

Dental Variation of Prehistoric Amerindian Populations
from Eastern Tennessee

M.A. Thesis Proposal

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9/20/2004

I. Abstract

The purpose of this thesis is to estimate biological distance between three Native American skeletal samples from the eastern Tennessee. Biological distance, or degree of genetic relatedness, will be assessed by a comparison of dental nonmetric trait frequencies. The samples included here represent three prehistoric populations from the Late Mississippian cultural period (AD 1000-1600). Archaeological data indicates that these populations are temporally successive and correspond to the late Hiwassee Island (AD 1200-1350), Dallas (AD 1350-1450), and Mouse Creek (AD 1400-1600) phases in this region. Previous research (Beck 1995; Chapman 1985; Lewis and Kneberg 1946, 1958; Lewis, Lewis, and Sullivan 1995; Powell 1988; Sullivan 1991) has shown that these populations exhibit large changes in settlement patterns and mortuary practices across the three phases. It is not clear if the changes in cultural practices reflect population replacement, acculturation of in situ populations with some admixture, or merely cultural changes within an intact population. The primary goal of this research is to determine if these three populations share a close biological affinity, or if they represent distinct biological groups. Biological affinity is an important consideration in developing an understanding of the relationships, and patterns of microevolution among prehistoric Amerindian populations. This study is significant because there has been little research conducted on the genetic relationships between Amerindian groups in the southeastern United States. Previous research (Griffin 1993, Griffin *et al.* 2001) has shown that many of the population relationships inferred from ethnographic and archaeological sources are inconsistent with biological data. In the interpretation of North American prehistory, it is important to include biological relationships between populations in order to fully understand the dynamics of these past populations.

II. Introduction

The purpose of this study is to examine the biological relationships and population history of three prehistoric Native American population samples from the Tennessee River Valley region of the Southeastern United States. This study will examine variation in dental morphology between and among these skeletal samples and attempt to assess the meaning of this variation in the broader perspective of population change over time. Biological distance, or degree of genetic relatedness, will be assessed by a comparison of dental nonmetric traits. Previous studies (Dahlberg 1951; Griffin 1993, 1994; Scott and Dahlberg 1981; Sofaer *et al.* 1972; Turner 1985, 1986, 1989, 1990) have shown that there is a correlation between biological distances and dental morphology and that this relationship can be used to determine the degree of relatedness among populations. Recent skeletal biological distance studies (Cucina *et al.* 1999, Hanihara *et al.* 2003, Higa *et al.* 2003, Ishida and Dodo 1993, Stefan 1999, Turner 1990) have effectively assessed the biological affinities of various populations around the world, leading to a greater understanding of inter- and intra-population relationships, geographical variation, and patterns of microevolution.

This study is important because there has been little research on the biological affinities of Native American groups in this region. Previous studies of native populations from the southeastern United States (Griffin 1993, 1994; Griffin *et al.* 1997, 2001; Stojanowski 2003a, b, 2004a) have suggested complex biological relationships indicating a high degree of diversity for these groups. Due to the lack of ethnographic data from this period, little is known about the genetic relationships of the native populations of eastern Tennessee. Archaeological data suggests that major cultural

changes occurred during the Mississippian period (AD 1000-1600). Historical accounts from the period of European contact have described differing accounts of population movement and migrations in this region (Chapman 1985; Lewis and Kneberg 1946, 1958; Lewis, Lewis, and Sullivan 1995). An examination of dental nonmetric traits and an assessment of biological distance between these groups will help to clarify the population history of Native Americans during the Late Mississippian period in eastern Tennessee.

The three population samples to be used in this study represent three archaeological sites (Hixon, Dallas, and Rymer) from the Chickamauga Basin area in eastern Tennessee. These sites are geographically and temporally distinct skeletal populations dating from the late Mississippian cultural period. Recent radiocarbon dating from these sites (Sullivan 2001) has placed the Hixon sample in the late Hiwassee Island phase (AD 1200-1350), the Dallas sample in the Dallas phase (AD 1350-1450) and the Rymer sample in the Mouse Creek phase (AD 1400-1600). Previous research (Beck 1995; Chapman 1985; Lewis and Kneberg 1946, 1958; Lewis, Lewis, and Sullivan 1995; Powell 1988; Sullivan 1991) has shown that these populations exhibit large changes in settlement patterns and mortuary practices across the three phases. It is not clear if the changes in cultural practices reflect differences in biological relationships. The primary goal of this research is to determine if these three populations share a close biological affinity, or if they represent distinct biological groups.

