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To the Graduate Council:

I am submitting herewith a thesis written by Michelle D. Hamilton entitled "Oral pathology at Averbuch (40DV60) : implications for health status." I have examined the final electronic copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Arts, with a major in Anthropology.

Murray K. Marks, Major Professor

We have read this thesis and recommend its acceptance:

Watler E. Klippel, Lyle W. Konigsberg

Accepted for the Council:
Carolyn R. Hodges

Vice Provost and Dean of the Graduate School

(Original signatures are on file with official student records.)

To the Graduate Council:

I am submitting herewith a thesis written by Michelle Dawn Hamilton entitled "Oral Pathology at Averbuch (40DV60): Implications for Health Status." I have examined the final copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Arts, with a major in Anthropology.

Murray K. Marks, Major Professor

We have read this thesis and
recommend its acceptance:

Lyle W. Konigsberg

Accepted for the Council:

Associate Vice Chancellor and
Dean of the Graduate School

Oral Pathology at Averbuch (40DV60): Implications for Health Status

A Thesis
Presented for the
Master of Arts
Degree
The University of Tennessee, Knoxville

Michelle Dawn Hamilton
May 1999

DEDICATION

It is with my most sincere appreciation, thanks, and love that I dedicate this work to my parents, Anna Antonia Clemente and Billy Dale Hamilton. Everything I am and have achieved is the result of their kindness and constant love, and I'm very grateful for the profound impact they've had on my life.

ACKNOWLEDGEMENTS

Grateful acknowledgement is given to the members of my thesis committee. Dr. Walter Klippel's eye for detail improved the content and composition of this work, while Dr. Lyle Konigsberg's editing and insight added to the clarity. Dr. Murray Marks' thoughtful comments and critical suggestions contributed immensely to the substance of this work, and his kindness and support are very much appreciated. I also wish to thank him for taking the photographs used in this work.

A special thank you goes to my wonderful sister, Nicole Scilla Hamilton. Little did she suspect that visiting Knoxville for a small vacation would lead to hours of enamel hypoplasia recording on her part. I couldn't have done it without her.

The excavations at Averbuch were funded through the U.S. Department of the Interior, National Park Service, Atlanta - Contract # C-5943(79). The Averbuch skeletal collection is housed and curated by the Department of Anthropology at The University of Tennessee, Knoxville.

Abstract

An examination of the permanent dentition of 304 individuals from the Averbuch (40DV60) skeletal series from Tennessee was undertaken to establish a profile of oral pathology in this Mississippian period population. The variables chosen for study include caries, enamel hypoplasia, alveolar resorption, and periapical and periodontal abscesses. These markers were chosen as a measure of adaptive efficiency because they are indicative of overall levels of health and disease.

The results of the study revealed caries rates at Averbuch at high percentages, showing 77% of the individuals from this skeletal sample had one or more carious lesions, surpassing the 17% average frequency rate for Mississippian groups. Results of the analysis of hypoplasias in the permanent adult dentition of the Averbuch sample also reveal high frequencies for this defect, with a total of 87% of the individuals possessing one or more hypoplasias. Alveolar resorption is in evidence in 39% of the individuals, while periapical and periodontal abscesses are present in 19% of the sample. These results show that the population from Averbuch was adaptively disadvantaged, and the heavy biological stress loads are recorded on the dental and oral hard tissues.

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Chapter 1

Introduction

Research Objectives

This study examines the dentition of individuals from the Averbuch (40DV60) skeletal series for oral pathologies in an effort to better understand the social, environmental, and biological factors influencing the health status of this Mississippian period population from Middle Tennessee. The goal of this project is to establish a descriptive account of dental pathology in order to provide an overall profile of the dental health of this Mississippian group. Dental pathological conditions were chosen as a measure of adaptive efficiency because they are indicative of overall levels of health and disease in a population. Powell, in her work on dietary reconstruction (1985:308) notes:

> "...population morbidity and mortality levels are directly affected to some degree by the prevalent quality of dental health, which is in turn influenced both directly and indirectly by dietary factors...systemic observation and careful analysis [of dental pathologies] can elucidate in clear quantifiable terms the consequences to dental health of particular subsistence technologies."

Previous skeletal biological research conducted on the Averbuch collection has documented evidence of poor health levels, including high levels of iron deficiency anemia associated with a subsistence strategy heavily dependant on maize, and high levels of infectious treponemal, tubercular, and mycotic diseases (Buikstra et al. 1988, Buikstra 1992, Eisenberg 1986; 1991, Kelley and Eisenberg 1987).

Demographic analysis has revealed unusual mortality profiles for this group (Berryman 1981, Buikstra and Konigsberg 1985). High infant and young adult mortality result in a demographic profile that has led some researchers to suggest possible catastrophic events as explanations for the "demise" of this culture, chief among them epidemic disease, warfare, nutritional stress, depletion of natural resources, and European contact (Buikstra 1992, Eisenberg 1991, Klippel and Bass 1984a; 1984b). The aim of this research is to provide a descriptive account of the oral health of the Averbuch population, while establishing a general profile of the dental health of a biologically stressed population.

General Overview of Averbuch

The Averbuch site (40DV60), is located in Davidson County, Tennessee, nine kilometers northwest of Nashville (Figure 1). It was discovered in 1975 when construction from the Royal Hills housing project unearthed several stone-box burials. The Department of Conservation, Tennessee Division of Archaeology began salvage excavations in October 1975 because of threats of vandalism and continuing construction. By the end of the field season, 35 burials containing 60 individuals were recovered (Reed 1984a).

In 1977, the Department of Anthropology at the University of Tennessee, Knoxville was contacted by the Interagency Archaeological Service of Atlanta to continue the excavations at Averbuch. Dr. William M. Bass and Dr. Walter E. Klippel served as the principal investigators, with Dr. Klippel serving as Project Director and

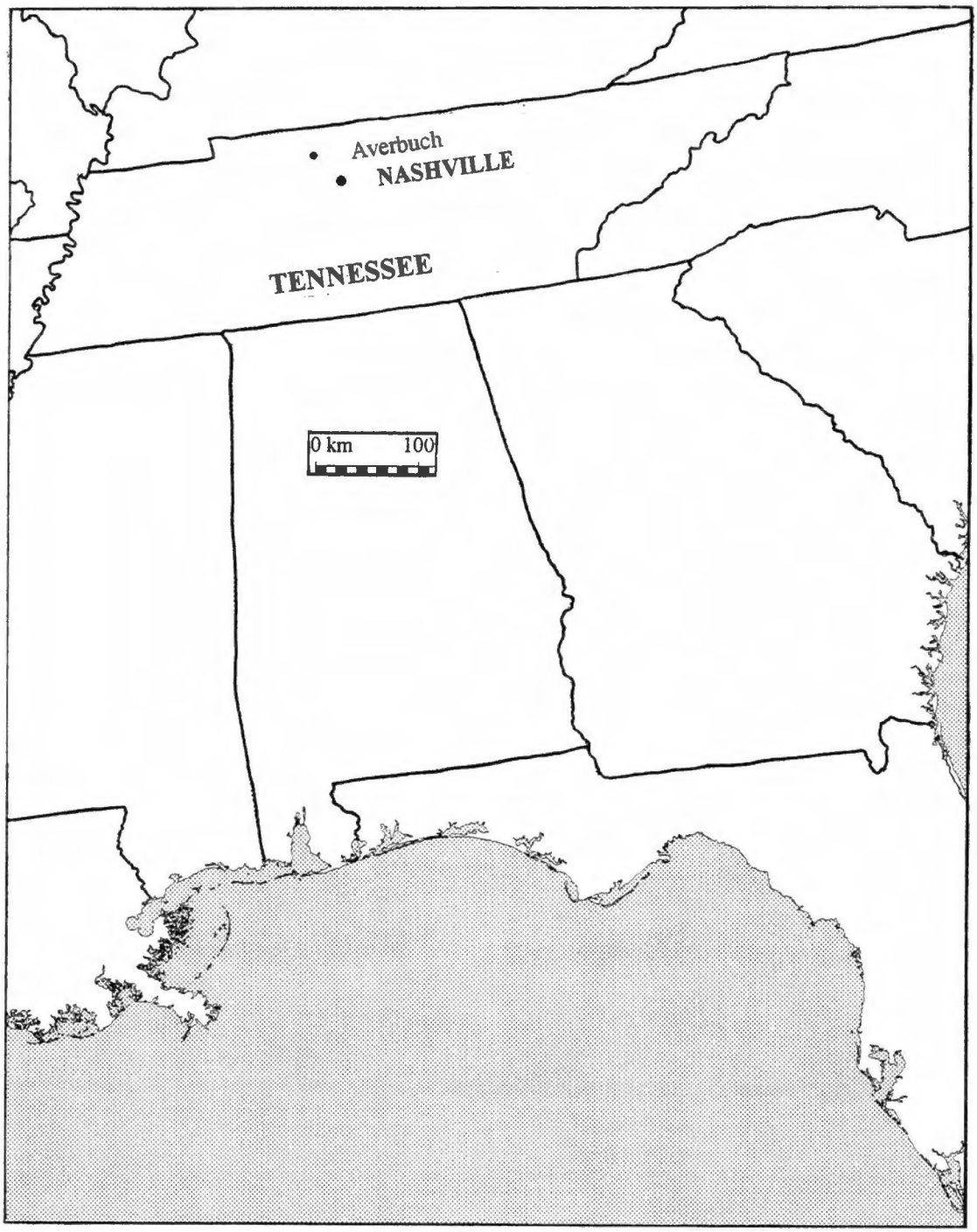

Figure 1. Location of the Averbuch (40DV60) site near Nashville, Tennessee.

