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CHAPTER 9

BIOARCHAEOLOGICAL ANALYSES OF HUMAN SKELETAL REMAINS FROM THE MITCHELL RIDGE SITE

by

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with a contribution by Barry W. Baker

This chapter presents the results of osteological and bioarchaeological analyses of human skeletal remains from the Mitchell Ridge site (41GV66), Galveston County, Texas. The data presented here are an extension of previous analyses of the human skeletal remains recovered during earlier excavations at the site by Rice University, the Houston Archaeological Society, and the Texas Archeological Society (Powell 1989).

The primary goal of the analyses of the skeletal remains was to provide basic biological information about human remains at Mitchell Ridge. A second, and perhaps more important, goal was to integrate traditional archaeological data with the data on population biology as a means of understanding the behavior of past peoples. Viewed as a whole, human mortuary remains from archaeological contexts reflect not only the economic, religious, and social systems of past peoples, but also the interaction between biological and cultural systems (Figure 9.1).

By necessity, analyses of human skeletal remains are retrospective, "time span" studies based on the assumption that the cemetery sample is representative of the biological population from which it is drawn. Unfortunately, as Wood et al. (1992:349) point out, this assumption is never true since the dead are a biased sample of all the individuals who were alive at a given age. As a result, interpretations of disease patterns, paleodemography, and mortuary behavior should proceed with caution. Another difficulty in analyzing prehistoric populations is that skeletal series typically represent a diachronic "population" rather than a synchronic one. In this regard, analyses of skeletal series are quite similar to long-term clinical studies: only those who were ill or otherwise at risk for death are included (i.e., the sample is biased since the healthy are usually not buried), and the sample accumulates over an extended period of time. These assumptions create particular problems in the analyses of paleodemography (Bocquet-Appel and Masset 1982) and paleopathology (Wood et al. 1992), especially in cases where the actual biological population creating the cemetery assemblage is heterogeneous for the risk of death. These problems will be addressed in later sections of this chapter.

Despite the inherent problems of osteological analyses, an examination of coastal skeletal series is a worthwhile endeavor for a number of reasons. The upper and central coast of Texas has been a focus of considerable archaeological and ethnohistorical investigation. While the body of data regarding subsistence strategies, technology, and social structure of prehistoric groups in the region continues to grow, relatively little research has focused on the biology of these populations. This report builds on the previous research of several authors (Comuzzie 1987; Comuzzie et al. 1986; Huebner and Comuzzie 1992; Powell 1987, 1989; Wilkinson 1973, 1977; Woodbury 1937; Woodbury and Woodbury 1935), and presents the results of taphonomic and dental microwear studies that have never before been conducted on human skeletal remains from the upper Texas coast.

The research presented here was designed to explore and answer questions regarding: 1) the depositional and post-depositional history of human remains; 2) patterns of health and disease; 3) population structure and biological variability; and 4) prehistoric and historic mortuary behavior. Data from paleodemography, paleopathology, taphonomy, and other specialized studies were examined in light of previously presented ethnohistoric and archaeological data, and known models of human behavior and human biology (see Wood et al. 1992).

The Mitchell Ridge assemblage is particularly important because it represents a large collection of individuals buried at the same locale during the Late Prehistoric (A.D. 700-1500), the Protohistoric (A.D. 1500 - 1700), and the Historic (A.D. 1700 and later) periods. Each individual was assigned to one of these three periods based on absolute and relative age assessments of features at the site. It should be pointed

