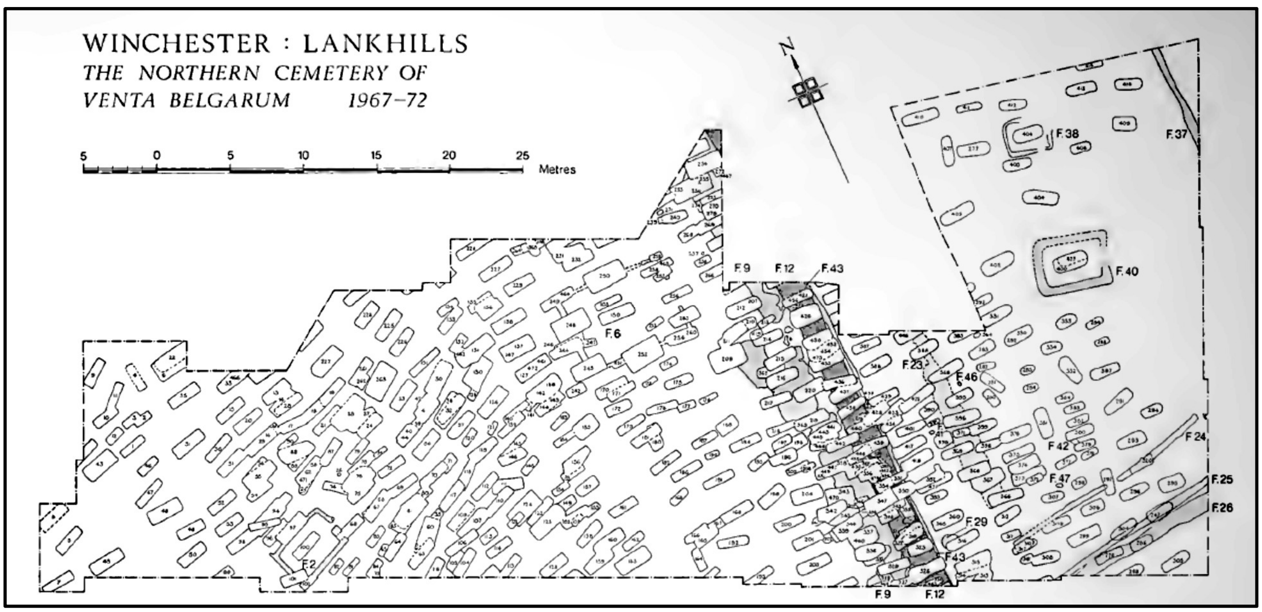


Figure 3.2. Limits of the LH excavations. Excavations at Lankhills published by Clarke (1979), illustrating individual burials as well as key features and enclosures. (Clarke, 1979: Figure 105).

A total of 451 inhumations and cremation burials were identified and recorded (Clarke, 1979). Ample grave goods provided confident dating, with use of the area as a burial ground beginning circa 310 CE. No artefacts from the fifth century were found, suggesting the use of this portion of the cemetery ceased circa 410 CE (Clarke, 1979).

The skeletal collection is located in Winchester, UK, under the care of the Hampshire Cultural Trust (formerly the Winchester City Council).

3.1.2 Lankhills (WINCM:AY21)

Excavations at Lankhills School Site were expanded by Oxford Archaeology (July 2000- April 2005; Fig 3.3) on behalf of Hampshire County Council prior to the sale and redevelopment of the Lankhills School property (Booth *et al*., 2010).

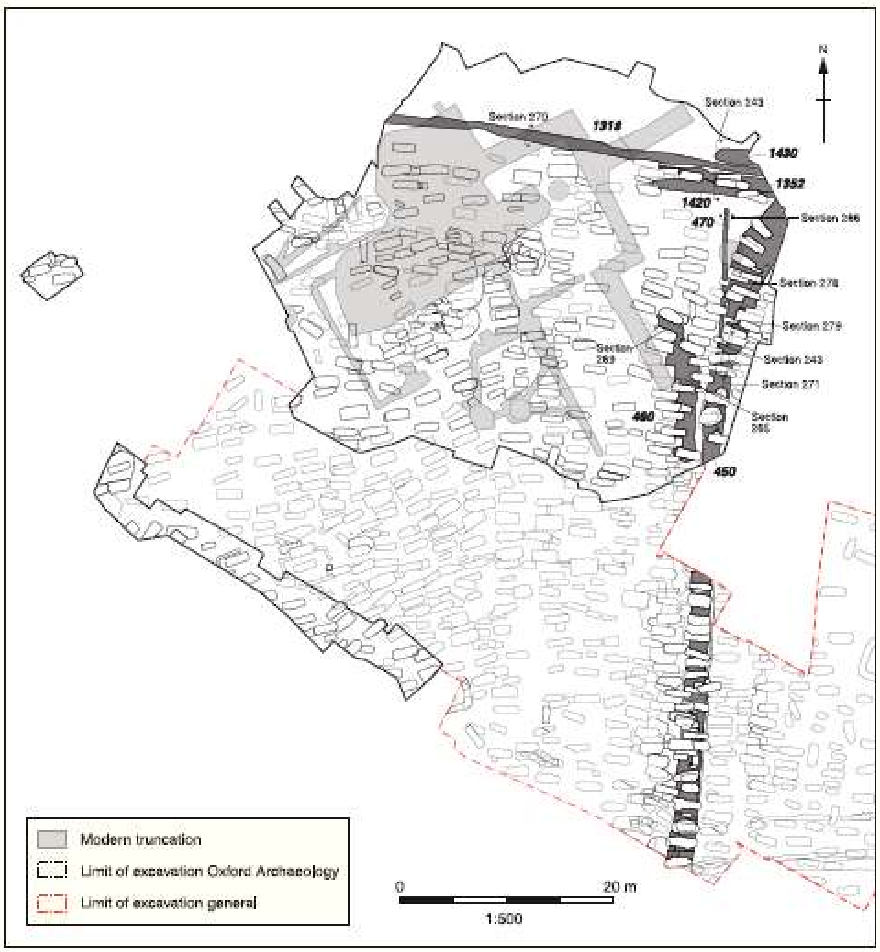


Figure 3.3. Limit of the WINCM:AY21 excavations. The LH excavation (indicated by the red dotted line) was expanded by Oxford Archaeology (2000-2005), and is delineated with dark lines surrounding the area. Individual burials and key features (dark grey) are illustrated. The foundations of the Lankhills School are indicated by the light gray shaded areas, the construction of which disturbed many burials. (Booth *et al*., 2010: 19).

Oxford Archaeology recorded 332 inhumations and cremations, in addition to six inhumations that were partially excavated by Clarke (1979), and completed by Oxford Archaeology. Grave goods indicate that burials in this portion of the cemetery most likely began in the early fourth century, while the use of the cemetery into the mid-fifth century remains uncertain (Booth *et al.,* 2010).

3.1.3 Andover Road (AR)

Andover Road was excavated in April 1998, within the car park of the former Eagle Hotel prior to private housing developments (Ottaway *et al*., 2012; Fig 3.4). Excavations finished on 24 April 1998, with the exception of the lifting of the lead-lined coffin, which took place on 28/29 April 1998. At this time, three additional inhumations were 'mechanically excavated', due to a lack of time to properly record and excavate them (Ottaway *et al*., 2012). The excavations were filmed for BBC's TV series: *Meet the Ancestors* (Ottaway *et al.,* 2012).

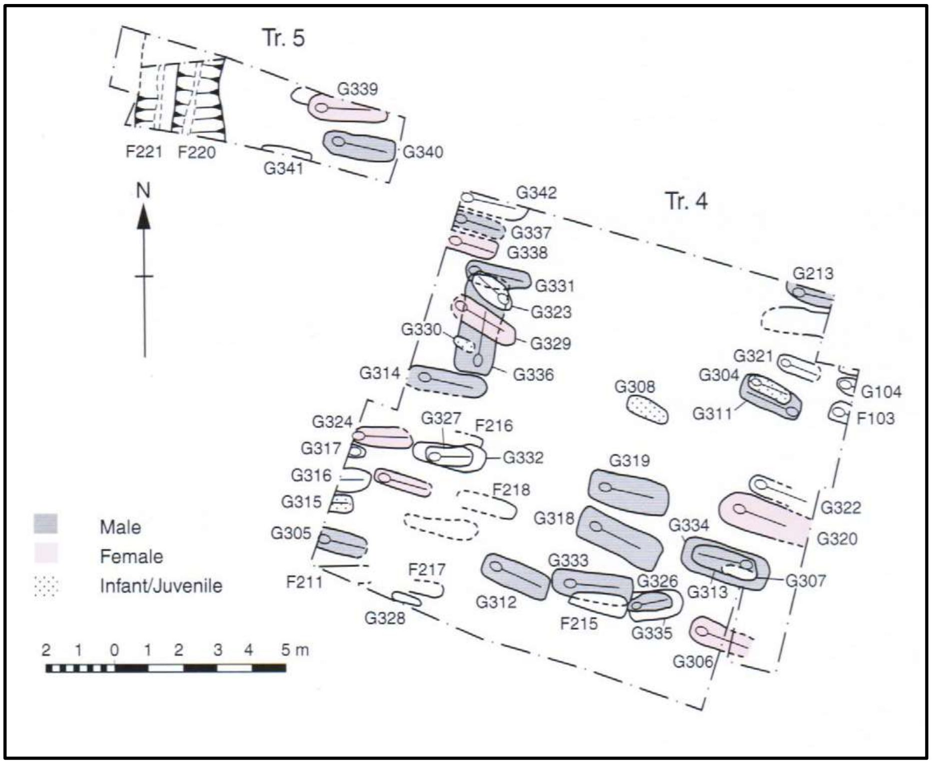


Figure 3.4. Limits of the AR excavation, with burials (shaded according to sex), and direction of burial indicated within each grave. (Ottaway *et al*., 2012: 122).

Forty-eight (48) Roman graves were recorded, 37 of which were at least partially excavated (Ottaway *et al*., 2012). A small number of graves provided artefacts that assisted in dating the site between early fourth and early fifth century CE.

3.1.4 Hyde Street (HYS)

Excavations at Hyde Street took place from 21 June to 1 July 1979 in response to impending construction work for private housing (Ottaway *et al*., 2012; Fig 3.5). During this time, 27 burials were excavated (including three double burials), and an additional five were recovered, but not thoroughly documented (Ottaway *et al*., 2012). Throughout the construction phase of the development, an additional 27 inhumations and one cremation burial were recorded, but not fully excavated, and were not available for study as a result.

Figure 3.5. Limits of the HYS excavation, and location of individual burials between the structures of Winchester, circa 1979. (Ottaway *et al.*, 2012: 119).

Grave goods and datable objects were scarce at this site. One coin dated to 388-402 CE and a bone comb suggest a date between the mid-fourth and early fifth centuries CE, although this is considered tentative (Ottaway *et al*., 2012).

3.1.5 Inclusions

The archaeological site reports identified a total of 891 individuals. The osteological analysis for this research identified an additional five individuals that were not originally accounted for, for a total of 896 individuals. Of these, 145 were excluded from the study as the physical remains were not present for analysis; this includes three graves that were empty, 32 cremation burials and 110 individuals for whom physical remains were excavated, but could not be located during data collection. The latter category includes remains that were removed from the collection for third-party analysis, remains being displayed or held at local and national museums, remains that did not survive excavation, as well as remains that could no longer be located within the collection itself.

Of the 751 individuals for whom physical remains were located, ten were excluded due to the presence of mixed remains, which affected age and/or sex estimations, or contained co-mingled dentition that could not be confidently separated. After completing age estimations, 301 were determined to be non-adults, and were excluded from this study. Of the remaining adults, 98 were excluded as they had no dentition (teeth or alveolar bone) to assess for dental health. A final number of 342 adults (38% of the total sample) with at least partial dentition were included within the scope of this thesis (Fig 3.6).

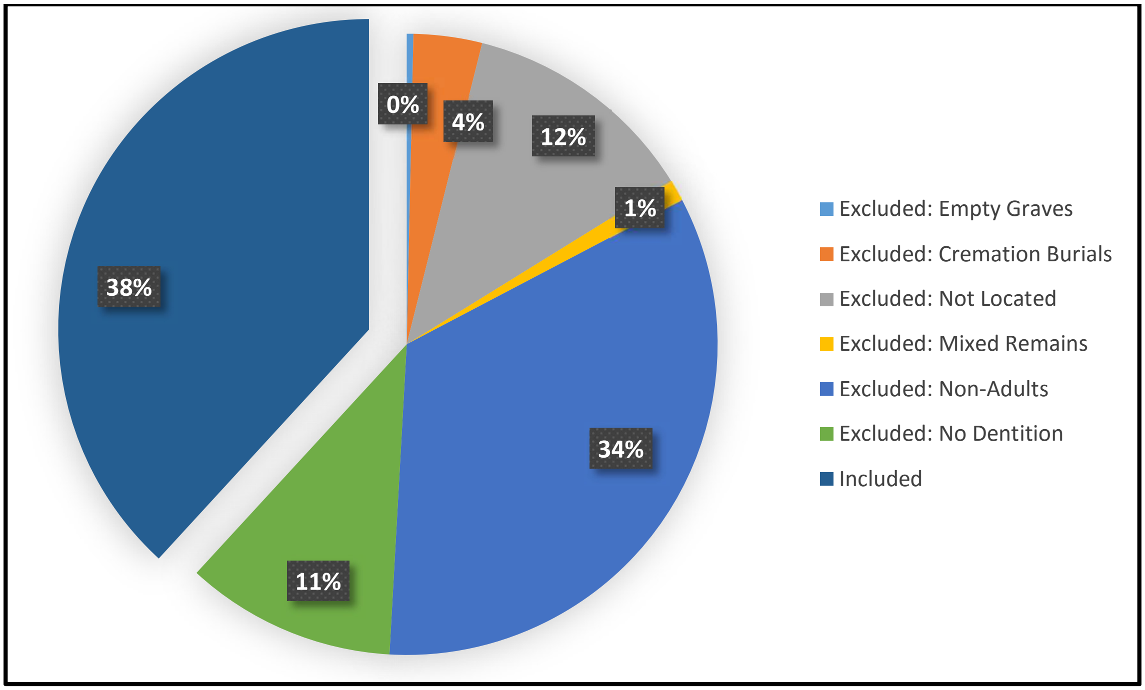


Figure 3.6. Inclusions and Exclusions of the Northern Cemetery Sample. The portion pulled away from the rest of the diagram indicates that portion of the entire sample that was included in this thesis (38%).

3.2 Methodology

Assessment of sex, age at death, and dental health were recorded in Winchester (LH, AR, HYS) and Oxford (WINCM:AY21), UK, between 15 May and 3 September 2015. Methods were largely used or adapted from the *Standards for Data Collection in Human Skeletal Remains*, by Buikstra and Ubelaker (1994) and *The Human Bone Manual*, by White and Folkens (2005). Some alterations were made as the level of detail suggested by Buikstra and Ublaker (1994) was not needed in this project. The methods are outlined below. Where standard methodologies do not exist (*i.e.* social status determination), approaches were adapted or created based on current theoretical understandings.

3.2.1 Assessment of sex

Within any population, some degree of sexual dimorphism between males and females can be seen in morphological features, however, these differences will vary among human groups, and the application of standards must be appropriate to the respective study sample (Buikstra and Ubelaker, 1994). For this research, osteological sex was determined based on pelvic and cranial morphology, as these methods are widely used in other studies based on Romano-British populations (*e.g.,* Bonsall, 2014; Redfern *et al.*, 2015; Stuckert and Kricun, 2011). For both the pelvis and cranium, the right side was only scored when the left side was not present or too damaged/incomplete to confidently assess. Sex estimation followed standard categories of Undetermined, Male, Probable Male, Ambiguous, Probable Female, and Female (Buikstra and Ubelaker, 1994). The designation of sex as Undetermined was only used when there was insufficient evidence to assess sex. All information for sex was complied on a recording sheet (Appendix A), created for the SSHRC Project, 'Social-Cultural Determinants of Community Wellbeing in the Western Roman Empire: Analysis and Interpretation of Vitamin D Status' (Insight Grant, File number 435-2013-1006, ID# 169793) and used with permission for this project.

3.2.1.1 Pelvic morphology

The pelvis is typically considered to be the most dimorphic skeletal aspect between sexes, and is scored using five features (Buikstra and Ubelaker, 1994). Some are scored on a three-point scale, while others use a five-point scale.

1. **Ventral Arc** (Scored 1-3): Females (score - 1) exhibit a ridge on the ventral surface of the pubis. Males (score - 3) exhibit a slight ridge that runs parallel to the pubic symphysis.
2. **Subpubic Concavity** (Scored 1-3): Females (score - 1) display a concave ischiopubic ramus. Males (score – 3) display a lack of concavity and is possibly convex.
3. **Ischiopubic Ramus Ridge** (Scored 1-3): On females (score – 1) this appears as narrow, possibly with a crest-like ridge. On males (score – 3) this presents as broad and flat ramus.
4. **Greater Sciatic Notch** (Scored 1-5): Females (score -1) have a broad notch with a wide angle. Males (score 5) have a narrow a narrow notch with an acute angle.
5. **Preauricular Sulcus** (Scored 0-4): Minimal expression (male) is absent, with no preauricular sulcus. Maximal expression (female) appears as wide and deep with the walls of the sulcus appearing as bony ridges.

3.2.1.2 Cranial morphology

The cranium is assessed based on five morphological features that commonly exhibit sexual dimorphism based on size, robusticity, and shape. Most often, males exhibit larger and more robust crania than females; however, the degree of differences varies between groups (Buikstra and Ubelaker, 1994). Features are scored between 1 and 5, corresponding to sex estimation terminology of Female, Probable Female, Ambiguous, Probable Male, and Male. Undetermined was used when features were damaged, obscured, or not present for observation.

1. **Nuchal Crest** (Scored 1-5): Minimal expression (female) exhibits a smooth occipital when viewed in a lateral profile. Maximal expression (male) exhibits a well-defined bony ledge or hook.
2. **Mastoid process** (Scored 1-5): Minimal expression (female) exhibits a mastoid process that projects only slightly below the external auditory meatus. Maximal expression (male) exhibits a mastoid process that is several times larger (length and width) than the external auditory meatus.
3. **Supraorbital Margin** (Scored 1-5): Minimal expression (female) exhibits a sharp border. Maximal expression (male) exhibits a thick, rounded margin.
4. **Glabella** (Scored 1-5): Minimal expression (female) appears as a smooth frontal with little or no projection. Maximal expression (male) appears as a rounded projection.
5. **Mental Eminence** (Scored 1-5): Minimal expression (female) has little to no projection. Maximal expression (male) exhibits a mental eminence that covers most of the anterior portion of the mandible.

3.2.2 Age estimation

To estimate age, multiple methods were employed, understanding that not all features are consistently present in bioarchaeological collections. The methods included dental development, epiphyseal fusion, pubic symphysis morphology, and Transition Analysis of the sacroiliac joint. All information for age complied on a recording sheet (Appendix A), created for the SSHRC Project (Insight Grant, File number 435-2013-1006, ID# 169793) and used with permission for this project.

In assigning individuals to adult age categories, it was found that the age estimation techniques used in this study could produce conflicting results. In these instances, the methods were ranked based on accuracy, reliability, and the size of age ranges provided. Dental development is only applicable for juveniles, and was used to determine if an individual was less than 16 years of age. For adults, epiphyseal fusion was given first priority as an aging method, although these are only helpful for determining the age of adolescents and young adults. Pubic symphysis morphology was then considered, and if this was not present Transition Analysis of the auricular surface was utilized.

After age estimation was complete, those without a confident age of 16+ were excluded from the study; this includes individuals who were aged as 15+ or those with age ranges that fell on both sides of this line (*e.g.,* age estimation of 13-17 years). Adults were then divided into five age categories: Adolescent (16-19 years old), Young Adult (20-34 years old), Middle Adult (35-49 years old), Old Adult (50+ years old), and Unaged Adult (16+ years old) in instances when an age bracket could not be determined. Often, the aging methods used in this study produced age ranges that overlapped between two or even three adult age categories. In these cases, multiple age estimations and most likely point estimates were used to determine the most appropriate age category.

3.2.2.1 Dental development

Dental development utilizes the development and eruption sequence of deciduous and permanent dentition to estimate age at death. While there is variation in the exact timing and sequence between individuals, and variation between sexes, tooth development is more confidently associated with chronological age than other methods, such as estimating age using long bone length (White and Folkens, 2005).

Using timing of dental development by Gustafson and Koch (1974, as outlined in White and Folkens, 2005), each tooth was assessed for its development from the beginning of crown mineralization to the completion of the apex of the root. Age ranges were then narrowed down based on observations of all teeth present. The Gustafson and Koch (1974) approach was selected over Ubelaker's method (1989, as outlined in Buikstra and Ubelaker, 1994) for two reasons. First, the former method looks at each individual tooth and compiles the information for a custom age range, instead of assessing the entire dentition as one unit for a set range. Second, the latter method was based on Native American skeletal samples, while Gustafson and Koch's (1974) method was developed using individuals of European descent, and may therefore be more applicable to a Roman British sample.

3.2.2.2 Epiphyseal fusion

Epiphyseal fusion age estimation utilizes the known sequence of fusion between epiphyses and growth plates in juveniles to estimate age at death. While the *Standards for Data Collection* (Buikstra and Ubelaker, 1994) utilizes the work of many researchers to inform epiphyseal fusion age estimates, the method has been critiqued as problematic, as these methods utilize radiographic images instead of dry bone observations, and are therefore not as accessible in the field without proper equipment and training (Cardoso, 2008a). Additionally, since the *Standards for Data Collection* (Buikstra and Ubelaker,

1994) were published, advances have been made with the method to better understand the sequence and timing of epiphyseal fusion.

The timing determined by Cardoso (2008a, b) is based on an early 20th century Portuguese sample. As this is temporally and geographically different from Roman Britain, this method was considered secondary to the dental development method, and was used cautiously. Cardoso (2008a) also warns that there is most likely a correlation between the effects of socioeconomic status and skeletal maturation, with those of lower socioeconomic status being slightly delayed in epiphyseal fusion, which has to be considered when using this method of age estimation. However, these differences would only influence results by a few years, and was not considered problematic within the scope of this research.

3.2.2.3 Pubic symphysis

Assessing morphological changes of the pubic symphysis is considered to be one of the most reliable methods for estimating age at death in adult skeletal remains (Buikstra and Ubelaker, 1994). While Buikstra and Ubelaker (1994) state the right and left side should be scored separately, only one side was scored in this study to allow for more rapid recording. In all cases, the left side was preferentially scored, only using the right when the left was missing, damaged, or pathological/traumatic factors were suspected. The Suchey-Brooks Pubic Symphysis scoring system was selected as it allows for sex-appropriate age estimations based on the symphyseal face of the pubis (Brooks and Suchey, 1990; Katz and Suchey, 1986). Utilizing drawings, descriptive texts, and casts, an individual is estimated to be one of six phases, which corresponds to an age bracket. In instances where age estimates bridged two or more age categories, mean ages were used to help determine which age category was most appropriate.

3.2.2.4 Transition analysis of the sacroiliac joint

Transition Analysis of the Sacroiliac Joint was developed by Boldsen and Milner utilizing the Terry and Coimbra collections, and later tested on the Base Donated Collection and Mercyhurst forensic cases (Boldsen *et al.*, 2002). In this method, nine features of the sacroiliac joint are scored, and then the data are entered into the ADBOU 2.1 computer software. The program calculates an age at death range, along with confidence intervals, and a most likely point age estimation. Not all features need to be present to score the surface, although a lack of features may result in a larger age range. Additionally, if a feature falls between two stages, a minimum and maximum stage can be scored.

Recent evaluations of the Transition Analysis method have found that it may produce unreliable and less accurate results than other experienced-based assessments (Milner and Boldsen, 2012). These researchers state that the Transition Analysis methodology is a noteworthy improvement for identifying old adults, but is uncertain and less reliable with middle to old adults (Milner and Boldsen, 2012). As a result, Transition Analysis is most beneficial when trying to identify these older individuals. As the age categories used within the context of this research are rather broad, large age ranges are not detrimental, and the strengths of this method outweigh the limitations. However, due to the lack of confidence of Transition Analysis to age middle-old adults, and the relative inexperience of the researcher using this method, Transition Analysis of the sacroiliac joint was only utilized when no other aging methods were possible. In instances where age estimates bridged two or more age categories, most likely point estimates were used to help determine which age category may be most appropriate. Particular features (*e.g.*, posterior iliac exostoses and degeneration of the dorsal symphyseal margin) are more likely associated with old age (Milner and Boldsen, 2012), and were also used to assist placing individuals in the Old Adult (50+) age category.

3.2.3 Dental health

Information regarding dental health was recorded for each individual aged 16+ with any dentition present (*i.e.,* teeth or alveolar bone). Notes on overall preservation and completeness of the bone, and macroscopic examination of tooth presence, dental caries, dental wear and calculus were included in these analyses. These were recorded by individual and tooth/socket using a data collection sheet (Appendix B). Descriptive writing, drawings, and digital photographs were also utilized. The methods selected for recording dental health were adapted from Buikstra and Ubelaker (1994), to ensure consistent recording and standardization within the field of bioarchaeology, but simplified to expedite the recording process.

3.2.3.1 Preservation and completeness

Understanding the completeness and condition of bioarchaeological material is important in any analysis, as differential completeness and/or preservation greatly impacts recording of human remains, including dentition (Buikstra and Ubelaker, 1994). Within the scope of this research preservation and completeness refer to two different aspects. Preservation refers to the condition of the bone, including visual quality, fragmentation, and weathering, while completeness refers to the amount of bone present.

As this thesis is concerned with dental health, preservation and completeness were only measured for the mandible and maxilla and not for the entire skeleton. Furthermore, preservation and completeness refer to the condition of the maxilla and mandible and not of the teeth themselves. Notes on condition of teeth were provided in comments and related to broken roots, peri-mortem trauma, or post-mortem damage, which are common in archaeological collections.

For researchers investigating differences in dental health between sub-groups, preservation and completeness is important to understand, as individuals with few surviving teeth/sockets can produce results that are less accurate than individuals with full dentition (Bonsall, 2014). The anterior teeth (*i.e.*, incisors and canines) are most often missing in skeletal samples, because the single-rooted teeth are more prone to post-mortem loss and damage. Missing teeth prevent the accurate assessment of caries rates and dental wear. Damage to teeth can obscure small carious lesions, or remove dental calculus, while damaged alveolar bone can influence the recording of AMTL, either because the bone is not present for analysis, or because it is damaged to the point where the researcher cannot determine if the socket is resorbing or not (Bonsall, 2014).

As well as *in situ* taphonomic processes, the age of the collections for the Northern Cemetery (10-45 years since excavation) has resulted in further post-mortem loss and damage. Researchers have noted that collections experience degradation with repeated use, such as the collections of the Northern Cemetery, due to frequent handling (Roberts and Mays, 2011; Caffell *et al.*, 2001). The recurrent use of the skeletal remains for research purposes can result in damage to individual elements by handling and improper repackaging, or misplaced elements if not returned to the correct box. Caffell and colleagues (2001) highlight that the loss of elements is not restricted to bone, but loose teeth are especially easy to lose, as they are not held in or protected by the alveolar bone. If teeth are placed back into the sockets, they have a greater tendency to fall out during handling, and teeth may easily go missing (Caffell *et al.*, 2001).

While Buikstra and Ubelaker (1994) recommend recording completeness on a three-point scale (complete, partial, poor), a five-point scale was used in this study, which allowed for more precise scoring (Table 3.2). Additionally, Buikstra and Ubelaker's (1994) inventory scoring does not consider preservation status, which can greatly affect post-mortem loss of dentition and obscure evidence of resorption. Therefore, the preservation scale produced by McKinley (2004) was adapted and employed to help understand rates of post-mortem loss (Table 3.2). The scale was adapted to include a sixth score, when no bone was present for analysis (although teeth often were). This was done to assist with subsequent statistical analysis of differential preservation between sub-groups.

TABLE 3.2: Dental Preservation and Completeness Scoring

Preservation[1]	**Completeness**[2]
1. Excellent: Slight or patchy erosion	0. 0%
2. Good: Moderate erosion (more than seen in Score 1)	1. 0-25%
3. Fair: Most of bone affected by erosion	2. 25-50%
4. Poor: All of bone affected by erosion	3. 50-75%
5. Destroyed: heavy erosion, masking normal morphology	4. 75-100%
6. No bone present (loose teeth only)	

[1]*Numerical score, followed by terminology and definition (adapted from McKinley, 2004: 16).*
[2]*Numerical score, followed by percentage of bone present.*

Often, bones listed as *destroyed* (preservation scores of 5) exhibited such severe weathering or damage that any teeth present could not be refitted into the bone. While those with preservation listed as *destroyed* were rarely, if ever, 75-100% complete, a rating in one category did not automatically, or consistently, correspond to a similar rating in the other category.

3.2.3.2 Dental presence

Presence was recorded for each individual tooth, with the following designations, adapted from Buikstra and Ubelaker (1994; Table 3.3):

TABLE 3.3: Dental Presence Coding

Code	Description	Score[1]
P	Present	1, 2
M	Missing, with no associated alveolar bone present	3
MA	Missing, with alveolus resorbing or fully resorbed: antemortem loss	4
MP	Missing with no alveolar resorption: post-mortem loss	5
MC	Missing, congenital absence	6
R	Root only, due to post-mortem damage (unobservable)	7
E	Present, but in eruption (unobservable)	8
S	Removed for previous isotopic sampling (unobservable)	8

[1] *Score corresponding to those found in Buikstra and Ubelaker (1994: 49).*

Other circumstances, such as the presence of retained deciduous teeth, impaction, supernumerary teeth were explained and expanded upon in the notes section of the recording sheet.

Antemortem tooth loss (AMTL) was distinguished from post-mortem tooth loss based on degree of resorption of alveolar bone (Fig 3.7). Complete or partial resorption indicated antemortem loss, while well-defined crypts and sharp edges of alveolar bone indicated post-mortem loss. Congenitally absent teeth were distinguished from AMTL based on the absence of wear on adjacent and occlusal partner teeth, and a lack of alveolar bone, indicating antemortem loss was unlikely.

Figure 3.7. Dental Presence (LH 140). Mandible displaying P, MP, and MA teeth. MA includes fully resorbed and partially resorbed alveolar bone, while MP includes missing teeth with sharp edges of the socket and no noticeable resorption.

3.2.3.3 Dental caries

Dental caries is defined as destruction of enamel, dentine and/or cement, leading to the formation of a cavity, as a result of acid-producing bacteria (Hillson, 1996). Carious lesions, or cavities, are one of the most widely studied and informative pathological conditions in archaeological samples (Wasterlain *et al*., 2009; Buikstra and Ubelaker, 1994). For this research, carious lesions were recorded according to the location on each individual tooth, utilizing the system developed by Moore and Corbett (1971; 1973) as outlined by Buikstra and Ubelaker (1994; Table 3.4; Fig 3.8).

TABLE 3.4: Dental Caries Coding

Code	Description	Score[1]
O	Occlusal Surface: all grooves, pits, cusps, dentin exposures, and the buccal and lingual grooves of the molars	1
I	Interproximal Surface: includes the mesial and distal cervical regions	2
B/L	Smooth surface: buccal/labial and lingual surfaces other than grooves	3
CEJ	Cervical Caries: Originates at any cemento-enamel junction, except the interproximal regions	4
R	Root caries: below the CEJ	5
G	Gross caries: carious lesions have destroyed so much of the tooth that they cannot be assigned as surface of origin	6[2]

[1] Score corresponding to those presented in Buikstra and Ubelaker (1994: 55). [2] In Buikstra and Ubelaker (1994), Gross caries are listed as Large Caries, however "L" was used for lingual caries, so "G" was used instead to prevent confusion.