III. Background

Prehistory of the Chickamauga Basin

The archaeological context links the biological element of skeletal remains with the cultural processes of past populations and allows for the interpretation of population history. Sociocultural information may reveal cultural behaviors that directly influence the biological configuration of a population. Both settlement patterns and mortuary activity are influenced by the cultural constructs present in a population, and these constructs are in turn influenced by the regional geography in which the population existed. Therefore, it is important to consider the regional archaeology of a population when assessing skeletal samples.

During the 1930's, the Works Progress Administration (WPA), in conjunction with the Tennessee Valley Authority (TVA) initiated a series of excavations in the Chickamauga Basin area of eastern Tennessee prior to scheduled dam-building projects in the area (Lewis, Lewis, and Sullivan 1995). The excavations conducted at this time were extremely important in establishing an archaeological record of the native cultures who once occupied this region. Massive amounts of artifacts and data were collected from numerous sites, providing an invaluable source of information. Analysis of stratigraphic positioning indicated that as many as four cultural components of the Mississippian period were present at some sites (Lewis, Lewis, and Sullivan 1995). Recent analysis of artifacts using radiocarbon dating has given a more precise chronology of these four cultural phases (Sullivan 2001).

The Mississippian period in eastern Tennessee is characterized by changes in pottery manufacture and style, the building of platform mounds on which religious and political

buildings were erected, an increased dependence on maize agriculture, large, complex chiefdoms with a stratified social structure, and increased warfare (Chapman 1985). Changes in material culture during the Mississippian period have led to its division into four phases: Martin Farm (AD 900-1100), Hiwassee Island (AD 1100-1300), Dallas (AD 1300-1600), and Mouse Creek (AD 1400-1600) (Sullivan 2001). Marked changes in pottery, architecture, and burial practices characterize these phases (Lewis, Lewis, and Sullivan 1995). Differences in burial practices include changes in body positioning and the placement of burials within the community. Architectural changes between cultures are found chiefly in framework construction, while changes in pottery include differences in style, technique, and decoration. Clearly, the Chickamauga Basin has experienced successive occupation by diverse cultural groups throughout the Mississippian period.

Biological Distance

Biological distance refers to a measurement of population divergence based on polygenic traits. Because polygenic traits typically have both an environmental and a genetic component, biological distances can reflect both genetic and environmental differentiation between populations. For this reason, the calculation of biological distances has been used frequently in the analysis of past populations, for whom true genetic distances are usually unobtainable (Buikstra *et al.* 1990). In particular, skeletal biodistance studies examine variation in bone and tooth shape and form in order to define patterns that are thought to reflect genetic relatedness within or between populations. This degree of relatedness assumes that populations sharing many morphological variations are more closely related than those who express many differences.

Nonmetric or quasi-continuous skeletal variations are features that are usually recorded as being either present or absent, although in many instances there are more than two states of trait manifestation (Saunders 1989). Previous researchers have relied primarily upon metric variables such as cranial indices to estimate population distance (Cybulski 1972; Howells 1966; Jantz 1970, 1974). However, other researchers argue that nonmetric variables offer a more reliable estimation of population distance than simple metric indices (Berry and Berry 1967, Ossenberg 1976, Sjøvold 1977, Suchey 1975).