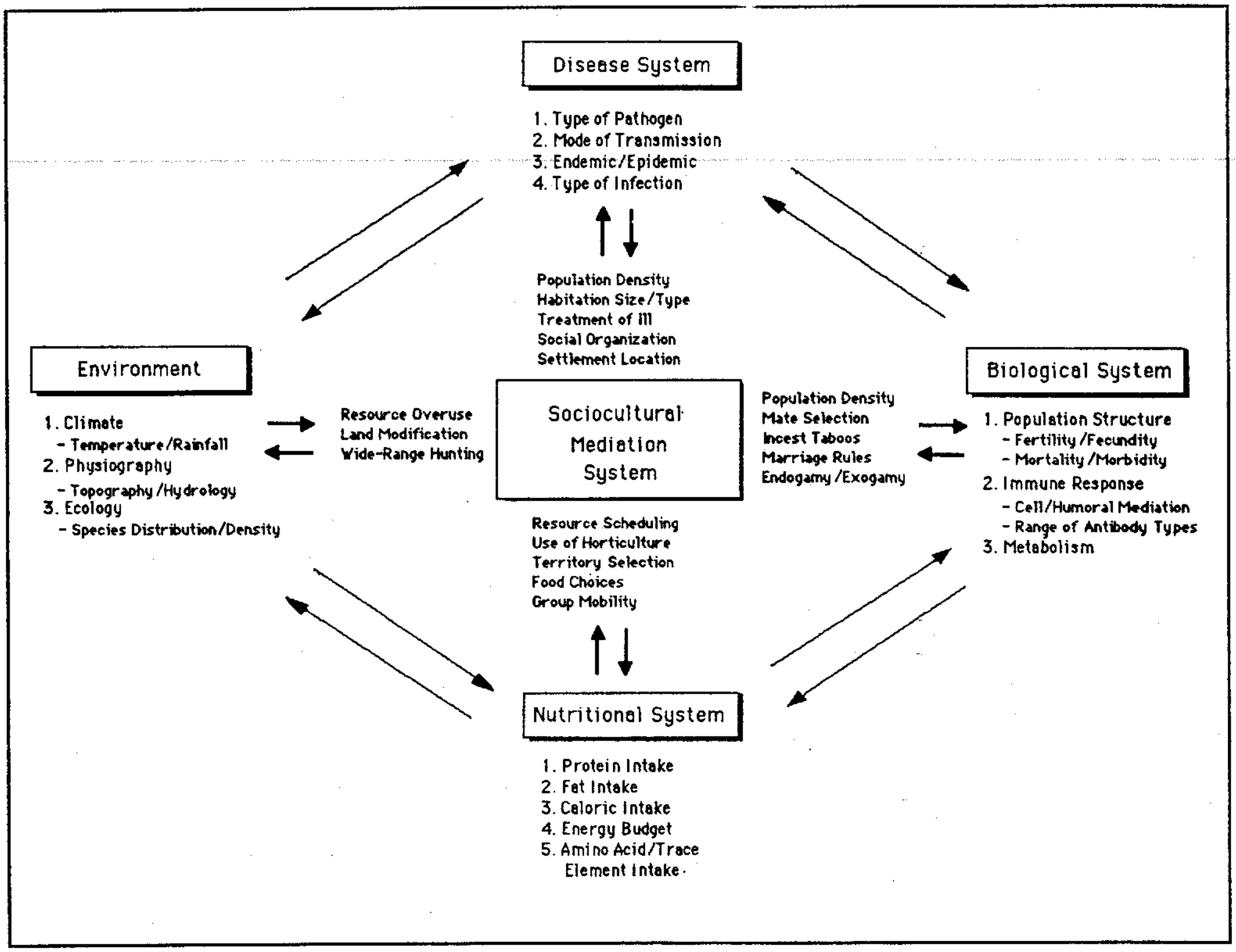

Figure 9.1. Model of interacting biocultural systems. From Powell (1989) with permission.

out that the assignment of burials to time periods in this chapter diverges slightly from the assignments presented in other sections of this volume, since the temporal assignments used here were based on initial radiocarbon dates and on the burial chronology available at the time of osteological analysis in 1992-1993. However, only one feature, 92-1, is placed in a different time period; this has been considered a Protohistoric rather than a Final Late Prehistoric feature. This discrepancy does not affect the overall results and interpretations presented here, since this feature is recognized elsewhere in the report as possibly pertaining to the Protohistoric (on the basis of 2-sigma radiocarbon range on human bone collagen; see Table 12.6). The assignments here of all other burial features are in accord with those in the remainder of the report.

The human skeletal remains from the Mitchell Ridge site afford a unique opportunity to explore the effects of European contact on Texas coastal populations. What were the effects of European contact on mortuary practices, population structure, diet, and community health? In order to explore this question more fully, a diachronic approach was taken for most analyses. Data on paleopathology, biological affinity, taphonomy, and diet in the Mitchell Ridge skeletal series were used to test whether pre- and post-contact populations at Mitchell Ridge exhibited significant biocultural differences, given the limits of the sample.

The results presented in this report are not the definitive statement on the biology of Late Prehistoric and Historic populations from the upper Texas coast. They can, however, be viewed as one small part of a growing bioarchaeological data set for the region. The interpretations presented here should provide new avenues for exploration and a testable framework for later research.