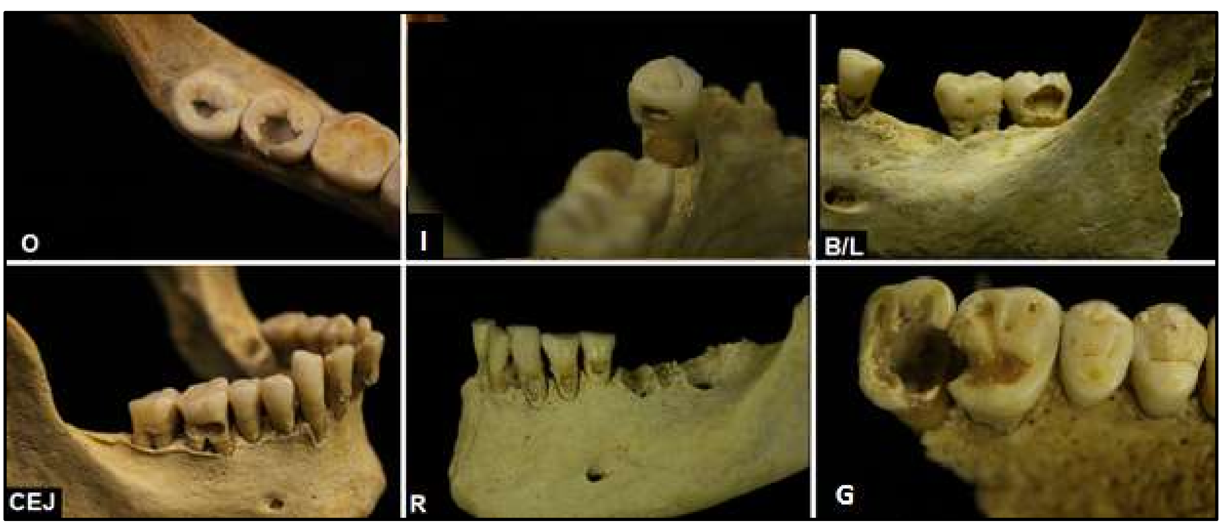


Figure 3.8. Dental Caries. Coding for carious lesions based on location of the lesion. O: Occlusal Caries (AR 339). I: Interproximal Caries (LH 204). B/L: Buccal/Lingual Caries (LH 204). CEJ: Cervical Caries (HYS 012-A). R: Root Caries (LH 273). G: Gross Caries (LH 442).

Carious lesions were shaded and labeled on the dental diagram of the recording sheet, with the exception of interproximal cavities, which could not be seen on the image. Areas of discolouration were often noted, but not recorded as carious lesions. Only instances where macroscopic tooth decay had occurred were recorded as a carious lesion. Exposure of pulp chambers was noted as well, for calculation of the Caries Correction Factor (Lukacs 1992; 1995) and Proportional Caries Factor (Erdal and Duyar, 1999).

3.2.3.4 Dental wear

Dental wear was scored using Smith (1984) for incisors, canines, and premolars, and Scott (1979) for molars (both outlined in Buikstra and Ubelaker, 1994). The method developed by Smith (1984) for anterior teeth is a modification of the Murphy (1959) system, and records the amount of exposed dentin on an eight-point scale ranging from *unworn* (*i.e.*, no dentition exposure) to *complete loss of crown* (*i.e.*, crown surface appears as root; Fig 3.9). It is recommended that Smith (1984) is not used for molars, as this system does not adequately differentiate between moderate and low rates of dental wear for these teeth (Buikstra and Ubelaker, 1994). For molars, the system developed by Scott (1979) was utilized. Scott's (1979) method divides each molar into quadrants, which are scored individually on a ten-point scale. These are then tallied for a score ranging between four and 40. As dental wear was scored according to two different methods, the scores for the anterior and posterior dentition cannot be easily compared, nor averaged to create one score. As a result, the two scores are presented and interpreted separately.

Figure 3.9. Dental Wear. Photo illustrating differences in wear, with mild wear (Anterior teeth score between 2 and 3 per tooth; Posterior teeth score between 7 and 17 per tooth) on the left (LH 243), and severe wear (Anterior teeth score between 5 and 7 per tooth; Posterior teeth score between 29 and 36 per tooth) on the right (LH 254).

In both methods (Smith, 1984; Scott, 1979), illustrations and descriptive writing were utilized to assess scoring of individual teeth (Buikstra and Ubelaker, 1994). While Buikstra and Ubelaker (1994) suggest only the left side is recorded, all dentition was recorded within the context of this research. As many dentitions exhibited post-mortem loss, recording both sides allowed for a more accurate score of the dentition.

3.2.3.5 Dental calculus

Dental calculus was recorded by location (occlusal, buccal/labial, lingual and interproximal locations, following Greene *et al.* (2005), and severity (small, medium or large, following Buikstra and Ubelaker (1994). However, due to the scope of this project, these data were not incorporated into the final thesis. The data have been retained for future analysis.

3.2.4 Social status determination

Within the context of this thesis, the terms Higher and Lower Social Status have been chosen, to stress that the two groups do not exist in isolation, but in exist in relation to one another. It also helps remind the reader that social status is best expressed on a continuum rather than in absolutes, even if this is the way our methods present them.

As discussed earlier, determining social status using methods based on other sites, samples, and cultural groups can be inappropriate and uninformative (see section 2.3). Consequently, the methods employed to determine social status at the Northern Cemetery of Roman Winchester were developed by the author using interpretations by excavators and archaeologists who worked closely with the site and the excavated materials (*i.e.*, Clarke, 1979; Booth *et al*., 2010; Ottaway *et al.*, 2012).

Social status was determined on an individual basis by considering grave construction and grave good typologies. First, those with monumental grave constructions (*i.e.*, enclosure and/or stepped graves) were determined to be of Higher Social Status, while those buried in pits without coffins were determined to be of Lower Social Status. Those buried in coffins were not initially assigned a social status group, but were further analyzed to consider grave good typologies. Excavators at the Northern Cemetery suggested that particular grave goods may indicate status including knives, belt equipment, and crossbow brooches for higher status males; and combs, and spindle whorls for higher status females (Cool, 2010; Ottaway *et al.,* 2012). Individuals buried in coffins with these items were determined to be of Higher Social Status, while individuals buried in coffins without these items were determined to be of Lower Social Status. A flow chart was designed to illustrate how social status was determined for each individual included within the scope of this research (Fig 3.10).

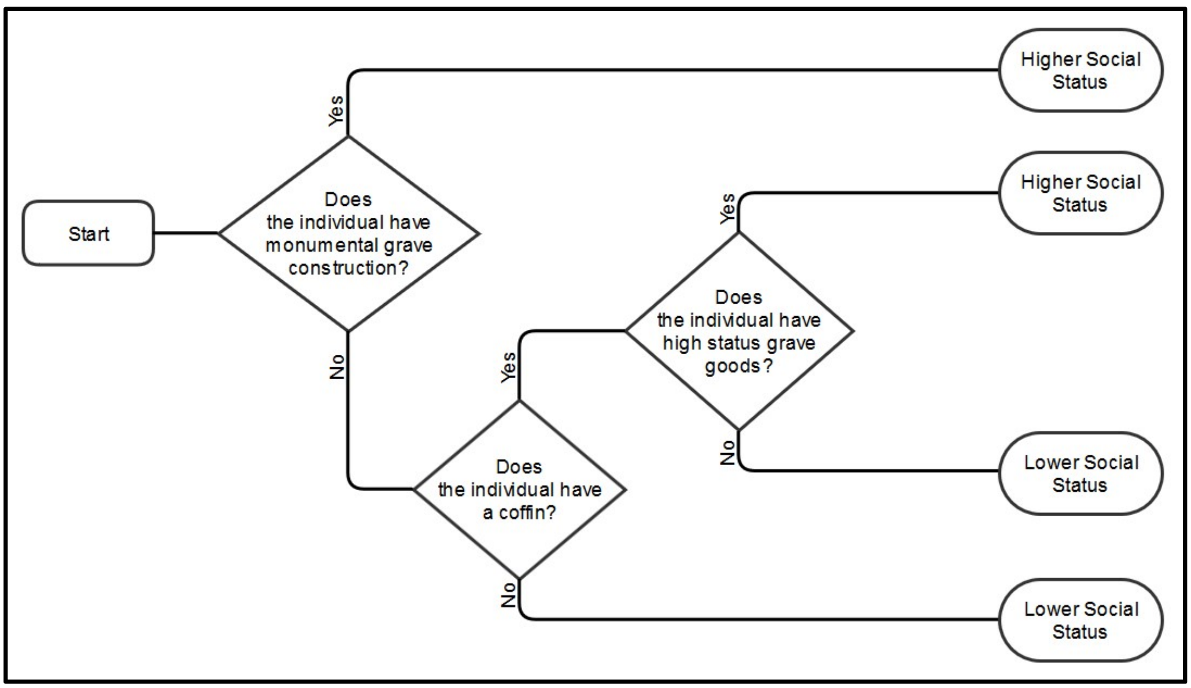


Figure 3.10. Social status methodology. Created by the author to determine relative social status for individuals in the Northern Cemetery, based on correlations published in appropriate site reports.

3.3 Calculating Dental Health Frequencies

Individual and sub-sample frequencies were calculated for each of the variables (AMTL, caries, wear) of dental health. Rates of AMTL were measured for the anterior, posterior and total dentition, at the individual and sub-sample level, according to the following equations:

Equation 3.1: **AMTL Rate of the Anterior Dentition**

$$AMTL_{Anterior\ Teeth} = \frac{\#\ Anterior\ teeth\ lost\ antemortem}{\#\ Anterior\ observable\ sockets}$$

Equation 3.2: **AMTL Rate of Posterior Dentition**

$$AMTL_{Posterior\ Teeth} = \frac{\#\ Posterior\ teeth\ lost\ antemortem}{\#\ Posterior\ observable\ sockets}$$

Equation 3.3: **AMTL Rate of Total Dentition**

$$AMTL_{Total} = \frac{\#\ Teeth\ lost\ antemortem}{\#\ Observable\ sockets}$$

Rates of dental caries were calculated by total dentition. In an archaeological sample, it is unlikely that researchers will ever know the real caries frequency as additional factors, such as ante- and post-mortem loss, will influence what teeth and sockets are present for analysis (Duyar and Erdal, 2003). As a result, all values represent the *observed* caries frequency, rather than the *real* caries frequency. Various corrections and calibrations have been proposed to account for ante- and post-mortem loss, however, no standardized approach has been created. The lack of standardization has made it difficult for researchers to compare caries frequencies across sites and samples.

Caries Rate by individual is simple and straightforward, and examines the percentage of carious teeth in each dentition:

Equation 3.4: **Caries Rate by Individual**

$$Caries\ Rate\ by\ individual = \frac{Number\ of\ carious\ teeth}{Number\ of\ observable\ teeth} \times 100$$

However, *Caries Rate by individual* only takes into consideration the teeth present, and does not consider the impact of antemortem tooth loss, which can be the result of severe carious lesions. As a result, the *Decayed and Missing Index* (DMI) was developed by Moore and Corbett (1971) based on clinical measurements[1], and expands on the *Caries Rate*, by including all AMTL into the equation:

Equation 3.5: **Diseased Missing Index**

$$DMI = \frac{\#\ Of\ carious\ teeth + \#\ of\ AMTL}{\#\ Of\ observable\ teeth + \#\ AMTL} \times 100$$

Critiques of this method suggest that the DMI overestimates caries rates within a sample, as it assumes all AMTL is the result of carious lesions, instead of other processes such as trauma and severe dental wear (Lukacs, 1995; Duyar and Erdal, 2003). Subsequently, the *Caries Correction Factor* (CCF) was proposed (Lukacs, 1995). The CCF approach considers the multi-factorial causes of AMTL (carious lesions and advanced wear), and incorporates pulp exposures to better understand the amount of antemortem tooth loss caused by caries within an individual's dentition:

[1] Clinical measurement: Decayed, Missing and Filled Index (DMF).

Equation 3.6: **Caries Correction Factor**

$$CCF = \frac{\left(\# \, AMTL \; \times \frac{\# \, teeth \, with \, pulp \, exposure \, due \, to \, caries}{\# \, teeth \, with \, pulp \, exposure}\right) + \# \, Carious \, Teeth}{(\# \, teeth + \# \, AMTL)} \times 100$$

While an important step in considering the multi-factorial causes of AMTL, Lukacs (1995) states that the CCF is not perfect, but is a methodological improvement for understanding caries frequencies within a sample. More recently, this approach has been expanded by Erdal and Duyar (1999) to also consider the impact of post-mortem tooth loss, utilizing the *Proportional Correction Factor* (PCF), which can be used in combination with CCF.

Equation 3.7: **Proportional Correction Factor**

$$PCF = (CCF_{anterior \, teet} \;\; \times 0.375) + (CCF_{posterior \, teeth} \times 0.625)$$

The PCF approach emphasizes that anterior and posterior teeth have different susceptibility to post-mortem tooth loss and damage. Specifically, the likelihood of post-mortem damage to anterior teeth and the single-root structure of anterior teeth makes them more likely to fall out post-mortem (Erdal and Duyar, 1999: 238). As a result, the Caries Correction Factor of anterior teeth is multiplied by 3/8, while that of the posterior teeth is multiplied by 5/8 (essentially, the number of anterior and posterior teeth, respectively, in a dental quadrant). When used in conjunction with CCF, the PCF compensates for ante- and post-mortem tooth loss, allowing researchers to get as close to a ‘real’ caries frequency as currently possible.

Within the context of this thesis, caries rates will be explored by using DMI and PCF. The Decayed and Missing Index is a widely used method within bioarchaeology, and will allow for comparisons to other Romano-British studies/samples. However, DMI does tend to over-estimate rates of carious lesions, and may not be a true reflection of the pathological condition within the sample. Therefore, PCF will also be used. Measuring dental caries rates through PCF has not yet been widely adopted by bioarchaeologists, largely due to the amount of information needed in order to complete the equations. However, as it corrects for both ante- and post-mortem tooth loss, it may be a more accurate representation of the pathological condition within the sample.

As dental wear was scored according to two different methods, scores for the anterior dentition cannot be simply compared to those of the posterior dentition, nor averaged to create one score. As a result, the two scores are presented separately for analysis. Overall, dental wear was determined according to the following equations:

Equation 3.8: **Dental Wear Score of the Anterior Dentition**

$$Dental\ Wear_{Anterior\ Teeth} = \frac{\sum Dental\ wear\ scores\ for\ anterior\ teeth}{\#\ Of\ anterior\ teeth}$$

Equation 3.9: **Dental Wear Score of the Posterior Dentition**

$$Dental\ Wear_{Posterior\ Teet} = \frac{\sum Dental\ wear\ scores\ for\ posterior\ teeth}{\#\ Of\ posterior\ teeth}$$

3.4 Statistical Testing

Following frequency calculations (by individual and sub-sample), parametric or non-parametric tests were used to investigate whether statistical significance existed in AMTL, dental caries, and dental wear rates between sub-groups.

Statistical analysis was carried out using SPSS Statistical Package Version 21. Assumptions of normality were checked for each variable in order to determine whether to use parametric or non-parametric statistical tests. For non-parametric testing, Mann-Whitney (for two groups) and Kruskal-Wallis (for more than two groups) were used, while the Student's *t*-test (for two groups) and one-way analysis of variance (ANOVA; for more than two groups) were used for parametric testing. A level of 5% to reject the null hypothesis was adopted for all tests, following levels set by other studies exploring dental health (*i.e*. Lopez *et al*., 2012; Keenleyside, 1998).

3.5 Summary

The materials used within the context of this thesis consist of four contemporary sites from the Northern Cemetery of Roman Winchester excavated between 1967 and 2005. Of the 896 individuals identified, a total of 342 individuals were included in the scope of this thesis, representing all adults (aged 16+) with some dentition in the sample that could be located within the collections.

Methods to assess age, sex, and to record dental health were adapted from recommended methodologies, as these are considered reliable and have been well tested within the discipline of bioarchaeology. These methods are also simple to complete, minimizing the occurrence of intra-observer error, and allows for these data to be more easily compared to other sites and samples in future studies.

The only new methodology introduced was related to determining social status. As each site and sample is unique, established methods to determine social status are inappropriate, so a simple method was developed. This method utilized the various site reports and patterns identified by excavators of the materials to infer status, and was informed by expected markers of social status in Roman Britain.

CHAPTER 4: RESULTS

4.1 Introduction

This chapter presents the dental health data for the Northern Cemetery (Winchester, UK) skeletal sample. It begins with a description of the sample size and distribution by sex, age, and social status group. Preservation and completeness of materials are assessed, as well as sample characteristics, which determined if parametric or non-parametric tests were used for statistical analyses. Antemortem tooth loss (AMTL), caries, and dental wear are examined in turn, subdivided by sex-based differences, status-based differences, and the results when sex and status are consisted simultaneously. Summary rates by status group and sex are presented within the chapter, and individual dental health data is presented in Appendix C.

4.1.1 Sample size and distribution

Between the four sites representing the Northern Cemetery, dental pathology data were collected on 342 individuals. Of these, 136 individuals (39.8% of the total sample) were estimated as Male (or Probable Male), 153 individuals (44.7% of the total sample) were estimated as Female (or Probable Female), and 23 individuals (6.7% of the total sample) were estimated as Ambiguous. The remaining 30 individuals were Undetermined (8.8% of the total sample) due to a lack of material to properly assess osteological sex. Sample distribution by age and sex is presented in Figure 4.1. The distribution of the sample by sex, age and social status group is presented in Table 4.1. Age, sex, and social status data for each individual are listed in Appendix D.

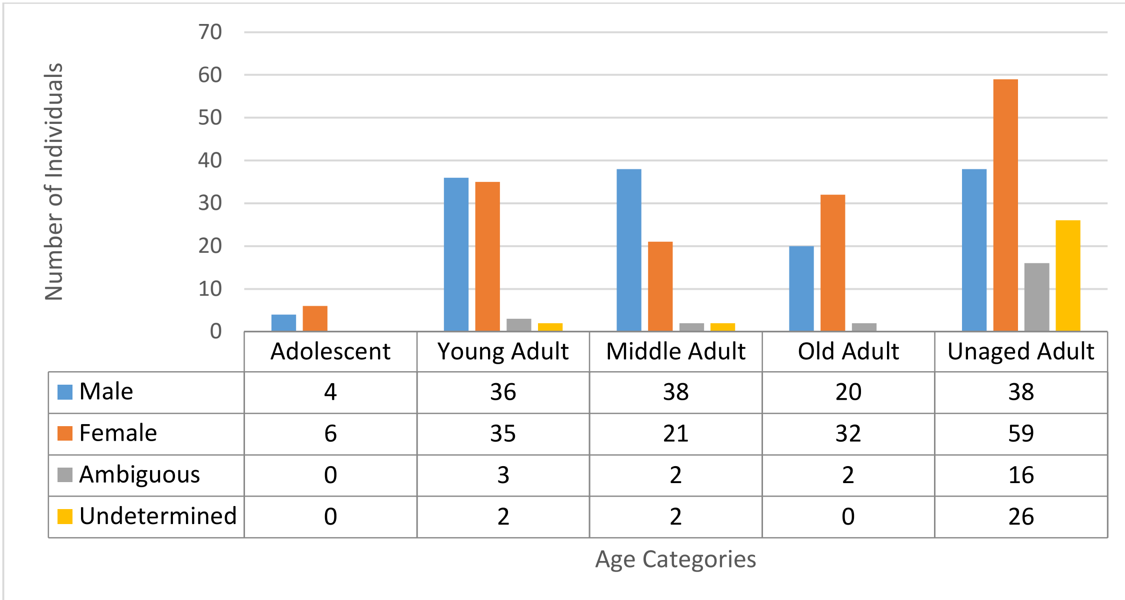
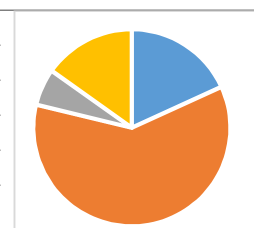
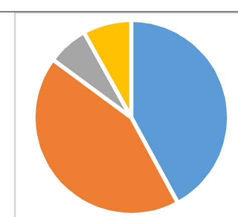


Figure 4.1. Sample Size Distribution (by Age and Sex) for the Northern Cemetery Sample at Roman Winchester. Age categories: Adolescent (16-19), Young Adult (20-34), Middle Adult (35-49), Old Adult (50+), Unaged Adult (16+). 'Male' includes Male and Probable Male; 'Female' include Females and Probable Female.

TABLE 4.1. Sex and Age Distribution for the Northern Cemetery, by Social Status Group

	Ado	YA	MA	OA	UA	Total
Higher Social Status Group[1]						
Male (Blue)	0	3	1	1	1	**6**
Female (Orange)	1	6	1	3	9	**20**
Ambiguous (Grey)	0	0	0	0	2	**2**
Undetermined (Yellow)	0	0	0	0	5	**5**
Total	1	9	2	4	17	**33**
Lower Social Status Group[2]						
Male (Blue)	4	33	37	19	37	**130**
Female (Orange)	5	29	20	29	50	**133**
Ambiguous (Grey)	0	3	2	2	14	**21**
Undetermined (Yellow)	0	2	2	0	21	**25**
Total	9	67	61	50	122	**309**





[1]Higher Social Status – Monumental grave constructions, or buried in coffins with signifying artefacts (see section 2.3). [2]Lower Social Status – Buried in pits, or coffins without signifying artefacts (see section 2.3). Ado: Adolescent (16-19), YA: Young Adult (20-34), MA: Middle Adult (35-49), OA: Old Adult (50+), UA: Unaged Adult (16+). 'Male' includes Male and Probable Male; 'Female' includes Female and Probable Females. Pie charts illustrate the proportions of males, females, ambiguous, and undetermined in respective social status groups.

4.1.2 Preservation and completeness

Preservation and completeness were assessed separately for the dentition, scored out of six and five, respectively (see Table 3.2 for the scoring used). Two-tailed t-tests between sub-sample values and total sample values were completed, to ensure that the dental pathology results are not due to differential preservation (Table 4.2) or differential completeness (Table 4.3) between groups.

TABLE 4.2. Mean, Median, and Mode, of Preservation by Sub-Sample, with T-test conducted between sub-sample and total sample

	Mean	Median	Mode	T-Test *p* value
Total Sample	2.9	2.5	2.0	-
Higher Social Status (Total)	3.3	3.0	3.0	0.117
HSS Males	2.3	2.5	3.0	0.750
HSS Females	3.1	3.0	4.0	0.096
HSS Ambiguous	2.3	2.3	-	0.751[1]
HSS Unknown Sex	**6.0**	**6.0**	**6.0**	**0.005**
Lower Social Status (Total)	2.9	2.5	2.0	0.968
LSS Males	2.5	2.0	2.0	0.416
LSS Females	2.8	2.5	2.0	0.903
LSS Ambiguous	3.2	3.0	2.0	0.581
LSS Unknown Sex	**4.68**	**6.0**	**6.0**	**0.007**

Significant at $p<0.05$. Statistically significant values are bolded and shaded. [1]Higher Social Status Ambiguous only has two individuals with different scores, therefore, there is no mode, as a result t-test is based on mean and median scores, rather than mean, median and mode.

TABLE 4.3. Mean, Median, and Mode of Completeness by Sub-Sample, with T-test conducted between sub-sample and total sample

	Mean	Median	Mode	T-test *p* value
Total Sample	2.9	3.5	4	-
Higher Social Status (Total)	2.8	3.5	4.0	0.950
HSS Males	3.8	4.0	4.0	0.271
HSS Females	3.1	3.8	4.0	0.747
HSS Ambiguous	3.8	3.8	-	0.321[1]
HSS Unknown Sex	**0.0**	**0.0**	**0.0**	**0.009**
Lower Social Status (Total)	2.9	3.5	4.0	0.994
LSS Males	3.3	2.0	4.0	0.619
LSS Females	2.9	3.5	4.0	1.000
LSS Ambiguous	2.5	3.4	4.0	0.621
LSS Unknown Sex	**1.3**	**0.0**	**0.0**	**0.006**

Significant at $p<0.05$. Statistically significant values are bolded and shaded. [1]Higher Social Status Ambiguous only has two individuals with different scores, therefore, there is no mode, as a result t-test is based on mean and median scores, rather than mean, median and mode.

The *p* values from these tests indicate that differences between most sub-samples do not differ statistically from the overall values, and are therefore similar in degrees of preservation and completeness. When exploring differences in preservation and completeness, *Higher Social Status Undetermined* and *Lower Social Status Undetermined* are significantly different (*i.e.*, remains were more poorly preserved and less complete); this is not unexpected, as these individuals were too damaged/incomplete to complete a sex estimation, and it is likely the mandible and maxilla could be in a similar state. As these groups do not have associated sex estimations, the sub-samples are not included in the following analyses.

While most of the preservation scored as good (moderate erosion), and overall completeness is between 50-75%, there are certainly elements missing from individuals within this sample. Thus, all rates and calculations in the following sections should be considered minimum expressions of AMTL, caries frequencies, and dental wear scores for the sample.

4.1.3 Sample characteristics

Assumptions of normality were tested by exploring skewness and kurtosis ($-1.96 <$ *z*-value $> +1.96$), Shapiro-Wilk's test ($p>0.05$), and through visual inspection of box plots (Appendix E). For almost all groups, tests showed that the dental health variables (AMTL, caries, and dental wear) were not normally distributed in the sample, and indicated non-parametric tests (*i.e.*, Mann-Whitney U, Kruskal-Wallis) were recommended. The two exceptions to this were anterior and posterior dental wear for *Ambiguous Sex* sub-groups, which were normally distributed; however, as these groups do not have a male or female sex estimation, they are not included in further statistical analyses.

For Mann-Whitney U tests, statistical analysis was not conducted if total sample size was less than seven individuals. Asymptotic significance *p*-values were used, unless exact significant *p*-values were provided. The latter *p*-value does not correct for ties, and is provided in instances of small sample sizes, for which tests could still be conducted. While *p* values indicate statistical significance, the *U* statistic compares the ranking of the two samples, and represents the number of times an observation in one sample preceded observations in the other sample in the ranking. Thus, larger *U* values indicates that the sample is well separated, while a small *U* value indicates the two groups overlap and may not be replicable in larger sample sizes (Samuels and Witmer, 1999). The upper range of *U* is limited by the sample size. As a result, in the following sections, both the *U* statistic and *p*-values will be presented, to indicate the strength of the relationship and the statistical significance.

4.2 Antemortem Tooth Loss

Prevalence of AMTL was calculated at the individual and sub-sample level (*e.g.*, High Status Males, Low Status Females) using the equations presented in section 3.3. Of the 7,543 sockets present for observation, 1066 (14.1%) displayed evidence of AMTL (*i.e.*, the socket was either partially or fully resorbed). Summary rates by sex and social status group are presented in Table 4.4, while AMTL rates for all sub-sample groups and age categories are presented in Appendix F. All Mann-Whitney U *p*-values for AMTL statistical tests are in Appendix G.

TABLE 4.4. AMTL Rates (%) By Social Status Group and Sex

	Anterior Teeth[1]		**Posterior Teeth[2]**		**Total**	
All	4.9%	(142/2917)	20.0%	(924/4626)	14.1%	(1066/7543)
All Male	4.7%	(64/1348)	17.5%	(373/2135)	12.5%	(437/3483)
All Female	4.4%	(58/1313)	22.6%	(470/2082)	15.6%	(528/3395)
All Ambiguous	9.3%	(15/162)	20.0%	(51/255)	15.8%	(66/417)
All Undetermined	5.3 %	(5/94)	19.5%	(30/154)	14.1%	(35/248)
Higher Social Status	1.5%	(4/270)	12.2%	(53/435)	8.1%	(57/705)
HSS Male	0.0%	(0/72)	13.6%	(15/110)	8.2%	(15/182)
HSS Female	2.2%	(4/179)	12.5%	(36/287)	8.6%	(40/466)
HSS Ambiguous	0.0%	(0/19)	5.3%	(2/38)	3.5%	(2/57)
HSS Undetermined	0.0%	(0/0)	0.0%	(0/0)	0.0%	(0/0)
Lower Social Status	5.2%	(138/2647)	20.8%	(871/4191)	14.8%	(1009/6838)
LSS Male	5.0%	(64/1276)	17.7%	(358/2025)	12.8%	(422/3301)
LSS Female	4.8%	(54/1133)	24.2%	(434/1795)	16.7%	(488/2929)
LSS Ambiguous	10.5%	(15/143)	22.6%	(49/217)	17.8%	(64/360)
LSS Undetermined	5.3 %	(5/94)	19.5%	(30/154)	14.1%	(35/248)

Percent followed by number of sockets exhibiting AMTL, over number of observable sockets in brackets. HSS = Higher Social Status group; LSS = Lower Social Status group. [1]Anterior teeth include incisors and canines. [2]Posterior teeth include premolars and molars.

Within the sample, rates of posterior AMTL is consistently higher than rates of anterior AMTL, in all sub-groups, and in the sample overall.

4.2.1 Antemortem tooth loss by sex

Within the Northern Cemetery sample, males had slightly higher rates of anterior AMTL than females, while females had higher rates of posterior and total AMTL (Table 4.4). Mann-Whitney U tests between all males and all females show that the differences in anterior AMTL were significant, while the differences between posterior and total AMTL were not statistically significant (Table 4.5).

When explored by age category, there is an age-progressive pattern with minimal rates of AMTL for Adolescent and Young Adult categories, and higher rates of AMTL in the Old Adult category (Fig 4.2). Except in the Adolescent and Unknown age categories, females had higher rates of total AMTL than males. The difference in AMTL rates between males and females was only significant for anterior AMTL within the Middle Adult category (Table 4.5).

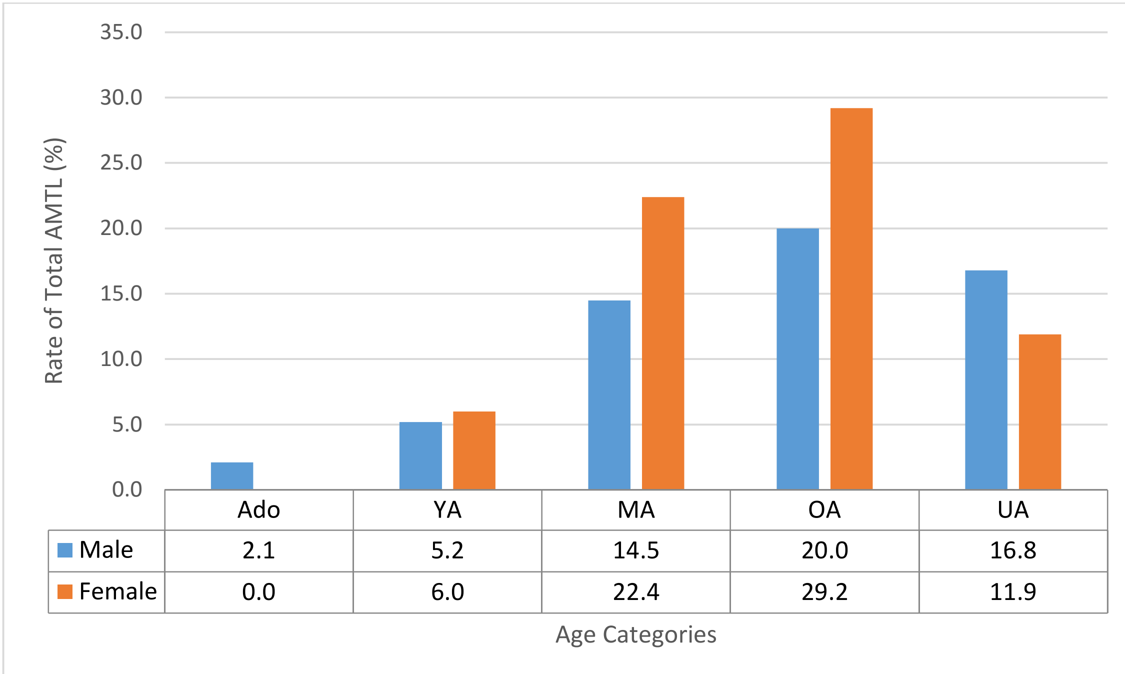


Figure 4.2. Total AMTL Rates (%) by Sex and Age Category. See Figure 4.1 for definitions of age categories.

