One of Us: Analyzing Social Integration in an Prehistoric Pueblo Site through Dental Caries

M.A. Thesis Proposal

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I. Abstract

This study will examine dental caries in a pre-contact Puebloan population from the Pottery Mound site (29-LA-416) in New Mexico. At Pottery Mound, males and females had different roles in food production which may have translated into differential dietary resource access or utilization. Several different ethnic subgroups are also thought to have been present in the Pottery Mound community. This study will look at caries rates in males and females, juveniles and adults, and in individuals who are thought to have been from different ethnic groups as evidenced by the type of structure they dwelled in.

The null hypotheses I will be testing are: 1) Adult males and females utilized the same types of dietary resources at the same rates as shown through similar caries rates 2) Juvenile males and females utilized the same type of dietary resources at the same rates as shown through similar caries rates 3) Individuals throughout the Pottery Mound community had similar caries rates regardless of the type of dwelling they lived in. This research is relevant because it can tell us about differential access to dietary resources in the past, based upon sex and ethnic identity. This can give us insight on how sex and membership in ethnic groups have influenced dietary resource utilization through time, and allow a critical look at dietary resource utilization today.

To look at these hypotheses, I will note the location of each burial in the overall layout of the Pottery Mound Pueblo in an attempt to distinguish between the families that founded the Pueblo and those that migrated to it. I will estimate age and sex of the individuals in this population, then take a full dental inventory of each element. Carious lesions will be measured and recorded using a form I have constructed for this study. Once collected, the data will be input into the SPSS statistical suite, and chi-square tests, t-tests, Wilcoxan signed-rank tests and will be run to look for statistically significant differences between the groups.

II. Introduction

The purpose of this study is to examine dental caries in a pre-contact population from the prehistoric Pueblo site of Pottery Mound (29-LA-416) in New Mexico. This study will examine dental caries in the Pottery Mound sample, curated at the Maxwell Museum of Anthropology at the University of New Mexico in Albuquerque, New Mexico. It will compare the rates of carious lesions between males and females, between juveniles and adults, and between individuals found in single story and multi-story dwellings. To do this, the remains will be sorted by location, sex and age group, and then macroscopically examined for carious lesions. Lesions will be identified using a jeweler's loupe and fluorescent light source, and measured using metric calipers. Once collected, this data will be input into the SPSS statistical suite and

analyzed using chi-square tests, t-tests, Wilcoxan signed-rank tests. Statistically significant differences between sexes and groups within the Pueblo will be sought.

A number of studies have been conducted that examine the prevalence of carious lesions in pre-historic populations (Costa 1980; Cucina and Tiesler 2003; Watson 2008; Lanfranco and Eggars 2010). This information is often used to reconstruct past life-ways and subsistence patterns (Costa 1980; Cucina and Tiesler 2003; Watson 2008; Lanfranco and Eggars 2010). It can also be used to analyze more abstract things like social status and group affiliation (Cucina and Tiesler 2003; Lanfranco and Eggars 2010). This study will attempt to examine the role membership in various social groups played in dietary dietary resource utilization at the Pottery Mound site area during the occupation period by comparing the carious lesion rates of various groups, including males and females; juvenile and adults, and individuals from different ethnic groups as determined by their type of dwelling.

The role of sex in dental health has been looked at by scientists in the past, with a focus on sex hormones and gland sizes. Bioarchaeologists have looked at how diet differently affected the overall health, and the dental health in particular, of males and females in Mesoamerica (Cucina and Tiesler 2003; Magaha 2008l Lanfranco and Eggars 2010). This study will examine how sex and dental health are related, both biologically and culturally.

When dietary dietary resource utilization patterns changed in an individual's life will also be looked at by comparing caries rates in the juveniles, looking at the spread of lesion rates using scatter plots. The overall integration of ethnic groups within the Pueblo will then be examined by looking at carious lesion rates by geographic location, looking for any correlation between health and the type of dwelling an individual lived in.