Hugh E. Berryman and Ann Reed as Field Supervisors.

At the close of the project in 1978, excavators had determined that the site consisted of a palisaded village with three separate and distinct cemeteries, over seventy structure loci, and numerous refuse pits (Reed 1984a). A total of 645 graves containing the remains of 888 individuals (Eisenberg 1986) were recovered from the three cemeteries, with a number of structures also containing subadult burials (Figure 2). The palisade wall enclosed a number of structures and Cemeteries 1 and 2, but there are five structures that lie outside the palisade (two of which show signs of having been burned). Cemetery 3 is intersected by the wall so that the majority lies outside the limit of the palisade (Klippel and Bass 1984a), indicating that the palisade was built at a later point in time than the cemetery.

Geography and Environment

Averbuch, located near the modern city of Nashville, is a non-mounded site which covers over eleven acres. The nearest water sources are two kilometers away at the Drake Branch and Whites Creek confluence, which joins the Cumberland River four kilometers from the site. Geographically, the site lies within the Nashville Basin, a region subdivided into two distinct areas known as the Outer and Inner Basin, distinguished from each other by their underlying topography.

The Nashville Basin itself is surrounded by the Highland Rim, a plateau with a subsurface strata of limestone. Averbuch is located within the Outer Basin, a region

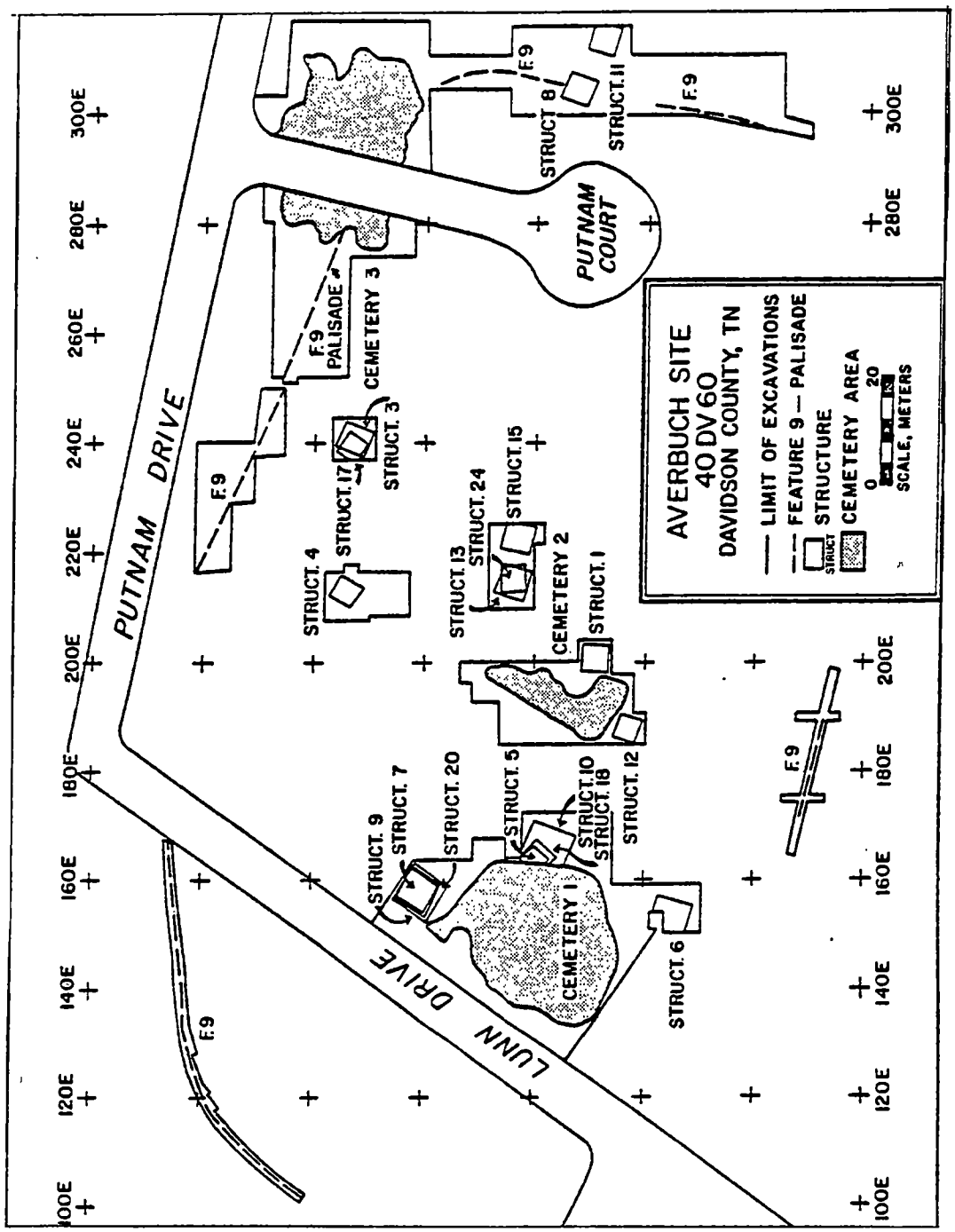

Figure 2. Map of the Averbuch (40DV60) site excavations (from Klippel and Bass 1984a; 1984b).

characterized by well-drained loamy surface soils with clayey subsoil horizons (Klippel and Reed 1984a).

Climactically, the Nashville Basin region is classified as Humid Mesothermal, a designation that is characterized by seasonal fluctuations in both temperature and rainfall (Edwards et al 1974, Thornwaite 1931). Fall is the driest season, often causing problems for plant growth, while the winter and spring months see the heaviest rainfall totals. As a result, during the months of December through March, soils can only be worked intermittently because of water saturation levels (Edwards et al 1974, Reed 1984a). Temperature levels range from near-freezing to 32 degrees Celsius, with the mean annual temperature around 15.5 degrees Celsius (Strand et al 1973). Annual soil temperatures range from 10 to 15 degrees Celsius, but during the winter the ground will typically freeze to a depth of 6 to 10 centimeters, remaining frozen on average between two and seven days (Edwards et al 1974, Reed 1984a). These temperatures limit the growing season to about 200 days out of the year, but a farming technique known as double-cropping practiced at Averbuch may well have compensated for this fact by increasing the yield amounts (Eisenberg 1986, Strand et al 1973).

Mississippian Culture Characteristics

Cultural stages in the American Southeast are divided into four main traditions; the Paleo-Indian, the Archaic, the Woodland, and the Mississippian (Fagan 1995, Fiedel 1988, Wenke 1990).

The earliest of these traditions is the Paleo-Indian, recognized by Clovis and fluted projectile points. In the American West, these types of points are found in association with mammoth bones and represent cultural materials dating back some 11,000 years B.P., but in the Southeast they have not been found in association with similar indicators, so absolute dating of Paleo-Indian presence in the Southeast must remain based on the presence of artifact type alone (Hudson 1976).

The next cultural tradition to develop in the region of the Southeast (specifically Tennessee) was the Archaic, which began at around 8,000 B.P. (Lewis and Kneberg 1958) and is characterized by a culture that included more complex projectile points and weapons, increasing sedentism, diversification of food sources, development of artistic and aesthetic objects, and mortuary treatment which included burial of the dead (Hudson 1976).

The Woodland tradition emerged in the Southeast at about 3000 years B.P. and lasted until about 700 A.D. (Hudson 1976, Lewis and Kneberg 1958). The characteristic hallmarks of this culture include elaborations of the previous Archaic traditions, including the increasing use of pottery and refinements in food exploitation in the form of "rudimentary" agriculture that included the cultigen maize (Hudson 1976). Another Woodland innovation was the construction of mounded earthworks. While many of these earth structures are in the shapes of geometric designs or animal effigies and unknown in function, others functioned as elaborate earthen burial mounds.

The Mississippian period represents a transition to the final and most complex prehistoric culture in the Southeast, developing and flourishing from the previous Woodland cultures sometime around 900AD, and lasting well into the 16th century in some areas (Hudson 1976). It was a tradition that was marked by refinements in all levels of society. Typical Late Mississippian culture in the American Southeast is characterized by a number of traits, including intensive flood plain agriculture, densely populated village sites, elaborate earthen mound constructions, extensive trade networks, and socially stratified societies (Hudson 1976, Lewis and Kneberg 1958).

The Averbuch population belongs to a variant of the Mississippian culture found in Middle Tennessee, a manifestation known as the Middle Cumberland Culture (Ferguson 1972). Averbuch, however, does not present itself as a prototypical Southeastern Mississippian site because typical Mississippian cultural factors are absent. It is a non-mounded site located some distance away from a major floodplain, unusual for Mississippian villages (Smith 1978). It has been described as a "marginal" population (Eisenberg 1986) for a number of reasons, including the "aberrant" location of the village (Klippel and Reed 1984a). One causal explanation offered for this scenario is that increasing population pressure forced the inhabitants of Averbuch to move away from the more productive floodplains to settle in an alternative area which optimized access to productive soils (Klippel and Reed 1984a). Other Mississippian hallmarks are still intact, however, including elaborate mortuary treatment in the form of stone-box graves, recovered grave goods evidencing levels of social stratification

(Kline 1984, Reed 1984a; 1984b, Romanoski 1984), and ethnobotanical evidence of agriculture (Crites 1984a).