Grüneberg (1952) studied skeletal variations of laboratory mice that are morphologically similar to those in humans. He proposed a model for the genetic control of minor skeletal variants based on a physical threshold that determined the presence of a trait along a continuum. Specifically, he examined the absence of the third molar tooth in mice that occurs due to an underlying continuous distribution that is effected by both genetic and environmental factors. The additive effects of multiple genes, as well as the pre- and post-natal environment influenced the size of the tooth germ, which needed to reach a critical threshold in order to manifest the trait. This threshold imposed a discontinuity on visible expression so that if the size of the tooth germ fell below a critical level, absence of the third molar would occur (Saunders 1989). After the threshold is reached, tooth size varies within a limited range. Grüneberg used the term “quasi-continuous” to describe the underlying continuity of a polygenic variable and the discontinuity imposed on the visible expression of the trait. Therefore, quasi-continuous, nonmetric variables are not only characterized by presence or absence, but can often exhibit a range of expression from slight to pronounced.

Biological distance, as used in this study, refers to a statistical expression of morphological similarity between populations that is derived from genetically controlled traits (Ubelaker 1999). As discussed by Buikstra and others (1990), biological distance is a measurement of population divergence based on polygenic traits, and has been used often in the analysis of prehistoric populations. Genetic relatedness within and between populations can be measured by analyzing bone and tooth morphology, which can then be correlated to the distance between populations. This degree of relatedness assumes that populations sharing many morphological variations are more closely related than those who express many differences (Larsen 1997).

The characteristics and variations of teeth have been used for many years as fundamental tools to reconstruct the diet, disease, and nutritional status of human groups, as well as the biological relationships among populations (Scott and Turner 1997). Over 40 dental nonmetric traits (Hillson 1996, Scott and Turner 1997, Turner *et al.* 1991) have been identified and are currently used in analysis of biological distance. Dental traits are useful for assessing population distance because they are largely under genetic control and minimally affected by environmental conditions (Griffin 1993). Teeth are often better preserved than bone, and tooth morphology is less influenced by the effects of environment, sex, and age than other skeletal elements (White 2000). Also, dental traits can be scored using the Arizona State University Dental Anthropology System (Turner *et al.* 1991), ensuring that population differences in trait frequency are a reflection of biological, not observational, variance. Plaques and descriptions from the current ASU Dental Anthropology System will be used in this study.

IV. Materials and Methods

The primary focus of this study will be to assess the population distance between three skeletal populations using a set of nonmetric dental traits developed by Turner *et al.* 1991. The skeletal samples to be used are part of the Human Skeletal Collection at the Frank H. McClung Museum, University of Tennessee, Knoxville. These samples represent three geographically and temporally separate populations from the Chickamauga Basin region of eastern Tennessee. As indicated in Table 1, these three groups date from the Late Mississippian cultural period and represent three successive phases of this period.

Table 1. Archaeological Sites and Data

County	Site Number	Site Name	Site Type	Number of Burials	References
Hamilton	1-3HA3	Hixon	PM,OH	77 LM, Hiwassee ls. phase	Acct. 120
Hamilton	7,8HA1	Dallas	PM,OH	279 LM, Dallas phase	Lewis and Kneberg n.d.
Bradley	15BY11	Rymer	OH	158 LM, Mouse Creek phase	Boyd 1984, Sullivan 1986

OH=Open Habitation; PM=Platform Mound
LM=Late Mississippian

Age and sex are important considerations in the analysis of nonmetric variation. Researchers have demonstrated that there are significant inter- and intra-population sex and age variation in nonmetric traits (Buikstra 1972, Corruccini 1974, Garn et al. 1966b, Konigsberg 1987, Scott 1977). Although dental nonmetric traits display far less sexual dimorphism than other nonmetric traits (Turner et al. 1991), sex and age will be estimated for each individual in the samples. Adult age-at-death will be estimated based on dental functional wear (Smith 1991) and the metamorphosis of the auricular surface of the

innominate (Lovejoy et al. 1985). Estimation of sex will be based on sex-specific characteristics of the cranium, os pubis (Phenice 1969) and overall pelvic morphology.