III. Background

The site known today as Pottery Mound (29-LA-416) is a Puebloan site in the Eastern Pueblo culture area. Pottery Mound was occupied from 1370-1450/1475 C.E, during the period known as Pueblo IV (Schaafsma 2007). It was known to modern scholars as far back as 1926 (Vivian 2007). It was first recorded in 1930 and was later excavated in 1954 by Frank C. Hibben and the University of New Mexico Archaeological Field Session (Hibben 1955; Vivian 2007). Excavations and recordation continued through 1961, with Hibben taking the helm. Work began again in 1975 and continued sporadically until 1986 (Vivian 2007).

Pottery Mound has been studied extensively by archaeologists and physical anthropologists (Vivian 2007). A great deal of work has been done on the murals found in the 17 kivas excavated by Hibben and his crews, as well as on the numerous pottery sherds that gave the site its moniker (Schaafsma 2007). Studies have also been conducted on the layout of the community and the design of the familial and community spaces within it (Wills 2001; Adler 2007). Of special note are the studies done by Eckert (2007) and Adler (2007) which discuss the integration and segregation of ethnic groups at the Pottery Mound Pueblo.

Eckert (2007) discusses the different type of pottery found at the site. She identifies several different styles, based on both the kind of temper and the type of glazing, and charts them through time, finding that Zuni and Hopi-style pottery began appearing early in the occupation period and continued throughout. She contends that this reflects two waves of migration, one Hopi and one Zuni. These introduced pottery types never eclipsed the original varieties, though they were found in great number. This suggests that the people who made them were numerous and retained their own ethnic identity even after living at the site for some time.

Adler (2007) finds a similar pattern in the architecture of the pueblo itself. He notes that single story, single family dwellings were the first to be built. These were then followed by multi-story multi-family units which appeared in the early occupation period, around the time the Hopi and Zuni wares began to appear. Changes in the religious iconography found in the kiva murals occur around the same time, with a distinctly Western-Pueblo influence, specifically the Sikyatki style designs characteristic of the Pueblo IV Hopi (Crotty 2007; Gilpin and LeBlanc 2007). The design of the kivas was also unusual, with most of the kivas having the rhombus shape that is characteristic of Western Pueblo kivas, rather the circular shape one would expect from an Eastern Pueblo site like Pottery Mound (Adler 2007)

Both Eckert (2007) and Adler (2007) note that in Pueblos across the region, there have been ethnographically documented instances of the communities "splintering". A large Pueblo would split into several small groups for political, religious or financial reasons, among others, and often one or more of these groups would leave the pueblo. The small groups would then often go join other, established pueblo communities. Pottery Mound was in an interesting geographic area, close to both the Eastern and Western Puebloan communities, making it the perfect place for people on the move. It is suggested that the changes in architecture, religious iconography and material culture over time suggest a wave of immigration in the early occupation period (Schaafsma 2007; Adler 2007; Eckert 2007).

Though a great deal of research has been done on the material culture of Pottery Mound, little has been done to look at the bioarchaeology of the site. Some studies that use individual remains from Pottery Mound use them as a reference sample for the region as a whole rather than looking to them as a source of data on the site itself. Others look to the skeletal remains of the individuals in the community to learn more about the people of Pottery Mound. Ogilvie and

Hilton (2011) looked at the role women played in the economy of Pottery Mound through an examination of their humeral dimensions, finding that women played an important role in food acquisition and preparation process. Women were found to have more humeral strength overall. This reflects the kiva murals which show women carrying burden baskets, making pottery, raising children and preparing food (Ogilvie and Hilton 2011). Knowing that women played such an important role in the subsistence economy of Pottery Mound, it begs the question: did all this hard physical work grant them equal access to dietary dietary resources?

Another study that looked at the remains of individuals from Pottery Mound with an eye towards gathering information about the people and culture of the site was a 2008 Master's thesis by S.M. Magaha. She looked at a variety of skeletal pathologies present in the Pottery Mound sample, including dental caries, and compared the overall rates to those found in the Mimbres sites. Unfortunately the data gathered was only used to shed light on the overall health of the population and did not provide any information about groups within Pottery Mound. Overall comparisons of health were made between the Pottery Mound and Mimbres samples, but no analysis of groups within Pottery Mound was done. Different pathology rates by sex, age and possible ethnic affiliation were not discussed.

That will be remedied in the study being proposed here. Dental caries will be used to indicate dietary dietary resource utilization and utilization by a variety of groups at the Pottery mound site, including men, women, juveniles and ethnic groups.