Mortuary Practices

The Averbuch people buried their dead in limestone-lined graves, a characteristic of other Mississippian groups in the region (Brown 1981). These stone-box graves were very numerous in and around the Nashville area, and late 19th century excavators recorded and unearthed many thousands of these burials from Middle Tennessee (Jones 1876, Thruston 1897).

The majority of the inhabitants of Averbuch were interred in primary inhumations in three separate cemeteries. Cemetery 1 yielded the remains of 562 individuals, Cemetery 2 yielded 98 individuals, and Cemetery 3 yielded 190 individuals. All told, 850 individuals were recovered from the three cemeteries, while the remains of 38 subadult burials were recovered from beneath structure floors.

Recovered grave artifacts of shell, lithic, ceramic, and bone material show differential patterning distributions based on age and sex categories, reflecting levels of social stratification typical of Mississippian cultures (Kline 1984, Reed 1984a; 1984b, Romanoski 1984).

Subsistence and Diet

Evidence for the Averbuch diet rests on ethnobotanical and zooarchaeological material recovered during excavations. Faunal remains include a diverse range of

animal species, including white-tailed deer, elk, turkey, Canadian geese, fish, and bivalves (Romanoski 1984). Analysis of botanical material reveals that agriculture was practiced and that maize was a large component of the Averbuch diet, along with hickory, walnut, squash, and other cultigens (Crites 1984). Overall, this evidence suggests that diet at Averbuch was quite varied, but it is likely that maize as a food staple was quite heavily utilized in the subsistence regime (Buikstra et al. 1988).

Warfare Evidence

There are a number of indications that warfare and interpersonal violence were factors of life at Averbuch. The village was fortified by a palisade, a defensive structure built to surround and protect villages (Lewis and Kneberg 1958). Archaeological excavations revealed that many of the structures at the site were destroyed by burning, indicating the possibility that a catastrophic event occurred at the site (Klippel 1984a), and skeletal evidence reveals the presence of at least four individuals with signs of healed scalping (Berryman 1981). All of this evidence taken together indicates that warfare and violence were factors of life at Averbuch.

Site Chronology

To date, radiocarbon samples have not been taken from the human osteological material at Averbuch, making it difficult to establish with any degree of certainty the site chronology. Eight out of nine radiocarbon samples taken from excavated wooden structures and features (Reed 1984c) yielded dates between 1145 and 1510 AD, with

the ninth date resulting in a 1765 AD date (obtained from a feature with historic artifacts, including a peach pit). Once calibrated, the radiocarbon dates from Averbuch yield a date of 1275 to 1400 AD (see Konigsberg and Frankenberg 1995 for applied Monte Carlo statistical methods to the distribution of these eight early radiocarbon dates for Averbuch). Occupation at the village was most likely of short duration, (100 years or less), but it is not possible to be more specific or offer a more exact occupation span at this point (Reed 1984c), although a number of chronologies have been proposed, ranging between 25 and 100 years (See Berryman 1984a, Kelley and Eisenberg 1987, and Konigsberg and Frankenberg 1995 for duration chronology arguments). Occupation at the site may have been on a seasonal basis, based on such factors as shallow midden depth, the lack of underground storage structures, and absence of large refuse pits at the boundaries of the site (Eisenberg 1986, Klippel quoted in Eisenberg 1986).

The chronological relationship between the three cemeteries themselves is difficult to ascertain. Because the palisade wall intersects Cemetery 3, it may be older than the other two, but efforts to distinguish temporally between the three cemeteries using biological categories have shown no significant differences (see Hens et al. 1996, Jablonski 1984, and Muendel 1998 for examples of efforts to use dental biological categories to distinguish between the three cemeteries).

Possible European Influence

Consideration must be given to the possibility that Averbuch was still occupied by the early to mid-1500's, and thus may have been influenced by European contact (directly or indirectly). Hudson (1976) has chronicled the waves of early Spanish explorers who landed in the New World and traveled through the region of the American Southeast. By 1524, Giovanni de Verrazzano had begun exploring the coast of North Carolina, and two years later Lucas Vazquez de Ayllon and 500 settlers attempted to establish a Spanish colony on the coast of South Carolina which failed due to epidemics of smallpox and other disease. While neither of these explorers traveled inland or had any direct contact with the indigenous Mississippian populations of Tennessee, European presence was firmly established in the Southeast and would eventually continue, reaching into Tennessee by the year 1540 (Hudson 1976).

Hernando de Soto, after serving under Francisco Pizarro during the conquest of the Incas in Peru, set his sights on the New World in search of more treasure to plunder. In 1539 he entered at Tampa Bay, Florida, and began a doomed three-year campaign, eventually dying of a fever in 1542 in the region of Louisiana. During his campaign, the Spaniards traveled from village to village, searching for gold and slaughtering the native inhabitants. By 1540, on their way to the regions of Georgia and Alabama, they stopped at the villages of Canasoga and Chihaha, both located on or near the border of what is now eastern Tennessee (Hudson 1976).

Although none of these early explorers physically set foot in the region of Middle Tennessee, it is possible that the Averbuch population (assuming occupation at the village was still in effect in the early to mid-1500's) could have indirectly felt the effects of European presence via trade networks, goods, and epidemics.

An interesting argument has been raised regarding the presence of modified deer and elk astragalus bones found at various Mississippian sites. Lewis (1988), in an article examining the presence of modified bone gaming dice in the American South, proposes that these game pieces are actually markers of Spanish contact rather than native Mississippian period artifacts. He proposes that modified cervid astragali, ground and smoothed for use as gaming dice, were an introduction by the Spanish and thus serve as an indicator of contact when found in archaeological contexts. Lewis outlines a number of conditions met at several Mississippian sites where modified astragali were found: astragalus dice are found only in regions of the country that were explored by Spaniards and found relatively late in the archaeological record; other than dice recovered from pit fill or structures, those found in burial contexts are associated with children; and just as in the Old World, New World astragalus dice are made from the bones of white-tailed deer and elk.

Modified astragali were recovered from Averbuch under the conditions outlined by Lewis, and the presence of these artifacts is interesting in light of his argument that they are markers of European influence. Radiocarbon dating of the human osteological material from burials containing the modified astragali would serve two purposes; it would clarify the temporal placement of Averbuch, and it would

also reveal whether the criteria outlined by Lewis for the presence of modified astragalus dice was satisfied at this site.

Previous Research

The Averbuch series represents an extensively studied skeletal collection. Previous research has examined this material for biological markers of stress and disease, with a number of studies focusing specifically on the dentition. A review of these investigations follows.

Berryman (1981, 1984): In addition to an extensive skeletal analysis and demographic profile of the Averbuch burials, Berryman focused on biological and social stress by examining the correlation between stature, enamel hypoplasia, and Harris lines between the three cemeteries. In terms of correlations, there were none found between stature and hypoplasia severity, Harris line number and hypoplasia severity, or Harris line number and hypoplasia number.

Stature was not found to differ significantly between the three cemeteries, but Berryman allows that it is not a useful indicator of stress at Averbuch, citing the obvious contradiction that while the Averbuch population was among the tallest recorded for a Native American skeletal collection, they were also among the most biologically and socially stressed, a fact not reflected by stature.

Harris lines in the distal tibia were found in 93% of males and 81% of females, but the number of stress episodes did not differ significantly between the three

cemeteries, perhaps indicating that the Averbuch population was experiencing chronic and constant stress episodes throughout the duration of occupation at the site.

Enamel hypoplasias were examined in 57 dentitions, with 91% showing hypoplastic defects. The breakdown of hypoplasias by sex shows males at 93% and females at 90%. Additionally, it was determined that hypoplasia formation occurs most between the ages from birth to 5.5 years – only three of these individuals had hypoplasias formed after 5.5 years of age. This present research, utilizing a larger sample size, will expand on these findings.

Buikstra (1992): This study examined the amounts of Carbon 13 present in bone collagen in order to evaluate levels of maize consumption for different skeletal series (including Averbuch) in order to assess the degree of dependence both temporally and regionally to this cultigen. Although maize was an indispensable component in many paleodiets, over-dependence on this resource was disastrous in terms of health and nutrition. Maize protein is lacking in lysine and trytophan which leads to a variety of nutritional deficiencies and diseases. When the levels were assessed for the Nashville Basin (and specifically Averbuch), the results revealed that maize consumption rates at Averbuch are among the highest in the Southeast and approach the high levels found in the American Southwest, a region whose subsistence regime depended heavily on maize.

Overall, this analysis revealed that maize was a large part of the subsistence strategy in the Nashville Basin and intensification of maize agriculture was rapid and

extreme, unlike many other areas where the shift was gradual. Implications to health and disease of stressed populations can be better understood by examining evidence of the possible underlying factors, and in this region of the Nashville Basin it is obvious that maize was an important influence.

Buikstra and Konigsberg (1985): In response to the Bouquet-Appel and Masset (1982) article criticizing paleodemographic methods, the authors undertake a principal components analysis on a series of skeletal collections in an effort to show that the creation and use of life tables is not as flawed as Bouquet-Appel and Masset assert. As part of this research, twenty-six skeletal collections were examined, including those from Averbuch. The results show an unusual demographic profile at Averbuch that is similar in terms of probability of dying to Crow Creek, a massacre site from South Dakota that was also analyzed in their study.