TABLE 4.5. Mann-Whitney U Test Results for AMTL rates (Anterior, Posterior, and Total Dentition) between Males and Females

	Anterior		Posterior		Total Dentition	
	U=	*p=*	*U=*	*p=*	*U=*	*p=*
All Ages	**9462.5**	**0.030**	10236.5	0.809	10382.0	0.975
Ado	12.0	1.000*	6.0	0.257*	6.0	0.257*
YA	577.5	0.083	629.5	0.995	628.0	0.980
MA	**288.0**	**0.018**	287.0	0.075	319.0	0.204
OA	289.5	0.422	245.0	0.157	247.0	0.169
UA	1007.0	0.168	952.0	0.196	938.5	0.163

*Significant at p<0.05. Statistically significant values are bolded and shaded. *Exact Significance used instead of Asymptotic Significance, due to small sample sizes. See Table 4.1 for definitions of age categories.*

4.2.2 Antemortem tooth loss by social status

Within the Northern Cemetery sample, the Lower Social Status group had higher rates of anterior, posterior and total AMTL when compared to rates of AMTL of the Higher Social Status group (Table 4.4). Mann-Whitney U tests between two social status groups show that the differences between posterior and total AMTL are statistically significant (Table 4.6). Differences in anterior AMTL are approaching statistical significance, which means there is either no real association, or the study was too small to detect statistical differences (*i.e.*, not enough participants). For that reason, it may mean the differences are still important and may warrant further consideration in future studies.

When explored by age category, there is an age-progressive pattern with minimal rates of AMTL for Adolescent and Young Adult categories, and higher rates of AMTL in the Old Adult category (Fig 4.3). The Lower Social Status group has higher rates of total AMTL in Adolescent, Young Adult, and Middle Adult categories, but lower rates in the Old Adult category. The difference in AMTL rates between Higher and Lower Social Status groups were not statistically significant in any age group (Table 4.6).

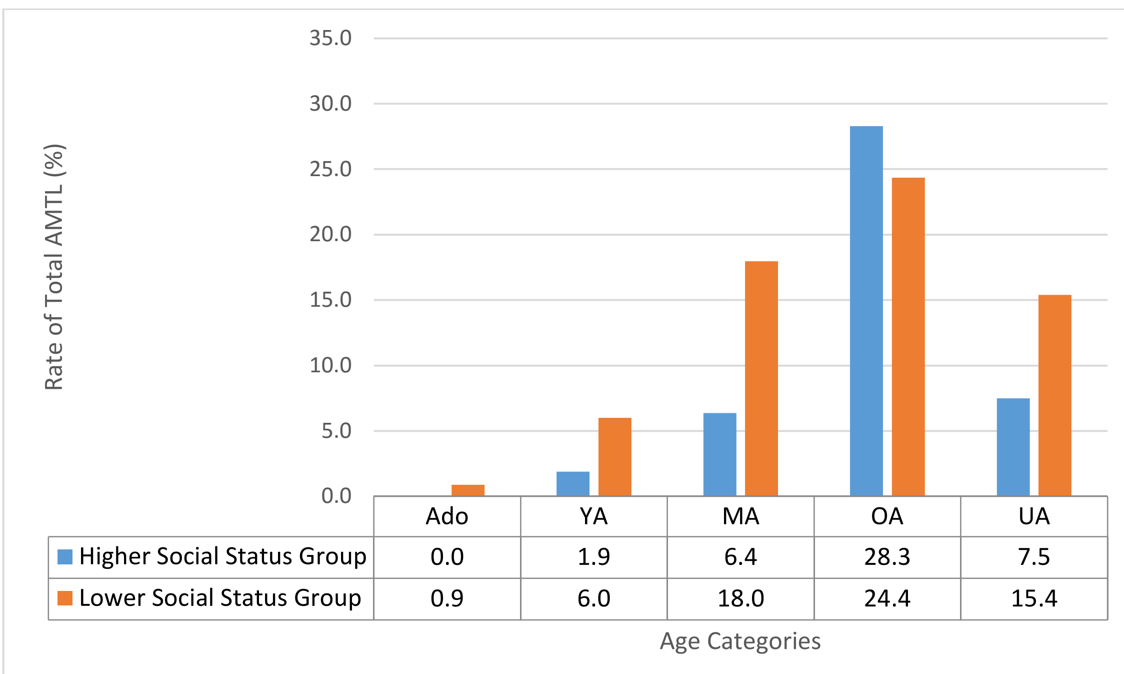


Figure 4.3. Total AMTL Rates (%) by Social Status Group and Age Category. See Figure 4.1 for definitions of age categories.

TABLE 4.6. Mann-Whitney U Test Results for AMTL (Anterior, Posterior, Total Dentition) between Higher Social Status and Lower Social Status

	Anterior		Posterior		Total Dentition	
	U=	*p=*	*U=*	*p=*	*U=*	*p=*
All Ages	4466.0	0.054	**4016.5**	**0.038**	**3952.5**	**0.028**
Ado	4.5	1.000*	3.5	0.800*	3.5	0.800*
YA	288.0	0.520	207.0	0.100	206.0	0.097
MA	45.0	0.565*	43.5	0.518*	41.5	0.473*
OA	96.5	0.911*	85.0	0.644*	85.5	0.644*
UA	875.5	0.082	856.5	0.215	842.5	0.182

*Significant at $p<0.05$. Statistically significant values are bolded and shaded. *Exact Significance used instead of Asymptotic Significance, due to small sample sizes. See Table 4.1 for definitions of age categories.*

4.2.3 Antemortem tooth loss by sex and social status

4.2.3.1 AMTL by Sex and Social Status Group: High Social Status Group

Within the Higher Social Status group, the male and female sub-samples had similar levels of AMTL for posterior teeth, and for overall dentition (<1% difference) (Table 4.4). While the female sub-sample had a very low rate of anterior AMTL (2.2%), male sub-sample had no anterior AMTL (0%). A Mann-Whitney U test indicates that the differences between the sexes for anterior, posterior, and total dentition were not statistically significant (Table 4.7). When analyzed by age group, Higher Social Status Females had lower levels of AMTL at the Young Adult category than their male counterparts, but much higher rates within the Middle Adult category (Fig 4.4). Rates of AMTL within the Old Adult category were comparable between males and females. For the Young Adult and Unknown Adult categories, there were no statistically significant differences (Table 4.7). Small sample sizes prevent statistical analysis in the Adolescent, Middle Adult, and Old Adult categories.

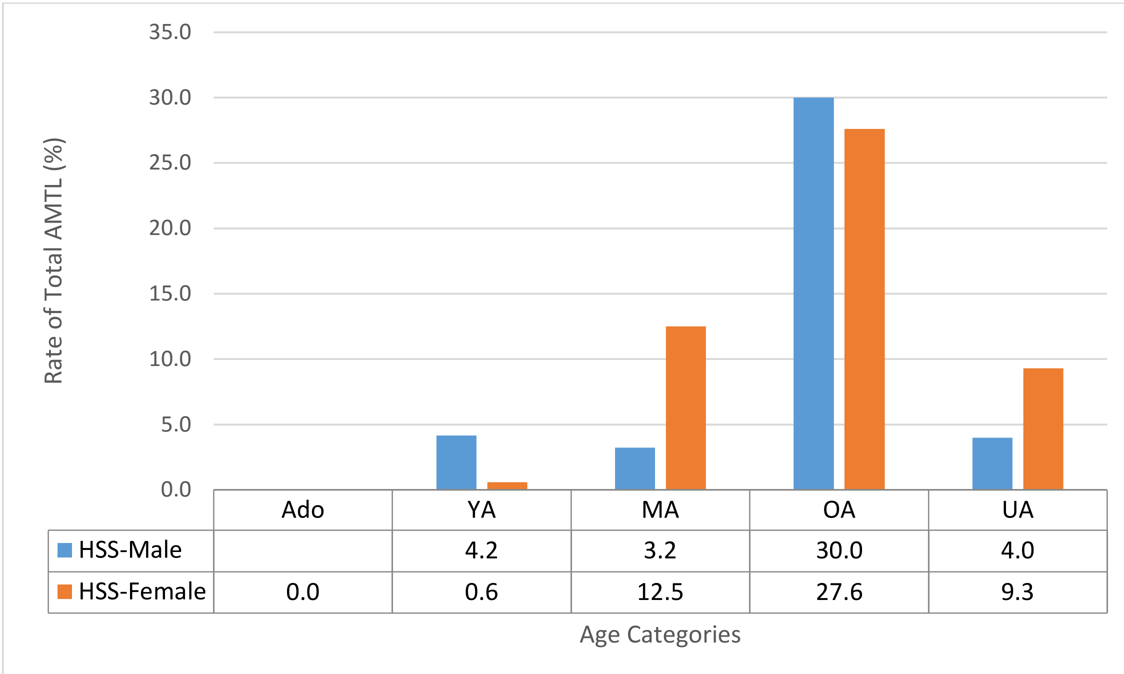


Figure 4.4. Total AMTL Rates (%) by Sex and Social Status Group and Age Category: Higher Social Status Group (HSS). See Figure 4.1 for definitions of age categories.

TABLE 4.7. Mann-Whitney U Test Results for AMTL (Anterior, Posterior, Total Dentition) between Higher Social Status Males and Higher Social Status Females

	Anterior		Posterior		Total Dentition	
	U=	*p=*	*U=*	*p=*	*U=*	*p=*
All Ages	57.0	0.882*	53.0	0.700*	53.0	0.700*
Ado	-	-	-	-	-	-
YA	9.0	1.000*	7.0	0.714*	7.0	0.714*
MA	-	-	-	-	-	-
OA	-	-	-	-	-	-
UA	4.5	1.000*	4.0	1.000*	4.0	1.000*

*Significant at $p<0.05$. Statistically significant values are bolded and shaded. *Exact Significance used instead of Asymptotic Significance, due to small sample sizes. – indicates small sample size (n<7) prevented statistical analysis. See Table 4.1 for definitions of age categories.*

4.2.3.3 AMTL by Sex and Social Status Group: Lower Social Status Group

Within the Lower Social Status group, males and females had similar levels of AMTL for anterior teeth (5.0% and 4.8% respectively), while females had higher rates of posterior and total AMTL (see Table 4.4). A Mann-Whitney U test indicates that the differences between the sexes for anterior AMTL were significant, while the differences between the sexes for posterior AMTL, and total AMTL were not statistically significant (Table 4.8). When broken down by age group, females exhibited higher levels of AMTL across Young Adult, Middle Adult, and Old Adult categories (Fig 4.5). Males exhibited higher levels of AMTL in both the Unaged Adult and Adolescent category. With the exception of anterior wear for Middle Adult, these differences were not statistically significant (Table 4.8).

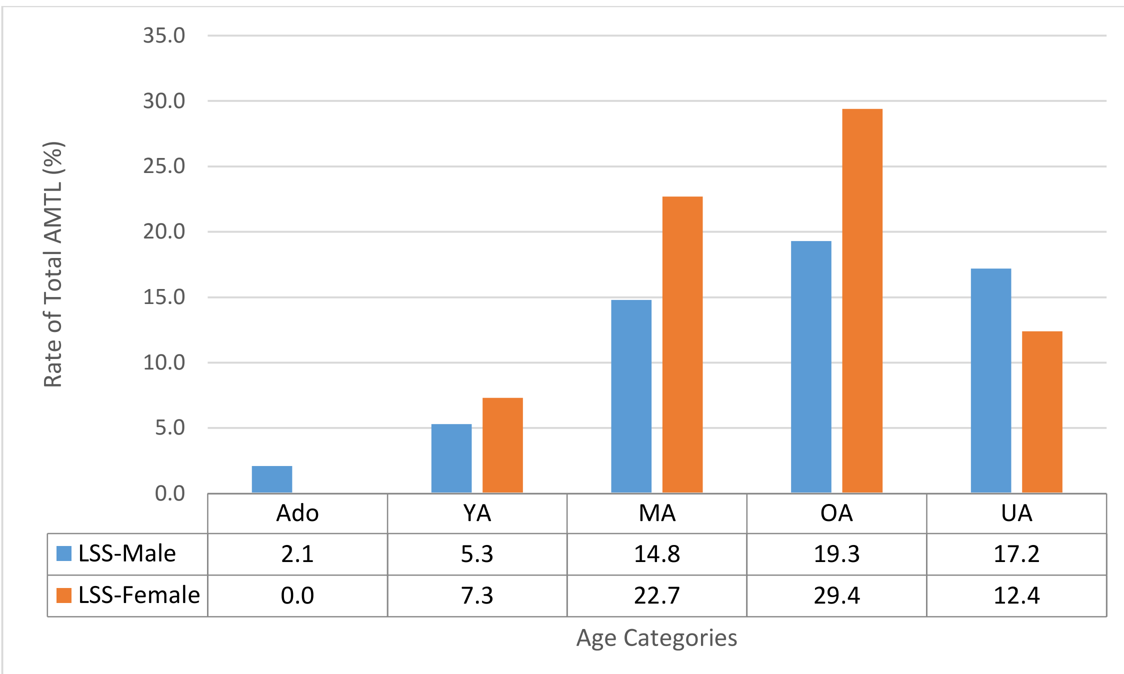


Figure 4.5. Total AMTL Rates (%) Sex and Social Status Group and Age Category: Lower Social Status Group (LSS). See Figure 4.1 for definitions of age categories.

TABLE 4.8. Mann-Whitney U Test Results for AMTL (Anterior, Posterior, Total Dentition) between Lower Social Status Males and Lower Social Status Females

	Anterior		Posterior		Total Dentition	
	U=	*p=*	*U=*	*p=*	*U=*	*p=*
All Ages	**7856.5**	**0.043**	8285.0	0.551	8404.0	0.690
Ado	10.0	1.000*	5.0	0.286*	5.0	0.286*
YA	435.0	0.099	444.5	0.612	446.0	0.628
MA	**265.0**	**0.020**	268.0	0.087	298.0	0.227
OA	253.5	0.513	204.0	0.130	205.5	0.139
UA	844.0	0.277	784.5	0.213	778.5	0.195

*Significant at p<0.05. Statistically significant values are bolded and shaded. *Exact Significance used instead of Asymptotic Significance, due to small sample sizes. See Table 4.1 for definitions of age categories.*

4.3 Dental Caries

Of the 6,384 teeth present for observation, 825 (12.9%) were affected by carious lesions. As discussed earlier (see section 3.3), this represents the observed caries frequency, rather than the real caries frequency in the Northern Cemetery sample due to complicating factors such as ante- and post-mortem tooth loss (Duyar and Erdal, 2003). Alternative methods of determining caries frequencies include Caries Rate by individual, Decayed and Missing Index (DMI), the Caries Correction Factor (CCF), and the Proportional Correction Factor (PCF). Results of these methods of measuring caries frequencies for the Northern Cemetery can be found in Table 4.9.

TABLE 4.9. Caries Frequencies (%) by Social Status Group and Sex

	Caries Rate	**DMI**	**CCF**	**PCF**
Total Sample	12.9%	25.4%	18.1%	19.9%
Male	12.6%	247%	17.2%	19.2%
Female	14.7%	28.4%	21.6%	23.8%
Ambiguous	8.9%	22.7%	11.6%	12.9%
Undetermined Sex	8.0%	13.7%	9.8%	9.9%

Calculated according to equations found in Materials and Methods 3.1. DMI= Decayed and Missing Index; CCF= Caries Correction Factor; PCF= Proportional Correction Factor, used in conjunction with CCF.

Within the context of this thesis, caries rates will be explored by DMI and by PCF. As discussed in section 3.3, DMI is a widely used method within bioarchaeology, and will allow for comparisons to other Romano-British sites. However, as this method tends to over-estimate rates of carious lesions, PCF will also be used. The latter method corrects for both ante- and post-mortem tooth loss, and may be a more accurate representation of the pathological condition within the sample.

Summary rates by status group and sex are presented in Table 4.10, while caries rates for all sub-sample groups and age categories are presented in Appendix H. All Mann-Whitney U *p*-values for caries rates analyses are in Appendix I.

TABLE 4.10. Caries Rates (%) by Sex and Social Status Group

	Higher Social Status		Lower Social Status		All Social Status Groups	
	DMI	PCF	DMI	PCF	DMI	PCF
All Sex Groups	18.8%	16.3%	26.1%	20.3%	25.4%	19.9%
Males	24.7%	23.4%	24.7%	18.8%	24.7%	19.2%
Females	20.5%	18.4%	29.7%	24.6%	28.4%	23.8%
Ambiguous	5.9%	2.4%	24.9%	18.6%	22.7%	12.9%
Undetermined	0.0%	5.2%	15.1%	10.5%	13.7%	9.9%

DMI= Decayed and Missing Index; PCF= Proportional Correction Factor, used in conjunction with Caries Correction Factor.

4.3.1 Dental caries by sex

Within the Northern Cemetery sample, females had slightly higher rates of caries (both DMI and PCF) than males (Table 4.10). Mann-Whitney U tests between males and females show that the differences in DMI and PCF are not statistically significant (Table 4.11). When explored by age category females have lower DMI rates for the Adolescent and Unaged Adult age category, and lower PCF rates for the Adolescent age category, but higher DMI and PCF rates in all other age categories (Fig 4.6a, b). These differences were not statistically significant.

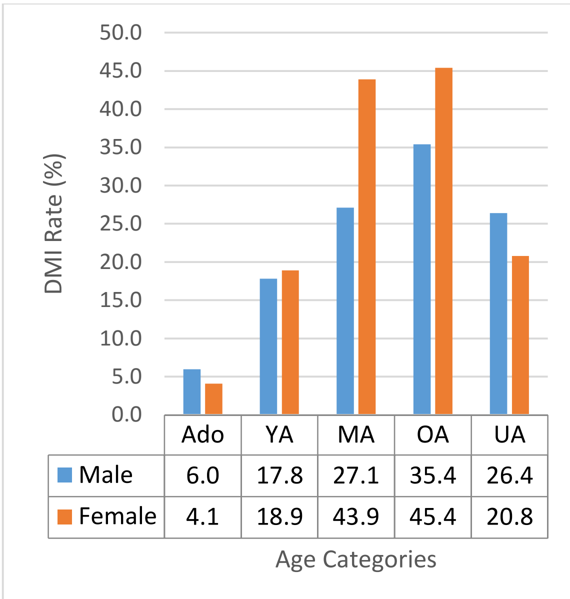


Figure 4.6a. DMI Rates (%) by Sex.

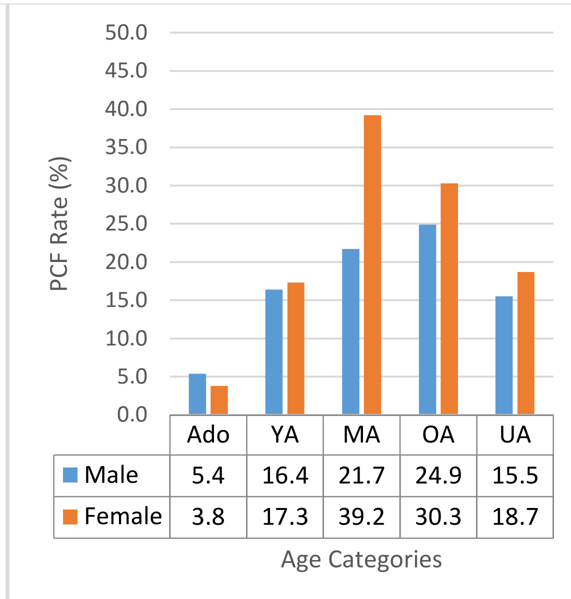


Figure 4.6b. PCF Rates (%) by Sex.

TABLE 4.11. Mann-Whitney U Test Results for Dental Caries (DMI, PCF) between Males and Females

	DMI		PCF	
	U=	*p=*	*U=*	*p=*
All Ages	9731.5	0.342	9315.5	0.120
Ado	9.0	0.610*	11.0	0.914*
YA	621.5	0.922	602.5	0.750
MA	293.0	0.093	289.0	0.079
OA	254.5	0.217	3302.0	0.729
UA	1084.5	0.787	968.0	0.254

*Significant at p<0.05. Statistically significant values are bolded and shaded. *Exact Significance used instead of Asymptotic Significance, due to small sample sizes. See Table 4.1 for definitions of age categories.*

4.3.2 Dental caries by social status

Within the Northern Cemetery sample, the Lower Social Status group had higher DMI and PCF rates when compared to the Higher Social Status groups (Table 4.10). Mann-Whitney U tests between the two social status groups show that these differences were not statistically significant (Table 4.12). When explored by age category, there is an overall age-progressive pattern for the Lower Social Status, although this pattern is not clear for the Higher Social Status group (Fig 4.7a, b). The differences in caries rates between social status groups were not statistically significant in any age group.

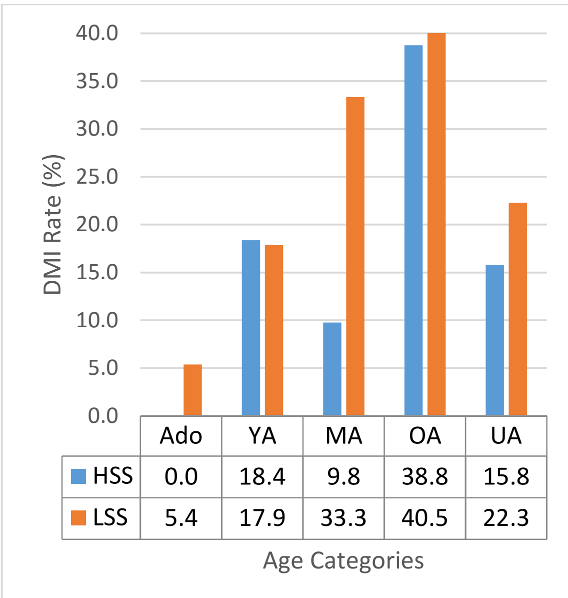


Figure 4.7a. DMI Rates (%) by Social Status Group. HSS= Higher Social Status. LSS= Lower Social Status.

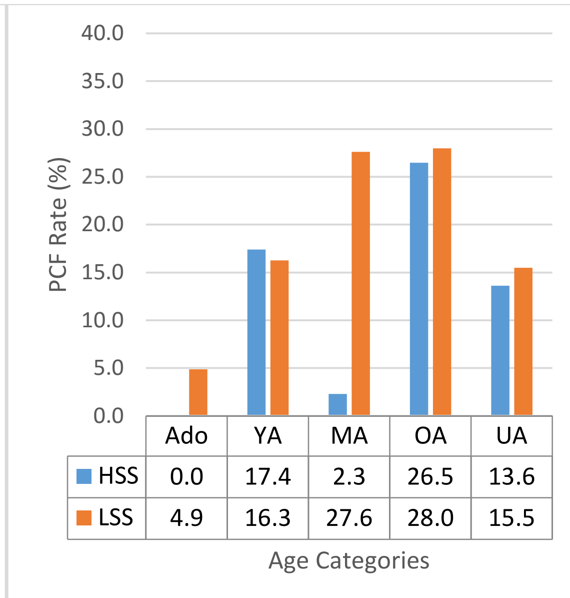


Figure 4.7b. PCF Rates (%) by Social Status Group. HSS= Higher Social Status. LSS= Lower Social Status.

TABLE 4.12. Mann-Whitney U Test Results for Dental Caries (DMI, PCF) between Higher Social Status and Lower Social Status

	DMI		PCF	
	U=	*p=*	*U=*	*p=*
All Ages	4420.5	0.208	4966.0	0.804
Ado	1.0	0.400*	1.50	0.400*
YA	291.0	0.866	274.5	0.661
MA	33.0	0.313*	33.0	0.313*
OA	95.5	0.886	99.0	0.987
UA	918.5	0.444	1030.0	0.964

*Significant at $p<0.05$. Statistically significant values are bolded and shaded. *Exact Significance used instead of Asymptotic Significance, due to small sample sizes. See Table 4.1 for definitions of age categories.*

4.3.4 Dental caries by sex and social status

4.3.4.1 Caries by Sex and Social Status Group: Higher Social Status Group

Exploring differences between males and females of the Higher Social Status group, females have lower rates of carious lesions than males in both DMI and by PCF calculations (Table 4.10). A Mann-Whitney U test indicates that the differences between the sexes for DMI and PCF are not statistically significant (Table 4.13).

When broken down by age group, no obvious trend appears. Females had higher DMI rates for Middle Adult, Old Adult and Unaged Adult categories, while males had higher DMI rates for Young Adult (Fig 4.8a). When exploring PCF rates, females were higher for Middle Adult and Unaged Adult, but males were higher in Young Adult and Old Adult categories (Fig 4.8b). No carious lesions were noted in the female Adolescent age group, and there were no Adolescent males from the Higher Social Status group. For the Young Adult and Unaged Adult age categories, differences in DMI and PCF were not statistically significant (Table 4.13). Analyses of the Adolescent, Middle Adult, and Old Adult categories was not possible due to small sample sizes.

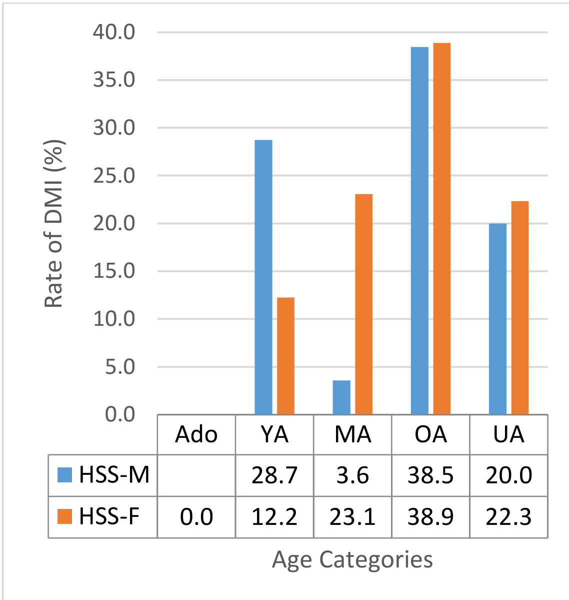


Figure 4.8a. DMI Rates (%) by Sex and Social Status Group: Higher Social Status (HSS). M= Male. F= Female.

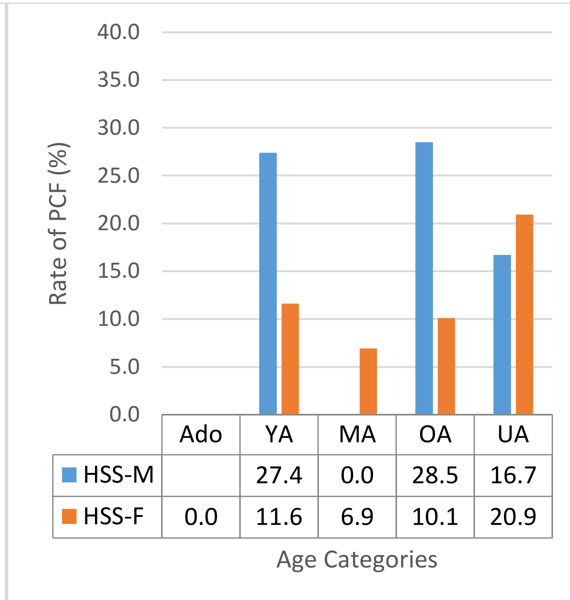


Figure 4.8b. PCF Rates (%) by Sex and Social Status Group: Higher Social Status (HSS). M= Male. F= Female.

TABLE 4.13. Mann-Whitney U Test Results for Dental Caries (DMI, PCF) between Higher Social Status Males and Higher Social Status Females

	DMI		PCF	
	U=	*p=*	*U=*	*p=*
All Ages	50.0	0.573*	57.0	0.882*
Ado	-	-	-	-
YA	3.0	0.167*	6.0	0.548*
MA	-	-	-	-
OA	-	-	-	-
UA	4.0	1.000*	4.0	1.000*

*Significant at p<0.05. Statistically significant values are bolded and shaded. *Exact Significance used instead of Asymptotic Significance, due to small sample sizes. – indicates small sample size (n<7) prevented statistical analysis. See Table 4.1 for definitions of age categories.*

4.3.4.2 Caries by Sex and Social Status Group: Lower Social Status Group

Within the Lower Social Status group, females have higher DMI and PCF rates (Table 4.10). However, a Mann-Whitney U test indicates that differences between the sexes for DMI and PCF were not statistically significant (Table 4.14). When broken down by age, an age-progressive pattern appears, with Adolescent and Young Adult categories having lower rates of carious lesions, while Middle Adult and Old Adult have higher rates. With the exception of the Adolescent and Unaged Adult age group, females had higher DMI and PCF rates than males (Fig 4.9a, b). No differences were found to be statistically significant when examined by age category (Table 4.14).

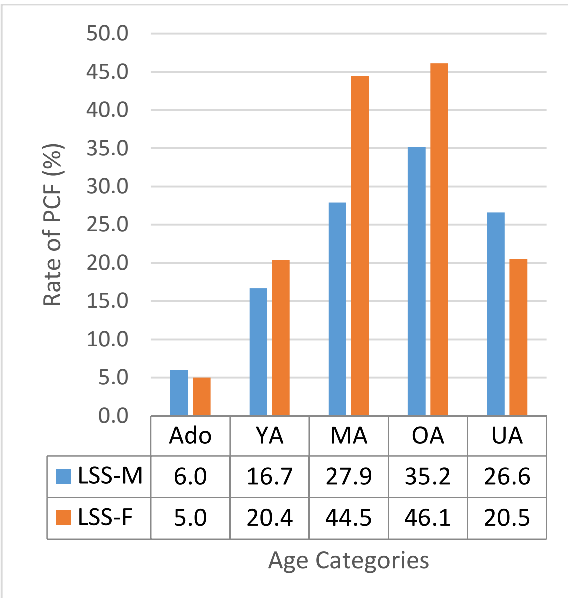


Figure 4.9a. DMI Rates (%) by Sex and Social Status Group: Lower Social Status (LSS). M= Male. F= Female.

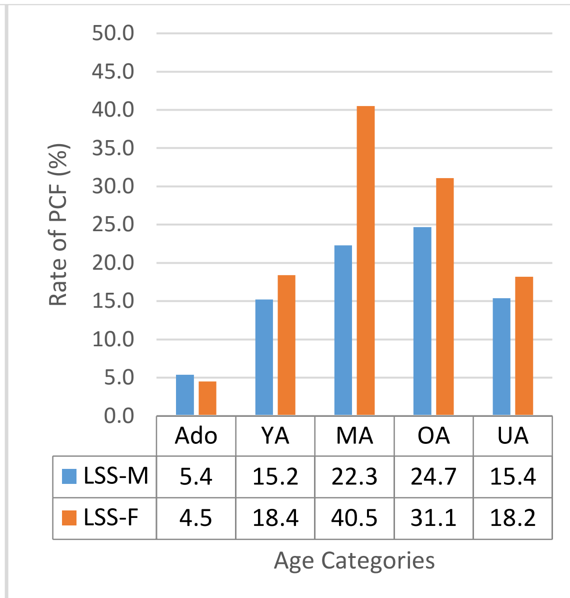


Figure 4.9b. PCF Rates (%) by Sex and Social Status Group: Lower Social Status (LSS). M= Male. F= Female.

TABLE 4.14. Mann-Whitney U Test Results for Dental Caries (DMI, PCF) between Lower Social Status Males and Lower Social Status Females

	DMI		PCF	
	U=	*p=*	*U=*	*p=*
All Ages	7905.5	0.229	7664.0	0.101
Ado	8.5	0.730*	8.0	0.730*
YA	444.5	0.630	437.5	0.559
MA	272.5	0.103	269.5	0.090
OA	215.0	0.201	254.5	0.651
UA	882.0	0.711	809.0	0.315

*Significant at $p<0.05$. Statistically significant values are bolded and shaded. *Exact Significance used instead of Asymptotic Significance, due to small sample sizes. See Table 4.1 for definitions of age categories.*

4.4 Dental Wear

As Dental Wear was scored according to two different methods (see section 3.3), scores for the anterior dentition and posterior dentition are presented separately. Summary rates by sex and social status group are presented in Table 4.15, while dental wear scores by sub-sample and age category are in Appendix J. All Mann-Whitney U *p*-values for dental wear analyses are presented in Appendix K.