Dental caries is a disease process that involves the demineralization of tooth enamel and dentin matrix by bacterial organic acids, forming carious lesions (Hillson 1986; Featherstone 2004). These bacteria inhabit the mouth, attaching themselves to the pellicle on the surface of the tooth (Bowen 2002). Acidogenic plaque bacteria, like *Lactobacillus* and *Staphylococcus*

mutans, ingest fermentable carbohydrates that enter the mouth. Lactic acids and other organic acids are produced as a byproduct of the bacteria's digestion. These acids work their way into the enamel, and sometimes into the dentin or cementum, of the tooth. There they proceed to break down the inorganic matrix. They also lower the overall pH of the oral cavity, making the environment more hospitable to the acidogenic bacteria that produced them. Over time, this causes acidogenic species to far outnumber species which are less acid tolerant (Bowen 2002).

The acids begin to dissolve the mineral crystals that make up the inorganic matrix components (Featherstone 2004). These broken down crystals can then diffuse out of the tooth, leaving it structurally weaker. At first the absence of matrix is not visible macroscopically. Over time, a white/brown spot will form, making the carious lesion visible to the naked eye. As the disease progresses, the discoloration is replaced by a small pit. This pit can grow along the tooth's surface, developing into a large shallow depression. It can also go deeper and deeper into the tooth, passing through the enamel and dentin, making its way to the periapical area (Dias and Tayles 1997).

The body has ways of compensating for this demineralization process. The salivary glands produce saliva, which acts as a lubricant, an antimicrobial agent, and a matrix transporter. Saliva flushes out some of the fermentable carbohydrates that the bacteria ingest, restricting their food supply (Lenander-Lumikari and Loimaranta 2000; Featherstone 2004). It also provides a medium for the acids to diffuse into, weakening them.

Saliva contains proteins that keep the pH in the oral cavity from dropping too low, thereby making the environment less hospitable to the microbes (Lenander-Lumikari and Loimaranta 2000). It contains antimicrobial agents which kill some of the bacteria. Inorganic compounds like calcium and phosphate are also found in saliva. These compounds can be utilized by the

body to reform the dissolved dental matrix and repair the carious lesions, actually making the tooth stronger than it was before.

It is possible for this remineralization process to cancel out damage done by the demineralizing organic acids (Featherstone 2004). Carious lesions can only form if more material is demineralized than is remineralized.

Scientists have found that some individuals seem to be more likely to develop carious lesions than others, all other things aside (Horowitz et al. 1958; Rosen et al. 1961; Boraas et al. 1988; Bretz et al. 2005). Studies have been conducted on both human and animals which suggest that a person's chances of developing carious lesions can be greatly reduced or increased depending on their genes. Caries susceptible rats that have been placed at birth with caries resistant rats will develop carious lesions at a much faster rate than caries resistant rats placed anywhere, even when both groups are on the same diet high in fermentable carbohydrates (Rosen et al. 1961).

How human beings develop caries is also influenced by their genetics (Horowitz et al. 1958; Boraas et al. 1988; Bretz et al. 2005). Numerous studies have been done on both monozygotic and dizygotic twins, looking at their caries rates. Boraas and colleagues (1988) looked at twins that had been reared apart and compared their caries rates. They found that twins who shared the exact same DNA (monozygotic) had caries at the same rates, while twins who did not (dizygotic) had more divergent caries rates (Boraas et al. 1988). Different environments could still produce the same caries rate. The same pattern has been found in twins reared together (Bretz et al. 2005). Pairs of monozygotic twins had the same caries rates, while pairs of dizygotic twins had variable rates (Boraas et al. 1988; Bretz et al. 2005).

If there were no genetic factors influencing caries development, we would expect monozygotic and dizygotic twins to have similar rates (Boraas et al. 1988). Instead, we find that

twins with the same genes (monozygotic) tend to develop caries similarly. Those with different genes develop caries at a more divergent rate. Because this happens in twins that share the same environment (reared together) and that grow up in different environments (reared apart), it shows that there is some unknown genetic component involved in the development of carious lesions.