Eisenberg (1986): This study examines the adaptive capabilities of the Averbuch population by focusing on paleopathological indicators of stress. Among the factors examined were the presence of high rates of infectious disease and the nutritionally-based diseases cribra orbitalia and porotic hyperostosis. These diseases have implications in terms of the overall health and stress levels of the Averbuch population, and Eisenberg uses these indicators in an attempt to understand the possible factors contributing to Middle Cumberland culture population density, subsistence technology, and depopulation.

Eisenberg (1991): This study examines the phenomena of cultural termination (collapse) in the Southeast by exploring a number of possible causal explanations, including warfare, disease, and contact. Using the Averbuch skeletal collection as a model, Eisenberg examines the skeletal series for evidence of infection and iron-deficiency anemia, and finds both. The author rules out European contact as a monocausal explanation (European arrival postdated the end of the Averbuch culture, according to the chronology Eisenberg assumes for Averbuch). She concludes that a series of catastrophic events (high disease levels and warfare) may be the responsible agents in the collapse of this culture.

Kelley and Eisenberg (1987): This study examined 12 individuals from the Mobridge site in South Dakota (Arikara, Coalescent Tradition) and 47 individuals from Averbuch for patterned lesions suggestive of either blastomycosis (a soil-borne fungus with mortality levels near 90%) or tuberculosis. They argue that both diseases were present and endemic in Averbuch but concede that differential diagnosis suggests blastomycosis as the more likely candidate in all but a few cases.

Guagliardo (1980): Using a "non-traditional" stress indicator, this study attempts to provide a temporal placement for Cemetery 2 by examining the amount of fluctuation in tooth size, allowing that a higher degree of asymmetry is indicative of higher stress levels. Cemetery 2 was found to have the highest degree of dental asymmetry, followed next by Cemetery 1, with Cemetery 3 showing the lowest degree.

Guagliardo makes the tentative suggestion that this may indicate Cemetery 2 was later temporally than the other two.

Hens et al. (1996): Although dental wear is not usually considered a pathological condition in itself, when used in conjunction with other dental indicators of disease it is a useful marker in the assessment of health and disease. This study examined the Averbuch collection for wear characteristics and found a positive linear trend with attrition and age, with males demonstrating higher posterior wear than females, and no wear differences between the three cemeteries.

The fact that no wear differences were found is explained either due to the fact that diet did not change between the cemeteries (assuming they are spread across a wide temporal span), or the fact that there is no real temporal span between the cemeteries.

Jablonski (1981, 1984): Examined 80 individuals from Averbuch (20 males and females from Cemeteries 1 and 3) for evidence of pathological bands on the dentition (hypoplasias) and Striae of Retzius in order to distinguish temporally between Cemetery 1 and 3. Although it was found that the incidence of pathological bands was high (estimated at upwards of 63%) and indicative that this population was suffering from severe malnutrition and associated diseases, there were no differences found between the two cemeteries or sexes. These results may indicate that Cemetery 1 and 3 are not separated by a large temporal span, and may perhaps overlap.

Marks et al. (1996): This study examined an individual burial from Averbuch (Burial 488A) displaying excessive and abnormal calculus on the right half of the mandibular dentition as a result of dental and/or neurological disease. An SEM and light microscopy analysis of the calculus, alveolar bone, and enamel-calculus interface revealed the presence of several elements including calcium, phosphorous, and aluminum. During the course of preparation for inspection, an area of calculus was removed and the presence of a previously unknown interproximal groove was revealed, presumably made for the purposes of pain reduction.

Muendel (1998): This research examined dental enamel microwear using an Environmental Scanning Electron Microscope (ESEM) in an effort to distinguish differences in both diet and temporal span between the three cemeteries. No significant inter-cemetery differences were found by either sex or age, and the author notes that this is not surprising, since temporal occupation at the site was relatively short term, but concludes that the fact that no intra-cemetery differences were found is unusual given the social stratification noted at Averbuch and indicative of Mississippian sites.

Stevenson (1985): This research examined 153 subadult individuals from Averbuch for the presence of anomalous dental conditions known as double teeth (fused or geminated teeth) and oligodontia (fusion resulting in a composite single tooth). Ten cases were found (seven double teeth, two oligodontia, and one combination of both).

Since the etiology is genetic, the author notes that this trait could be useful in assessing familial burial patterning, although this was not proven conclusively at Averbuch with this study. It should also be noted that while the etiology has a genetic basis, other factors such as mechanical injury, disease, and crowding could influence the expression of this trait.

The next chapter will survey the suite of oral pathological indicators selected for analysis in this research including caries, enamel hypoplasias, alveolar resorption, and abscesses. It will also touch upon the implications of a maize-based subsistence strategy to dental health.

Chapter 2

Dental Anthropological Techniques

The human dentition is of extreme importance in many arenas of anthropological research. Often, the teeth are the most well preserved of all osteological material recovered during archaeological excavations. For paleoanthropological studies, teeth are sometimes the only biological component remaining of fossilized materials, and in forensic applications, analysis of the dentition is often the quickest and most reliable means for positive identification of remains. For bioarchaeological research, teeth are important not only for the wealth of information they can provide on factors such as age, sex, subsistence, and biological distance, but also for what they can reveal about overall individual and population health status (see Hillson 1996, Larsen 1984; 1997 and Lukacs 1989 for summaries).

The markers of dental disease and stress to be focussed on for this investigation include the following: caries, hypoplasia, alveolar resorption, and periapical and periodontal abscesses. Many of these are interrelated processes (for example, caries may eventually lead to periapical abscessing), and are useful indicators of the quality of life. A brief outline of the etiology and manifestation of these markers will now be presented.

Variables Analyzed

Caries

Caries (Plate 1) is the process by which the progressive destruction of the tooth surface by microbial agents (including *Lactobacillus acidophilus* and *Streptococcus mutans*) causes lesions on crown or root surfaces (Coykendall 1976, Mandel 1974, Pindborg 1970). Caries may typically be characterized as chronic or arrested, and may remain stable for months or years (Hillson 1986).

Carious lesions on the crown (enamel surface) begin as small, microscopic defects on the surface. As they begin to develop, these defects are usually pinpricks of a brown color, signifying the presence of bacteria. As the lesion progresses, the brown gives way to a white, opaque spot that becomes visible macroscopically and it is at this stage that the break-down of the smooth enamel surface begins to form a lesion or cavity (Duray 1990; 1992, Hillson 1986).

Different tooth types are inherently more susceptible to caries than others, owing to such varying factors as surface area and tooth complexity (Buikstra and Ubelaker 1994, Hardwick 1960, Moore and Corbett 1975). Teeth with greater surface area and more crenulations are more likely to prove attractive to bacteria, and this is why the posterior dentition (premolars and molars) are more prone to cavities than the anterior dentition (incisors and canines).

Plate 1. Carious lesions of the first and second left maxillary molars of an individual from Averbuch.

Tooth wear also affects the presence of caries. Abrasive diets or the use of teeth as tools contributes to an increase in wear (see Molnar 1971), which has the effect of cleaning tooth surfaces and hence actually lowering the rates of caries. Because wear in the Averbuch collection is high and typical of that of prehistoric agriculturists, caries rates may actually be underrepresented.

Foods high in carbohydrates and soft in texture (such as maize) are very cariogenic in nature. Based on this, and the fact that stable carbon isotope research has shown that the Averbuch population practiced a subsistence base heavily dependant on maize (Buikstra et al 1988, Buikstra 1992), it is expected that caries frequency rates at Averbuch will surpass the 2.3% - 26.9% hunter-gatherer, mixed economy, and agricultural societies scale developed by Turner (Turner 1979:624).

Enamel Hypoplasia

Hypoplasias are classified as developmental defects in enamel thickness due to disruptions in ameloblast activity from systemic stressors such as malnutrition and infectious disease (Buikstra and Ubelaker 1994, Goodman et al. 1980, Sarnat and Schour 1941, Suckling and Thurley 1984). Linear enamel hypoplasias manifest themselves typically as horizontal lines across the labial surface of the tooth (Plate 2).

Hypoplastic defects are useful indicators because they reflect the health status of the individual during early development through episodes of metabolic or growth disturbance (Giro 1947, Kreshover 1960). Because the formation of hypoplastic lines leaves a permanent physical record on the enamel, it is possible to calculate the age at which the defect occurred, since tooth formation and maturation rates are

Plate 2. Multiple hypoplasias on the anterior maxillary dentition of an individual from Averbuch.

theoretically known (Buikstra and Ubelaker 1994, Goodman and Rose 1990, Rose et al. 1985, Swardstedt 1966). It is thus possible to observe on the permanent adult dentition a record of juvenile morbidity (see Goodman 1989 for a summary).

Previous non-dental paleopathological research has documented levels of poor health at Averbuch (see Buikstra 1992 and Eisenberg 1991 for summaries), so it is hypothesized that there will be high levels of hypoplasias present in this collection as well.