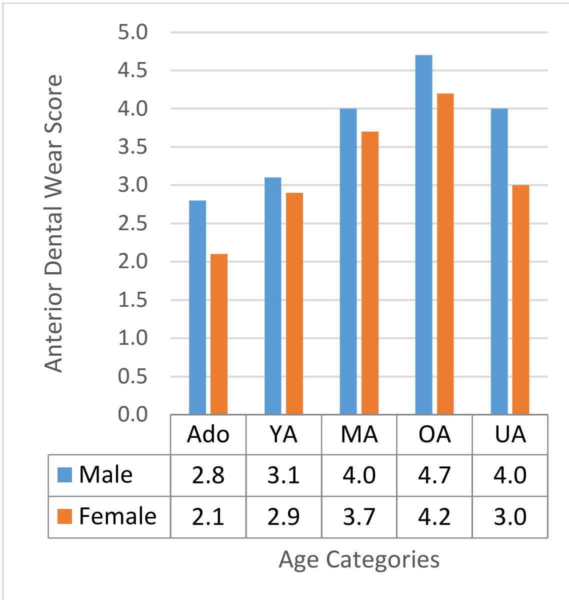
TABLE 4.15. Dental Wear Scores by Sex and Social Status Group

	Anterior Teeth[1]		Posterior Teeth[2]	
All	3.5	(14982/4234)	15.6	(33692/2157)
All Male	3.8	(6737/1795)	16.7	(15623/935)
All Female	3.3	(6178/1869)	13.9	(12405/895)
Higher Social Status	3.0	(1368/451)	14.2	(3341/236)
HSS Male	3.7	(337/102)	15.0	(773/49)
HSS Female	2.7	(716/267)	12.6	(1808/143)
Lower Social Status	3.6	(13614/3783)	15.8	(30351/1921)
LSS Male	3.8	(6360/1693)	16.8	(14890/886)
LSS Female	3.4	(5462/1602)	14.1	(10597/752)

Total dental wear score, followed in brackets by sum of all dental wear scores over the number of teeth present. [1]Anterior Teeth include incisors, canines and premolars. [2]Posterior Teeth include molars.

4.4.1 Dental wear by sex

Within the Northern Cemetery sample, males had higher rates of both anterior and posterior wear than females (Table 4.15). Mann-Whitney U tests between males and females show that the differences in anterior and posterior tooth wear are statistically significant (Table 4.16). When explored by age category an age-progressive trend is apparent, with lower rates for Adolescents, increasing towards the Old Adult age category (Fig 4.10a, b). Four of the age specific comparisons between males and females were statistically significant, including anterior wear for Adolescents, posterior wear for Old Adults, and both anterior and posterior for Unaged Adults (Table 4.16).



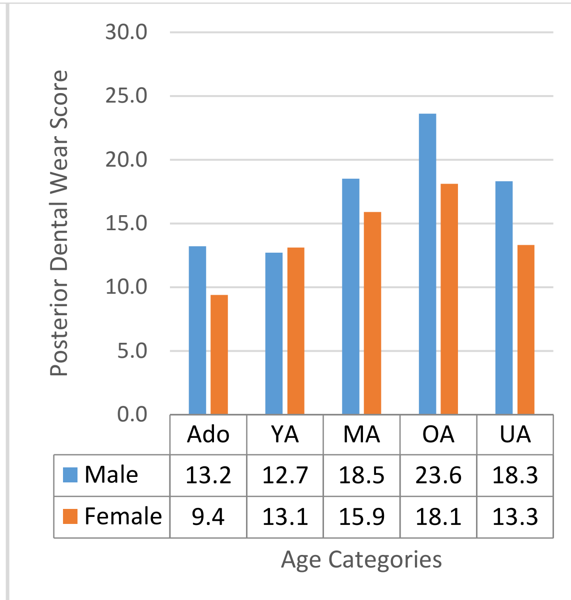


Figure 4.10a. Anterior Dental Wear by Sex. **Figure 4.10b.** Posterior Dental Wear by Sex.

TABLE 4.16. Mann-Whitney U Test Results for Dental Wear (Anterior, Posterior) between Males and Females

	Anterior		Posterior	
	U=	*p=*	*U=*	*p=*
All Ages	**7358.0**	**0.000**	**7044.5**	**0.000**
Ado	**0.0**	**0.010***	3.0	0.067*
YA	496.0	0.123	530.0	0.250
MA	339.0	0.423	340.0	0.350
OA	266.5	0.314	**161.5**	**0.008**
UA	**472.0**	**0.000**	**597.5**	**0.000**

*Significant at p<0.05. Statistically significant values are bolded and shaded. *Exact Significance used instead of Asymptotic Significance, due to small sample sizes. See Table 4.1 for definitions of age categories.*

4.4.2 Dental wear by social status

Within the Northern Cemetery sample, the Lower Social Status group had slightly higher anterior and posterior dental wear scores than the Higher Social Status group (Table 4.15). Mann-Whitney U tests between the two social status groups indicate that the differences in anterior and posterior dental wear were not statistically significant (Table 4.17). When explored by age category, an age-progressive trend is apparent, with

Adolescents having low dental wear scores, increasing to Old Adult (Fig 4.11a, b). The differences between the social status groups were not statistically significant in any age group (Table 4.17).

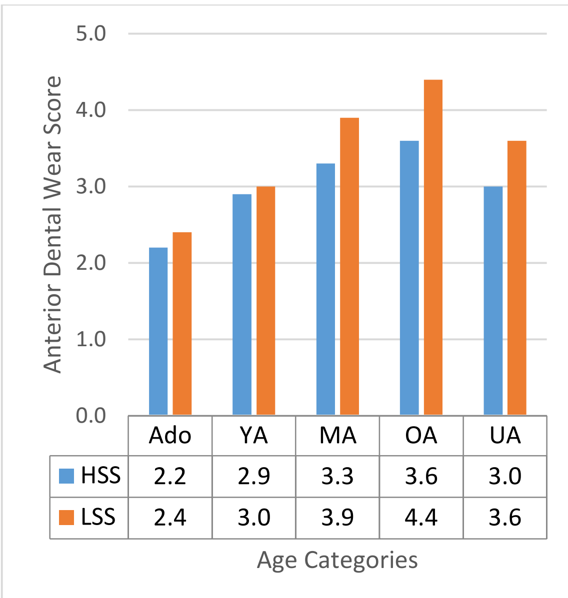


Figure 4.11a. Anterior Dental Wear by Social Status Group. HSS= Higher Social Status. LSS= Lower Social Status.

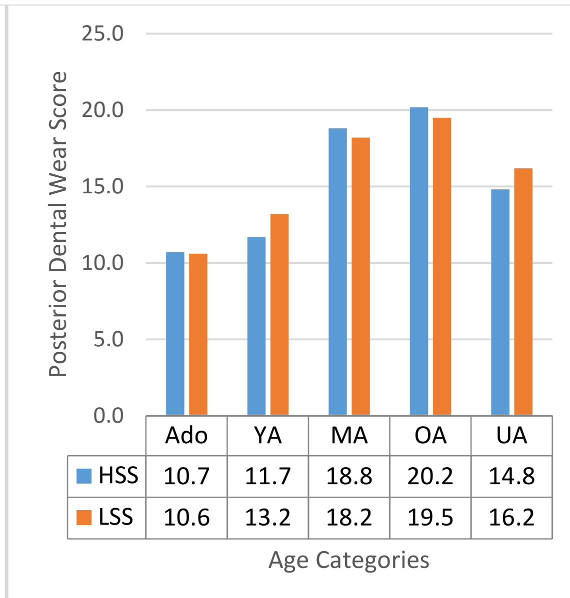


Figure 4.11b. Posterior Dental Wear by Social Status Group. HSS= Higher Social Status. LSS= Lower Social Status.

TABLE 4.17. Mann-Whitney U Test Results for Dental Wear (Anterior, Posterior) between Higher Social Status and Lower Social Status

	Anterior		Posterior	
	U=	*p=*	*U=*	*p=*
All Ages	4172.0	0.091	7968.0	0.881
Ado	4.0	1.000*	1.0	0.400*
YA	293.0	0.891	258.5	0.489
MA	41.0	0.489*	45.0	0.565*
OA	80.0	0.534*	81.5	0.631*
UA	902.5	0.387	1010.5	0.907

*Significant at p<0.05. Statistically significant values are bolded and shaded. *Exact Significance used instead of Asymptotic Significance, due to small sample sizes. See Table 4.1 for definitions of age categories.*

4.4.3 Dental wear by sex and social status

4.4.3.1 Wear by Sex and Social Status Group: Higher Social Status Group

Exploring differences between males and females of the Higher Social Status group, males have higher rates of anterior and posterior wear (Table 4.15). A Mann-Whitney U test indicates that the differences between the sexes for anterior and posterior wear were not statistically significant for the Higher Social Status group (Table 4.18). However, differences in anterior wear are approaching statistical significance suggesting this relationship may warrant further consideration. When broken down by age, an age-progressive pattern is present among the males, and loosely present for the females (Fig 4.12a, b). The differences between Young Adult and Unaged Adult males and females were not statistically significant (Table 4.18). Other age analyses were not possible due to the small sample sizes.

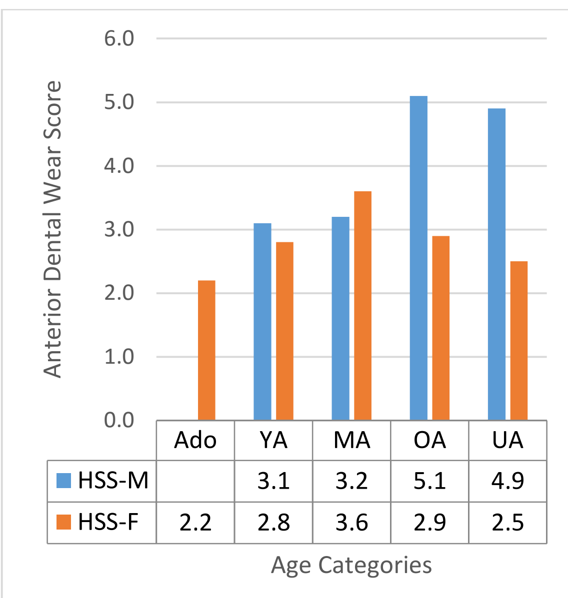


Figure 4.12a. Anterior Dental Wear by Sex and Social Status Group: Higher Social Status (HSS). M= Male. F= Female.

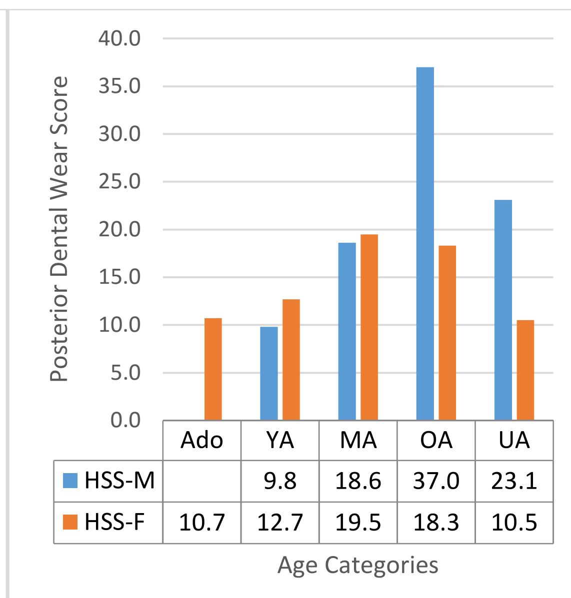


Figure 4.12b. Posterior Dental Wear by Sex and Social Status Group: Higher Social Status (HSS). M= Male. F= Female.

TABLE 4.18. Mann-Whitney U Test Results for Dental Wear (Anterior, Posterior) between Higher Social Status Males and Higher Social Status Females

	Anterior		Posterior	
	U=	*p=*	*U=*	*p=*
All Ages	28.5	0.054*	44.0	0.355*
Ado	-	-	-	-
YA	4.0	0.262*	9.0	1.000*
MA	-	-	-	-
OA	-	-	-	-
UA	1.0	0.400*	2.0	0.600*

*Significant at p<0.05. Statistically significant values are bolded and shaded. *Exact Significance used instead of Asymptotic Significance, due to small sample sizes. – indicates small sample size (n<7) prevented statistical analysis. See Table 4.1 for definitions of age categories.*

4.4.3.2 Wear by Sex and Social Status Group: Lower Social Status Group

Exploring differences in dental wear between males and females of the Lower Social Status group, males have higher rates of anterior and posterior wear, matching the trend seen in the Higher Social Status Group (Table 4.15). A Mann-Whitney U test indicates that the differences between the sexes of the Lower Social Status group for anterior and posterior dental wear were statistically significant (Table 4.19). When broken down by age, age-progressive trends are present with males typically having higher dental wear scores than females, for both anterior and posterior scores (Fig 4.13a, b). Statistically significant differences were found for Adolescent anterior and posterior wear and Unaged Adult anterior and posterior wear. All others were not statistically significant (Table 4.19).

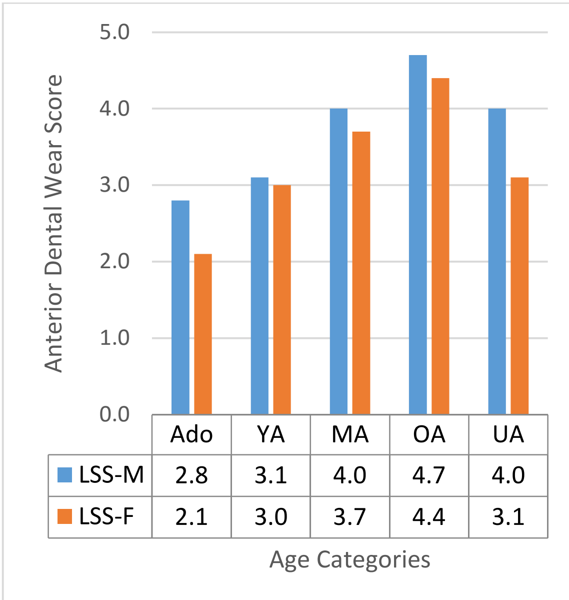


Figure 4.13a. Anterior Dental Wear by Sex and Social Status Group: Lower Social Status (LSS). M= Male. F= Female.

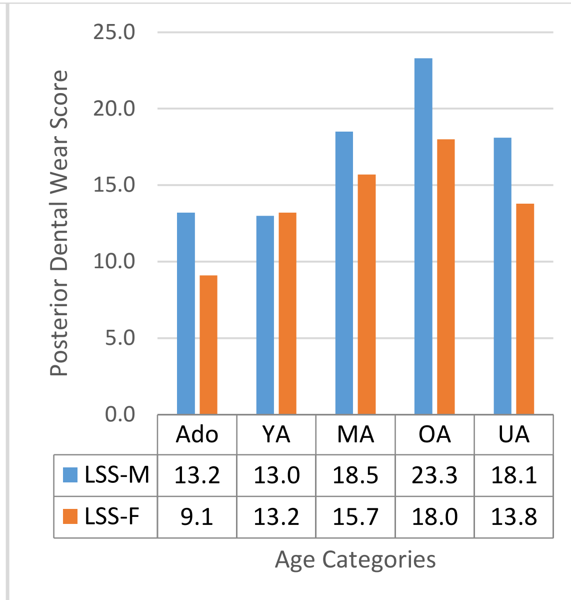


Figure 4.13b. Posterior Dental Wear by Sex and Social Status Group: Lower Social Status (LSS). M= Male. F= Female.

TABLE 4.19. Mann-Whitney U Test Results for Dental Wear (Anterior, Posterior) between Lower Social Status Males and Lower Social Status Females

	Anterior		Posterior	
	U=	*p=*	*U=*	*p=*
All Ages	**6379.5**	**0.000**	**5803.0**	**0.000**
Ado	**0.0**	**0.016***	**0.0**	**0.016***
YA	384.0	0.187	398.0	0.256
MA	312.0	0.412	299.0	0.235
OA	299.0	0.235	244.5	0.513
UA	**404.0**	**0.000**	**489.5**	**0.000**

*Significant at p<0.05. Statistically significant values are bolded and shaded. *Exact Significance used instead of Asymptotic Significance, due to small sample sizes. See Table 4.1 for definitions of age categories.*

4.5 Summary

Dental remains for 342 individuals were analysed for this thesis, with similar numbers of males and females. Of the sample, 9.6% of all individuals were determined to be Higher Social Status, and the remaining 90.4% were determined to be Lower Social Status. Preservation and completeness between the sub-groups were similar, indicating that statistical differences in dental health are unlikely due to differential rates of preservation and/or completeness. While slight differences in dental health rates between sub-groups were found within each category, only statistically significant results are summarized within this section.

Sex-based results indicate males have higher rates of anterior AMTL (for all ages, and Middle Adult) than females, but no differences were found in caries rates between sexes. Males have higher rates of anterior and posterior dental wear than females when considering all ages, and Unaged Adults; as well, males have higher anterior dental wear for the Adolescent age group, and higher posterior dental wear for the Old Adult age category than females.

When comparing dental health by social status group, individuals of the Lower Social Status group have significantly higher rates of posterior and total AMTL when compared to the Higher Social Status group. No differences were found between social status groups for caries rates, or dental wear.

Considering both sex and social status allows for a deeper understanding of the previous results. Within the Higher Social Status group, males and females exhibited no significant differences related to rates of AMTL, dental caries, or dental wear. Lower Social Status males, however, exhibited higher anterior AMTL (all ages, and Middle Adults), and higher anterior and posterior dental wear (all ages, Adolescent, and Unaged Adults) than Lower Social Status females. No differences were found in caries rates between males and females of the Lower Social Status group.

As well as these statistically significant differences, there were a few *p* values that were approaching statistical significance ($0.06 > p > 0.05$). These results suggest the differences may be statistically significant, but the sample was too small to detect it. For future studies, these areas may warrant further sampling and investigation. However, in the context of this thesis, only statistically significant results ($p < 0.05$) will be discussed. In the following chapter, these results will be discussed in the context of social status, identity, and diet, to understand reasons for, and possible implications of these differences.

CHAPTER 5: DISCUSSION

5.1 Introduction

Using the theoretical frameworks of Embodiment and Intersectionality, this Chapter will discuss the major findings of this study as they relate to differences in dental health between various sub-groups at Roman Winchester. The discussion will focus on answering the following questions:

1. Do males and females at Roman Winchester exhibit different dental health patterns? What can this tell us about differences or similarities in diet between the sexes, and how does this relate to gendered patterns of dietary behaviour?
2. Do Higher and Lower Social Status groups at Roman Winchester exhibit different dental health patterns? What can this tell us about differences or similarities in diet in relation to social status?
3. Are there dental health differences when examining the intersection of sex and social groups at Roman Winchester? What can this tell us about differences or similarities in diet in relation to sex and social status?

To answer these questions, historical, archaeological, and modern clinical evidence will be used to better understand possible causes for any differences or similarities, and to contextualize these within a Late Romano-British site. Where possible, comparisons will be made to other Romano-British sites to better understand if these results are typical of Late Roman Britain dietary practices, or unique to Roman Winchester.

The theoretical approach of Embodiment suggests that social conditions manifest in physical and biological ways (Martin *et al.*, 2013; Jimenez *et al.*, 2009). As a result, differences in dental health are not necessarily due to biological differences and susceptibility to dental disease, but are the manifestations of social and cultural differences in diet, patterns of consumption, and other behavioural activities such as using teeth as tools, or oral hygiene practices. These social and cultural differences will be the focus of the discussion. Furthermore, to answer the third question, the theoretical framework of Intersectionality will be used, which refers to how multiples aspects of identity influence an individual's experiences and health conditions, and emphasizes that inequalities are never the result of a single, distinct factor (Hankivsky, 2014).

5.2 Sex-Based Differences

In the Northern Cemetery sample of Roman Winchester, males and females exhibited similar dental caries rates, suggesting that both groups were incorporating comparable levels of cariogenic foods within their diets. These results were largely unexpected, as differences in dental caries rates between males and females have been examined and documented throughout the world, in both bioarchaeological and modern clinical studies (*e.g.*, Arantes *et al.,* 2009; Bonsall, 2014; Ferraro and Vieira, 2010; Keenleyside, 2008; Lukacs and Largaespada, 2006; Lopez *et al.,* 2012; Walker and Hewlett, 1990). Differences in caries experiences between osteologically defined sex groups are often interpreted as the result of gendered variations in diet (*e.g.*, Bonsall, 2014; White, 2005; Somerville *et al*., 2015). While changes in dental health are observed in sex-based groups, they are attributed to cultural or social differences in diet, and thus, have been interpreted as gendered differences. The theoretical approach of Embodiment supports this correlation, suggesting that the performance of socially-constructed gendered activities leave marks on the physical remains, and in contextualizing these remains we can understand gender differences, rather than just as sex-based differences (Brumfiel, 2006; Fisher and DiPaolo Loren, 2003).

The lack of differences in caries rates between males and females in the Northern Cemetery sample contradicts ancient literary evidence, which points to dietary differences between women and men; specifically, that women should minimize or eliminate meat from their diet (Fuller *et al.*, 2006; Oribasius *Liber Incertus* 18.10 in Garnsey, 1999: 101; Bonsall, 2014). Medical writers, such as Galen, argued that gendered differences in diet were required due to differences in energy and nutritional requirements between men and women, as well as the belief that food could influence behaviour and health, according to the idea of maintaining a balance of the 'four humours' (Bonsall, 2014). However, analysis of dental remains from other Romano-British sites, including Baldock and Ancaster, UK, did not find marked differences between males and females, consistent with the evidence found here (*e.g.*, Griffin *et al.,* 2011; Bonsall, 2014). The contradictions between the physical remains and the literary evidence are not necessarily surprising, as the theory of Embodiment stresses that bodies and physical remains may be able to challenge stories that are biased, or provide additional information to otherwise incomplete accounts (Krieger, 2005). Therefore, the physical manifestations of social conditions within the human remains may provide clues as to how Romano-British life truly was, as opposed to how it was written about in texts. It is possible that men and women were eating different foods, however, the overall effect on their teeth was the same between males and females.

Just as physical remains may contradict historical records, Krieger (2005) stresses that the embodied physical remains may provide evidence that supports other accounts and other lines of evidence. Examining ancient texts, researchers have suggested that meat and grains were selected not only for their nutritional value, but also based on their status and perceived social value in the Roman Empire (Cool, 2006; Garnsey, 1999). Cool (2006: 77) suggests that determining a hierarchical relationship of food types in Roman Britain, such as the social status of differences "between white and brown bread", or more accurately, fine grain and coarse breads, may be proven through the analysis of dental wear patterns. In the Northern Cemetery sample, males exhibited 2.2 (anterior) and 2.4 (posterior) times the levels of dental wear found in the dentition of females. Although dental wear can also be attributed to the non-dietary use of teeth (Hillson, 2005), the similar rates of wear in both anterior and posterior teeth suggest that these differences may be due to males consuming tougher and more abrasive foods, while females consumed foods that were softer and produced less dental wear. As Cool (2006) suggests, these differences may be due to differences in the consistency of grains or other foods consumed by men and women. Exploring dental wear patterns at Isola Sacra, a Roman port town in Italy, Prowse (2010) hypothesizes that higher rates of dental wear in males may be due to the ingestion of sand and grit found in seafood; a food source that literary evidence suggests was consumed predominately by men (Bonsall, 2014). Therefore, the differences in dental wear patterns between males and females may also be due to differential consumption of marine resources.

During the Iron Age, fish and shellfish were not a common part of the diet in Great Britain, but following the conquest by the Romans, evidence of marine resource consumption drastically increased (Muldner, 2013). The dietary change is so marked between the two time periods, it has been considered the most important dietary change during the process of Roman colonization (Cool, 2006; Cheung *et al.*, 2012). In Roman Britain, shellfish has been found primarily in urban contexts or, less frequently, in rural villa estates, suggesting a connection with higher social status individuals (Cool, 2006). Shellfish remains have been found throughout the Roman province, as far inland as Leicester, and were found in vast quantities in Roman Silchester (Cheung *et al.,* 2012). Examining Roman road systems, it seems likely that the shellfish in Roman Silchester would have been transported from the south coast to the Roman town, via Roman Winchester (Fig 5.1). Therefore, as a large urban centre, located near cities with evidence of marine resources, it is likely that inhabitants of Roman Winchester also had access to fish and shellfish.

Researchers have suggested that the consumption of marine resources in Roman Britain was restricted to particular portions of society, whether this restriction was based on status or gender, and may be an indication of individuals trying to associate themselves more closely with Roman society (Cheung *et al.*, 2012; Muldner, 2013). However, Cool (2006) cautions against imposing our own standards of luxury on Roman consumption patterns; suggesting that oysters and shellfish may have been a delicacy in the Mediterranean region, but more mundane in Romano-British communities with relatively easy access to oyster beds.

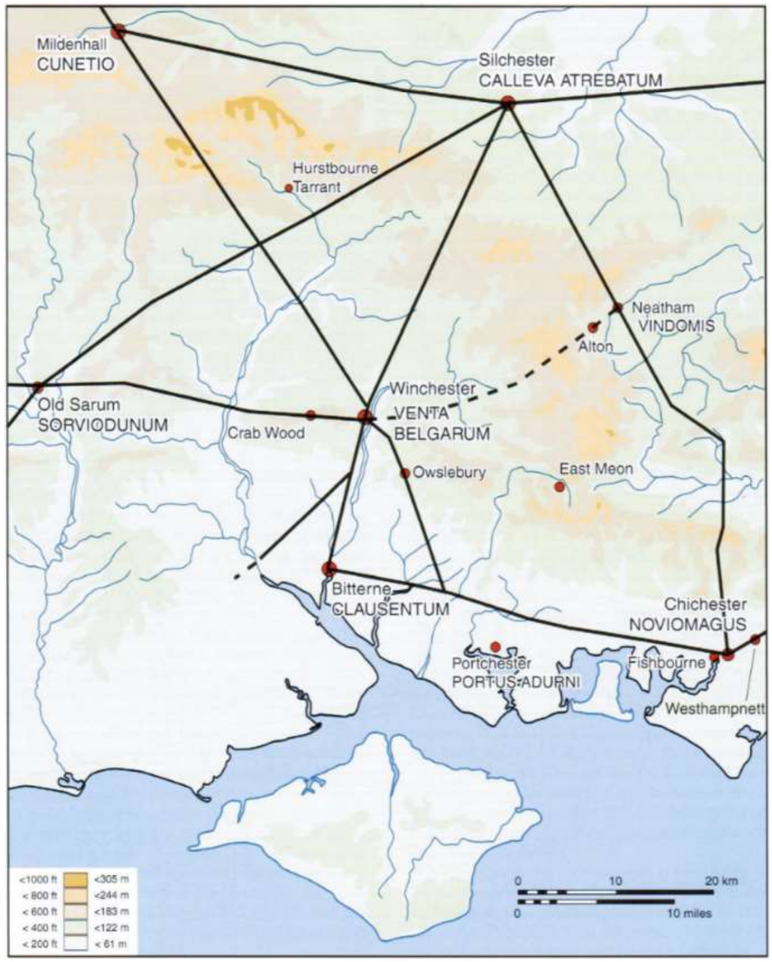


Figure 5.1. Map of Southern England, showing principle Roman sites and roads, specifically *Venta Belgarum* (Roman Winchester) connecting *Calleva Atrebatum* (Roman Silchester) to the south coast. (Ottaway *et al.*, 2012:10, Fig 3).

Carbon and nitrogen isotopic studies of skeletal remains from Roman Winchester (WINCM:AY21) indicate that a small portion of the community consumed marine resources on a consistent basis (Cummings and Hedges, 2010). When analyzing isotopic results by sex, there is considerable overlap between males and females in terms of both carbon and nitrogen isotopic values, however, there is a small portion of males at the highest carbon range ($\delta^{13}C$ values between -18.3‰ and -17.9‰) that is not occupied by any females (Fig 5.2). Cummings and Hedges (2010) explain that $\delta^{13}C$ values around -

18‰ suggest a diet supplemented with marine resources, while $\delta^{13}C$ values around -20‰ indicate a terrestrial based diet. Nitrogen isotopic values are a better indicator of marine consumption, and in this respect, males occupy the highest nitrogen range ($\delta^{15}N$ values between 10.5‰ and 11.5‰), which is not occupied by any females (Fig 5.2). Alternatively, the lowest nitrogen values correspond to samples taken from female skeletons; however, a great deal of overlap between the sexes exists. Therefore, the results of carbon and nitrogen isotopic analyses from Roman Winchester (WINCM:AY21) suggest that it was predominately males who had access to marine resources, providing a possible explanation for higher rates of dental wear in males in the Northern Cemetery sample, if there was considerable grit associated with the consumption of marine resources.

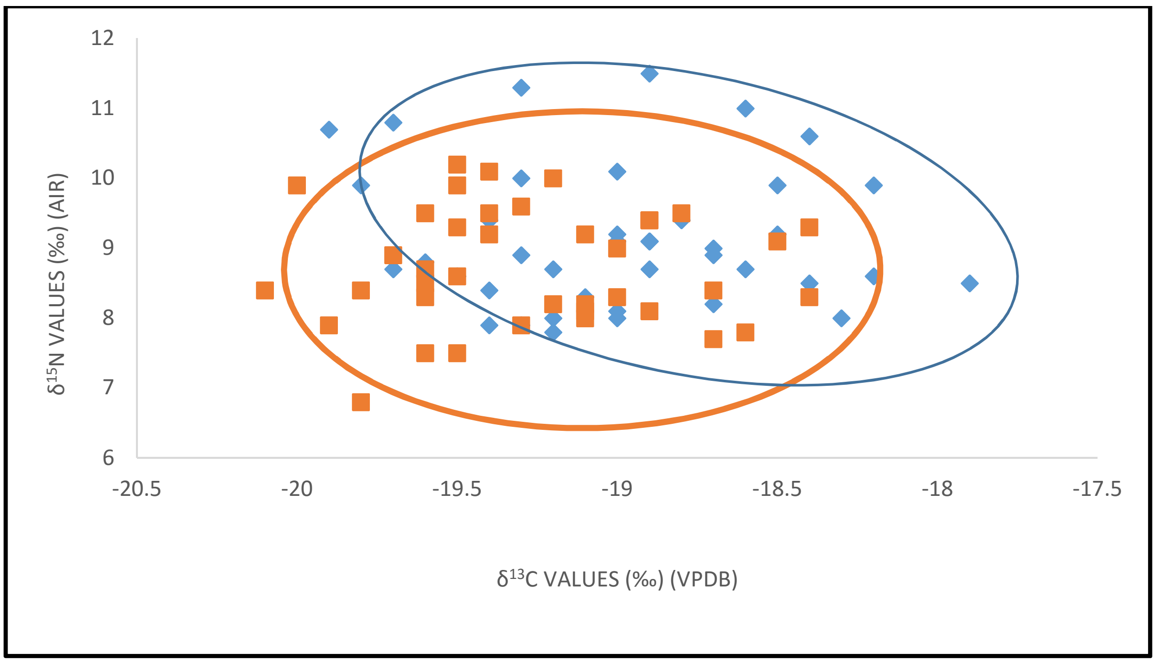


Figure 5.2. Carbon and Nitrogen isotopic values, by sex (males are blue diamonds, females are orange squares. Figure created by author, using isotopic data derived from Cumming and Hedges (2010: 419-420).

Nitrogen isotopic analyses conducted at other Late Romano-British sites (*i.e.,* Queensford Farm, Poundbury, Dorchester-On-Thames, and Gloucester) also found significantly lower nitrogen values in females than in males, indicating a lower trophic level position, and reduced consumption of marine resources (Fuller *et al.,* 2006; Muldner, 2013; Bonsall, 2014). The isotopic analyses support the literary evidence, which advised women to stay away from wet and cold foods, including fish, eels, and fatty meats (Rufus 20.1-2, 13, 17, as quoted in Garnsey, 1999). The medical writer, Oribasius from Athenaeus of Attaleia (*Liber Incertus* 20.1, as quoted in Garnsey, 1999) explained that these restrictions were required to maintain equilibrium, as women were inherently wet and cold and as a result, must eat foods that are hot and dry. Conversely, men were believed to be hot and dry, and were therefore encouraged to consume wet and cold foods, like marine resources, to balance the humours.