Genes influence a number of things, including tooth development and salivary gland function (Bretz et al. 2005). Genes determine how soon teeth erupt, which is important because teeth seem to be most susceptible to caries right after eruption. Teeth that erupt earlier would also be exposed to cariogenic bacteria for a longer amount of time, potentially allowing them to incur more damage (Lukacs and Largaespada 2006). Their form also influences the severity of carious lesions. Fermentable carbohydrates get stuck in deep fissures on the tooth's surface. This is where caries are most likely to form (Hillson 1986; Featherstone 2004). Genes determine the final form of teeth, thereby determining the final location of carious lesions.

The influence of genes of salivation is well known (Lenander-Lumikari and Loimaranta 2000). Individuals born with xerostomia and other hyposalivary conditions have a much higher rate of caries than those born with normal saliva levels. If a person's genes make them produce too little saliva, the remineralization process can be retarded and the carious lesion development process accelerated.

The genes that determine sex have a recognized influence on the rate of salivation (Lukacs and Largaespada 2006). Women have been found, both in the archaeological record and in the modern day, to have a higher rate of carious lesions than their male counterparts. Cucina and Tiesler (2003) found that high status women in the Mayan world had the highest rate of caries. Watson (2008) found the same thing in the Sonoran desert. This could in part be because women

have smaller salivary glands than men, giving them less saliva overall (Lukacs and Largaespada 2006). More likely is the estrogen link.

Lukacs and Largaespada (2006) explain that high amounts of estrogen have been shown to cause low levels of saliva production. This could be why historically people have observed a direct correlation between number of pregnancies and rate of dental disease. The genes are the starting point for later reactions that lead to carious lesions.

Archaeologists have long recognized the non-environmental factors in carious lesion rates, noting that sometimes groups in the same geographic area who utilize the same dietary dietary resources will still have very different caries rates (Costa 1980; Cucina and Tiesler 2003). Costa (1980) looked at three Eskimo groups: two from Point Hope, Alaska and one from Kodiak Island, Alaska. The two Point Hope groups lived in the same area and utilized most of the same dietary dietary resources, but they ended up with very different caries rates. He suggests that in addition to utilizing some dietary dietary resources at different rates than others, genetic differences could account for much of the caries rate variation (Costa 1980).

Anthropologists and dental researchers alike have recognized that there seems to be some link between an individual's sex and their susceptibility to carious lesions (Costa 1980; Hillson 2001; Bretz et al. 2005). It is believed that women have a higher caries rate than men, though the reasons behind this are not understood.

Some have proposed that it could be genetic, while others believe it has to do with behavior, specifically with sex roles giving differential access to fermentable carbohydrates. Tayles and colleagues (2000) found that women started out with a much higher caries rate than men, and as rice agriculture became more intensely exploited, the caries rates of both sexes dropped. The caries rates of women started out much higher than those of men, and dropped much more in

absolute terms, becoming almost equal to those of men in later samples. Admittedly they had much further to go, because they started out at a much higher rate.

Tayles and colleagues (2000) suggest that women may have had a much higher caries rate initially because of their role in food preparation. Snacking during the day can lead to the pH in the mouth being acidic for longer periods. This is because every time a person snacks, the acidogenic bacteria of the mouth consume fermentable carbohydrates and produce acid, sending the pH lower (Loesche 1986). After the initial drop, it takes several hours for the pH to return to normal. Continual eating, even if the amounts of food are small, prevents the mouth from ever returning to its neutral pH, leading to a higher rate of caries. Tayles and colleagues (2000) suggest that this process led to women having rates of caries as high as 21% in their Khok Phanom Di sample. They posit that the adoption of agriculture, which put women in the field rather than in the kitchen, led to less snacking and was therefore one of the factors in women's later lower rates of caries.

This is especially pertinent to Puebloan groups. According to Ogilvie and Hilton (2011), the people of Pottery Mound lived in a society where women were expected to contribute in a significant, physical way to the subsistence economy of the community. Their 2011 study lends credence to this theory of a sexual division of labor, showing that men and women engaged in different tasks and had different levels of muscle and bone development as a result. The kiva paintings show this as well. This study can take those facts and look at them in a new light, shedding light on whether the worlds of men and women were truly as divorced as they seem on the surface to be.