Alveolar Resorption

Alveolar resorption is a loss in alveolar crest bone from near the level of the cementoenamel junction (CEJ) on the tooth toward the roots (Plate 3). It is one indicator of periodontal disease, a blanket term given to the process of an inflammatory response affecting the tissues of the periodontium, usually in response to irritants such as plaque and calculus (Littleton and Frohlich 1989, Ortner and Putschar 1981). Because of the relative lack of studies focusing on periodontal disease, there exists no real systemic method of classifying and quantifying this disease process (Hildebolt and Molnar 1991). As such, this research will limit itself to merely recording absence or presence information for this indicator.

Plate 3. Alveolar resorption of the mandible, right side view.

Abscess

Abscesses, whether the result of caries, pulp exposure, or periodontal disease, are useful indicators of dental health when assessed in combination with other dental pathological conditions (Plate 4). Abscesses are caused by bacterial toxin drainage which forms channels from the roots that ultimately penetrate the alveolar bone (Hillson 1996). They may be located periapically - at the apices of tooth roots, or periodontally - between the tooth roots (Ortner and Putschar 1981, Ruben et al 1970).

Wear

Attrition, or tooth wear, while not in itself a disease process, may be linked to a variety of factors including normal biomechanical action, food preparation techniques, diet, environment, and paramasticatory use of the teeth as tools (Brothwell 1981, Molnar 1971, Murphy 1959). Normal attrition is viewed by many researchers as beneficial because it serves to clean the teeth and wear away fissures which might otherwise prove attractive to cariogenic bacteria. On the other hand, severe attrition leads to the wearing away of the occlusal surface of the tooth, creating the potential for pulp cavity exposure resulting in infection of the pulp and alveolar bone, and exfoliation of the tooth from the alveolus (Ortner and Putschar 1981). Attrition is important because of the variety of information it can provide about subsistence, cultural practices, and normal masticatory stresses.

Plate 4. Abscess above the first left maxillary molar of an individual from Averbuch.

Hens et al. (1996) focussed on dental wear among the Averbuch skeletal sample. Using the Smith (1984) method for scoring the degree of occlusal dental wear, the authors examined 328 adult individuals and determined that dental wear increased with age; that males had faster wear rates; and that there were no differences between the three cemeteries in terms of wear.

Because this foundation had already been laid, the present study did not collect information on degree of tooth wear. Instead, it was taken into account that wear in the Averbuch collection followed typical agriculturalist wear patterns. In the Eastern Woodlands region foragers demonstrate higher degrees of wear than agriculturalists due to the consumption of hard-textured and abrasive food, but the shift to an agricultural strategy did not entirely eliminate grit and hard-textures in the food, so wear among agriculturalist peoples is still considerable (Larsen 1997). The implications to this study involve data collection in the categories of caries and hypoplasias. Both of these variables are affected to a negative degree; that is, their frequencies are most likely underrepresented because of the effect wear has on smoothing down or grinding away newly forming carious lesions, and obliterating hypoplastic lines near the occlusal surfaces of teeth.

Maize, Disease, and Dental Health

A number of researchers have studied levels of dental health at archaeological sites in an effort to understand temporal trends in diet and subsistence (see Larsen 1983; 1995, Smith 1982). Studies of caries frequencies are especially valuable for this

type of research, as they document the shift from foraging to an agricultural subsistence base. Data from the Eastern Woodlands focusing on dental caries frequencies has been collected ranging temporally from foragers (including Archaic, Early Woodland, and Middle Woodland periods) to agriculturists (including Late Woodland, Mississippian, and Contact periods). Figure 3 shows the percentage of teeth affected by caries from a series of 75 archaeological populations from the Eastern Woodlands (from Larsen 1997:69).

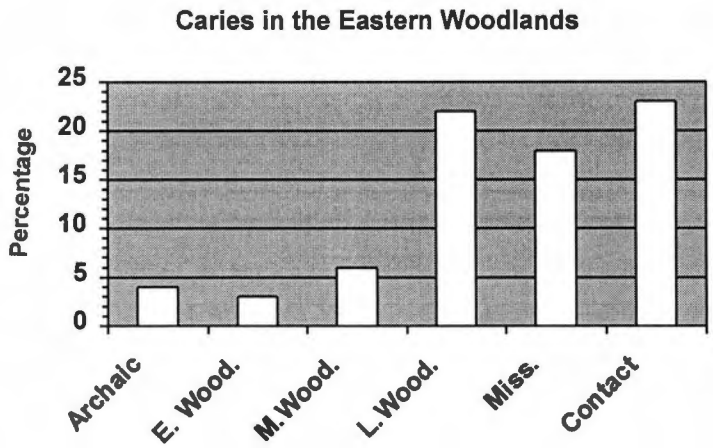

Figure 3. Caries trends from 75 foraging and agricultural economies in the Eastern Woodlands of North America (from Larsen 1997:69, based on data from Milner 1984 and Larsen et al. 1991).

These results are explained in terms of dietary change and the adoption of largely maize-based agricultural subsistence bases. As the graph illustrates, the three foraging groups (Archaic, Early Woodland, and Middle Woodland) show caries rates at 6% or less. By contrast, the three agricultural groups (Late Woodland,

Mississippian, and Contact) all have caries rates between 17% and 23% (with the Mississippian group at 17%). This increasing caries frequency trend is due to the adoption of maize agriculture and the corresponding increase in the amounts of sucrose in the diet, which increases cariogenic bacteria. Based on these calculated frequencies, and previous research documenting extensive support for a higher-than-average reliance on maize at Averbuch (Buikstra 1992, Buikstra et al. 1988), it is expected that caries frequencies at Averbuch will be found in excess of the 17% rate calculated for the Mississippian agricultural groups.

Chapter 3

Materials and Methods

For this study, a total of 304 individuals with permanent adult dentitions from the Averbuch skeletal sample were examined for the presence of a number of oral pathologies including carious lesions, enamel hypoplasias, alveolar resorption, and periapical and periodontal abscesses. Criteria used to determine which individuals were to be included in this study were based on the presence of permanent adult dentition (no deciduous or mixed dentition) as a prerequisite for inclusion in the sample, as well as relative completeness of the dentition and the state of preservation of the dental and skeletal tissues. The data sets were collected based on gross visual inspection of the dentition of each individual burial, aided by a hand magnifier, dental probes, and Fowler-NSK digital calipers. The findings were recorded on a dental inventory chart specifically created for this project (see Appendix).

Demographic Information from Previous Research

Demographic analysis by Berryman (1981) on the Averbuch skeletal material has already been conducted and specific ages and sexes for each individual burial determined. This present research will rely on those determinations, which were made using conventional skeletal biological methods of age and sex assessment (see Berryman 1981 for a complete review of methods and procedures used).

Age Category Revision

For the purposes of this research, the original age categories assigned by Berryman (1981) to each individual have been condensed into a format more suited to this research. Table 1 lists both the previous age codes and the newly revised codes along with their new age range assignments. This was done to create a smaller age range in the lower ages (5 year spans), while allowing larger ranges for the upper ages (10 year + spans). This facilitated a less complicated data entry method since the age ranges for adults were condensed and grouped by decade at age of death.

Table 1. Previous age codes assigned to the Averbuch collection along with the new codes and the corresponding age range assignments for this study.

Previous Age Codes	New Age Codes	New Age Range
0 - 5, 29	0	0 - 4 years
6 - 10, 30	1	5 - 9 years
11 - 15, 31	2	10 - 14 years
16 - 20, 32	3	15 - 19 years
21 - 22	4	20 - 29 years
23 - 24	5	30 - 39 years
25 - 26, 34	6	40 + years

General Demographic Information

The overall composition of this sample by age range and sex is illustrated in Figure 4. The 304 adult individuals used in this research were selected from a total sample of about 400 adult dentitions considered. Although additional data were recorded on over 200 infants and subadults from the Averbuch sample, they were not included for analysis in this research because of the imposed limitations. The dearth

of individuals within the 10-14 year range, as well as the complete absence of any individuals younger than 10 in this study is thus due to the fact that they did not qualify for inclusion due to the absence of the permanent adult dentition.

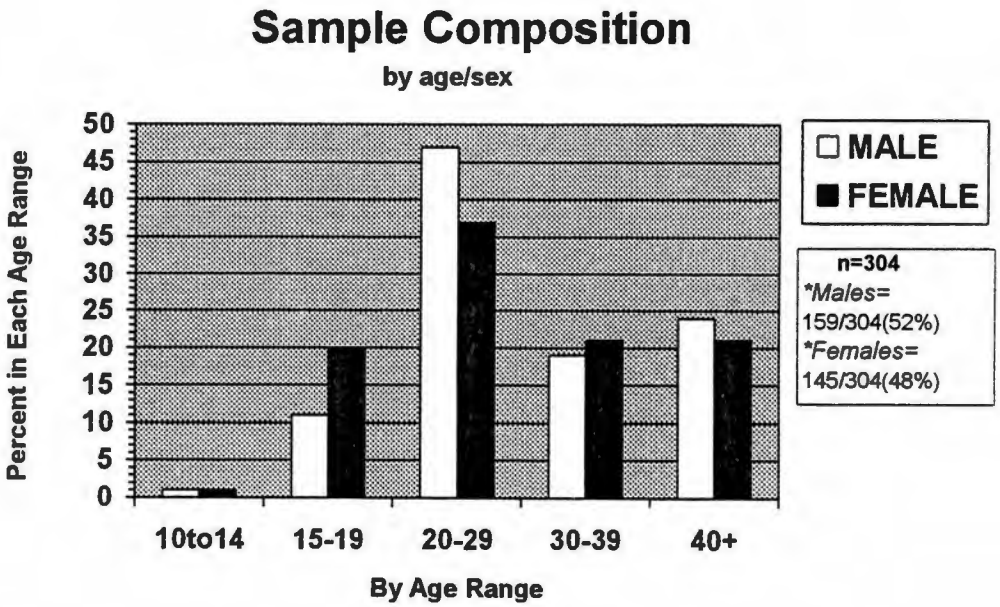

Figure 4. The sample composition from the Averbuch skeletal series used in this research.