Differences in AMTL are an important measure of dental health and diet, but are often difficult to interpret (Lukacs, 2007). The theory of Embodiment acknowledges that social experiences and their impacts on physical remains cannot be neatly packaged or analyzed, and often different experiences (*i.e.* diet and activity) can impact the same physical remains (*i.e.* dentition) (Krieger, 2005). In the Northern Cemetery sample, males exhibited statistically higher rates of anterior AMTL than females, but no differences were found for posterior and total AMTL. While posterior AMTL is often related to severe carious lesions or advanced dental wear, anterior AMTL is often related to the use of teeth as tools, accidental falls, or interpersonal violence, but determining the exact cause is almost impossible in archaeological samples (Lukacs, 2007).

Examining fracture patterns between males and females at Roman Winchester, Bonsall (2013) found that males had higher rates of fractures than females, and that these differences were statistically significant. Although Bonsall's (2013) samples were from Roman Winchester, they were not derived from the exact same collections as were used in this thesis;[2] therefore, caution must be used when applying these data to the Northern Cemetery sample. In the skeletal sample examined by Bonsall (2013), injuries consistent with interpersonal violence (*e.g.,* cranial trauma, ulnar parry fractures, fractures of the hand) were predominately found in males. Additional archaeological evidence, such as the addition of bastions to the defences of Roman Winchester, also point to increased violence or conflict within the city (Bonsall, 2013). Bonsall (2013) concludes that males were more likely than females to be the victims and perpetrators of violence, but also had greater risk of breaking bones in sports and occupational related activities. Therefore, it is possible that the different rates of anterior AMTL between sexes in the Northern Cemetery sample is due to the embodiment of male participation in higher risk activities, and not the result of dietary differences. However, without identifiable facial trauma, this cannot be assumed as the definitive cause of the differences in anterior AMTL rates between the sexes.

Another possibility for increased rates of anterior AMTL in males is the use of teeth as tools. While differences between sex-based groups for anterior dental wear were not statistically significant, males did exhibit slightly higher rates of wear than females

[2]Bonsall used samples from the Northern (Victoria Rd, Hyde St, Hyde Close, Andover Rd), Western (Carfax, Romsey Rd), and Eastern (Chester) cemeteries.

(anterior dental wear scores of 3.8 for males and 3.3 for females). Therefore, the differences in anterior AMTL may be due to the accumulative impacts of dental wear differences, suggesting differential use of teeth as tools; a pattern not recorded in literary evidence (Keenleyside, 2008).

A third possibility to explain differences in anterior AMTL rates between males and females, is differential oral care practices. When studying a possible apothecary-dentist stall at the Temple of Castor and Pollux in the Roman Forum, Becker (2014) found that of the teeth extracted by a ‘dentist’, males seemed to be more represented than females. Becker (2014: 222) hypothesizes that this may be due to differential oral care practices between men and women, where men may have been more likely to seek treatment and extraction, while women simply “suffered the pain”. Therefore, the differences to tooth loss at Roman Winchester may be due to differential practices of oral hygiene and care, but with no direct evidence of extraction at the site, this cannot be proven. Additionally, the method employed by Becker (2014) to estimate sex was based on tooth size, a method he argues has been successfully employed at other sites close to the Roman Forum, from different time periods. Therefore, the reliability of this method for Roman samples is unknown, and thus, the results should be viewed as tentative.

When all dental variables are considered, and contextualized through the use of archaeological and literary evidence, it appears that in Roman Winchester, men and women incorporated similar quantities of carbohydrates and proteins within their diets. However, a hierarchy of grains, meats, and seafood was most likely present, and access to higher status foods within this hierarchy was likely influenced by sex and/or gender; this is evident in the consumption of marine resource, predominately consumed by men in the *civtas* capital.

5.3 Status-Based Differences

At Roman Winchester, individuals of the Lower Social Status group exhibited almost double the rates of posterior and total AMTL than individuals of the Higher Social Status group. Determining the exact cause of AMTL is unlikely in an archaeological sample, and instead is regarded as a nonspecific indicator of dental health (Lukacs, 1995; Belcastro *et al*., 2007). Studying tooth loss in a modern population with limited oral health care, Corraini and colleagues (2009) suggest that tooth loss can be viewed as a proxy for the culmination of oral health experiences. Hillson (2000) supports this, stating that rates of AMTL can vary depending on other dental indicators, including dental caries, severe wear, and dental abscesses. Although dental abscesses were not recorded within the scope of this thesis, individuals of the Lower Social Status group exhibited higher rates of carious lesions (DMI and PCF) and dental wear scores (anterior and posterior) than individuals of the Higher Social Status group. The differences in caries rates and dental wear scores between the social status groups were not statistically significant, however, the accumulation of these small differences may have contributed to the statistically significant differences in total and posterior AMTL rates.

Literary and archaeological evidence demonstrates that Roman society was very conscious of status and rank, which influenced all aspects of life including property ownership, occupation, and political rights (Bonsall, 2013; Grubbs, 2002). Roman laws depict status groups, specifically free individuals and slaves, as distinct groups and mixing between these groups was strongly discouraged (Grubbs, 2002). In Roman Britain, it is understood that the poorest of society lived in wattle and daub huts, working as tenant farmers, while the elite lived in houses made of stone masonry in urban centres or, more often, on rural estates (Pitts and Griffin, 2012; Roberts and Cox, 2003). Within urban environments, life was more diverse but social inequalities still existed, particularly between the traders, craftsmen and small scale merchants, and the ruling elite who worked as politicians and administrators of the *civitas* capital (Lewis, 2010; Bonsall, 2014).

Previous bioarchaeological examinations of status-based differences at Baldock, UK, found that individuals of the Lower Social Status[3] group exhibited statistically higher rates of AMTL and uncorrected caries rates[4] (Griffin *et al.*, 2011). However, Baldock is characterized as a small nucleated settlement with most of the population engaged in agricultural work, while Roman Winchester was a large urban centre. The distinction between settlement type is important, as Redfern and colleagues (2015) suggest that in Late Roman Britain, rural areas, such as Baldock, exhibited considerable inequalities in health and diet when compared to urban areas, such as Winchester. While previous studies of Roman Britain have suggested uniform Roman influences throughout the province, Muldner (2013) suggests that the influence of Roman colonization in Great Britain was more varied than previously considered, with some sites adopting new foodways and diets, while others adapted particular foods, but kept a more traditional

[3] Griffin *et al.,* (2011) determined status through analysis of grave construction.
[4] Uncorrected caries rate is simply the number of carious teeth divided by the number of teeth observed, and, as the name suggests, is not corrected for ante- or post-mortem tooth loss.

lifestyle overall. As a result, variation between settlements types and locations is expected within the Roman province. Therefore, it is possible that the differences between social status groups at *Venta Belgarum,* and other urban sites, were not as severe or marked as differences in rural communities within Roman Britain.

While the literary evidence suggests marked differences between status groups, an Embodied approach uses the skeletal remains to put these claims into perspective, especially claims perpetuated by those who benefitted from the 'status quo' and worked to maintain these divisions (*i.e.*, higher social status groups) (Krieger, 2005). Thus, it may be that the literary evidence is not a true representation of life in Roman Britain, or that Roman Winchester was unique from other sites, as the differences between social status groups were not as severe as implied in historical documentation from the period. Results from other Romano-British urban environments are mixed, with some sites suggesting marked differences between social status groups (*e.g.,* Cheung *et al*., 2012), and others echoing the results found in this study, which is that urban environments were characterized by more equality than suggested in literary evidence (*e.g.,* Pitts and Griffin, 2012). However, it must also be considered that, rather than differences between settlement type, the differences may be due to different ways of classifying and determining social status groups, as some researchers based status solely on grave construction, while others looked a grave goods, and others still considered by grave construction and grave goods.

As previously discussed, in the Roman Empire, grains and meats were selected not only for nutritional value, but for the perceived social value of the foods. More accurately, individuals of the higher status groups may have selected foods based on perceived status, while individuals of lower status groups would have limited choice and be dependent on what was affordable. Prowse (2001) states that in the Roman Empire, lower social status groups would have limited access to meats, fish, wine and oil, and possibly consumed inferior grains, such as barley. As seen previously, isotopic analysis of carbon at Roman Winchester showed sex-based differences as it relates to marine resources consumption. However, when analyzing carbon isotopes by grave construction, Cummings and Hedges (2010) note that those buried in coffins had significantly higher $\delta^{13}C$ values compared to those with no evidence of a coffin (p=0.000), however, the two groups overlapped considerably. Thus, it appears marine resource consumption was dependent on more than one aspect of identity. While stable isotopes provide information about marine resource consumption between social status groups, they cannot be used to determine different types of grains such as fine and coarse breads within a diet, but is limited to determining differences in C_3 and C_4 plants. Rather, as differences are present in one aspect of the diet (*e.g.*, marine resources), it is possible that differences existed elsewhere in the diet as well (*e.g.*, grains).

When combining archaeological, isotopic, and literary evidence with dental variables, it appears that social status groups in Roman Winchester experienced slight differences in diet. Although ancient texts speak to marked differences between social status groups, the data presented here suggest differences were present but subtle. Specifically, the Lower Social Status group consumed slightly more cariogenic and slightly rougher foods that individuals of the Higher Social Status group. Furthermore, these results may be unique to larger urban centres, rather than characteristic of Roman Britain in general.

5.4 Intersectionality

Inequalities are most often examined as they related to a single factor of identity, such as sex or social status. However, in doing this, bioarchaeological research represents groups of individuals as homogenous and distinct, where in reality, groups are diverse and overlapping. The theoretical framework of Intersectionality challenges this approach, and encourages researchers to move beyond single identities, which are ineffective at uncovering the range of variation and subtle nuances of human lives, to consider inequalities as they relate to multiple aspects of identity simultaneously (Hankivsky, 2014). Although it is important to understand sex and status-based differences in past societies, it is equally, if not more important, to explore and understand how various aspects of identity overlap and interplay with one another.

In the Northern Cemetery sample, no significant differences in dental pathology were present between Higher Social Status males and females, suggesting that men and women consumed diets that were more similar than was originally thought. Lower Social Status males and females, however, exhibited differences in anterior AMTL, as well as anterior and posterior dental wear, suggesting these men and women experienced differences in activity, occupation, and/or texture of foods. Together, these results emphasize that differences in diet at Roman Winchester were not only based on gender or social status individually, but were dependent on the confluence of gender and social status.

In Roman law, the intersection of gender and social status is also present, as women of the elite classes often had privileges and responsibilities that were denied to women of the lower classes (Grubbs, 2002). The results of this thesis suggest that the privileges of Higher Social Status women may have also extended to diet, possibly allowing access to additional high status foods such as softer breads. Furthermore, Garnsey (1999) suggests that in Roman families, food distribution was often based on the needs of the family for survival. In families where resources were plenty, everyone had access to food, minimizing differences in dental health between individuals. However, in families where resources were strained, as may be the case in Lower Social Status families, preferential access was given to the most productive members of the household, and as a result, the "inferior status of women" may have influenced food distribution within the family unit (Garnsey, 1999: 108).

The lack of sex-based differences in the Higher Social Status group suggest that, contrary to literary evidence, women were not inherently inferior to men with respect to diet, and at times had access to many of the same types of foods that men did. The very subtle differences in the Lower Social Status group suggest that in families where resources were strained, men and women consumed slightly different diets. However, these differences are not as drastic or clear-cut as ancient texts suggest. It is hypothesized that in periods of intense resource depletion, Higher Social Status women would also begin to consume diets that were slightly different from the Higher Social Status men.

5.5 Summary

In the current research, the theoretical framework of Embodiment was used to structure the discussion of sex- and status-based differences in dental health at a Late Romano-British site. Embodiment has been used by a number of researchers studying identity, to investigate the biological effects of social and cultural actions, and combining this approach with Intersectionality allowed for the analysis of sex and social status to further understand inequalities in Roman Winchester. In response to the three questions posed at the beginning of this chapter:

1. Sex-based differences in dental health patterns do exist. Contextualizing this information with historic and archaeological data, we can see that gendered variations in diet were subtle, but present at Roman Winchester. Contrary to ancient texts, lack of statistical difference in caries rates suggest that men and women consumed similar levels of protein and carbohydrates, but a hierarchy of foods may have been present, as seen with increased marine resource consumption by men (as indicated by the isotopic evidence). The comparatively higher rate of tooth wear among males is consistent with great consumption of marine resources containing grit that wore down tooth enamel over time. Furthermore, marine resources were more prevalent in urban centres, as the differences seen in this sample are consistent with results found at other urban Late Romano-British sites.
2. Status-based differences in dental health patterns do exist. The results presented in this thesis point to differences in AMTL, which may be attributed to accumulated differences in both the type of food and its consistency between Higher and Lower

Social Status groups. However, much like sex-based differences, these differences were not as marked as suggested in ancient texts. Comparing these results to other Romano-British sites suggests the lack of marked inequalities between the social status groups in the Northern Cemetery sample may be due to the composition of the site as an urban centre, and does not necessarily reflect status-based inequalities throughout Roman Britain. It is also possible, however, that the methods for determining status used in this research is not a good predictor of status, at least in terms of dental health.

3. When considering sex *and* social status groups, differences in dental health patterns are present. The data point to slight differences in dental health between men and women in the Lower Social Status group, but more equal access to resources in the Higher Social Status group. These differences highlight that preferential access to food was not only dependent on class or gender, but was influenced by the confluence of both.

The results presented here suggest that diet in Roman Winchester was much more equal than as it is presented in ancient texts, and by incorporating multiple lines of identity, exposes that diet in Roman Britain was more nuanced and complex than previously considered.

CHAPTER 6: CONCLUSIONS

Eating and drinking is about much more than caloric intake, and is often related to what is available and what is considered appropriate to eat (Cool, 2006). Often these choices are not choices at all, but are dictated by a complicated system of social conditions, relating to gender and social status, among other aspects of identity. The aims of this research was to better understand inequalities at Roman Winchester, specifically, how sex and social status influenced or determined diet within the *civitas* capital. This was completed through the analysis of dental health, which was compared against aspects of identity, including sex, age, social status, and the convergence of sex and social status.

By exploring rates of AMTL, caries, and dental wear, it was found that males exhibited higher rates of anterior AMTL, as well as higher rates of dental wear than females. Through the use of historical, archaeological, and clinical evidence, it was determined that the differences in anterior AMTL may be related to gendered differences in activities and occupation, oral hygiene practices, or patterns of consumption. Differences in dental wear between males and females may be due to gendered differences in diet; specifically, that men consumed harder and more abrasive foods than women. These results suggest that while both men and women consumed similar levels of carbohydrates and proteins, a hierarchical relationship of foods was present. For example, isotopic evidence from other investigations demonstrates men were more likely to have access to marine resources, while women were more dependent on terrestrially-based animals for their protein.

Exploring dental health by social status groups, it was found that differences were present for total and posterior AMTL. Total AMTL has been interpreted as a nonspecific indicator of dietary differences, and may be the result of minor differences in both caries rate and dental wear experiences (Lukacs, 1995; Hillson, 2000). From this, it was determined that Higher and Lower Social Status individuals consumed slightly different diets, both in terms of cariogenicity and in texture. However, this pattern may not be representative of Roman Britain, but are more representative of an urban centre, as similar studies in rural areas of Roman Britain found greater differences between social status groups than those found in the context of this thesis. Therefore, it is concluded that while differences were present between Higher and Lower Social Status individuals, these differences were not as pronounced when compared to other sites, specifically rural locations. Another possibility, is that the methods employed in this thesis to determined status were not entirely accurate, and is not representative of Higher and Lower Social Status groups at Roman Winchester; however, analyses of other locations in Roman Britain have also found less pronounced differences in urban locations between status groups than in rural areas (*e.g*., Pitts and Griffin, 2012). Future research focused on urban and rural differences may help determined if the lack of marked differences at Roman Winchester is due to its composition as an urban environment, or due to problems with the methods employed.

By combining both sex and social status, more could be learned about Roman Winchester through the incorporation of Intersectionality. Specifically, it was found that males and females of the Higher Social Status group were characterized by more equality in dental health, while males and females of the Lower Social Status group exhibited slight differences. By studying the intersection of sex and social status, it is concluded that the diet consumed by women was not intrinsically sub-standard to the diet consumed by men, even though this is the way the ancient literature depicts differences between genders. Rather, in families where resources may have been more stressed, women and men consumed slightly different diets. Garnsey (1999: 108) suggests in families where resources were limited, the most productive members of the household needed to be provided for, and women's "inferior status" to men may have influenced food distribution further. As a result, men and women of the Lower Social Status groups consumed diets that were slightly different from one another. However, even in Lower Social Status groups, where resource may have been more stressed than in Higher Social Status groups, women continued to consume protein and carbohydrates similar to the levels consumed by men. Perhaps, in periods of extreme resources stress, women of the Lower Social Status group would experience a decrease in protein consumption, and the diet of men and women of the Higher Social Status group would also begin to differ.

The data gathered and analyzed in this thesis has contributed to a greater understanding of dietary variation in Roman Winchester, and in a *civitas* capital or large urban centre, in Late Roman Britain. It has explored dental health patterns as it relates to sex and status, providing new insights into the lives of women and the lower social status groups; both of which are often under-represented in historical analyses (Allason-Jones, 2005). The thesis has also attempted to expose and to understand the range of features and facets of life that contribute to differential access to food in Roman Britain. In many bioarchaeological studies, women are characterized as a single group, on the assumption of a shared oppression (Mohanty, 1988). However, the results of this study show that women from the Higher Social Status group lived different lives, and had different experiences than women of the Lower Social Status group; the same can be said for men. Additionally, comparing the results of this study to other sites emphasizes regional and settlement type variation. Together, this thesis contributes to a more nuanced understanding of gender roles and dietary variation in Roman Britain.

To understand and contextualize the dental health results, the theoretical framework of Embodiment was employed. Embodiment has been used within archaeology for more than a decade, while the use of this approach for bioarchaeologists is much more recent. To understand how gender and social status interplay to further influence and affect inequalities, the feminist framework of Intersectionality was also utilized.

The intersectional approach used in this thesis was minimal, and only incorporated two aspects of identity into the final analysis. However, the strengths and additional information derived from using this approach has allowed for a much deeper understanding of inequalities in Roman Winchester. Future bioarchaeological analyses may also benefit from an intersectional approach, to better understand the complexity of inequalities, and the multitude of social groups that existed in the past. By incorporating additional aspects of identity, such as gender, ability/disability, ethnicity, religion/beliefs, migrant status, and occupation, we may be able to better understand the "complexity, contradiction, and plurality of lived experiences" in past societies (Geller, 2009: 70).

Other researchers have noted that inequalities are multi-faceted, and have called for the inclusion of various aspects of identity, such as migration status (Muldner, 2013). Researchers have begun to answer this call, and have studied dietary differences as it relates to sex and settlement type (Cheung *et al.,* 2012; Redfern *et al.,* 2015; Pitts and Griffin, 2012) or sex and grave good typologies (Griffin *et al.,* 2011) in Romano-British studies. Although time consuming, the inclusion of an intersectional framework will ultimately help bioarchaeologists understand the various nuances of inequalities, and the interconnectedness regarding multiple aspects of identity.

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APPENDICES

Appendix A: Age and Sex Recording Form (SSHRC Project)

This form was developed by Dr. Megan Brickley and Dr. Tracy Prowse for the SSHRC Project (Insight Grant, File number 435-2013-1006, ID# 169793) and used with permission for this project, to collect age and sex information.

Sex/Age Estimation Date: ______________________________ Site - ______________________________

Observer: ______________________________ Sk # ______________________________

Age Estimation – Juvenile

Dental Development (following Gustafson and Koch 1974)

Deciduous Dentition

Maxilla	Left	Right	Unsided 1	Unsided 2	Mandible	Left	Right	Unsided 1	Unsided 2
m^2	-	-	-	-	m_2	-	-	-	-
m^1	-	-	-	-	m_1	-	-	-	-
c	-	-	-	-	c	-	-	-	-
i^2	-	-	-	-	i_2	-	-	-	-
i^1	-	-	-	-	i_1	-	-	-	-

Permanent Dentition

Maxilla	Left	Right	Unsided 1	Unsided 2	Mandible	Left	Right	Unsided 1	Unsided 2
M^2	-	-	-	-	M^2	-	-	-	-
M^1	-	-	-	-	M^1	-	-	-	-
PM^2	-	-	-	-	PM^2	-	-	-	-
PM^1	-	-	-	-	PM^1	-	-	-	-
C	-	-	-	-	C	-	-	-	-
I^2	-	-	-	-	I^2	-	-	-	-
I^1	-	-	-	-	I^1	-	-	-	-

Scoring: - = could not be assessed; 1 = start of mineralization; 1.5 = past start of mineralization, but not yet at complete crown; 2 = complete crown; 2.5 = crown complete, but not certain if eruption has occurred; 3 = eruption in progress; 3.5 eruption complete (teeth are in occlusion), but not certain if root is fully formed; 4 = eruption and root complete

If M3s are present, record side & development here: Max ____ Max ____ Mand ____ Mand _____

Long Bone Length (in mm)

	Left	Right
Femur		
Tibia		
Fibula		
Humerus		
Radius		
Ulna		

Notes:

Epiphyseal Fusion (following Cardoso 2008 a, b) - Fusion should be scored on **left** bone only. If left is not present right should be scored.

Femur: 1 - proximal epiphysis; 2 – greater trochanter; 3 – lesser trochanter; 4 – distal epiphysis
Tibia: 1 – proximal epiphysis; 2 – distal epiphysis
Humerus: 1 – proximal epiphysis; 2 – distal epiphysis; 3 – medial epicondyle
Radius: 1 – proximal epiphysis; 2 – distal epiphysis
Pelvis: 1 – iliac crest; 2 – ischial epiphysis
Clavicle: 1 – sternal epiphysis

	Side	Epiphysis 1	Epiphysis 2	Epiphysis 3	Epiphysis 4
Femur	-	-	-	-	-
Tibia	-	-	-		
Humerus	-	-	-	-	
Radius	-	-	-		
Pelvis	-	-	-		
Clavicle	-	-			
Other	-	-	-	-	-

Scoring: - = could not be assessed; 1 = non-union (epiphysis and diaphysis are completely separate); 2 = partial union; 3 – complete union (all visible aspects of epiphysis are united)

Sex/Age Estimation Date: ______________________ Site - ______________________

Observer: ______________________ Sk # ______________________

Summary Information

Dental Dev. Age Estimate	Long Bone Length Age Estimate	Epiphyseal Fusion Age Estimate	Dental Wear Age Estimate (if applicable)
Notes:			

Dental Wear (modified from Brothwell 1965) – for older adolescents and adults (M1 must be erupted and in occlusion)

Maxilla		
	Left	**Right**
M3	-	-
M2	-	-
M1	-	-

Mandible		
	Left	**Right**
M3	-	-
M2	-	-
M1	-	-

Modified scoring: - = could not be assessed; score - 1-13 (refer to diagram)

Notes:

Sex/Age Estimation Date: ______________________ Site -______________________

Observer:______________________ Sk #______________________

Sex Estimation – Adult

Will not be attempted for those <16 years old. For those 16+ years the features of the skull/mandible and pelvis set out in Buikstra and Ubelaker (1994) will be used.

Pelvis	Left	Right
Ventral Arc (1-3) *	-	-
Subpubic Concavity (1-3) *	-	-
Ischiopubic Ramus Ridge (1-3) *	-	-
Greater Sciatic Notch (1-5) *	-	-
Preauricular Sulcus (1-4) *	-	-
Estimated Sex	Undeterminec	

Skull	Left	Right
Nuchal Crest (1-5) *	-	
Mastoid Process (1-5) *	-	-
Supraorbital Margin (1-5) *	-	-
Glabella (1-5) *	-	
Mental Eminence (1-5) *	-	
Estimated Sex	Undeterminec	

Notes:

In all cases (skull and pelvis) the left should be preferentially scored. When the left side is absent, the right can be scored.
* after observations described in Buikstra & Ubelaker 1994 (pp. 16-21):
0-3 scale: - (blank) = not observable; 1 = female; 2 = ambiguous; 3 = male
0-4 scale: - (blank) = no sulcus; 1 = sulcus is wide (>0.5cm) and deep; 2 = sulcus is wide but shallow; 3 = sulcus is well defined but narrow; 4 = sulcus is a narrow (<0.5cm), shallow, and smooth-walled depression.
0-5 scale: - (blank) = not observable; 1 = female; 2 = probable female; 3 = ambiguous; 4 = probable male; 5 = male

Age Estimation - Adult

Pubic Symphysis Scoring System (following Brooks and Suchey 1990; Suchey and Katz 1986)

	Left	Right
Phase	-	-

Notes:

Scoring: - = could not be assessed; phases 1-6 (see Buikstra and Ubelaker, 1994: 23-24)

Sex/Age Estimation Date: ______________________ Site - ______________________

Observer: ______________________ Sk # ______________________

Auricular Surface Scoring System – Transition Analysis (following Boldsen et al. 2002:101-103) (can record multiple stages for a single feature)[1]

	Left		Right	
	Min	Max	Min	Max
Superior Topography (1-3)	-	-	-	-
Inferior Topography (1-3)	-	-	-	-
Superior Characteristics (1-5)	-	-	-	-
Apical Characteristics (1-5)	-	-	-	-
Inferior Characteristics (1-5)	-	-	-	-
Inferior Texture (1-3)	-	-	-	-
Superior* Exostoses (1-6)	-	-	-	-
Inferior* Exostoses (1-6)	-	-	-	-
Posterior Exostoses (1-3)	-	-	-	-

Notes:

[1]Record the left auricular surface. When the left is absent, the right can be recorded but do not mix the two sides.
Scoring: - = could not be assessed; see Boldsen et al. 2002
* Superior and Inferior Posterior Iliac Crest

Summary Information – Adult Age and Sex

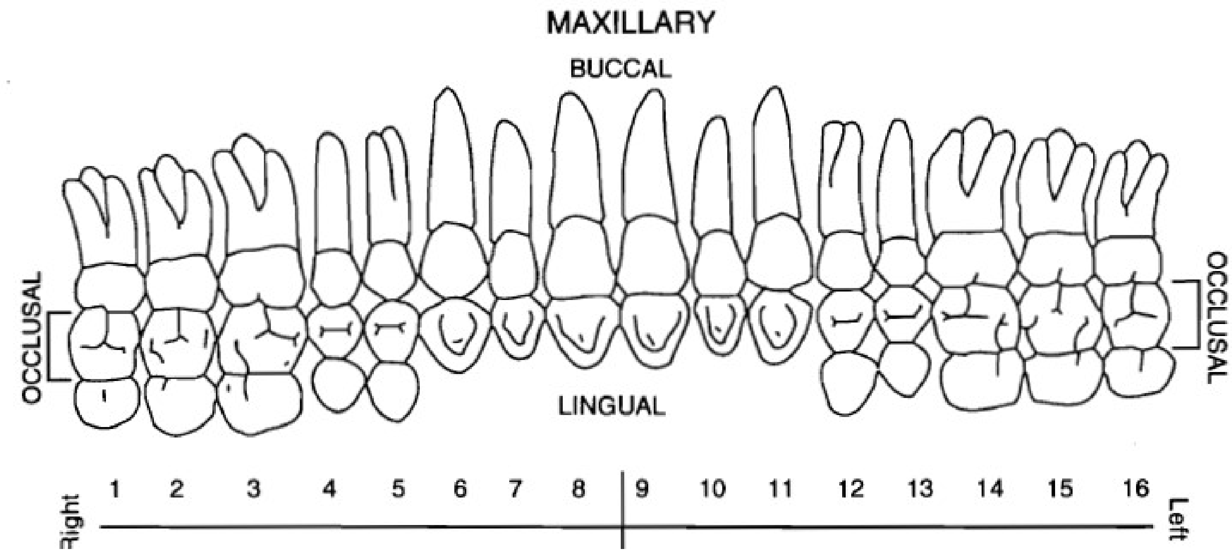
Age[1]	
Sex[2]	

[1]Young adult (20-34), middle adult (35-49), old adult (50+)
[2]After Buikstra and Ubelaker (1994: 21): undetermined; female; probable female; ambiguous; probable male; male

Appendix B: Dental Health Recording Form

Data collection sheet developed by the author, to facilitate in quick and accurate recording of any individual aged 16+ with some dentition (teeth or alveolar bone). Drawing, coded recording (see section 3.2.3), and descriptive writing was used on the sheet, and further supplemented by digital photos, retained by the author. Figure of teeth taken from Buikstra and Ubelaker (1994, Attachment 14a).

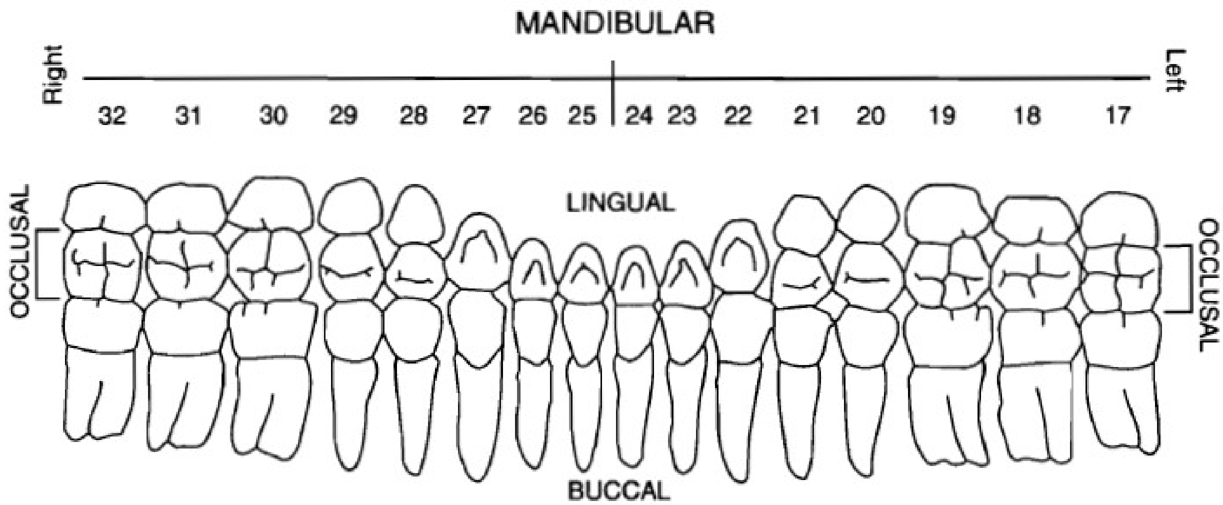
Site: _______________ Skeleton #: ____________ Date: ______________ Observer: ______
Preservation: Completeness:



	M3	M2	M1	P2	P1	C	I2	I1	I1	I2	C	P1	P2	M1	M2	M3	
Presence (AMTL)																	
Caries																	
Calculus																	
B																	B
L																	L
I																	I
O																	O
Wear																	
	M3	M2	M1	P2	P1	C	I2	I1	I1	I2	C	P1	P2	M1	M2	M3	

Notes:

Site: _______________ Skeleton #: ____________ Date: ______________ Observer: ______
Preservation: Completeness:



	M3	M2	M1	P2	P1	C	I2	I1	I1	I2	C	P1	P2	M1	M2	M3	
Presence (AMTL)																	
Caries																	
Calculus																	
B																	B
L																	L
I																	I
O																	O
Wear																	
	M3	M2	M1	P2	P1	C	I2	I1	I1	I2	C	P1	P2	M1	M2	M3	

Notes:

Appendix C: Dental Health Data

Dental data provided by individual. Teeth present, Sockets present, AMTL, Carious Teeth, Carious Pulp Exposures, and All Pulp Exposures are represented by number of teeth exhibiting such conditions, broken down by anterior, posterior and total dentitions. In brackets beside anterior or posterior: I= Incisors, C= Canines, P= Premolars, M= Molars. Dental Wear scores are total dental wear scores, divided by the number of teeth present, according to equations set out in *Materials and Methods 3.3.* Cells with "ND" indicate no data available, for example, in cases where the teeth were too damaged to assess dental wear. Column headings on subsequent pages: A= Anterior, P= Posterior, T=Total.