Differences in behavior are often cited as the reason for the differences in the rates of caries in men and women. However, because dental caries is a multifactoral disease process, sex

differences in any one of the factors can play a role. In addition to the behavioral reasons mentioned above, hormones can also play a factor. As mentioned earlier, the effects of high estrogen levels can decrease salivation, thereby retarding the remineralization and buffering process. This could lead to women having higher caries rates than men. Further exploration of the reasons behind differential caries rates needs to be performed.

For over twenty years, anthropologists have been positing a link between a population's subsistence modes and their rate of carious lesions. In 1982 a conference was held at State University of New York College at Pittsburgh. At this conference, a number of landmark papers were presented, which were later compiled in the book Paleopathology at the Origins of Agriculture (Cohen 1984). These papers discussed an apparent drop in health that seemed to coincide with the rise of agriculture. Recently, studies have begun to discredit this hypothesis, suggesting instead that what individuals eat before and after the transition to agriculture is what determines caries rates.

Numerous studies have looked at dental caries in prehistoric populations in much the same fashion I will. Watson (2008) looked at caries rates in a Zapotec population from the Sonoran desert. Watson's (2008) sample consisted of 135 individuals from the Early Agricultural Period (1600 BC – 200 AD). Sex and age were estimated for these individuals, and their dental health was assessed (Watson 2008). 13.5% of the population was found to have carious lesions, and 17.6% had ante-mortem tooth loss (Watson 2008). There were no statistically significant differences between the males and females in this sample, leading Watson (2008) to conclude that sex had little to no impact on access to dietary dietary resources. Watson (2008) concluded that these high rates of dental caries were caused by the sticky carbohydrates being gathered, rather than the grains being cultivated.

Costa (1980) looked at caries rates in males and females in pre-contact populations from Kodiak Island, Alaska and Point Hope, Alaska. There were so few caries in the sample that Costa (1980) could not run statistical analyses. Rather, he had to use the raw data to look for general trends (Costa, 1980). He found some differences between sex and age groups, though whether these differences are statistically significant or not remains to be seen (Costa 1980). According to Costa (1980), the caries rates are a product of cultural and environmental factors.

Cucina and Tiesler (2003) looked at dental caries in a Classic Maya sample. They found statistically significant differences in caries rates between upper class males and the rest of the population, which they attributed to differential access to protein (Cucina and Tiesler 2003). Sex and social class determined dietary dietary resource access in this society, and was reflected in the caries rates (Cucina and Tiesler 2003).

Lanfranco and Eggars (2010) looked at four different Pre-Columbian groups in Peru, three from the Formative Period and one from the Late Intermediate Period. They found that all four of these groups overall had low rates of carious lesions, despite being agricultural and, in the case of the Late Intermediate Period sample, highly socially stratified societies. Antemortem tooth loss was also fairly low, and only one Formative period group had higher lesion rates. When these samples was broken down by age and gender though, a whole new pattern emerged. Adults were found to have higher rates of caries overall as time, and reliance on grain agriculture, intensified. Young men in the highly stratified Late Formative Period were found to have significantly higher caries rates than their female counterparts. Lanfranco and Eggars point out that their study was hindered by the small size of their populations, and the unevenness of sex and age ratios within it. I believe a larger study with a wider variety of individuals, like mine, would not suffer from these problems.

Caries rates have been studied in old world populations as well. Tayles and colleagues (2000) looked at caries rates in Thailand before, during and after the transition to rice agriculture. Caries rates appeared to go down uniformly when rice was introduced, suggesting equal access to dietary resources within these groups (Tayles et al. 2000). The fact that the development of agriculture led to a decrease in overall caries rates is attributed to the way rice was processed in Southeast Asia at the time (Tayles et al. 2000). Much of the rice husk remained intact throughout the processing cycle, which led it its consumption (Tayles et al. 2000). The rice husk is thought to have scrubbed the teeth clean as people chewed it, leading to cleaner teeth and lower caries rates (Tayles et al. 2000).

These studies show that the subsistence mode itself has nothing to do with caries rates. Rather, what people eat determines whether or not they have good oral health (Tayles et al. 2000). This study will be looking at a population that had a mixed subsistence economy, with some agriculture being practiced, along with some hunting/gathering (Magaha 2008). A number of kiva paintings depict the women of Pottery Mound as having participated in the planting, harvesting and processing of things like corn, beans and squash (Magaha 2008). The layout of the community and evidence of irrigated fields confirms that agriculture provided a great deal of the nutritional dietary resources used at Pottery Mound.