The total sample used in this study is composed of 304 individuals, broken down into 159 males (52% of the total sample) and 145 females (48% of the total sample). By age range, the distributions are found in the following totals. In the 10 to 14 year range, there are 3 individuals (1% of the total sample); 1 male and 2 female (sex assigned by Berryman 1981). In the 15 to 19 year range, there are 47 individuals (15% of the total sample); 18 male and 29 female. In the 20 to 29 year range, there are

124 individuals (41% of the total sample); 71 male and 53 female. In the 30 to 39 year range, there are 62 individuals (20% of the total sample); 31 male and 31 female. Lastly, in the 40+ year range, there are 68 individuals (22% of the total sample); 38 male and 30 female.

Dental Categories

The following section details which markers of oral pathology were recorded for this study, how presence or absence was assessed, and which measurements were taken. The categories selected for inclusion in this study were caries, linear enamel hypoplasias, alveolar resorption, and abscesses. The procedures followed for data collection of these variables were adapted from the *Standards for Data Collection from Human Skeletal Remains* (Buikstra and Ubelaker 1994).

Caries Recording

Caries prevalence information was collected by gross visual assessment. When carious lesions were obvious in their expression, they were recorded by tooth location and size. In cases where the lesion was small or just beginning to form on enamel surfaces, a dental probe was used to determine if the spot penetrated the smooth surface of the enamel. In cases where the results were questionable or difficult to determine, the lesions were not recorded as carious. It should also be remembered that due to the nature and degree of wear present within this sample (agriculturalists

with high degrees of tooth wear), caries frequencies are undoubtedly underrepresented in this sample.

Hypoplasia Recording

Hypoplasia data was collected by gross visual assessment. The permanent maxillary central incisors and mandibular canines were chosen for inspection because they are the most susceptible to stressful events and provide the best indicator of all the teeth in the dental arcade (Goodman et al. 1980). When linear enamel hypoplastic lines (as opposed to vertical, pitted, or amorphous hypoplastic defects) were noted on a tooth and its antimere, the total crown height (measurement from the occlusal surface to CEJ) was taken with the digital calipers in millimeters (See *Standards for Data Collection from Human Skeletal Remains,* Buikstra and Ubelaker 1994, for procedures followed in measuring these defects).

Next, the hypoplastic line (or lines, in the case of multiple linear enamel hypoplasias) was measured from the CEJ to the most occlusal aspect of the defect (Buikstra and Ubelaker 1994).

With the use of standardized tables (see Goodman et al. 1980, Rose et al. 1985), these measurements can be converted into known ages of occurrence, because tooth eruption and formation rates are known (Figure 5).

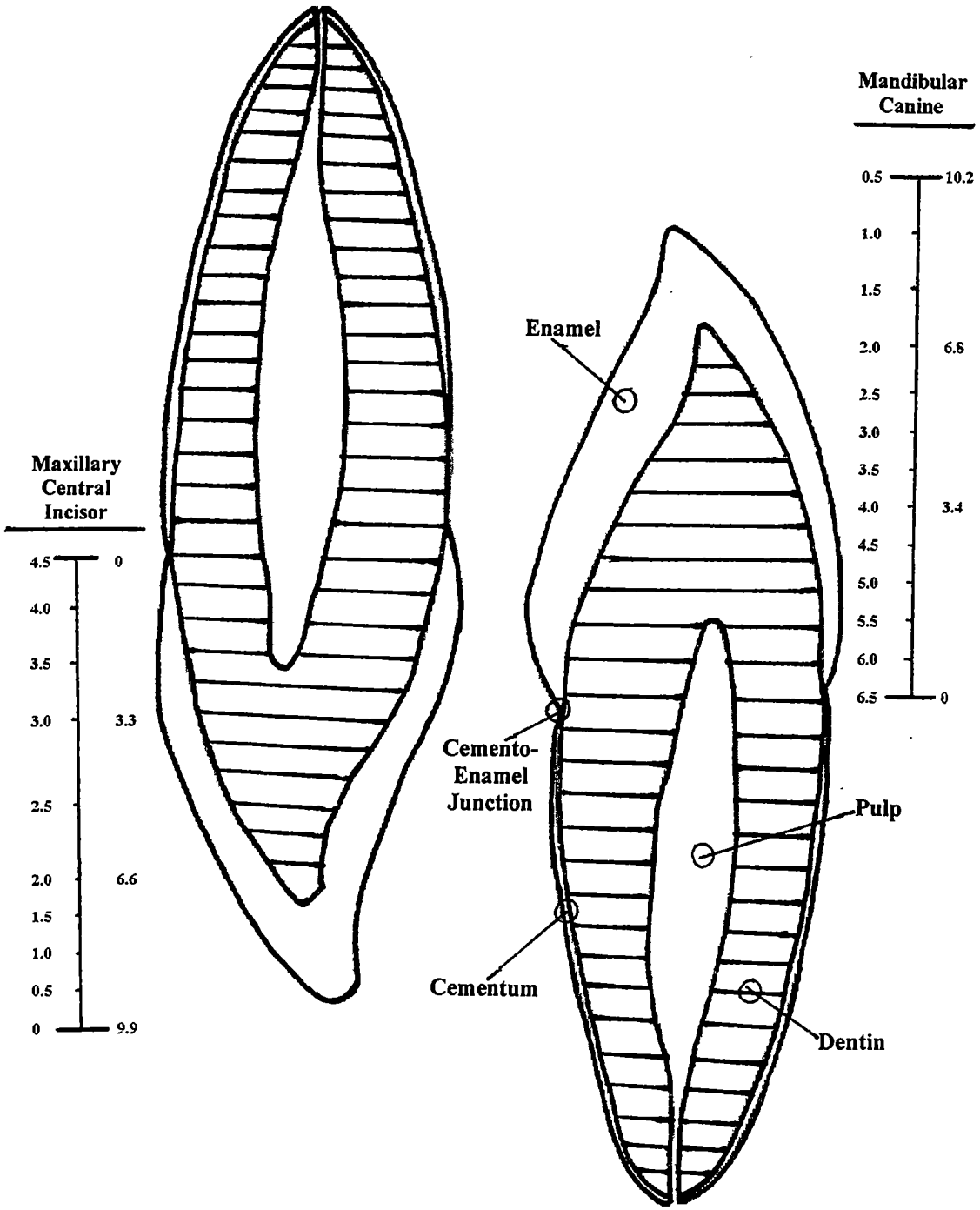

Figure 5. Mineralization and conversion chart for the permanent adult maxillary central incisor and mandibular canine alongside a representation of each tooth. Numbers to the left of each chart are the ages at which the corresponding sections of enamel formed (Goodman et al. 1980, modified from Swardstedt 1966 and from Massler et al. 1941).

Alveolar Resorption Recording

Alveolar resorption, an indicator of periodontal disease, was measured by examining the alveolar area surrounding the molars. Alveolar resorption was recorded as positive if there was a loss of more than 3 millimeters (mm) in height from the level of the CEJ to the top of the alveolar portion of bone in either the mandible or maxilla. This 3 mm measurement was a subjective and arbitrary level, but chosen because with that amount it was visually obvious that periodontal disease was occurring.

Abscess Recording

Abscesses were recorded on a presence or absence basis only. Attention was taken to carefully distinguish between true abscesses and postmortem taphonomic defects. An abscess was considered present if a drainage passage existed along the alveolar region (lingual, labial, or buccal surface) of the maxilla or mandible of an individual.

Chapter 4

Results

This chapter presents the results of the 304 permanent adult dentitions. The analysis will be presented in text and/or graphical format, beginning with caries, and followed by enamel hypoplasias, alveolar resorption, and abscess data. These categories will be broken down by sex and age ranges in order to gain a clearer picture of the percentage of individuals showing expression of each pathology.

Caries Results

Figure 6 shows the relationship between caries by sex and age range. Of the 304 individuals included in this study, 234 (or a total of 77%) showed evidence of having one or more carious lesions in the adult permanent dentition. When assessed by sex, the results show no significant differences. Males account for 49% (115 of 234) of the total, while females make up 51% (119 of 234) of the total sample.

When examined by age range, total caries frequencies for both sexes are found in the following totals. In the 10 to 14 year range, no individuals with lesions were noted (0%). In the 15 to 19 year range, 31 individuals with lesions were noted (13%). In the 20 to 29 year range, 93 individuals with lesions were noted (40%). In the 30 to 39 year range, 51 individuals with lesions were found (22%). Lastly, in the 40+ year range, 59 individuals had carious lesions (25%).