Skeleton	Teeth Present			Sockets Present			AMTL			Carious Teeth			Wear		Carious Pulp Exposures			All Pulp Exposures		
	Anterior (I, C)	Posterior (P, M)	Total	Anterior (I, C)	Posterior (P, M)	Total	Anterior (I, C)	Posterior (P, M)	Total	Anterior (I, C)	Posterior (P, M)	Total	Anterior (I, C, P)	Posterior (M)	Anterior (I, C)	Posterior (P, M)	Total	Anterior (I, C)	Posterior (P, M)	Total
AR 306	12	16	28	12	16	28	0	3	3	0	8	8	3.8	22.2	0	6	6	0	6	6
AR 311	2	3	5	12	20	32	5	15	20	0	0	0	3.8	11.0	0	0	0	0	0	0
AR 312	4	3	7	9	15	24	2	11	13	3	0	3	5.0	34.0	0	0	0	1	0	1
AR 313	5	6	11	6	8	14	0	1	1	0	2	2	4.4	16.3	0	1	1	0	1	1
AR 318	12	13	25	12	17	29	0	1	1	0	7	7	3.8	16.0	0	6	6	0	6	6
AR 319	10	6	16	12	20	32	0	10	10	1	2	3	6.6	16.0	0	0	0	8	2	10
AR 320	10	18	28	12	20	32	0	1	1	0	5	5	2.5	11.8	0	2	2	0	2	2
AR 324	12	9	21	12	16	28	0	6	6	1	4	5	4.8	22.0	0	4	4	0	4	4
AR 326	7	10	17	12	16	28	1	2	3	0	2	2	6.5	36.5	0	0	0	4	1	5
AR 331	12	18	30	12	20	32	0	1	1	0	1	1	3.4	14.0	0	0	0	0	0	0
AR 333	10	16	26	12	19	31	0	3	3	0	4	4	2.5	12.9	0	2	2	0	2	2
AR 334	11	16	27	12	20	32	0	1	1	0	6	6	5.0	36.5	0	5	5	0	8	8

Skeleton	Teeth Present			Sockets Present			AMTL			Carious Teeth			Wear		Carious Pulp Exposures			All Pulp Exposures		
	A	P	T	A	P	T	A	P	T	A	P	T	A	P	A	P	T	A	P	T
AR 338	5	14	19	6	13	19	0	1	1	0	3	3	3.8	19.4	0	0	0	0	0	0
AR 339	8	17	25	12	20	32	0	1	1	0	5	5	2.4	16.8	0	3	3	0	3	3
HYS 001	10	17	27	12	20	32	0	1	1	0	4	4	2.8	10.3	0	1	1	0	1	1
HYS 002-A	9	17	26	0	4	4	0	0	0	0	3	3	2.3	10.3	0	1	1	0	1	1
HYS 003-A	7	11	18	11	8	19	3	3	6	3	4	7	5.3	22.8	1	1	2	4	1	5
HYS 005	9	10	19	12	10	22	0	4	4	1	4	5	5.7	16.7	0	0	0	1	2	3
HYS 007	3	18	21	12	19	31	0	0	0	0	1	1	2.3	11.9	0	1	1	0	1	1
HYS 012-A	6	12	18	9	12	21	0	0	0	0	2	2	2.8	21.5	0	1	1	0	1	1
HYS 012-B	3	7	10	12	17	29	0	10	10	1	0	1	5.7	15.0	0	0	0	0	0	0
HYS 013	7	12	19	12	20	32	0	6	6	0	4	4	3.1	22.4	0	0	0	0	0	0
HYS 016	5	2	7	12	16	28	0	12	12	0	0	0	7.3	ND	0	0	0	5	2	7
HYS 017	11	20	31	12	20	32	0	0	0	0	7	7	3.1	18.0	0	3	3	0	3	3
HYS 021	10	12	22	12	9	21	0	1	1	0	4	4	1.8	11.4	0	1	1	0	1	1
HYS 025	11	19	30	12	20	32	0	0	0	0	0	0	2.3	7.3	0	0	0	0	0	0
HYS 027	8	17	25	12	18	30	0	0	0	0	1	1	2.2	6.4	0	0	0	0	0	0
LH 008	1	11	12	0	3	3	0	0	0	0	3	3	3.5	21.6	0	0	0	0	0	0
LH 009	1	2	3	6	8	14	1	4	5	0	1	1	5.0	ND	0	0	0	1	0	1
LH 011	12	15	27	12	20	32	0	3	3	0	0	0	4.2	18.9	0	0	0	0	0	0
LH 014	4	5	9	0	0	0	0	0	0	0	0	0	2.7	22.0	0	0	0	0	0	0
LH 015	0	1	1	6	9	15	0	5	5	0	1	1	ND	23.0	0	0	0	0	0	0
LH 017	4	7	11	6	10	16	0	2	2	0	1	1	3.6	26.0	0	0	0	0	1	1
LH 019	8	13	21	12	20	32	0	6	6	0	12	12	3.3	14.6	0	3	3	0	3	3
LH 020	8	18	26	12	20	32	0	0	0	0	5	5	2.4	13.1	0	3	3	0	3	3

Skeleton	Teeth Present			Sockets Present			AMTL			Carious Teeth			Wear		Carious Pulp Exposures			All Pulp Exposures		
	A	P	T	A	P	T	A	P	T	A	P	T	A	P	A	P	T	A	P	T
LH 021	5	14	19	7	14	21	0	2	2	0	0	0	2.5	16.3	0	0	0	0	0	0
LH 024	8	7	15	11	11	22	0	2	2	0	1	1	5.1	20.7	0	0	0	4	0	4
LH 031	6	12	18	12	18	30	0	4	4	0	3	3	3.1	19.6	0	1	1	0	1	1
LH 035	12	16	28	12	20	32	0	0	0	0	0	0	3.6	19.1	0	1	1	0	1	1
LH 036	6	7	13	6	10	16	0	3	3	0	0	0	5.0	16.8	0	0	0	0	0	0
LH 037	10	17	27	12	19	31	0	1	1	0	0	0	3.4	18.6	0	0	0	0	0	0
LH 038	8	12	20	12	20	32	0	0	0	1	1	2	2.6	11.8	0	0	0	0	0	0
LH 039	11	19	30	12	20	32	0	0	0	0	0	0	2.6	15.7	0	0	0	0	0	0
LH 043	0	1	1	0	0	0	0	0	0	0	0	0	0.0	21.0	0	0	0	0	0	0
LH 045	6	5	11	12	20	32	6	13	19	1	3	4	5.1	12.5	0	1	1	3	2	5
LH 047	9	14	23	12	17	29	0	3	3	0	3	3	5.4	28.1	0	0	0	8	3	11
LH 052	11	11	22	12	18	30	0	6	6	3	5	8	6.8	36.0	4	3	7	11	4	15
LH 053	10	13	23	12	16	28	0	0	0	0	0	0	3.8	22.8	0	0	0	0	0	0
LH 055	1	3	4	6	10	16	0	5	5	0	1	1	6.0	35.0	0	0	0	1	2	3
LH 058	4	12	16	12	20	32	0	2	2	0	1	1	2.8	16.3	0	1	1	0	1	1
LH 059	0	1	1	2	3	5	0	1	1	0	0	0	0.0	30.0	0	0	0	0	0	0
LH 061	10	19	29	12	20	32	0	1	1	0	6	6	3.0	21.7	0	4	4	0	4	4
LH 064	4	16	20	12	19	31	0	2	2	0	0	0	3.6	17.9	0	0	0	0	0	0
LH 069	1	4	5	0	0	0	0	0	0	0	0	0	3.5	25.0	0	0	0	0	0	0
LH 070	2	4	6	11	13	24	4	1	5	0	1	1	4.0	23.5	0	0	0	0	0	0
LH 072	5	7	12	0	0	0	1	3	4	0	1	1	4.3	21.0	0	0	0	0	0	0
LH 0073/AY21-284	9	4	13	6	10	16	0	7	7	2	0	2	6.3	ND	0	0	0	7	2	9
LH 074	4	15	19	12	19	31	0	2	2	0	0	0	2.7	14.2	0	0	0	0	0	0

Skeleton	Teeth Present			Sockets Present			AMTL			Carious Teeth			Wear		Carious Pulp Exposures			All Pulp Exposures		
	A	P	T	A	P	T	A	P	T	A	P	T	A	P	A	P	T	A	P	T
LH 075	10	10	20	6	0	6	0	0	0	0	1	1	2.0	8.0	0	0	0	0	0	0
LH 076	6	10	16	12	20	32	1	5	6	0	0	0	4.6	24.2	0	0	0	0	0	0
LH 078	3	11	14	12	20	32	1	1	2	0	2	2	3.3	18.9	0	0	0	0	0	0
LH 079	0	2	2	0	0	0	0	0	0	0	0	0	0.0	8.0	0	0	0	0	0	0
LH 087	9	18	27	12	20	32	0	0	0	0	0	0	1.8	11.3	0	0	0	0	0	0
LH 088	10	14	24	12	13	25	0	0	0	0	0	0	2.3	13.5	0	0	0	0	0	0
LH 089	7	17	24	12	20	32	0	0	0	0	0	0	2.2	12.8	0	0	0	0	0	0
LH 094	9	8	17	12	18	30	0	9	9	0	1	1	5.9	37.0	0	3	3	4	4	8
LH 096	7	17	24	12	20	32	1	1	2	0	1	1	4.4	27.5	0	1	1	0	1	1
LH 097	11	20	31	12	20	32	0	0	0	0	5	5	3.4	15.3	0	3	3	0	3	3
LH 098	7	19	26	12	20	32	0	1	1	0	4	4	2.5	7.6	0	4	4	0	4	4
LH 099/AY21-0032	11	18	29	12	20	32	0	1	1	0	0	0	4.0	16.7	0	0	0	0	0	0
LH 100	6	7	13	6	10	16	0	0	0	0	0	0	2.3	7.3	0	0	0	0	0	0
LH 101	2	2	4	3	10	13	0	6	6	2	2	4	5.3	37.0	1	1	2	1	2	3
LH 104	9	19	28	12	19	31	0	0	0	0	3	3	2.2	12.7	0	1	1	0	1	1
LH 107	0	12	12	12	20	32	0	0	0	0	1	1	2.5	12.8	0	0	0	0	0	0
LH 110	6	17	23	3	14	17	0	1	1	0	1	1	3.5	21.6	0	1	1	0	1	1
LH 112	10	18	28	12	16	28	0	0	0	0	1	1	2.8	14.3	0	0	0	0	0	0
LH 114	9	13	22	7	12	19	0	0	0	0	0	0	3.0	14.0	0	0	0	0	0	0
LH 115/AY21-0317	8	18	26	12	20	32	0	0	0	0	0	0	2.9	15.5	0	0	0	0	0	0
LH 116/AY21-0190	6	13	19	0	0	0	0	0	0	0	1	1	3.2	11.0	0	0	0	0	0	0
LH 119	9	19	28	12	20	32	0	0	0	0	0	0	3.0	9.9	0	0	0	0	0	0
LH 123	8	9	17	6	8	14	0	1	1	0	0	0	4.7	17.4	0	0	0	0	0	0

Skeleton	Teeth Present			Sockets Present			AMTL			Carious Teeth			Wear		Carious Pulp Exposures			All Pulp Exposures		
	A	**P**	**T**	**A**	**P**	**T**	**A**	**P**	**T**	**A**	**P**	**T**	**A**	**P**	**A**	**P**	**T**	**A**	**P**	**T**
LH 124	3	0	3	0	0	0	0	0	0	0	0	0	4.7	0.0	0	0	0	0	0	0
LH 128	8	6	14	12	18	30	1	9	10	0	3	3	5.0	27.0	0	0	0	3	1	4
LH 130	10	19	29	7	18	25	0	0	0	0	0	0	3.9	18.0	0	0	0	0	0	0
LH 137	8	9	17	7	10	17	0	0	0	0	0	0	3.7	12.4	0	1	1	0	1	1
LH 138	2	6	8	1	4	5	0	0	0	0	0	0	3.5	20.8	0	0	0	0	0	0
LH 139	3	9	12	0	0	0	0	0	0	0	0	0	3.6	12.0	0	0	0	0	0	0
LH 140	10	12	22	11	17	28	0	5	5	0	0	0	3.0	21.3	0	0	0	0	0	0
LH 141	10	17	27	12	17	29	0	0	0	0	0	0	4.9	23.2	0	0	0	0	0	0
LH 159	1	10	11	6	7	13	0	0	0	0	0	0	2.0	14.0	0	0	0	0	0	0
LH 161	7	15	22	12	18	30	0	1	1	0	2	2	5.2	18.5	0	0	0	0	0	0
LH 166	0	4	4	6	10	16	0	6	6	0	2	2	4.5	22.0	0	0	0	0	0	0
LH 168	8	4	12	12	16	28	0	11	11	3	0	3	3.8	0.0	3	1	4	3	1	4
LH 170	1	4	5	0	0	0	0	0	0	0	1	1	2.0	17.3	0	0	0	0	0	0
LH 171	7	11	18	6	9	15	0	0	0	0	3	3	3.1	13.7	0	0	0	0	0	0
LH 181	8	12	20	6	10	16	0	2	2	0	2	2	4.0	18.2	0	0	0	0	0	0
LH 191	9	14	23	12	17	29	0	0	0	0	0	0	2.3	8.7	0	0	0	0	0	0
LH 192	6	12	18	12	20	32	0	4	4	0	1	1	3.3	12.0	0	0	0	0	0	0
LH 194	12	12	24	12	19	31	0	7	7	0	2	2	3.8	14.8	0	1	1	0	1	1
LH 196	10	14	24	12	6	18	1	1	2	0	0	0	4.7	21.0	0	0	0	0	0	0
LH 201	12	19	31	12	19	31	0	1	1	0	0	0	2.5	13.4	0	0	0	0	0	0
LH 203	9	18	27	12	20	32	0	0	0	0	0	0	2.6	13.2	0	0	0	0	0	0
LH 204	8	15	23	2	9	11	0	1	1	0	3	3	2.9	12.2	0	1	1	0	1	1
LH 208	10	16	26	12	20	32	0	4	4	0	0	0	2.8	15.5	0	0	0	0	0	0

Skeleton	Teeth Present			Sockets Present			AMTL			Carious Teeth			Wear		Carious Pulp Exposures			All Pulp Exposures		
	A	P	T	A	P	T	A	P	T	A	P	T	A	P	A	P	T	A	P	T
LH 212	8	13	21	0	0	0	0	0	0	0	4	4	4.6	19.8	0	0	0	0	0	0
LH 214	10	15	25	12	20	32	0	5	5	0	3	3	4.1	24.7	0	0	0	0	0	0
LH 218	10	12	22	12	20	32	0	6	6	1	1	2	6.7	17.5	0	1	1	7	3	10
LH 219	9	19	28	0	0	0	0	0	0	0	2	2	2.7	11.8	0	0	0	0	0	0
LH 222	7	11	18	0	0	0	0	0	0	0	2	2	2.8	13.0	0	1	1	0	1	1
LH 225	9	16	25	6	15	21	0	2	2	0	0	0	4.9	27.3	0	0	0	0	0	0
LH 226	8	14	22	12	18	30	0	4	4	0	5	5	3.1	18.0	0	5	5	0	5	5
LH 227	5	15	20	12	20	32	0	0	0	0	0	0	5.5	25.2	0	0	0	0	0	0
LH 228/AY21-0144	5	11	16	0	0	0	0	0	0	0	0	0	3.6	16.3	0	0	0	0	0	0
LH 229	0	1	1	1	7	8	0	6	6	0	0	0	2.0	0.0	0	0	0	0	0	0
LH 239	0	0	0	6	8	14	0	2	2	0	0	0	0.0	0.0	0	0	0	0	0	0
LH 243	11	17	28	12	20	32	0	0	0	0	4	4	2.8	12.1	0	3	3	0	3	3
LH 249	5	3	8	12	19	31	4	12	16	1	3	4	4.3	0.0	0	0	0	0	0	0
LH 250	11	20	31	12	20	32	0	0	0	0	0	0	2.4	7.9	0	0	0	0	0	0
LH 254	6	11	17	12	19	31	0	5	5	0	1	1	6.1	31.0	0	0	0	4	4	8
LH 256	9	12	21	11	16	27	0	0	0	0	0	0	2.3	10.7	0	0	0	0	0	0
LH 260	10	20	30	10	20	30	0	0	0	0	4	4	3.5	12.6	0	1	1	0	1	1
LH 264	6	13	19	12	15	27	0	0	0	0	1	1	4.0	14.7	0	0	0	0	0	0
LH 266	5	18	23	12	20	32	0	1	1	0	1	1	3.3	15.8	0	1	1	0	1	1
LH 270	10	18	28	12	20	32	0	2	2	0	7	7	2.8	14.3	0	0	0	0	0	0
LH 272	9	9	18	6	10	16	0	0	0	5	2	7	6.1	23.8	3	1	4	6	3	9
LH 273	11	8	19	12	20	32	0	9	9	5	3	8	4.9	37.0	2	0	2	2	2	4
LH 277	10	8	18	12	18	30	0	2	2	0	1	1	4.2	32.4	0	1	1	0	2	2

Skeleton	Teeth Present			Sockets Present			AMTL			Carious Teeth			Wear		Carious Pulp Exposures			All Pulp Exposures		
	A	P	T	A	P	T	A	P	T	A	P	T	A	P	A	P	T	A	P	T
LH 278	4	10	14	1	5	6	0	0	0	0	5	5	3.4	17.0	0	2	2	0	3	3
LH 287	6	14	20	12	15	27	2	2	4	0	3	3	4.5	21.9	0	0	0	0	0	0
LH 288	0	1	1	0	0	0	0	0	0	0	1	1	0.0	14.0	0	1	1	0	1	1
LH 291	7	20	27	12	20	32	0	0	0	0	1	1	3.3	17.9	0	1	1	0	1	1
LH 293	10	18	28	12	20	32	0	0	0	0	3	3	2.3	12.6	0	0	0	0	0	0
LH 296	0	3	3	5	5	10	0	2	2	0	0	0	6.5	20.0	0	0	0	0	0	0
LH 297	8	5	13	8	8	16	0	1	1	0	1	1	2.6	14.0	0	0	0	0	0	0
LH 299	9	12	21	12	20	32	1	4	5	0	1	1	5.3	22.4	0	0	0	0	0	0
LH 305	5	15	20	7	19	26	0	0	0	0	0	0	3.6	15.8	0	0	0	0	0	0
LH 306	5	5	10	12	20	32	1	11	12	2	3	5	6.0	13.3	1	2	3	4	2	6
LH 307	8	10	18	5	14	19	0	3	3	1	4	5	3.6	29.3	0	1	1	0	1	1
LH 308	4	5	9	3	3	6	0	1	1	0	0	0	5.3	29.7	0	0	0	0	0	0
LH 309	7	6	13	6	10	16	0	3	3	1	5	6	6.9	16.0	1	1	2	6	3	9
LH 312	1	5	6	0	0	0	0	0	0	0	0	0	4.3	18.0	0	0	0	0	0	0
LH 315	8	8	16	12	18	30	0	4	4	1	4	5	4.1	10.0	0	1	1	0	1	1
LH 319	7	9	16	6	15	21	0	3	3	1	4	5	5.3	21.0	0	2	2	0	2	2
LH 320	5	6	11	5	12	17	0	2	2	1	5	6	3.6	20.5	0	0	0	0	0	0
LH 328	4	19	23	12	20	32	0	0	0	0	0	0	3.3	14.2	0	0	0	0	0	0
LH 330	3	4	7	12	20	32	0	14	14	1	1	2	6.2	26.0	0	0	0	1	0	1
LH 331	9	6	15	12	15	27	1	10	11	4	3	7	5.9	17.0	2	0	2	7	1	8
LH 332	8	15	23	9	15	24	0	0	0	0	3	3	2.3	12.9	0	0	0	0	0	0
LH 335	8	10	18	11	8	19	0	0	0	1	0	1	3.4	22.5	0	0	0	0	0	0
LH 340	10	20	30	12	20	32	0	0	0	0	1	1	2.6	10.5	0	0	0	0	0	0

Skeleton	Teeth Present			Sockets Present			AMTL			Carious Teeth			Wear		Carious Pulp Exposures			All Pulp Exposures		
	A	P	T	A	P	T	A	P	T	A	P	T	A	P	A	P	T	A	P	T
LH 343	11	18	29	12	20	32	0	0	0	0	0	0	2.8	8.6	0	0	0	1	0	1
LH 347	3	15	18	0	0	0	0	0	0	0	0	0	2.9	15.3	0	0	0	0	0	0
LH 349	11	16	27	12	17	29	0	0	0	0	0	0	5.0	28.8	0	0	0	0	0	0
LH 352	8	18	26	12	20	32	0	1	1	0	5	5	3.3	10.8	0	3	3	0	3	3
LH 356	7	7	14	6	8	14	0	1	1	6	4	10	5.0	36.0	1	3	4	1	3	4
LH 357	6	19	25	2	11	13	0	0	0	0	0	0	4.9	30.0	0	0	0	1	3	4
LH 358	12	14	26	12	17	29	0	3	3	1	9	10	3.8	15.6	0	1	1	1	1	2
LH 360	1	6	7	0	0	0	0	0	0	0	2	2	4.5	15.6	0	0	0	0	0	0
LH 362	6	6	12	12	11	23	4	6	10	2	4	6	6.4	26.7	0	2	2	4	2	6
LH 363	1	2	3	0	0	0	0	0	0	0	0	0	5.5	38.0	0	0	0	0	0	0
LH 365	8	20	28	12	20	32	0	0	0	0	5	5	3.4	21.3	0	0	0	0	0	0
LH 367	6	5	11	6	5	11	0	0	0	0	0	0	3.4	6.0	0	0	0	0	0	0
LH 373	9	12	21	0	0	0	0	0	0	0	1	1	4.6	30.5	0	0	0	0	0	0
LH 374	9	17	26	12	18	30	0	0	0	0	0	0	3.3	16.1	0	0	0	0	0	0
LH 379	6	10	16	3	17	20	1	5	6	0	3	3	4.5	32.8	0	0	0	1	2	3
LH 380	8	11	19	12	20	32	2	7	9	6	3	9	5.4	20.3	1	1	2	8	1	9
LH 381	5	4	9	6	5	11	1	1	2	0	3	3	6.1	24.0	0	0	0	3	1	4
LH 386	1	1	2	10	18	28	0	14	14	1	0	1	4.0	0.0	1	0	1	1	0	1
LH 389	3	7	10	0	0	0	0	0	0	1	0	1	4.9	35.0	0	0	0	0	0	0
LH 392	0	3	3	0	4	4	0	0	0	0	2	2	0.0	18.0	0	0	0	0	0	0
LH 395	7	10	17	6	10	16	0	1	1	1	3	4	3.6	16.4	0	0	0	0	0	0
LH 397	9	17	26	10	18	28	0	0	0	0	3	3	3.8	17.3	0	2	2	0	2	2
LH 398	4	9	13	12	20	32	0	0	0	0	4	4	4.0	20.0	0	0	0	1	1	2

Skeleton	Teeth Present			Sockets Present			AMTL			Carious Teeth			Wear		Carious Pulp Exposures			All Pulp Exposures		
	A	P	T	A	P	T	A	P	T	A	P	T	A	P	A	P	T	A	P	T
LH 399	3	1	4	12	20	32	6	14	20	0	1	1	6.3	0.0	0	0	0	2	1	3
LH 402	3	12	15	3	8	11	0	0	0	0	1	1	2.9	19.2	0	1	1	0	1	1
LH 408	8	12	20	12	20	32	1	4	5	0	1	1	2.4	16.1	0	0	0	0	0	0
LH 410	3	0	3	11	15	26	4	4	8	0	0	0	0.0	0.0	0	0	0	0	0	0
LH 411	5	5	10	12	16	28	1	6	7	0	3	3	3.3	14.0	0	0	0	0	0	0
LH 412	12	18	30	12	20	32	0	1	1	0	3	3	3.7	17.6	0	2	2	0	2	2
LH 415	11	15	26	11	9	20	0	1	1	0	3	3	3.6	17.3	0	0	0	0	0	0
LH 418	4	7	11	0	0	0	0	0	0	0	1	1	3.6	18.0	0	0	0	0	0	0
LH 427	12	19	31	12	20	32	0	0	0	1	4	5	3.3	12.1	0	1	1	0	1	1
LH 428	9	19	28	4	12	16	0	0	0	0	0	0	2.9	8.6	0	0	0	0	0	0
LH 430	10	13	23	8	20	28	0	5	5	0	7	7	3.1	12.0	0	6	6	0	6	6
LH 432	6	8	14	6	8	14	0	0	0	0	2	2	2.8	18.0	0	2	2	0	2	2
LH 436	9	7	16	6	10	16	0	5	5	5	3	8	3.8	31.0	2	3	5	2	3	5
LH 437	4	2	6	6	10	16	1	6	7	0	0	0	6.0	14.0	0	0	0	1	0	1
LH 438	10	12	22	0	0	0	0	0	0	0	0	0	2.4	12.0	0	0	0	0	0	0
LH 440	7	6	13	0	0	0	0	0	0	0	2	2	5.6	24.0	0	0	0	0	0	0
LH 441	11	12	23	12	18	30	0	2	2	2	0	2	5.8	24.4	1	0	1	2	1	3
LH 442	8	9	17	6	7	13	0	1	1	0	3	3	4.5	20.5	0	2	2	0	2	2
LH 443	11	24	35	6	6	12	0	0	0	3	2	5	2.3	11.2	0	1	1	0	1	1
LH 444	11	12	23	0	3	3	0	0	0	0	1	1	3.7	19.8	0	0	0	0	0	0
LH 445	11	14	25	10	20	30	0	5	5	0	7	7	5.8	28.5	0	2	2	0	3	3
LH 447	5	8	13	10	16	26	1	3	4	2	3	5	4.8	34.0	0	0	0	0	0	0
LH 448	4	0	4	8	10	18	0	6	6	2	0	2	6.8	0.0	1	0	1	3	0	3

Skeleton	Teeth Present			Sockets Present			AMTL			Carious Teeth			Wear		Carious Pulp Exposures			All Pulp Exposures		
	A	**P**	**T**	**A**	**P**	**T**	**A**	**P**	**T**	**A**	**P**	**T**	**A**	**P**	**A**	**P**	**T**	**A**	**P**	**T**
LH 451	9	14	23	7	17	24	0	2	2	0	7	7	6.1	31.0	0	2	2	6	7	13
AY21-0012	11	17	28	12	19	31	0	1	1	0	2	2	3.3	16.2	0	0	0	0	0	0
AY21-0016	5	11	16	6	13	19	0	3	3	0	5	5	4.3	9.8	0	1	1	0	1	1
AY21-0025	11	20	31	12	20	32	0	0	0	0	0	0	4.4	16.4	0	0	0	2	0	2
AY21-0050	10	7	17	12	16	28	0	5	5	1	3	4	4.3	17.0	0	1	1	0	1	1
AY21-0055	8	11	19	12	20	32	0	7	7	0	3	3	4.5	29.0	0	3	3	0	3	3
AY21-0061	11	20	31	12	20	32	0	0	0	0	5	5	2.4	15.1	0	2	2	0	2	2
AY21-0077	8	13	21	12	13	25	0	0	0	0	2	2	2.5	11.7	0	1	1	0	1	1
AY21-0084	12	17	29	12	19	31	0	0	0	0	1	1	2.9	12.6	0	1	1	0	1	1
AY21-0093	10	9	19	12	18	30	0	4	4	0	3	3	2.7	11.0	0	0	0	0	0	0
AY21-0108	12	16	28	12	16	28	0	0	0	0	0	0	2.3	14.6	0	0	0	0	0	0
AY21-0119	6	14	20	12	20	32	0	0	0	0	1	1	1.9	9.4	0	0	0	0	0	0
AY21-0122	9	19	28	6	11	17	0	0	0	0	5	5	3.1	13.8	0	2	2	0	2	2
AY21-0134	8	20	28	12	20	32	0	0	0	0	0	0	3.4	15.5	0	0	0	0	0	0
AY21-0157	0	2	2	0	0	0	0	0	0	0	1	1	4.0	14.0	0	0	0	0	0	0
AY21-0212	4	3	7	12	20	32	4	15	19	0	2	2	6.5	0.0	0	1	1	3	3	6
AY21-0232	5	1	6	12	20	32	6	19	25	0	0	0	7.5	0.0	0	0	0	4	1	5
AY21-0244	4	4	8	6	9	15	0	6	6	0	2	2	5.3	21.5	0	0	0	2	1	3
AY21-0255	11	14	25	0	0	0	0	1	1	0	3	3	4.5	25.8	0	1	1	1	1	2
AY21-0259	12	17	29	12	16	28	0	1	1	0	2	2	2.6	11.8	0	2	2	0	2	2
AY21-0271	10	15	25	12	18	30	0	1	1	0	6	6	2.9	13.8	0	4	4	0	4	4
AY21-0281	10	13	23	12	16	28	0	1	1	0	1	1	3.3	25.8	0	0	0	0	0	0
AY21-0421	1	10	11	0	0	0	0	0	0	0	1	1	2.8	17.6	0	1	1	0	1	1

Skeleton	Teeth Present			Sockets Present			AMTL			Carious Teeth			Wear		Carious Pulp Exposures			All Pulp Exposures		
	A	P	T	A	P	T	A	P	T	A	P	T	A	P	A	P	T	A	P	T
AY21-0429	2	1	3	6	10	16	0	8	8	0	0	0	2.7	0.0	0	0	0	0	0	0
AY21-0434	2	1	3	6	10	16	0	8	8	0	1	1	3.5	0.0	0	1	1	0	1	1
AY21-0435	9	8	17	12	16	28	0	4	4	0	3	3	3.1	22.0	0	0	0	0	0	0
AY21-0441	6	17	23	7	14	21	0	0	0	0	2	2	2.5	15.7	0	1	1	0	1	1
AY21-0451	9	17	26	12	20	32	0	2	2	0	6	6	3.2	21.1	0	3	3	0	3	3
AY21-0454	9	13	22	6	11	17	0	3	3	1	7	8	2.6	16.8	0	3	3	0	3	3
AY21-0459	10	14	24	0	0	0	0	0	0	0	4	4	2.7	12.4	0	3	3	0	3	3
AY21-0476	8	7	15	12	20	32	2	7	9	3	2	5	3.5	17.0	0	1	1	0	1	1
AY21-0479	0	12	12	8	14	22	0	0	0	0	0	0	2.5	14.9	0	0	0	0	0	0
AY21-0488	8	13	21	4	6	10	0	1	1	0	2	2	3.2	15.3	0	1	1	0	1	1
AY21-0489	8	9	17	12	20	32	1	9	10	0	1	1	3.9	26.0	0	1	1	2	1	3
AY21-0497	12	19	31	6	8	14	0	0	0	0	0	0	2.3	10.0	0	0	0	0	0	0
AY21-0522	11	9	20	12	18	30	0	7	7	0	5	5	4.6	14.5	0	4	4	1	4	5
AY21-0527	2	7	9	0	0	0	0	0	0	0	0	0	6.3	36.4	0	0	0	2	7	9
AY21-0543	5	8	13	7	15	22	0	7	7	0	4	4	6.0	30.7	0	0	0	4	1	5
AY21-0547	6	12	18	0	0	0	0	0	0	0	1	1	3.1	17.0	0	0	0	0	0	0
AY21-0554	6	9	15	12	20	32	0	11	11	4	2	6	6.7	34.3	0	0	0	6	4	10
AY21-0559	5	2	7	6	10	16	0	6	6	0	2	2	5.7	21.0	0	0	0	1	0	1
AY21-0562	7	16	23	2	4	6	0	0	0	0	4	4	2.9	17.0	0	0	0	0	0	0
AY21-0566	9	14	23	12	16	28	0	0	0	0	4	4	2.6	18.7	0	1	1	0	1	1
AY21-0567	9	16	25	0	5	5	0	0	0	0	0	0	3.7	29.7	0	0	0	0	0	0
AY21-0579	10	19	29	12	20	32	0	0	0	0	12	12	3.5	9.3	0	10	10	0	10	10
AY21-0593	8	17	25	12	20	32	0	0	0	0	4	4	2.5	12.7	0	3	3	0	3	3