Inventory of Remains

All human skeletal remains from the Mitchell Ridge site were examined at the Physical Anthropology Laboratory, Department of Anthropology, Texas A&M University by the author and by Helen Danzeiser Dockall. Skeletal remains for each feature were laid out in anatomical order on analysis tables, then inventoried by element, portion of element, and side on data sheets. For most burials and cremations, inventory and taphonomic data were recorded using a modified version of the Faunal Analysis Coding System (FACS) developed by Shaffer and Baker (1992). This system allowed precise identification of skeletal materials, and made calculation of the minimum number of individuals (MNI) much easier. In addition to written descriptions and element/portion coding, each element present was colored in on a line drawing of an articulated human skeleton. This provided a quick and easy means of assessing skeletal completeness and determining the location of pathologies. Skeletal completeness was determined by scoring whether any elements were present in each of 19 "regions" of the skeleton: the skull, cervical, thoracic and lumbar vertebrae, the chest (ribs and sternum), upper arm/shoulder girdles (including the humerus), lower arms, hands, os coxae, femora, lower legs, and feet. Completeness was calculated as the percentage of regions represented by one or more elements.

Minimum number of individuals (MNI)

The MNI for the site was determined by matching (Klein and Cruz-Uribe 1984:26), taking into account the age of the individual and form of disposal (i.e., primary vs. cremations). This method is less likely to underestimate the MNI since juvenile remains, which tend to be more fragmentary, are analyzed separately (Klein and Cruz-Uribe 1984:26-27). Several burials originally thought to represent a single individual actually contained multiple same-side elements or elements representing both adults and juveniles. Because of unusual mortuary patterns at this site, extra elements were matched by age and size to skeletal remains from other features to insure that body parts, such as hands and feet, were not removed from one individual and deposited with another. This proved to be very time consuming, but it was necessary given the large number of secondary burials and the atypical pattern of corpse disposal. The final MNI for the Mitchell Ridge site was based on repeated left lunates.

Composite burials

Human skeletal remains unearthed during dragline operations at the West Pilot Canal represent a number of primary or secondary burials that were mixed together during machine operations at the site. In these cases skeletal remains were assigned to separate individuals through a seriation technique based on the age, sex, joint articulation, and preservation of elements. Each individual was then assigned an accession number in the laboratory. Elements that could not be assigned to a particular individual with accuracy were deleted from the analysis. However, these materials were included in subsequent element-by-element and taphonomic analyses.

Taphonomy

Biological Modification

Fracture patterns

The general pattern of fracturing was summarized for each burial rather than tabulated by element, since all bone breakage in the assemblage could be attributed to post-depositional events such as dry bone horizontal tension failure (i.e., fracture front cuts across the diaphysis and produces perpendicular, parallel, or diagonal breaks from either dynamic or static loading) or dry bone dynamic loading. In no case was there evidence for impact fractures, anvil damage, or spiral fractures that have been used to infer human-mediated bone damage in faunal (Binford 1981) and human (White 1992) assemblages.

Root etching and chemical weathering

Bone damage from exposure to chemical agents was another taphonomic factor described as either present or absent per individual. Root etching typically leaves depressions or grooves outlining rootlets which lay against the bone, an easily recognized form of pitting with a familiar dendritic outline (Binford 1981:50). Exfoliation and discoloration of the bone cortex that does not follow the dendritic pattern is usually caused by some other chemical agent, including the natural pH of the soil, or chemical agents carried through the soil by rainwater percolation (White and Hannus 1983).

Rodent gnawing and mammalian chewing

Each skeletal element was examined for signs of chewing or gnawing by mammals, following White (1993), Binford (1981), and Haglund (1992) in distinguishing between "gnawing" and "chewing." Gnawing is typically associated with damage produced by incisor wear on bones, and is typically attributed to members of the Rodentia. Canids such as coyotes (*Canis latrans*), wolves (*C. lupus*), and dogs (*C. familiaris*) also gnaw bones, and produce damage which is similar to rodent gnawing (Haglund 1992). Rodent gnawing is generally characterized by minute parallel striae on the bone surface (Haglund 1992). "Windows" in bone may occur, whereby a small area of the element is chewed all the way through from cortex to medullary cavity (Gilbert 1980:10).

Mammalian chewing includes carnivore damage and artiodactyl chewing patterns. Carnivore damage is characterized by pitting, scoring and puncturing of elements, especially at the metaphyses (Binford 1981; Gilbert 1980:9-10; Haynes 1983; Milner and Smith 1989). Some elements, such as the ascending ramus of the mandible, are key sites for carnivore damage yet yield long, deep striations or depressions that are sometimes mistaken for rodent damage (Haglund 1991, 1992). Artiodactyl chewing produces fork-like remnants of bone separated by parallel rows of V-shaped grooves (Gilbert 1980:10).