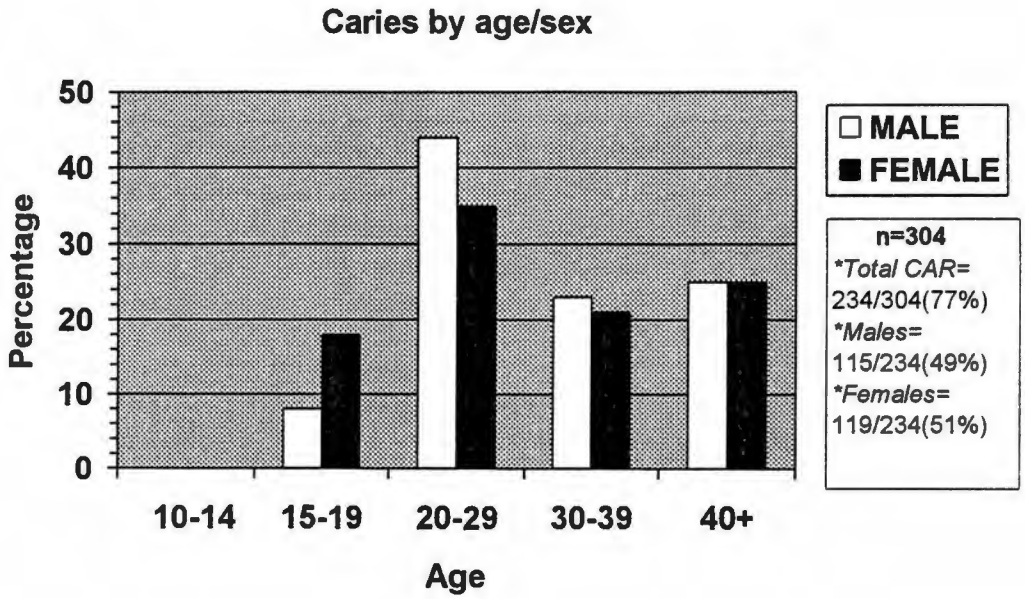

Figure 6. Percent of individuals from the Averbuch sample exhibiting one or more carious lesions on the adult permanent dentition by sex and age.

Hypoplasia Results

Figure 7 shows the relationship between enamel hypoplasia by sex and age of onset range. Of the 304 individuals included in this study, 265 (or a total of 87%) showed evidence of having linear enamel hypoplasias (multiple lines at differing ages of onset on single individuals) in the adult permanent dentition. By sex, males account for 50% (133 of 265) of the total of individuals with hypoplasias, while females make up 50% (132 of 265) of the total sample.

Examining the total of both sexes by age of onset, the 726 linear enamel hypoplasias recorded on all 265 individuals are found in the following distributions

(note that totals will not add to100% due to rounding). In the birth to 1 year range, hypoplasias occurred at a rate of 0%. In the 1 to 1.5 year range, hypoplasias occurred at a rate of .002%. In the 1.5 to 2 year range, hypoplasias occurred at a rate of 2%. In the 2 to 2.5 year range, hypoplasias occurred at a rate of 8%. In the 2.5 to 3 year range, hypoplasias occurred at a rate of 19%.

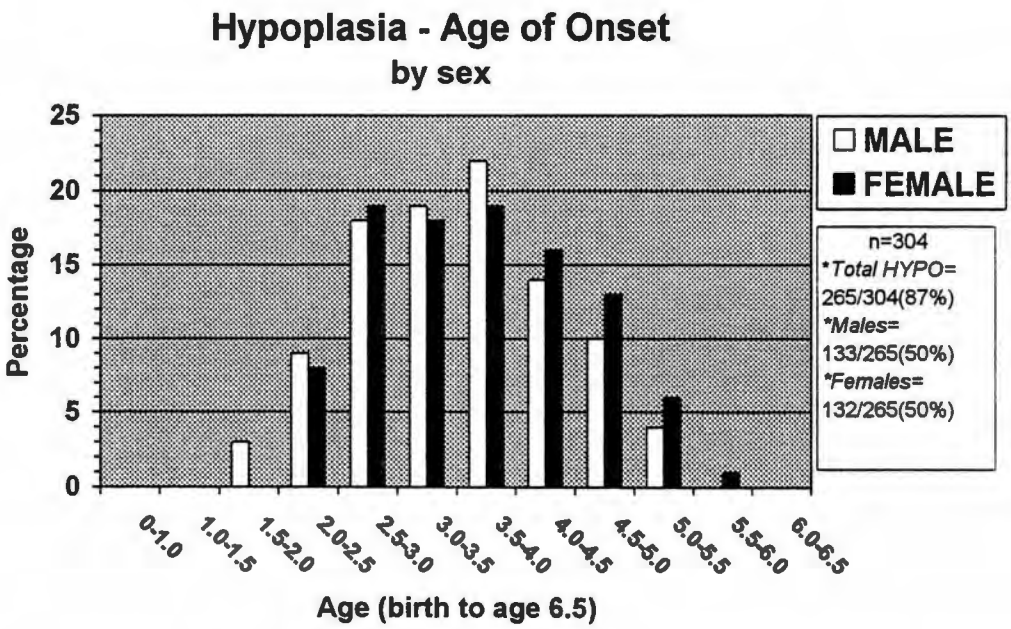

Figure 7. Percent of individuals from the Averbuch sample exhibiting enamel hypoplasias of the adult permanent dentition by sex and age of onset.

In the 3 to 3.5 year range, hypoplasias occurred at a rate of 19%. In the 3.5 to 4 year range, hypoplasias occurred at a rate of 21%. In the 4 to 4.5 year rate, hypoplasias occurred at a rate of 15%. In the 4.5 to 5 year rate, hypoplasias occurred at a rate of 11%. In the 5 to 5.5 year range, hypoplasias occurred at a rate of 5%. In

the 5.5 to 6 year range, hypoplasias occurred at a rate of .006%. In the 6 to 6.5 year range, hypoplasias occurred at a rate of 0%.

Alveolar Resorption Results

Periodontal disease, based on the degree of alveolar resorption measurements, is a very difficult marker of dental pathology to quantify. Because of the inherent subjectivity involved with assessing alveolar resorption (for example, how many millimeters loss is necessary before it is considered indicative of periodontal disease), a graphical representation was not attempted. Instead, a flat percentage of 39% of the 304 individuals in this sample were assessed as having alveolar resorption, this condition having been met when two or more measurements taken at the posterior dentition were greater than 3 millimeters each.

Abscess Results

Figure 8 shows the relationship between abscess by sex and age range. Of the 304 individuals included in this study, 58 (or a total of 19%) showed evidence of having one or more abscesses in the alveolar region of the maxilla or mandible. When broken down by sex, males account for 57% (33 of 58) of the total of individuals with abscesses, while females make up 43% (25 of 58) of the total sample. When examined by age range, total abscess frequencies for both sexes are found in the following percentages. In the 10 to 14 year range, 1 individual with an abscess was noted (1%). In the 15 to 19 year range, 4 individuals with abscesses were noted (7%).

In the 20 to 29 year range, 18 individuals with abscesses were noted (31%). In the 30 to 39 year range, 16 individuals with abscesses were found (28%). Lastly, in the 40+ year range, 19 individuals with abscesses were observed (33%).

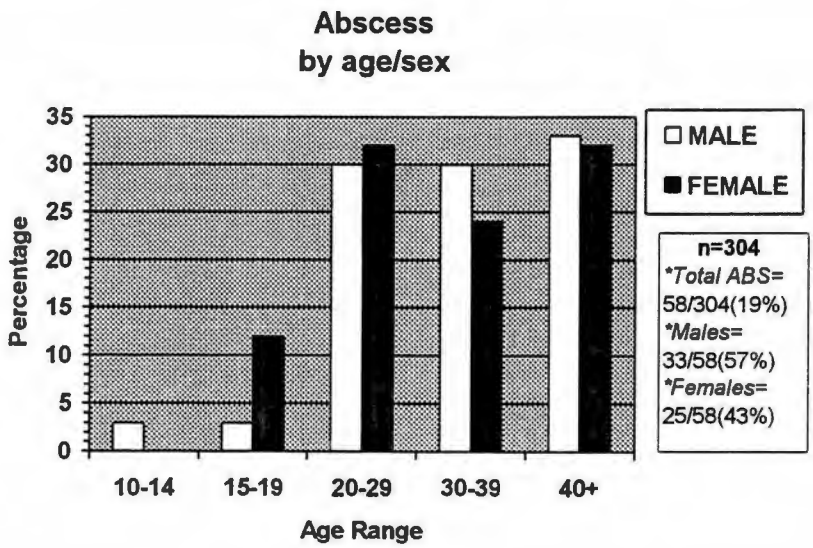

Figure 8. Percent of individuals from the Averbuch sample exhibiting one or more abscesses in the maxilla or mandible by sex.

Chapter 5

Discussion

The results of the analyses from the preceding chapter are in some ways both expected and surprising. The population from Averbuch is severely disadvantaged, and the heavy biological stress loads are recorded on the dental tissues.

Caries in the Averbuch Sample

The results of the analysis revealed caries rates at Averbuch at extremely high percentages - 77% of the individuals from this skeletal sample had one or more carious lesions.

Intersite Comparisons

The resulting percentage of individuals with carious lesions at Averbuch far exceeds the suppositions put forth earlier regarding foraging and agriculturalist caries frequencies (see Chapter 2). Based on comparisons with other prehistoric agriculturalists the Averbuch caries percentages obviously surpass the 17% average frequency rate for Mississippian groups (Larsen 1997).