Skeleton	Teeth Present			Sockets Present			AMTL			Carious Teeth			Wear		Carious Pulp Exposures			All Pulp Exposures		
	A	P	T	A	P	T	A	P	T	A	P	T	A	P	A	P	T	A	P	T
AY21-0612	2	15	17	0	0	0	0	0	0	0	0	0	2.8	10.6	0	0	0	0	0	0
AY21-0616	10	18	28	12	20	32	0	2	2	0	1	1	2.7	12.5	0	0	0	0	0	0
AY21-0623	10	11	21	12	17	29	0	4	4	0	2	2	5.9	17.2	0	1	1	7	2	9
AY21-0636	0	0	0	12	10	22	5	6	11	0	0	0	0.0	0.0	0	0	0	0	0	0
AY21-0642	11	16	27	12	19	31	0	2	2	0	0	0	3.5	22.4	0	0	0	0	1	1
AY21-0661	2	1	3	8	13	21	7	12	19	0	0	0	4.7	0.0	0	0	0	0	0	0
AY21-0683	10	10	20	12	18	30	1	5	6	2	1	3	5.7	25.0	0	0	0	7	1	8
AY21-0686	3	9	12	0	6	6	0	0	0	0	4	4	3.8	16.8	0	0	0	0	0	0
AY21-0702	12	13	25	12	20	32	0	6	6	0	1	1	2.8	15.5	0	1	1	0	1	1
AY21-0709	6	4	10	6	9	15	6	5	11	0	1	1	3.7	17.0	0	0	0	0	0	0
AY21-0717	8	18	26	12	20	32	0	0	0	0	0	0	3.0	20.6	0	0	0	0	0	0
AY21-0724	11	6	17	11	13	24	0	6	6	0	1	1	5.0	16.0	0	0	0	2	0	2
AY21-0726	4	11	15	0	3	3	0	0	0	0	0	0	2.6	15.7	0	0	0	0	0	0
AY21-0729	9	16	25	0	0	0	0	0	0	0	1	1	2.5	10.4	0	0	0	0	0	0
AY21-0776	6	13	19	7	14	21	0	2	2	0	1	1	3.6	19.3	0	0	0	0	0	0
AY21-0792	10	13	23	12	19	31	0	3	3	0	5	5	3.3	16.7	0	3	3	0	3	3
AY21-0806	8	6	14	12	16	28	0	7	7	0	0	0	4.0	20.0	0	0	0	0	0	0
AY21-0812	5	10	15	0	1	1	0	0	0	0	3	3	4.2	21.5	0	1	1	0	1	1
AY21-0826	9	20	29	12	20	32	0	0	0	0	0	0	2.9	14.8	0	0	0	0	0	0
AY21-0861	6	2	8	12	14	26	6	10	16	0	0	0	4.8	0.0	0	0	0	0	0	0
AY21-0862	2	6	8	0	0	0	0	0	0	1	1	2	4.0	17.8	0	0	0	0	0	0
AY21-0879	10	17	27	12	18	30	0	1	1	0	4	4	2.4	11.3	0	3	3	0	3	3
AY21-0908	11	13	24	12	15	27	0	7	7	1	9	10	2.7	16.3	1	8	9	1	8	9

Skeleton	Teeth Present			Sockets Present			AMTL			Carious Teeth			Wear		Carious Pulp Exposures			All Pulp Exposures		
	A	P	T	A	P	T	A	P	T	A	P	T	A	P	A	P	T	A	P	T
AY21-0914	11	12	23	12	18	30	0	7	7	1	4	5	5.2	15.1	0	1	1	4	1	5
AY21-0917	10	18	28	9	15	24	0	1	1	0	7	7	2.4	12.9	0	3	3	0	3	3
AY21-0919	12	13	25	5	7	12	0	1	1	1	4	5	4.4	15.6	1	0	1	4	0	4
AY21-0922	7	15	22	6	5	11	0	0	0	0	0	0	2.3	12.1	0	0	0	0	0	0
AY21-0932	6	15	21	12	20	32	0	0	0	0	0	0	2.4	16.4	0	0	0	0	0	0
AY21-0938	11	11	22	12	20	32	0	9	9	0	7	7	5.7	19.7	0	6	6	6	7	13
AY21-0939	0	0	0	6	5	11	6	5	11	0	0	0	0.0	0.0	0	0	0	0	0	0
AY21-0949	10	19	29	0	0	0	0	0	0	0	3	3	3.7	20.6	0	3	3	0	3	3
AY21-0956	1	4	5	12	20	32	9	13	22	0	3	3	4.5	27.5	0	0	0	0	2	2
AY21-0963	9	14	23	0	0	0	0	0	0	0	3	3	3.6	18.0	0	2	2	0	2	2
AY21-0967	8	17	25	12	20	32	0	1	1	0	3	3	2.5	21.3	0	3	3	0	3	3
AY21-0971	8	11	19	6	10	16	0	2	2	0	3	3	4.3	18.2	0	0	0	0	0	0
AY21-1002	7	11	18	6	10	16	0	2	2	0	4	4	2.3	16.6	0	1	1	0	1	1
AY21-1022	10	15	25	12	20	32	0	3	3	0	9	9	3.3	14.3	0	4	4	0	4	4
AY21-1038	10	8	18	5	5	10	0	2	2	0	1	1	2.8	15.4	0	1	1	0	1	1
AY21-1046	8	19	27	6	14	20	0	0	0	0	0	0	3.2	18.1	0	0	0	0	0	0
AY21-1082	0	0	0	2	5	7	1	5	6	0	0	0	2.8	15.0	0	0	0	0	0	0
AY21-1084	5	11	16	7	15	22	0	3	3	1	5	6	0.0	0.0	0	2	2	0	2	2
AY21-1091	10	11	21	12	18	30	0	1	1	0	5	5	3.4	11.3	0	4	4	0	4	4
AY21-1094	9	1	10	0	0	0	0	0	0	1	0	1	3.7	0.0	1	0	1	2	0	2
AY21-1114	8	14	22	12	17	29	0	0	0	0	0	0	2.3	14.7	0	0	0	0	0	0
AY21-1119	8	12	20	12	20	32	0	2	2	0	1	1	5.8	35.3	0	1	1	6	8	14
AY21-1127	8	12	20	12	18	30	0	2	2	0	0	0	5.6	19.0	0	0	0	2	0	2

Skeleton	Teeth Present			Sockets Present			AMTL			Carious Teeth			Wear		Carious Pulp Exposures			All Pulp Exposures		
	A	P	T	A	P	T	A	P	T	A	P	T	A	P	A	P	T	A	P	T
AY21-1134	8	6	14	12	20	32	0	10	10	1	4	5	3.8	27.5	0	0	0	0	0	0
AY21-1137	12	19	31	12	20	32	0	1	1	0	0	0	3.9	28.0	0	0	0	1	1	2
AY21-1156	7	3	10	12	17	29	1	12	13	2	2	4	4.9	20.5	0	0	0	1	0	1
AY21-1162	5	4	9	1	5	6	0	0	0	0	1	1	5.0	17.5	0	0	0	0	0	0
AY21-1167	7	17	24	0	0	0	0	0	0	0	1	1	3.6	16.8	0	0	0	0	0	0
AY21-1173	4	5	9	11	18	29	1	7	8	0	0	0	4.3	26.0	0	0	0	1	0	1
AY21-1191	7	16	23	9	20	29	0	0	0	0	0	0	2.3	12.1	0	0	0	0	0	0
AY21-1197	2	4	6	12	18	30	4	12	16	2	2	4	5.0	20.0	0	0	0	1	0	1
AY21-1201	3	2	5	0	0	0	0	0	0	1	1	2	3.4	0.0	1	2	3	1	2	3
AY21-1207	5	10	15	0	0	0	0	0	0	0	0	0	2.7	15.8	0	0	0	0	0	0
AY21-1209	12	9	21	12	20	32	0	8	8	1	5	6	4.5	21.0	0	5	5	0	5	5
AY21-1214	12	18	30	9	18	27	0	1	1	0	2	2	2.9	15.1	0	1	1	0	1	1
AY21-1219	12	11	23	12	20	32	0	8	8	0	3	3	3.8	23.0	0	1	1	0	1	1
AY21-1223	12	19	31	12	20	32	0	0	0	1	1	2	2.6	11.1	0	0	0	0	0	0
AY21-1227	11	15	26	12	13	25	0	3	3	1	2	3	3.2	19.9	0	0	0	0	0	0
AY21-1232	11	14	25	11	17	28	0	1	1	0	3	3	5.5	28.3	0	0	0	5	4	9
AY21-1247	4	5	9	10	10	20	5	5	10	0	4	4	5.8	24.0	0	2	2	2	3	5
AY21-1258	7	11	18	12	18	30	0	6	6	2	7	9	3.8	19.6	0	3	3	0	3	3
AY21-1271	10	14	24	12	13	25	0	1	1	0	4	4	4.9	23.1	0	0	0	1	0	1
AY21-1274	8	7	15	12	20	32	0	11	11	0	4	4	6.9	21.5	0	1	1	8	4	12
AY21-1277	2	2	4	0	0	0	0	0	0	0	0	0	5.5	36.0	0	0	0	0	0	0
AY21-1281	4	13	17	12	18	30	0	1	1	0	5	5	2.1	7.5	0	5	5	0	5	5
AY21-1284	8	15	23	10	17	27	0	1	1	0	0	0	3.8	16.6	0	0	0	0	0	0

Skeleton	Teeth Present			Sockets Present			AMTL			Carious Teeth			Wear		Carious Pulp Exposures			All Pulp Exposures		
	A	P	T	A	P	T	A	P	T	A	P	T	A	P	A	P	T	A	P	T
AY21-1289	10	13	23	12	18	30	0	2	2	0	3	3	2.7	15.2	0	0	0	0	0	0
AY21-1304	10	16	26	12	15	27	0	1	1	0	8	8	2.3	14.8	0	7	7	0	7	7
AY21-1341	0	2	2	9	19	28	4	14	18	0	1	1	7.0	16.0	0	0	0	0	0	0
AY21-1393	10	19	29	12	19	31	0	0	0	0	6	6	4.6	36.2	0	2	2	2	7	9
AY21-1405	9	14	23	0	0	0	0	0	0	0	1	1	3.0	13.4	0	0	0	0	0	0
AY21-1416	6	17	23	12	17	29	0	0	0	0	1	1	1.8	7.8	0	0	0	0	0	0
AY21-1474	10	20	30	12	20	32	0	0	0	0	0	0	3.4	18.8	0	0	0	0	0	0
AY21-1481	11	15	26	12	20	32	0	0	0	0	0	0	2.3	11.6	0	0	0	0	0	0
AY21-1488	8	14	22	12	17	29	2	1	3	0	1	1	3.0	22.3	0	0	0	0	0	0
AY21-1493	9	12	21	0	7	7	0	2	2	0	1	1	3.4	13.5	0	0	0	0	0	0
AY21-1498	12	14	26	12	20	32	0	2	2	0	2	2	4.9	30.7	0	1	1	3	1	4
AY21-1512	8	20	28	12	20	32	0	0	0	1	4	5	3.0	18.5	0	3	3	0	3	3
AY21-1517	4	7	11	10	14	24	1	4	5	0	7	7	4.4	20.5	0	5	5	0	5	5
AY21-1522	8	8	16	12	14	26	0	6	6	1	1	2	4.1	17.5	0	0	0	0	0	0
AY21-1532	8	15	23	12	19	31	0	0	0	0	0	0	2.7	9.5	0	0	0	0	0	0
AY21-1552	12	17	29	12	18	30	0	1	1	0	2	2	3.3	16.4	0	2	2	0	2	2
AY21-1557	7	11	18	12	17	29	5	4	9	2	4	6	3.5	19.3	0	0	0	0	0	0
AY21-1598	10	5	15	12	14	26	0	11	11	2	2	4	5.9	12.0	1	2	3	5	3	8
AY21-1605	6	5	11	5	2	7	0	3	3	3	0	3	6.1	18.0	0	0	0	1	1	2
AY21-1621	12	10	22	12	20	32	0	9	9	0	1	1	6.7	22.8	0	0	0	12	1	13
AY21-1637	9	12	21	12	19	31	0	4	4	0	7	7	2.9	15.0	0	6	6	0	6	6
AY21-1640	7	13	20	12	20	32	0	4	4	0	5	5	4.9	22.0	0	2	2	1	3	4
AY21-1697	10	18	28	12	20	32	0	0	0	0	9	9	3.8	16.4	0	3	3	0	3	3

Skeleton	Teeth Present			Sockets Present			AMTL			Carious Teeth			Wear		Carious Pulp Exposures			All Pulp Exposures		
	A	**P**	**T**	**A**	**P**	**T**	**A**	**P**	**T**	**A**	**P**	**T**	**A**	**P**	**A**	**P**	**T**	**A**	**P**	**T**
AY21-1734	8	18	26	1	18	19	0	2	2	0	0	0	3.6	21.9	0	0	0	0	0	0
AY21-1738	11	19	30	12	20	32	0	0	0	0	0	0	3.2	14.0	0	0	0	0	0	0
AY21-1793	7	6	13	12	20	32	0	8	8	1	2	3	4.4	17.7	0	2	2	0	2	2
AY21-1802	6	16	22	10	17	27	0	1	1	0	1	1	3.9	21.9	0	0	0	0	0	0
AY21-1852	7	12	19	11	18	29	1	6	7	0	1	1	3.0	19.7	0	1	1	0	1	1
AY21-1882	6	7	13	12	19	31	5	7	12	0	3	3	3.1	26.0	0	0	0	0	0	0
AY21-1894	12	19	31	12	20	32	0	0	0	0	0	0	2.3	11.5	0	0	0	0	0	0
AY21-1919	9	12	21	0	0	0	0	0	0	0	1	1	5.7	29.7	0	0	0	3	0	3

Appendix D: Identity Information (age, sex, and social status) by Individual

Each individual is identified by site code and skeleton number, corresponding to the various site reports. Age designation is by category (Adolescent 16-19; Young Adult 20-34; Middle Adult 35-49; Old Adult 50+; Unaged Adult 16+). Sex estimation corresponds to Buikstra and Ubelaker (1994) designations of Male, Probable Male, Ambiguous, Probable Female, Female, and Undetermined. Status was based on grave construction and grave good typology, and are divided as High (indicating Higher Social Status Group) and Low (indicating Lower Social Status Group).

Skeleton	Age Category	Sex Estimation	Social Status
AR 306	Unaged Adult	Probable Male	Low
AR 311	Old Adult	Female	Low
AR 312	Middle Adult	Ambiguous	Low
AR 313	Unaged Adult	Probable Female	Low
AR 318	Old Adult	Probable Male	Low
AR 319	Young Adult	Female	Low
AR 320	Young Adult	Probable Female	Low
AR 324	Middle Adult	Female	Low
AR 326	Middle Adult	Male	Low
AR 331	Young Adult	Male	Low
AR 333	Unaged Adult	Probable Female	Low
AR 334	Unaged Adult	Undetermined	Low
AR 338	Young Adult	Female	Low
AR 339	Young Adult	Probable Female	Low
HYS 001	Young Adult	Probable Male	Low
HYS 002-A	Adolescent	Probable Female	Low
HYS 003-A	Middle Adult	Male	Low
HYS 005	Old Adult	Female	Low
HYS 007	Adolescent	Probable Male	Low
HYS 012-A	Young Adult	Probable Female	Low
HYS 012-B	Old Adult	Male	Low
HYS 013	Old Adult	Female	Low
HYS 016	Old Adult	Male	Low
HYS 017	Middle Adult	Male	Low
HYS 021	Unaged Adult	Probable Female	Low
HYS 025	Young Adult	Male	Low
HYS 027	Adolescent	Female	Low

Skeleton	Age Category	Sex Estimation	Status
LH 008	Unaged Adult	Ambiguous	Low
LH 009	Unaged Adult	Probable Male	Low
LH 011	Young Adult	Male	Low
LH 014	Unaged Adult	Probable Female	Low
LH 015	Middle Adult	Male	Low
LH 017	Middle Adult	Female	High
LH 019	Middle Adult	Female	Low
LH 020	Young Adult	Probable Male	Low
LH 021	Old Adult	Female	High
LH 024	Unaged Adult	Female	Low
LH 031	Middle Adult	Female	Low
LH 035	Middle Adult	Male	Low
LH 036	Old Adult	Probable Male	Low
LH 037	Middle Adult	Male	High
LH 038	Young Adult	Female	High
LH 039	Unaged Adult	Ambiguous	Low
LH 043	Unaged Adult	Female	Low
LH 045	Old Adult	Female	Low
LH 047	Unaged Adult	Male	Low
LH 052	Old Adult	Probable Male	Low
LH 053	Old Adult	Female	Low
LH 055	Unaged Adult	Probable Female	High
LH 058	Unaged Adult	Undetermined	Low
LH 059	Unaged Adult	Female	Low
LH 061	Middle Adult	Male	Low
LH 064	Young Adult	Male	Low
LH 069	Old Adult	Male	Low
LH 070	Unaged Adult	Probable Female	Low
LH 072	Unaged Adult	Probable Female	Low
LH 073/AY21-0284	Old Adult	Female	Low
LH 074	Young Adult	Probable Female	Low
LH 075	Unaged Adult	Probable Female	Low
LH 076	Young Adult	Male	Low
LH 078	Young Adult	Male	Low
LH 079	Young Adult	Female	Low
LH 087	Adolescent	Female	Low
LH 088	Unaged Adult	Undetermined	Low

Skeleton	Age Category	Sex Estimation	Status
LH 089	Adolescent	Probable Female	High
LH 094	Old Adult	Male	High
LH 096	Old Adult	Male	Low
LH 097	Young Adult	Probable Male	Low
LH 098	Young Adult	Female	High
LH 099/AY21-0032	Unaged Adult	Probable Male	Low
LH 100	Young Adult	Female	Low
LH 101	Old Adult	Female	Low
LH 104	Young Adult	Male	Low
LH 107	Young Adult	Male	Low
LH 110	Unaged Adult	Ambiguous	Low
LH 112	Young Adult	Probable Male	Low
LH 114	Unaged Adult	Female	Low
LH 115/AY21-0317	Unaged Adult	Female	Low
LH 116/AY21-0190	Unaged Adult	Female	Low
LH 119	Old Adult	Ambiguous	Low
LH 123	Unaged Adult	Male	Low
LH 124	Unaged Adult	Male	Low
LH 128	Unaged Adult	Probable Male	Low
LH 130	Unaged Adult	Ambiguous	High
LH 137	Unaged Adult	Female	High
LH 138	Middle Adult	Female	Low
LH 139	Young Adult	Undetermined	Low
LH 140	Middle Adult	Probable Male	Low
LH 141	Middle Adult	Male	Low
LH 159	Unaged Adult	Probable Female	Low
LH 161	Young Adult	Male	Low
LH 166	Old Adult	Probable Male	Low
LH 168	Middle Adult	Female	Low
LH 170	Unaged Adult	Ambiguous	Low
LH 171	Unaged Adult	Female	Low
LH 181	Unaged Adult	Male	Low
LH 191	Young Adult	Female	Low
LH 192	Young Adult	Male	Low
LH 194	Young Adult	Female	Low
LH 196	Unaged Adult	Ambiguous	Low
LH 201	Unaged Adult	Probable Female	Low

Skeleton	Age Category	Sex Estimation	Status
LH 203	Unaged Adult	Female	Low
LH 204	Young Adult	Probable Female	Low
LH 208	Young Adult	Male	High
LH 212	Unaged Adult	Undetermined	Low
LH 214	Young Adult	Female	Low
LH 218	Old Adult	Probable Female	Low
LH 219	Unaged Adult	Undetermined	Low
LH 222	Unaged Adult	Probable Male	Low
LH 225	Middle Adult	Male	Low
LH 226	Young Adult	Male	Low
LH 227	Old Adult	Probable Male	Low
LH 228/AY21-0144	Old Adult	Probable Female	Low
LH 229	Unaged Adult	Probable Female	Low
LH 239	Unaged Adult	Probable Female	Low
LH 243	Young Adult	Female	High
LH 249	Old Adult	Female	Low
LH 250	Unaged Adult	Female	High
LH 254	Unaged Adult	Undetermined	Low
LH 256	Young Adult	Female	Low
LH 260	Unaged Adult	Male	Low
LH 264	Unaged Adult	Probable Male	Low
LH 266	Unaged Adult	Female	Low
LH 270	Young Adult	Female	Low
LH 272	Old Adult	Female	Low
LH 273	Middle Adult	Female	Low
LH 277	Old Adult	Male	Low
LH 278	Unaged Adult	Probable Male	Low
LH 287	Middle Adult	Male	Low
LH 288	Unaged Adult	Probable Female	Low
LH 291	Young Adult	Male	Low
LH 293	Young Adult	Male	Low
LH 296	Middle Adult	Male	Low
LH 297	Middle Adult	Female	Low
LH 299	Middle Adult	Male	Low
LH 305	Middle Adult	Male	Low
LH 306	Middle Adult	Probable Male	Low
LH 307	Old Adult	Female	Low

Skeleton	Age Category	Sex Estimation	Status
LH 308	Adolescent	Probable Male	Low
LH 309	Young Adult	Male	Low
LH 312	Unaged Adult	Probable Male	Low
LH 315	Young Adult	Probable Female	Low
LH 319	Old Adult	Male	Low
LH 320	Unaged Adult	Probable Female	Low
LH 328	Old Adult	Probable Female	Low
LH 330	Old Adult	Female	Low
LH 331	Middle Adult	Male	Low
LH 332	Young Adult	Female	Low
LH 335	Unaged Adult	Ambiguous	Low
LH 340	Unaged Adult	Female	Low
LH 343	Unaged Adult	Probable Female	High
LH 347	Unaged Adult	Undetermined	Low
LH 349	Old Adult	Probable Male	Low
LH 352	Young Adult	Probable Male	Low
LH 356	Middle Adult	Probable Male	Low
LH 357	Middle Adult	Undetermined	Low
LH 358	Middle Adult	Female	Low
LH 360	Unaged Adult	Ambiguous	Low
LH 362	Middle Adult	Male	Low
LH 363	Unaged Adult	Ambiguous	Low
LH 365	Young Adult	Female	High
LH 367	Old Adult	Probable Female	Low
LH 373	Unaged Adult	Undetermined	High
LH 374	Young Adult	Probable Female	Low
LH 379	Old Adult	Female	Low
LH 380	Middle Adult	Male	Low
LH 381	Unaged Adult	Undetermined	Low
LH 386	Middle Adult	Probable Female	Low
LH 389	Unaged Adult	Undetermined	Low
LH 392	Unaged Adult	Probable Female	Low
LH 395	Old Adult	Probable Male	Low
LH 397	Young Adult	Probable Male	Low
LH 398	Young Adult	Female	Low
LH 399	Old Adult	Probable Female	Low
LH 402	Young Adult	Female	High

Skeleton	Age Category	Sex Estimation	Status
LH 408	Middle Adult	Male	Low
LH 410	Middle Adult	Male	Low
LH 411	Middle Adult	Ambiguous	Low
LH 412	Young Adult	Male	Low
LH 415	Unaged Adult	Probable Female	Low
LH 418	Unaged Adult	Undetermined	High
LH 427	Young Adult	Probable Male	Low
LH 428	Unaged Adult	Probable Female	Low
LH 430	Middle Adult	Female	Low
LH 432	Unaged Adult	Undetermined	Low
LH 436	Unaged Adult	Probable Female	High
LH 437	Unaged Adult	Probable Male	Low
LH 438	Unaged Adult	Undetermined	High
LH 440	Unaged Adult	Ambiguous	Low
LH 441	Middle Adult	Female	Low
LH 442	Young Adult	Ambiguous	Low
LH 443	Unaged Adult	Probable Female	High
LH 444	Young Adult	Undetermined	Low
LH 445	Middle Adult	Female	Low
LH 447	Unaged Adult	Probable Male	Low
LH 448	Unaged Adult	Probable Female	Low
LH 451	Unaged Adult	Probable Male	Low
AY21-0012	Middle Adult	Male	Low
AY21-0016	Unaged Adult	Ambiguous	Low
AY21-0025	Middle Adult	Probable Male	Low
AY21-0050	Middle Adult	Female	Low
AY21-0055	Old Adult	Probable Female	Low
AY21-0061	Middle Adult	Probable Female	Low
AY21-0077	Unaged Adult	Female	Low
AY21-0084	Young Adult	Female	High
AY21-0093	Young Adult	Female	Low
AY21-0108	Young Adult	Male	Low
AY21-0119	Adolescent	Female	Low
AY21-0122	Young Adult	Female	Low
AY21-0134	Middle Adult	Probable Male	Low
AY21-0157	Unaged Adult	Undetermined	Low
AY21-0212	Old Adult	Female	Low

Skeleton	Age Category	Sex Estimation	Status
AY21-0232	Unaged Adult	Ambiguous	Low
AY21-0244	Unaged Adult	Probable Male	Low
AY21-0255	Unaged Adult	Undetermined	Low
AY21-0259	Adolescent	Probable Male	Low
AY21-0271	Old Adult	Female	Low
AY21-0281	Middle Adult	Male	Low
AY21-0421	Unaged Adult	Probable Female	Low
AY21-0429	Old Adult	Probable Female	Low
AY21-0434	Unaged Adult	Probable Male	Low
AY21-0435	Middle Adult	Female	Low
AY21-0441	Unaged Adult	Probable Male	Low
AY21-0451	Young Adult	Male	Low
AY21-0454	Middle Adult	Female	Low
AY21-0459	Unaged Adult	Undetermined	Low
AY21-0476	Unaged Adult	Probable Female	Low
AY21-0479	Young Adult	Female	Low
AY21-0488	Unaged Adult	Probable Female	Low
AY21-0489	Unaged Adult	Male	Low
AY21-0497	Unaged Adult	Female	Low
AY21-0522	Middle Adult	Probable Male	Low
AY21-0527	Unaged Adult	Undetermined	Low
AY21-0543	Unaged Adult	Male	Low
AY21-0547	Unaged Adult	Probable Female	Low
AY21-0554	Old Adult	Male	Low
AY21-0559	Middle Adult	Probable Female	Low
AY21-0562	Unaged Adult	Female	Low
AY21-0566	Young Adult	Male	Low
AY21-0567	Unaged Adult	Male	Low
AY21-0579	Young Adult	Probable Male	High
AY21-0593	Young Adult	Male	Low
AY21-0612	Unaged Adult	Probable Male	Low
AY21-0616	Middle Adult	Male	Low
AY21-0623	Unaged Adult	Female	Low
AY21-0636	Unaged Adult	Ambiguous	Low
AY21-0642	Unaged Adult	Male	Low
AY21-0661	Middle Adult	Female	Low
AY21-0683	Middle Adult	Male	Low

Skeleton	Age Category	Sex Estimation	Status
AY21-0686	Young Adult	Ambiguous	Low
AY21-0702	Middle Adult	Male	Low
AY21-0709	Unaged Adult	Probable Female	Low
AY21-0717	Unaged Adult	Probable Male	Low
AY21-0724	Unaged Adult	Undetermined	Low
AY21-0726	Unaged Adult	Undetermined	Low
AY21-0729	Unaged Adult	Undetermined	Low
AY21-0776	Unaged Adult	Probable Male	Low
AY21-0792	Unaged Adult	Female	Low
AY21-0806	Old Adult	Female	Low
AY21-0812	Unaged Adult	Probable Male	Low
AY21-0826	Unaged Adult	Male	Low
AY21-0861	Middle Adult	Male	Low
AY21-0862	Unaged Adult	Undetermined	High
AY21-0879	Old Adult	Probable Female	Low
AY21-0908	Old Adult	Probable Female	Low
AY21-0914	Old Adult	Probable Female	Low
AY21-0917	Young Adult	Female	Low
AY21-0919	Middle Adult	Probable Female	Low
AY21-0922	Young Adult	Probable Female	Low
AY21-0932	Young Adult	Ambiguous	Low
AY21-0938	Young Adult	Male	Low
AY21-0939	Old Adult	Male	Low
AY21-0949	Middle Adult	Undetermined	Low
AY21-0956	Unaged Adult	Probable Male	Low
AY21-0963	Unaged Adult	Probable Female	Low
AY21-0967	Old Adult	Ambiguous	Low
AY21-0971	Unaged Adult	Probable Male	Low
AY21-1002	Unaged Adult	Probable Female	High
AY21-1022	Young Adult	Male	Low
AY21-1038	Unaged Adult	Female	Low
AY21-1046	Middle Adult	Probable Male	Low
AY21-1082	Unaged Adult	Female	Low
AY21-1084	Young Adult	Female	Low
AY21-1091	Unaged Adult	Female	Low
AY21-1094	Unaged Adult	Female	Low
AY21-1114	Young Adult	Female	Low

Skeleton	Age Category	Sex Estimation	Status
AY21-1119	Unaged Adult	Ambiguous	High
AY21-1127	Unaged Adult	Male	Low
AY21-1134	Middle Adult	Female	Low
AY21-1137	Middle Adult	Male	Low
AY21-1156	Unaged Adult	Probable Female	Low
AY21-1162	Unaged Adult	Probable Female	Low
AY21-1167	Young Adult	Male	Low
AY21-1173	Old Adult	Female	Low
AY21-1191	Adolescent	Probable Male	Low
AY21-1197	Old Adult	Female	High
AY21-1201	Unaged Adult	Undetermined	Low
AY21-1207	Unaged Adult	Undetermined	High
AY21-1209	Middle Adult	Male	Low
AY21-1214	Unaged Adult	Female	Low
AY21-1219	Middle Adult	Male	Low
AY21-1223	Middle Adult	Probable Male	Low
AY21-1227	Old Adult	Female	High
AY21-1232	Unaged Adult	Male	Low
AY21-1247	Unaged Adult	Male	Low
AY21-1258	Old Adult	Probable Female	Low
AY21-1271	Unaged Adult	Male	High
AY21-1274	Unaged Adult	Male	Low
AY21-1277	Old Adult	Probable Male	Low
AY21-1281	Young Adult	Female	Low
AY21-1284	Unaged Adult	Probable Male	Low
AY21-1289	Young Adult	Male	Low
AY21-1304	Unaged Adult	Probable Female	Low
AY21-1341	Unaged Adult	Undetermined	Low
AY21-1393	Middle Adult	Probable Male	Low
AY21-1405	Unaged Adult	Undetermined	Low
AY21-1416	Adolescent	Female	Low
AY21-1474	Unaged Adult	Undetermined	Low
AY21-1481	Young Adult	Male	Low
AY21-1488	Unaged Adult	Probable Male	Low
AY21-1493	Unaged Adult	Female	Low
AY21-1498	Old Adult	Male	Low
AY21-1512	Young Adult	Female	Low

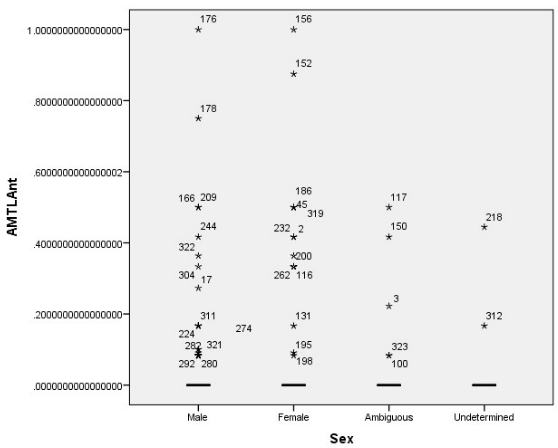
Skeleton	Age Category	Sex Estimation	Status
AY21-1517	Middle Adult	Male	Low
AY21-1522	Unaged Adult	Probable Male	Low
AY21-1532	Unaged Adult	Ambiguous	Low
AY21-1552	Unaged Adult	Female	Low
AY21-1557	Unaged Adult	Female	Low
AY21-1598	Old Adult	Female	Low
AY21-1605	Unaged Adult	Female	Low
AY21-1621	Old Adult	Female	Low
AY21-1637	Unaged Adult	Probable Female	High
AY21-1640	Old Adult	Male	Low
AY21-1697	Young Adult	Male	High
AY21-1734	Young Adult	Probable Female	Low
AY21-1738	Unaged Adult	Female	Low
AY21-1793	Young Adult	Female	Low
AY21-1802	Middle Adult	Probable Male	Low
AY21-1852	Young Adult	Male	Low
AY21-1882	Old Adult	Probable Male	Low
AY21-1894	Young Adult	Male	Low
AY21-1919	Unaged Adult	Ambiguous	Low

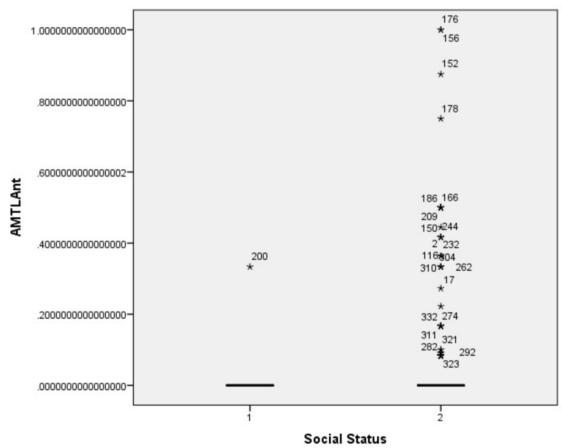
Appendix E: Assumptions of Normality Test Results

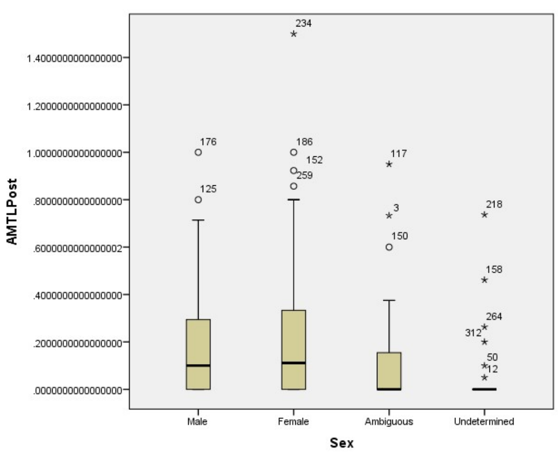
For the data to be normally distributed, three conditions had to be met: Z-values (skewness and kurtosis) between -1.96 and +1.96; *p*-values greater than 0.05 (in order to keep the null hypothesis, which states that the data are normally distributed), and box plots that are approximately symmetrical. If these conditions are met, parametric tests are used. Where one or more of these conditions are not met, non-parametric testing is used in subsequent statistical analysis. Failed tests (indicating non-parametric tests should be used) are bolded. Box plots are provided at the end of the table.