Dental morphological traits will be scored following the Arizona State University (ASU) Dental Anthropology System set forth by Turner *et al.* (1991). This system uses plaques that provide physical representations of minimal and maximal trait expression and various gradations between. Traits are selected in this system are easily observed, display little or no sexual dimorphism, are minimally affected by the environment, and evolve slowly. For these reasons, the traits used in the ASU system are ideal for biological distance studies. Dental traits described in this study include morphological characteristics and variations of the tooth crown and root. Based on work by Dahlberg (1956) and Turner (1967), there are numerous standard nonmetric dental traits used currently in biological distance studies and analysis (Hillson 1996, Scott and Turner 1997, Turner *et al.* 1991). Dental trait frequencies will be calculated for all traits and for each population sample. Table 2 lists the 27 dental traits that will be examined in this study.

Table 2. Nonmetric Dental Traits

Trait	Teeth Observed
winging	upper central incisor
shoveling	upper incisors
double-shoveling	upper central incisors
curvature	upper central incisors
interruption groove	upper lateral incisors
canine mesial ridge	upper canines
metacone	upper 3 rd molars
hypocone	upper 1 st and 2 nd molars
metaconule	upper 1 st and 2 nd molars
Carabelli's trait	upper 1 st and 2 nd molars
parastyle	upper 3 rd molars
premolar root number	upper 3 rd premolar
molar root number	upper 2 nd molars
radical number	all teeth

peg-shaped incisors	upper lateral incisor
peg-shaped molar	upper 3 rd molars
1 st lower premolar lingual cusp variation	lower 1 st premolars
2 nd lower premolar lingual cusp variation	lower 2 nd premolars
groove pattern	lower 1 st and 2 nd molars
deflecting wrinkle	lower 1 st and 2 nd molars
protostylid	lower 1 st and 2 nd molars
cusp 5	lower 1 st and 2 nd molars
cusp 6	lower 1 st and 2 nd molars
cusp 7	lower 1 st and 2 nd molars
canine root number	lower canines
Tomes' root	lower 1 st premolar
lower molar root number	lower molars

Statistical Procedures

A number of different statistical procedures will be employed in order to determine if the population samples from the Chickamauga Basin are derived from the same population, and to explore the genetic relationships between and among each population. These procedures include chi-square tests of significance, tau b tests of correlation, and taxonomic statistics of cluster analysis, mean measure of divergence, and multidimensional scaling. The degree of relatedness between these groups assumes that populations sharing many morphological variations are more closely related than those who express many differences.

V. Summary and Expected Findings

Using the above considerations, this study should contribute to the overall understanding of population change over time. It has been demonstrated by ethnographic and archaeological evidence that the prehistoric southeast was inhabited by a diverse group of Native Americans represented by at least five major language groups and seventeen major cultural groups (Spencer and Jennings 1977). Also, previous analysis of dental morphology has shown that these ethnographic and linguistic divisions do not necessarily correspond to biological divisions (Griffin 1993, 1994; Griffin *et al.* n.d.).

The Mississippian period in eastern Tennessee is characterized by a number of cultural changes. Archaeological evidence from the Hixon, Dallas, and Rymer sites displays distinctive variations in pottery, architecture, and burial customs from site to site and over the successive time periods. This data suggests the possibility of a large amount of in- or –out migration, population replacement, or gene flow occurring in this region. Considering the relatively short time span of the three phases (approximately 400 years), it is probable that such dramatic variation in cultural practices is a reflection of biologically distinct groups. For this reason, it is expected that the three population samples will not show a close affinity to each other. Also, it is anticipated that the Chickamauga Basin populations will display the high degree of morphological diversity, in terms of dental variation, that has been seen in other native southeastern Amerindian groups. This study should contribute to the overall understanding of the cultural changes found during the Late Mississippian period and help to more clearly define the biological relationships of native populations from the southeastern United States.

VI. Schedule

- June-August 2004: Design forms for recording data.
Data collection from Native American skeletal remains at McClung Museum, University of Tennessee, Knoxville.
Begin writing thesis.
- September-December 2004: Statistical analysis of data.
Continue writing thesis, rough draft to be completed by the end of the semester.
- January 2005: Additional data collection from McClung Museum, if necessary.
- January-May 2005: Final draft of thesis, meet with committee for feedback.
Submit thesis to committee for approval by March 15th.

VII. Committee

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