Despite having access to agricultural goods, a great deal of hunting was going on as well. Archaeologists have excavated the remains of both large (deer, wolves) and small (rabbits, rodents) mammals, along with over 50 different bird species (Emslie 1981; Magaha 2008). Emslie (1981) suggests that the diversity of bird species in the Pottery Mound diet is due in part to their tradition of agriculture. He suggests their crops attracted hungry birds to the community, which were then hunted and consumed.

If sex affects how dietary resources are distributed, as it did in the world of the Classic Maya, it can be reflected in caries rates (Cucina and Tiesler 2003). At the same time, if dietary resource utilization is unaffected by sex, then differences between males and females will be small (Costa 1980; Watson 2008; Lanfranco and Eggars 2010). My study will attempt to determine if there is a difference between the sexes and, if it exists, why.

IV. Methods

The goal of this study is to look at caries rates in the Pottery Mound (29-LA-416) population and examine how things like sex roles impacted health in prehistoric populations. By looking at caries rates in the Pottery Mound population, this study will shed light on what relationship, if any, existed between sex and dental health in this group. In this study I will be using a dental probe and jeweler's loupe to search for carious lesions on each skull and mandible in the population. I will begin by placing each skeletal element into one of two age groups (juvenile or adult) using the Ubelaker's (1989) diagram outlining the "sequence of formation and eruption of teeth among American Indians", as found in Buikstra and Ubelaker (1994). Juveniles will be placed in specific age cohorts (0-5, 6-10, 11-15, 16-21). All individuals in the adult group will then be further aged using the Smith (1984) and Scott (1979) methods for scoring surface wear, as described in Buikstra and Ubelaker (1994).

I will then estimate the sex of the individual, placing them in either the male, female, or indeterminate category. Burials that contain both a skull and pelvis will have sex estimated using innominate sex estimation methods. Any burials lacking a pelvis will have sex estimated using one of the cranial methods discussed below.

There are many different methods, both mathematical and subjective, that can be used to estimated sex using the innominate and the skull. Bass (1995), Buikstra and Ubelaker (1994), Phenic (1969), Krogman and İşcan (1986), Wolfe and colleagues (1994), Skelton (1996), and Acsádi and Nemeskéri (1970). Some of these methods were not designed for use with Native American remains. Others will not work with the fragmentary remains I will be encountering. For the purposes of this study, sex will be estimated using the methods outlined by Buikstra and Ubelaker (1994).

Pelvic elements will be looked at using the methods described by Buikstra and Ubelaker (1994) in Standards for Data Collection from Human Skeletal Remains. They instruct researchers to look at the pubis, greater sciatic notch and preauricular sulcus. Using the metod they outline, the ventral arc, subpubic concavity and ischiopubic ramus ridge are examined and given a score of 0-3; the greater sciatic notch is scored from 1-5 based on the openness of the angle; and the preauricular sulcus is scored on a scale of 1-4. This information is then recorded on a form included in the standards. Once gathered, sex can be estimated for the individual in question.

When it is necessary to estimate the sex of an individual using only their crania, the primary method I intend to use will be the one outlined by Buikstra and Ubelaker (1994) in the standards, as it relies on cranial and mandibular features while recognizing that these features exist on a spectrum. The method they describe was first discussed by Acsadi and Nemeskeri (1970). It requires researchers to score the nuchal crest, mastoid process, supra-orbital margin, supra-orbital ridge/labella, and the mental eminence on a scale of 1-5. These measurements are then recorded on a form included in the standards. Once gathered, sex can be estimated for the

individual in question. Any remains that are too fragmentary to estimate the sex of using one of the two above mentioned methods, unfortunately, will not be included in this study.

Once an individual's remains have had age and sex estimated, a dental inventory of each element will be taken, using the attached Lesion Recording Form. Once a lesion is detected, I will measure it using calipers, recording its dimensions and depth in millimeters, along with the tooth and surface it is located on. Missing teeth will be noted, with an eye to distinguishing ante-mortem from post-mortem loss.