When compared to contemporaneous Mississippian period groups, Averbuch falls at the high end of caries frequencies (Table 2). Compared to Moundville (a Mississippian ranked chiefdom from Alabama), Lubbub Creek (a Mississippian village in Alabama), Nodena (a Mississippian population from Arkansas), Kane

Mounds (a Mississippian group from Illinois), and Campbell (a Mississippian site from Indiana), Averbuch ranks higher than all except Kane Mounds, and yields similar numbers to Nodena (percentages are rounded out).

Table 2. Caries frequencies among six Mississippian sites from North America. Source: Milner 1984:86, Powell 1988:189.

Site	N Carious Individuals	% Carious
Lubbub Creek (Powell 1983)	15/30	50%
Moundville (Powell 1988)	192/355	54%
Campbell (Spier 1955)	18/25	72%
Averbuch (Present Study)	234/304	77%
Nodena (Powell 1987)	120/155	77%
Kane Mounds (Milner 1984)	18/23	78%

Implications

Over-reliance on a maize-based subsistence regime can be disastrous in terms of dental health, and this is confirmed once again by the results of the analysis of caries frequencies at Averbuch. The percentages for Averbuch are exceeded only by the Kane Mounds sample, but it should be noted that the Kane Mounds study involved a small sample of only 23 individuals of a somewhat fragmentary nature (Milner 1984), and this may have had some impact on the resulting percentages.

Hypoplasias in the Averbuch Sample

Results of the analysis of hypoplasias in the permanent adult dentition of the Averbuch sample also revealed very high frequencies for this defect. A total of 87% of the individuals in this sample possessed one or more hypoplasias, which is indicative of systemic stress disruption (Buikstra and Ubelaker 1994, Goodman et al. 1980, Sarnat and Schour 1941, Suckling and Thurley 1984).

Intersite Comparisons

When compared to contemporaneous Mississippian period groups, Averbuch again falls at the high end of the hypoplasia frequency amount (Table 3). In addition to comparisons with Moundville, Lubbub Creek, Nodena, and Kane Mounds, when also compared to Dickson Mounds (a Mississippian site from Illinois) Averbuch again ranks higher than all except Kane Mounds, and again yields similar results to Nodena (percentages are rounded out).

Implications

The high frequency of enamel hypoplasias in the Averbuch sample is impressive and indicative of a generalized level of systemic distress within the entire population. Almost nine out of every ten individuals suffered some sort of chronic or acute insult as a child, severe enough to leave a permanent record of the disturbance on the adult dentition.

Aside from the high percentage of individuals with hypoplasias (males and

Table 3. Hypoplasia frequencies among six Mississippian sites from North America. Source: Goodman et al. 1980, Powell 1988:187.

Site	% with Hypoplasias
Moundville (Powell 1988)	54%
Lubbub Creek (Powell 1983)	61%
Dickson Mounds (Goodman et al. 1980)	79%
Averbuch (Present Study)	87%
Nodena (Powell 1987)	89%
Kane Mounds (Milner 1984)	90%

females distributed quite equally), it is interesting to note the patterning of the age of onset of the hypoplasias (refer to Figure 9 in Chapter 4). Distributions are quite equal between males and females by age range, and in terms of the age of onset, fully 85% of the hypoplastic lines (in most cases, multiple hypoplastic lines on single individuals) are contained within the 2.5 to 5 year age ranges.

This matches the so-called "weaning hypothesis" model, where hypoplasias peak between 2.0 and 4.0 years of age due to the negative effects of weaning stress (Corruccini et al. 1985, Larsen 1997, Goodman et al. 1980). However, caution must

be exercised before ascribing weaning stress and the resulting decrease in enamel strength and stability to patterns of hypoplasia expression.

Blakey et al. (1994) recently conducted a test of the weaning hypothesis using both historical and skeletal records from a population of African American slaves from the American Northeast. The hypoplasia information, if it were accurately reflecting weaning stress, showed the ages between 1.5 an 4.5 years as the peak ages. However, Blakey and coworkers were able to ascertain that weaning in this population took place between 9 months to 1 year, so it is obvious that weaning stress can not be said to explain the patterns.

Instead, it may be the result of more than just a monocausal event. At Averbuch, stressors such as endemic disease, poor nutrition, regional hostility, and weaning may all have played a part in the onset of hypoplasias which peak between the ages of 2.5 and 5 years.

Alveolar Resorption in the Averbuch Sample

Within this sample, alveolar resorption of 3 millimeters or more at the molars was in evidence in 39% of the individuals. With the suite of factors involved in the periodontal disease processes, it is not surprising to see such a high frequency manifested at Averbuch, along with a wide array of other dental pathological problems.

Abscesses in the Averbuch Sample

Results of the analysis of periapical and periodontal abscessing in the permanent adult dentition of the Averbuch sample revealed a frequency of 19% for individuals in the sample.

Chapter 6

Conclusions

With respect to the goals of this project, the results can be summarized as follows:

- A general descriptive study of a number of oral pathologies within the Averbuch population was undertaken in an effort to better understand the social, environmental, and biological stressors exerting influence on the oral health status of this group of Mississippian-period Native Americans.

- Based on the findings, it is apparent that the adaptive efficiency of this group was compromised. Furthermore, when compared to spatially and temporally similar groups, Averbuch scores the worst. This indicates that it is not Mississippian-period groups on the whole who are failing to adapt to their environment, but Averbuch specifically.

- It is reasonable to infer that stressors in the form of population pressure, warfare, hostility, high endemic and infectious disease levels, and a maladaptive subsistence strategy had a direct bearing on the health and welfare of this population.

- The dentition is a sensitive barometer that records biological insults to individuals quite accurately. It is not surprising, therefore, to see high rates of carious lesions and linear enamel hypoplastic defects, and relatively high levels of alveolar resorption and rates of abscesses.

- It is clear that dental anthropology is an important and necessary component to any bioarchaeological investigation. Assuming for the moment that no archaeological context information was available about the Averbuch site and skeletal material, dental indicators would still lead to the conclusion that they were an agricultural group (angles, planes, and degree of wear), most likely engaged in a subsistence base that relied heavily on maize (caries frequencies), with an undetermined but significant level of biological stressors affecting nearly every individual in the group (hypoplasia frequencies). The value of dental anthropology as a tool to aid in understanding past behaviors, environments, and cultural constraints is underscored.

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Appendix

Sample protocol sheet used during data recording of oral and dental pathologies for the Averbuch (40DV60) adult dentition.

AVERBUCH (40DV60) ORAL HEALTH RECORDING FORM **PERMANENT DENTITON**

Burial #. _____ Age: _____ Sex: _____ Date: _____ Observer. _____

MAXILLA

R	#	PRES	WEAR	CARIES	CALC	ABSC	ALV	HYPOPLASIA
	1							
	2							
	3							
	4							
	5							
	6							
	7							
	8							
	9							
	10							
	11							
	12							
	13							
	14							
	15							
L	16							

MANDIBLE

L	#	PRES	WEAR	CARIES	CALC	ABSC	ALV	HYPOPLASIA
	17							
	18							
	19							
	20							
	21							
	22							
	23							
	24							
	25							
	26							
	27							
	28							
	29							
	30							
	31							
R	32							

PRESENCE :
1 Present - not in occlusion 2 Present - dev't completed 3 Missing - no associated alveolar bone 4 Missing - antemortem loss 5 Missing - postmortem loss
6 Missing - congenital absence 7 Present but damaged - all possible info recorded 8 Present but unobservable 9 Present - no associated alveolus X Missing - cast present
WEAR:
Code 1 - 8 (Smith 1984)
CARIES: by surface
1 Occlusal - incl buccal and lingual grooves of molars 2 Occlusal - large lesion, restricted to occlusal surface only 3 Interproximal - includes mesial and distal cervical regions
4 Smooth surface - buccal and lingual surfaces other than grooves 5 Cervical - at the CEJ except at interproximal regions 6 Root - below the CEJ 7 Large - no surf assigned
8 Pulp chamber exposure from attrition
CALCULUS:
1 Flecks 2 Connected flecks, surface coatings - little relief 3 Raised profiles with relief
ABSCESS:
1 Buccal/labial alveolar channel 2 Lingual alveolar channel 3 Alveolar crest discharge 4 Apex-crest (comp buccal + labial) 5 Apex-crest (comp lingual) 6 Combo 4+5
ALVEOLAR RESORPTION
Measurement from CEJ of mesial buccal cusp of molar to alveolar crest, in millimeters
HYPOPLASIA: Mandibular canines and maxillary central incisors
1 Linear horizontal grooves 2 Linear vertical grooves 3 Linear horizontal pits 4 Nonlinear array of pits 5 Single pits

Adapted and modified from Standards for Data Collection from Human Skeletal Remains 1994. Buikstra and Ubelaker, eds MDH 11/95

Vita

Michelle Dawn Hamilton was born November 24, 1969 at the New London Naval Submarine Base in Groton, Connecticut. At the age of two she packed her bags and took the show on the road, touring all over Texas, Florida, Italy, and California.

In 1988, Michelle graduated in California from Simi Valley High School. Setting her sights on an archaeological career, she attended California State University Northridge, where she decided that physical anthropology was where it was at. She graduated with a B.A. in anthropology in 1992.

Late in 1993 she hitched a four day ride on a Greyhound bus (a monumental lapse in judgement), and took off to attend The University of Tennessee Knoxville, where she received her Master's Degree in December 1998.