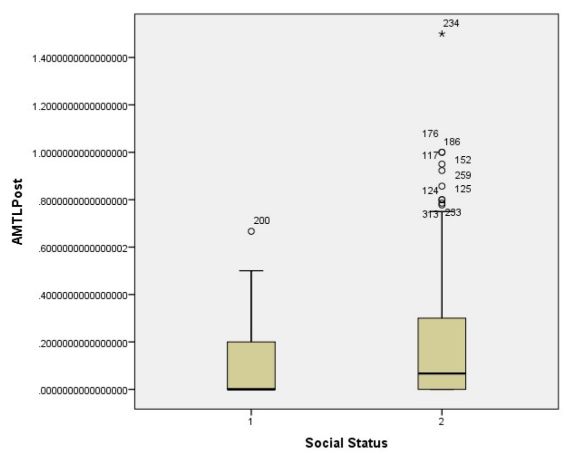
Variable	Z-values	P-values	Box Plots	Results
AMTL-Anterior				
Male	**21.5, 65.5**	**0.000**	**Asymmetrical**	Non-parametric Tests
Female	**21.6, 51.7**	**0.000**	**Asymmetrical**	Non-parametric Tests
Ambiguous	**5.4, 6.5**	**0.000**	**Asymmetrical**	Non-parametric Tests
High Status	**14.0, 41.4**	**0.000**	**Asymmetrical**	Non-parametric Tests
Low Status	**29.5, 69.5**	**0.000**	**Asymmetrical**	Non-parametric Tests
AMTL-Posterior				
Male	**6.8, 3.3**	**0.000**	**Asymmetrical**	Non-parametric Tests
Female	**8.3, 8.1**	**0.000**	**Asymmetrical**	Non-parametric Tests
Ambiguous	**4.3,** 0.0	**0.000**	**Asymmetrical**	Non-parametric Tests
High Status	**4.5, 3.2**	**0.000**	**Asymmetrical**	Non-parametric Tests
Low Status	**11.8, 11.0**	**0.000**	**Asymmetrical**	Non-parametric Tests
AMTL-Total				
Male	**10.0, 15.0**	**0.000**	**Asymmetrical**	Non-parametric Tests
Female	**8.9, 7.5**	**0.000**	**Asymmetrical**	Non-parametric Tests
Ambiguous	**4.6, 4.7**	**0.000**	**Asymmetrical**	Non-parametric Tests
High Status	**5.6, 6.7**	**0.000**	**Asymmetrical**	Non-parametric Tests
Low Status	**13.8, 14.4**	**0.000**	**Asymmetrical**	Non-parametric Tests
Caries-DMI				
Male	**4.8,** 0.5	**0.000**	**Asymmetrical**	Non-parametric Tests
Female	**4.3,** -0.5	**0.000**	**Asymmetrical**	Non-parametric Tests
Ambiguous	**3.0,** 1.3	**0.000**	**Asymmetrical**	Non-parametric Tests
High Status	**4.1, 3.2**	**0.000**	**Asymmetrical**	Non-parametric Tests
Low Status	**7.0,** 0.4	**0.000**	**Asymmetrical**	Non-parametric Tests
Caries-PCF				
Male	**8.4, 7.6**	**0.000**	**Asymmetrical**	Non-parametric Tests
Female	**14.7, 36.3**	**0.000**	**Asymmetrical**	Non-parametric Tests
Ambiguous	**2.0,** 0.1	**0.002**	**Asymmetrical**	Non-parametric Tests
High Status	**10.1, 24.9**	**0.000**	**Asymmetrical**	Non-parametric Tests
Low Status	**12.1, 11.5**	**0.000**	**Asymmetrical**	Non-parametric Tests
Wear-Ant				
Male	0.2, 0.4	**0.008**	Symmetrical	Non-parametric Tests
Female	1.1, 1.6	**0.000**	**Asymmetrical**	Non-parametric Tests
Ambiguous	-1.7, 1.0	0.889	Symmetrical	Parametric Tests

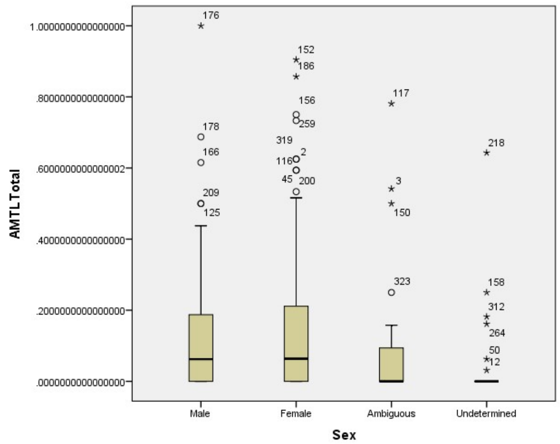
Variable	Z-values	P-values	Box Plots	Results
(Wear-Ant cont'd)				
High Status	0.6, 1.6	**0.026**	Symmetrical	Non-parametric Tests
Low Status	0.6, 1.0	**0.000**	Symmetrical	Non-parametric Tests
Wear-Post				
Male	0.5, 1.5	**0.002**	Symmetrical	Non-parametric Tests
Female	0.8, 2.2	**0.000**	Symmetrical	Non-parametric Tests
Ambiguous	0.1, 0.3	0.407	Symmetrical	Parametric Tests
High Status	**2.5,** 0.5	**0.004**	Symmetrical	Non-parametric Tests
Low Status	0.8, 1.9	**0.000**	Symmetrical	Non-parametric Tests







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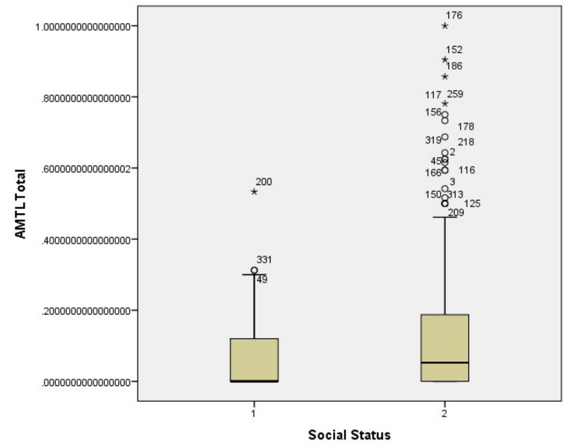
.4000000000000000
.2000000000000000
.0000000000000000
Male
Female
Ambiguous
Undetermined
Sex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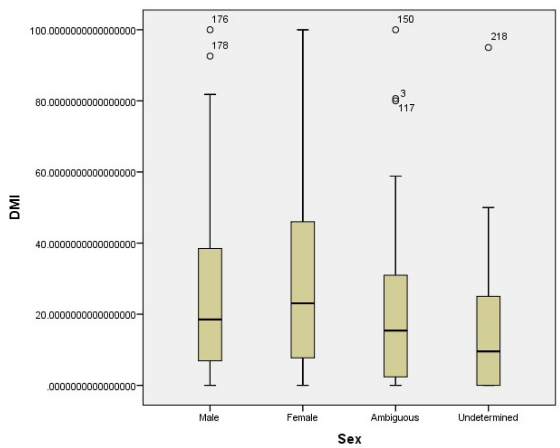
1
2
Social Status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40.0000000000000000
20.0000000000000000
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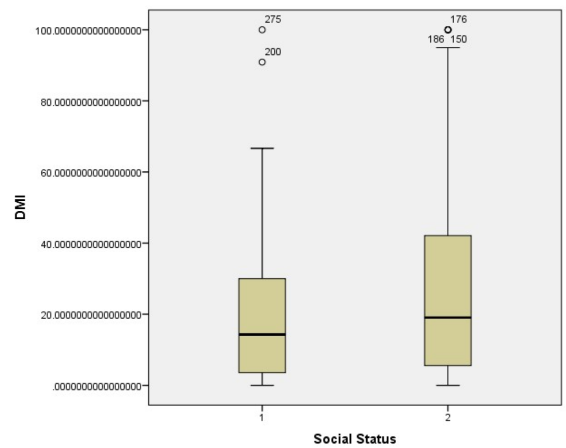
Male
Female
Ambiguous
Undetermined
Sex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60.0000000000000000
40.0000000000000000
20.0000000000000000
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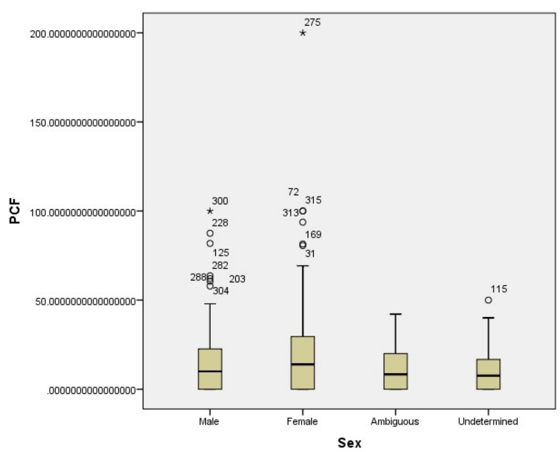
2
Social Status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100.0000000000000000
50.0000000000000000
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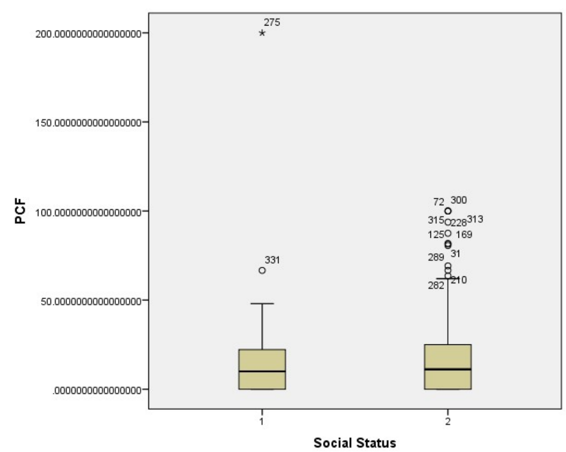
Male
Female
Ambiguous
Undetermined
Sex


PCF
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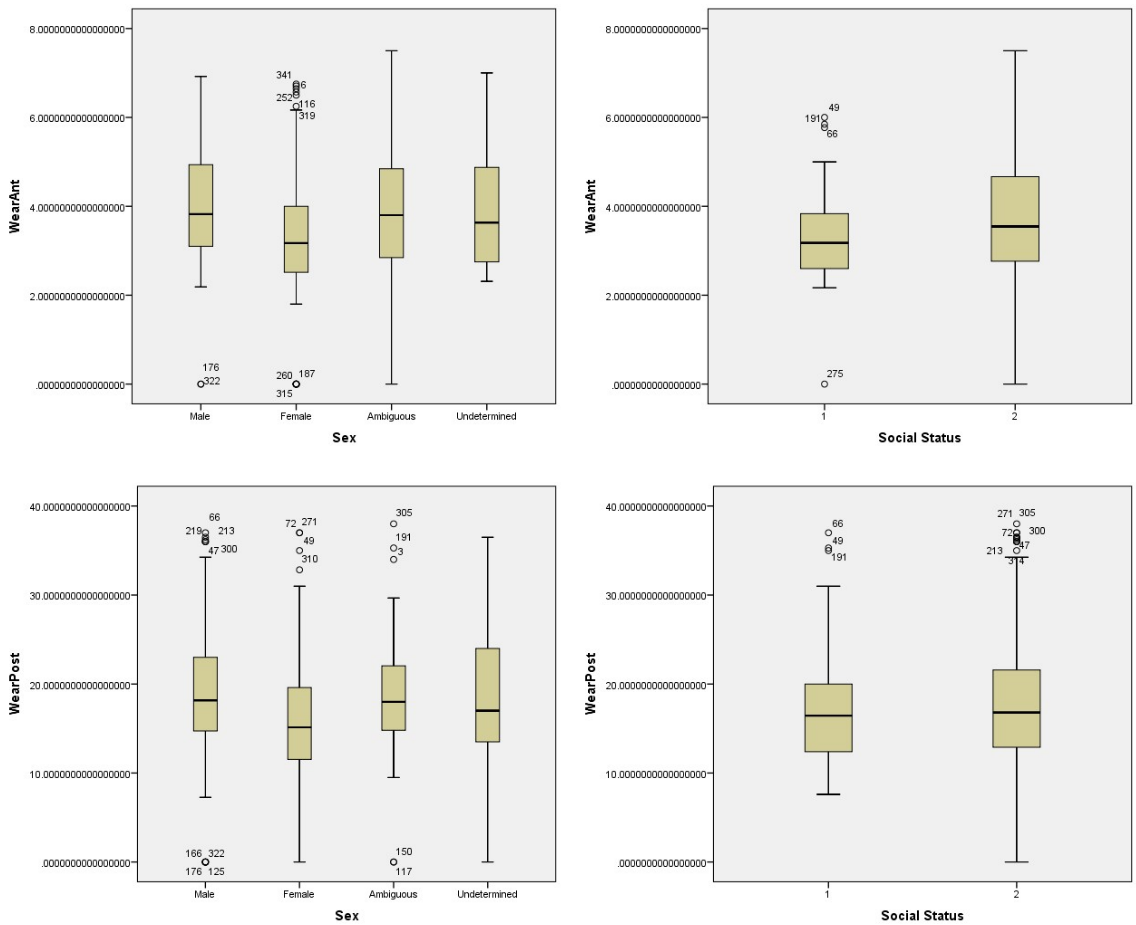
150.0000000000000000
100.0000000000000000
50.0000000000000000
.0000000000000000
1
2
Social Status


WearAnt
WearPost
Sex
Social Status
Male
Female
Ambiguous
Undetermined
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2
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6.0000000000000000
4.0000000000000000
2.0000000000000000
.0000000000000000
40.0000000000000000
30.0000000000000000
20.0000000000000000
10.0000000000000000

Appendix F: AMTL Rates (Anterior, Posterior, Total) by Sub-sample group and age (%).

AMTL Rates as a percentage, followed by the raw data of the number of sockets exhibiting antemortem tooth loss (A), over the total number of sockets (S). Cells with dash (-) indicate there were no individuals for that age category in that sub-group (*e.g.*, there were no Adolescent Higher Social Status Males).

	Ado		YA		MA		OA		UA		All Ages	
	%	A/S	%	A/S	%	A/S	%	A/S	%	A/S	%	A/S
All												
Anterior	0.0	0/96	0.4	3/764	6.0	38/636	8.2	43/527	6.5	58/894	4.9	142/2917
Posterior	1.3	2/157	8.5	108/1266	25.1	250/998	35.1	292/831	19.8	272/1374	20.0	924/4626
Total	0.8	2/253	5.5	111/2030	17.6	288/1634	24.7	335/1358	14.6	330/2268	14.1	1066/7543
Males												
Anterior	0.0	0/36	0.7	3/411	6.8	28/413	6.5	12/186	7.0	21/302	4.7	64/1348
Posterior	3.4	2/58	8.0	53/666	19.4	124/638	28.6	83/290	23.0	111/483	17.5	373/2135
Total	2.1	2/94	5.2	56/1077	14.5	152/1051	20.0	95/476	16.8	132/785	12.5	437/3483
Females												
Anterior	0.0	0/60	0.0	0/335	3.5	7/200	9.8	31/317	5.0	20/401	4.4	58/1313
Posterior	0.0	0/99	9.6	54/564	34.3	109/318	41.5	208/501	16.5	99/600	22.6	470/2082
Total	0.0	0/159	6.0	54/899	22.4	116/518	29.2	239/818	11.9	119/1001	15.6	528/3395
Higher Social Status –Total												
Anterior	0.0	0/12	0.0	0/99	0.0	0/18	9.3	4/43	0.0	0/98	1.5	4/270
Posterior	0.0	0/20	3.0	5/167	10.3	3/29	41.3	26/63	12.2	19/156	12.2	53/435
Total	0.0	0/32	1.9	5/266	6.4	3/47	28.3	30/106	7.5	19/254	8.1	57/705
Higher Social Status-Male												
Anterior	-	-	0.0	0/36	0.0	0/12	0.0	0/12	0.0	0/12	0.0	0/72
Posterior	-	-	6.7	4/60	5.3	1/19	50.0	9/18	7.7	1/13	13.6	15/110
Total	-	-	4.2	4/96	3.2	1/31	30.0	9/30	4.0	1/25	8.2	15/182
Higher Social Status –Female												
Anterior	0.0	0/12	0.0	0/63	0.0	0/6	12.9	4/31	0.0	0/67	2.2	4/179
Posterior	0.0	0/20	0.9	1/107	20.0	2/10	37.8	17/45	15.2	16/105	12.5	36/287
Total	0.0	0/32	0.6	1/170	12.5	2/16	27.6	21/76	9.3	16/172	8.6	40/466

	Ado		YA		MA		OA		UA		All Ages	
	%	A/S	%	A/S	%	A/S	%	A/S	%	A/S	%	A/S
Lower Social Status –Total												
Anterior	0.0	0/84	0.5	3/665	6.1	38/618	8.1	39/484	7.3	58/796	5.2	138/2647
Posterior	1.5	2/137	9.4	103/1099	25.5	247/969	34.6	266/768	20.8	253/1218	20.8	871/4191
Total	0.9	2/221	6.0	106/1764	18.0	285/1587	24.4	305/1252	15.4	311/2014	14.8	1009/6838
Lower Social Status-Male												
Anterior	0.0	0/36	0.8	3/375	7.0	28/401	6.9	12/174	7.2	21/290	5.0	64/1276
Posterior	3.4	2/58	8.1	49/606	19.9	123/619	27.2	74/272	23.4	110/470	17.7	358/2025
Total	2.1	2/94	5.3	52/981	14.8	151/1020	19.3	86/446	17.2	131/760	12.8	422/3301
Lower Social Status –Female												
Anterior	0.0	0/48	0.0	0/272	3.6	7/194	9.4	27/286	6.0	20/334	4.8	54/1134
Posterior	0.0	0/79	11.6	53/457	34.7	107/308	41.9	191/456	16.8	83/495	24.2	434/1795
Total	0.0	0/127	7.3	53/729	22.7	114/502	29.4	218/742	12.4	103/829	16.7	488/2929

Appendix G: Mann-Whitney U *p*-values for AMTL by Sub-sample

Italicized and bolded values indicate statistically significant tests (*p*<0.050). *Indicates Exact Significance [2*(1-tailed Sig.)] *p*-value was used instead of Asymptotic Significance (2-tailed) due to total sample size <20. – indicates statistical test was not preformed due to sample size <7.

	Ado		YA		MA		OA		UA		All Ages	
	U=	*p*=	U=	*p*=	U=	*p*=	U=	*p*=	U=	*p*=	U=	*p*=
Males - Females												
Anterior	12.0	1.000*	577.5	0.083	**288.0**	**0.018**	289.5	0.422	1007.0	0.168	**9462.5**	**0.030**
Posterior	6.0	0.257*	629.5	0.995	287.0	0.075	245.0	0.157	952.0	0.196	10236.5	0.809
All Teeth	6.0	0.257*	628.0	0.980	319.0	0.204	247.0	0.169	938.5	0.163	10382.0	0.975
Higher Social Status Group - Lower Social Status Group												
Anterior	4.5	1.000*	288.0	0.520	45.0	0.565*	96.5	0.911*	875.5	0.082	4466.0	0.054
Posterior	3.5	0.800*	207.0	0.100	43.5	0.518*	85.0	0.644*	856.5	0.215	**4016.5**	**0.038**
All Teeth	3.5	0.800*	206.0	0.097	41.5	0.473*	85.5	0.644*	842.5	0.182	**3952.5**	**0.028**
Higher Social Status Males - Higher Social Status Females												
Anterior	-	-	9.0	1.000*	-	-	-	-	4.5	1.000*	57.0	0.882*
Posterior	-	-	7.0	0.714*	-	-	-	-	4.0	1.000*	53.0	0.700*
All Teeth	-	-	7.0	0.714*	-	-	-	-	4.0	1.000*	53.0	0.700*
Lower Social Status Males - Lower Social Status Females												
Anterior	10.0	1.000*	435.0	0.099	**265.0**	**0.020**	253.5	0.513	844.0	0.277	**7856.5**	**0.043**
Posterior	5.0	0.286*	444.5	0.612	268.0	0.087	204.0	0.130	784.5	0.213	8285.0	0.551
All Teeth	5.0	0.286*	446.0	0.628	298.0	0.227	205.5	0.139	778.5	0.195	8404.0	0.690

Appendix H: Caries Rates (DMI, PCF) by Sub-sample group and age (%).

Caries Rates according to equations set out in *Materials and Methods 3.1*. Raw data regarding number of antemortem teeth, pulp exposures, and other data needed for equations can be found in Appendix C: Dental Health Data. Cells with dash (-) indicate there were no individuals for that age category in that sub-group (*e.g.*, there were no Adolescent Higher Social Status Males).

	Ado	YA	MA	OA	UA	All Ages
All						
DMI	4.8	17.9	32.7	40.3	21.5	25.4
PCF	4.4	16.5	26.9	27.8	15.3	19.9
Males						
DMI	6.0	17.8	27.1	35.4	26.4	24.7
PCF	5.4	16.4	21.7	24.9	15.5	19.2
Females						
DMI	4.1	18.9	43.9	45.4	20.8	28.4
PCF	3.8	17.3	39.2	30.3	18.7	23.8
Higher Social Status -Total						
DMI	0.0	18.4	9.8	38.8	15.8	18.8
PCF	0.0	17.4	2.3	26.5	13.6	16.3
Higher Social Status-Male						
DMI	-	28.7	3.6	38.5	20.0	24.7
PCF	-	27.4	0.0	28.5	16.7	23.4
Higher Social Status -Female						
DMI	0.0	12.2	23.1	38.9	22.3	20.5
PCF	0.0	11.6	6.9	10.1	20.9	18.4
Lower Social Status -Total						
DMI	5.4	17.9	33.3	40.5	22.3	26.1
PCF	4.9	16.3	27.6	28.0	15.5	20.3
Lower Social Status-Male						
DMI	6.0	16.7	27.9	35.2	26.6	24.7
PCF	5.4	15.2	22.3	24.7	15.4	18.8

	Ado	YA	MA	OA	UA	All Ages
Lower Social Status -Female						
DMI	5.0	20.4	44.5	46.1	20.5	29.7
PCF	4.5	18.4	40.5	31.1	18.2	24.6

Appendix I: Mann-Whitney U *p*-values for Dental Caries by Sub-sample

Italicized and bolded values indicate statistically significant tests ($p<0.050$). *Indicates Exact Significance [2*(1-tailed Sig.)] *p*-value was used instead of Asymptotic Significance (2-tailed) due to total sample size <20. – indicates statistical test was not preformed due to sample size <7.

	Ado		**YA**		**MA**		**OA**		**UA**		**All Ages**	
	U=	*p*=	U=	*p*=	U=	*p*=	U=	*p*=	U=	*p*=	U=	*p*=
Males – Females												
DMI	9.0	0.610*	621.5	0.922	293.0	0.093	254.5	0.217	1084.5	0.787	9731.5	0.342
PCF	11.0	0.914*	602.5	0.750	289.0	0.079	302.0	0.729	968.0	0.254	9315.5	0.120
Higher Social Status Group – Lower Social Status Group												
DMI	1.0	0.400*	291.0	0.866	33.0	0.313*	95.5	0.886*	918.5	0.444	4420.5	0.208
PCF	1.5	0.400*	274.5	0.661	33.0	0.313*	99.0	0.987*	1030.0	0.964	4966.0	0.804
Higher Social Status Males – Higher Social Status Females												
DMI	-	-	3.0	0.167*	-	-	-	-	4.0	1.000*	50.0	0.573*
PCF	-	-	6.0	0.548*	-	-	-	-	4.0	1.000*	57.0	0.882*
Lower Social Status Males – Lower Social Status Females												
DMI	8.5	0.730*	444.5	0.630	272.5	0.103	215.0	0.201	882.0	0.711	7905.5	0.229
PCF	8.0	0.730*	437.5	0.559	269.5	0.090	254.5	0.651	809.0	0.315	7644.0	0.101

Appendix J: Dental Wear (Anterior and Posterior) by Sub-sample group and age.

Dental Wear scores, according to equations found in *Materials and Methods 3.1*. Overall score is followed by raw data (total dental wear scores for all teeth/number of teeth). Cells with dash (-) indicate there were no individuals for that age category in that sub-group (*e.g.*, there were no Adolescent Higher Social Status Males).

	Ado	YA	MA	OA	UA	All Ages
All						
Anterior	2.4 (302/126)	3.0 (3280/1085)	3.9 (3326/858)	4.3 (2650/613)	3.5 (5424/1552)	3.6 (14982/4234)
Posterior	10.6 (1074/101)	13.0 (8189/632)	18.2 (6554/360)	20.0 (4637/237)	16.0 (13238/827)	15.6 (33692/2157)
Males						
Anterior	2.8 (137/49)	3.1 (1726/563)	4.0 (2115/536)	4.7 (1013/214)	4.0 (1746/433)	3.8 (6737/1795)
Posterior	13.2 (435/33)	12.7 (4157/327)	18.5 (4679/253)	23.6 (2097/89)	18.3 (4255/233)	16.7 (15623/935)
Females						
Anterior	2.1 (165/77)	2.9 (1366/467)	3.7 (1026/276)	4.2 (1551/367)	3.0 (2070/682)	3.3 (6178/1869)
Posterior	9.4 (639/68)	13.1 (3593/275)	15.9 (1301/82)	18.1 (2293/127)	13.3 (4579/343)	13.9 (12405/895)
Higher Social Status -Total						
Anterior	2.2 (26/12)	2.9 (432/148)	3.3 (82/25)	3.6 (172/48)	3.0 (656/218)	3.0 (1368/451)
Posterior	10.7 (128/12)	11.7 (1022/87)	18.8 (254/13)	20.2 (403/20)	14.8 (1543/104)	14.2 (3341/236)
Higher Social Status-Male						
Anterior	-	3.1 (170/54)	3.2 (57/18)	5.1 (76/15)	4.9 (74/15)	3.7 (337/102)
Posterior	-	9.8 (284/29)	18.6 (167/9)	37.0 (74/2)	23.1 (208/9)	15.0 (733/49)
Higher Social Status –Female						
Anterior	2.2 (26/12)	2.8 (262/92)	3.6 (25/7)	2.9 (96/33)	2.5 (307/121)	2.7 (716/267)
Posterior	10.7 (128/12)	12.7 (738/58)	19.5 (78/4)	18.3 (329/18)	10.5 (535/51)	12.6 (1808/143)
Lower Social Status –Total						
Anterior	2.4 (276/114)	3.0 (2848/937)	3.9 (3244/833)	4.4 (2478/565)	3.6 (4768/1334)	3.6 (13614/3783)
Posterior	10.6 (946/89)	13.2 (7167/545)	18.2 (6309/347)	19.5 (4234/217)	16.2 (11695/723)	15.8 (30351/1921)
Lower Social Status-Male						
Anterior	2.8 (137/49)	3.1 (1556/509)	4.0 (2058/518)	4.7 (937/199)	4.0 (1672/481)	3.8 (6360/1693)
Posterior	13.2 (435/33)	13.0 (3873/298)	18.5 (4512/244)	23.3 (2023/87)	18.1 (4047/224)	16.8 (14890/886)

	Ado	YA	MA	OA	UA	All Ages
Lower Social Status –Female						
Anterior	2.1 (139/65)	3.0 (1104/373)	3.7 (1001/269)	4.4 (1455/334)	3.1 (1763/561)	3.4 (5462/1602)
Posterior	9.1 (511/56)	13.2 (2855/217)	15.7 (1223/78)	18.0 (1964/109)	13.8 (4044/292)	14.1 (10597/752)

Appendix K: Mann-Whitney U *p*-values for Dental Wear by Sub-sample

Italicized and bolded values indicate statistically significant tests ($p<0.050$). *Indicates Exact Significance [2*(1-tailed Sig.)] *p*-value was used instead of Asymptotic Significance (2-tailed) due to total sample size <20. – indicates statistical test was not preformed due to sample size <7.

	Ado		**YA**		**MA**		**OA**		**UA**		**All Ages**	
	U=	*p=*	U=	*p=*	U=	*p=*	U=	*p=*	U=	*p=*	U=	*p=*
Males – Females												
Anterior	**0.0**	**0.010***	496.0	0.123	339.0	0.423	266.5	0.314	**472.5**	**0.000**	**7358.0**	**0.000**
Posterior	3.0	0.067*	530.0	0.250	340.0	0.350	**161.5**	**0.008**	**597.5**	**0.000**	**7044.5**	**0.000**
Higher Social Status Group – Lower Social Status Group												
Anterior	4.0	1.000*	293.0	0.891	41.0	0.489*	80.0	0.534*	902.5	0.387	4172.0	0.091
Posterior	1.0	0.400*	258.5	0.489	45.0	0.565*	81.5	0.631*	1010.5	0.907	4968.0	0.880
Higher Social Status Males – Higher Social Status Females												
Anterior	-	-	4.0	0.262*	-	-	-	-	1.0	0.400*	28.5	0.054*
Posterior	-	-	9.0	1.000*	-	-	-	-	2.0	0.600*	44.0	0.335*
Lower Social Status Males – Lower Social Status Females												
Anterior	**0.0**	**0.016***	384.0	0.187	312.0	0.412	299.0	0.235	**404.0**	**0.000**	**6379.5**	**0.000**
Posterior	**0.0**	**0.016***	398.0	0.256	299.0	0.235	244.5	0.513	**489.5**	**0.000**	**5803.0**	**0.000**