Many osteologists note how advanced the lesion is by using systems that rate the tooth subjectively on a scale. The scales used vary by researcher. Costa (1980) for example uses a scale of zero to six to rate visible lesions, while Tayles and colleagues (2000) simply noted when a lesion was "massive". Because these scales are subjective, they are impossible to reproduce. This makes it incredibly difficult to compare studies in terms of severity.

Some such scales use more concrete features to define what a "5" is, and how it is different from a "3". Lanfranco and Eggers (2010) used a 1-4 scale that rated each lesion based on the tissue involved. Lesions that involved only the enamel or cementum, as evidenced by having a depth of less than 2mm, were scored as a 1. Dentine caries, identified as lesions with a depth of 2mm, were scored as a 2. Pulp caries, lesions that exposed the pulpar cavity, were scored as a three, regardless of specific depth. Gross-gross caries and root remains were scored as a 4.

The most easily reproducible method of studying carious lesions is to measure the size of the lesion in question, or how far it is from any given edge. Hillson (2001) suggests taking these steps, and this may be especially good to do if an individual is studying how lesions form on teeth. It is also an objective measure of lesion severity and can be easily replicated by others using the same methodology.

For this study, Lanfranco and Eggar's (2010) scale will be slightly modified. In addition to their 1-4 scoring, a score of 0 has been added to represent teeth without lesions. A score of 5 has been added to represent teeth which are absent due to antemortem tooth loss, as evidenced by alveolar resorption. A score of 6 has been added represent teeth which were lost perimortem or postmortem, as shown by alveolar integrity.

Additionally, as suggested by Hillson (2001), lesion dimensions will be noted in this study. The surface on which the lesion is located will also be noted, as it can give information about how the lesion was formed.

This data will be recorded using a data recording form I have devised for this study. Once collected, the data will be entered into SPSS, a statistics program that will allow me to compare frequencies between groups and look for statistically significant differences. I will perform chi-square tests, t-tests, Wilcoxan signed-rank tests to determine if the null hypotheses are correct. The first null hypothesis will be that there is no difference between males and females in the population. The second null hypothesis will be that there is no difference between age groups in the population.

V. Expected Findings

I expect to find that females in the have a significantly higher caries rate than males. Many earlier studies suggest that females tend to have a higher incidence of dental caries than males (Tayles et al. 2000; Cucina and Tiesler 2003). Because of this, I expect females in both my groups to have a higher incidence of dental caries than males. Further, because the population

practiced some corn agriculture and women processed and prepared corn for consumption, the women should have higher cares rates.

I also expect to find that younger individuals will have a lower rate of dental caries than older individuals. I believe this will be the case as younger individuals will have had less exposure to the cariogenic bacteria. When examining the rates of dental caries in subadults, I expect the caries to fall in a normal utilization on the scatter plots, showing male and female subadults received access to the same dietary resources with no clear preference of some individuals over others.

It is possible that males and females could have similar rates of dental caries, due to cultural or environmental factors. It is also possible that age groups would also have similar rates of dental caries. Such a result was found in the study conducted by Costa (1980) at Kodiak Island in Alaska. Such uniform rates suggest that males and females ate the same things, with sex roles and social position having little impact on an individual's access to dietary resources. Such negative results are just as informative as the positive results I expect to find, as they can tell anthropologists a great deal about how societies functioned.

I also expect to find that caries rates do not vary based on the ethnic identity of the individuals under study. Though ethnic groups were clearly present at Pottery Mound and maintained an ethnic identity, these groups seem to have integrated a great deal (Eckert 2007; Adler 2007). I expect to find that an individual's caries rate is based more on their sex than their ethnic identity, as determined by the geographic location of their burial.

VI. Schedule

I plan to travel to the Maxwell Museum of Anthropology at the University of New Mexico in Albuquerque, New Mexico in June of 2011, when I will begin recording my data. I plan to record my data during the months of June and July. I will return to the Bay Area in August to begin my data analysis. I will conduct my statistical analysis and work on writing my thesis from August through December of 2011. During this time, I will construct my Data and Conclusions sections, while continuing work on my Literature Review and Methods Sections, which I have already begun researching and drafting. I plan to have my thesis completed in December of 2011.

VII. Committee

Mark Griffin – Major Advisor
Cynthia Wilczak – 2nd reader

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