Cultural Modifications

Staining

At the Mitchell Ridge Site, most bones exhibited some degree of discoloration. Non-cultural forms of staining (i.e. from contact with sediments or from chemical weathering) were not recorded. Ash stained bones were recorded under "Burning". The only human-mediated staining was from the application of red or yellow ochre (hematite) to the body before burial. Ochre staining is typically associated with application to bodies with some soft tissue. As body fats undergo hydrolysis and hydrogenation, adipocere ("grave wax") is formed, which acts to bind the pigment to the bone. Red ochre stains were initially described by element, but are reported here per individual.

Burning

Burned bone was only encountered in cremations from the site. Burning stages generally depend on an element's exposure to heat (i.e., in a fire or nearby), state of preservation (dry bone, green but defleshed bone, or fleshed bone), duration of firing, and temperature of the fire. Variation in any one of these factors makes the interpretation of burned human remains quite difficult. An even greater problem is the fact that authors disagree about how to interpret patterns of burning in human remains (see Baby 1954 and Shipman et al. 1984). For this analysis, the experimental data of Buikstra and Swegle (1989), was used in conjunction with information presented by Ubelaker (1989).

Burned remains were sorted into identifiable and unidentifiable portions. Each identified element was coded for degree of burning based on descriptions provided by Bradtmiller and Buikstra (1984), Buikstra and Swegle (1989), Gilchrist and Mytum (1986), Shipman et al. (1984), and Spennemann and Colley (1989) as synthesized by Barry W. Baker, Texas A&M University. Burning codes correspond to the degree of exposure to heat and the state of preservation for each element and are listed in Table 9.1.

Cut Marks

Cut marks were noted by element, portion of element, number of cuts, and the area of the shaft affected by this type of modification. Subsequent discussion of cut marks on human remains follows

Table 9.1. Burning Codes used for the Analysis of Cremated Remains at the Mitchell Ridge Site. Complied by Baker n.d. from descriptions in Bradtmiller and Buikstra 1984, Buikstra and Sweagle 1989, Gilchrist and Mytum 1986, Shipman et al. 1984, and Spennemann and Colley 1989.

Code	Description	Comments and Possible Interpretation
00	**No burning**	
01	**Unburned, with gray staining**	Contact with ash or dark deposits
02	**Predominately unburned with localized areas of light tan heat discoloration**	Indicative of periosteal removal to ease bone breakage
03	**Discoloration and blackening on the edges**	Scorching
04	**Light brown/tan external cortex and blackened/white/gray inner cortex**	Indicative of burned dry bone or smoking
05	**Burned evenly black with glossy cortex**	Indicative of burned defleshed, green bone, low firing temprature (< 525° C), or bone smoking
06	**Burned predominately black**; not glossy	Indicative of burned defleshed, green bone, low firing temprature (< 525° C), or bone smoking
07	**Burned black**; additional patches of calcination present	Indicative of burned green or fleshed bone and/or low firing temprature (< 645° C).
08	**Calcination Stage 1**: cortical surface is bluish/white-gray; often porcelain or vitrified in appearance	Indicative of burned green or fleshed bone; firing tempratures of > 645° C
09	**Calcination Stage 2:** cortical surface is predominately neutral white-gray; inner cortex is black-blue)	Indicative of burned green or fleshed bone; firing tempratures of >645° C.
10	**Calcination Stage 3:** neutral white throughout, possibly chalky	Indicative of burned green or fleshed bone; firing tempratures of > 940° C.

Binford (1981).

Osteological Analyses

Determination of Sex

Sex determinations were conducted only for adults. Subjective sex assignments were based on differences in the structure of the os pubis, os coxae (Phenice 1969; Steele and Bramblett 1988; Suchey et al. 1979), and cranium (Keen 1950; Krogman and Iscan 1986; Steele and Bramblett 1988; Ubelaker 1989; Wienker 1984). A seriation method was used for sex determinations following Acsadi and Nemeskeri (1970). This method is quite useful because determination of "masculine" and "feminine" features is tailored to the range of sexual dimorphism in a given population. In the case of the Mitchell Ridge assemblage, the most masculine (Feature 86) and feminine (Feature 61) elements in the series were used for rating other skeletal remains along a continuum of variation. Each feature, such as browridge size or sciatic notch width, was assigned a score from -2 (most feminine) to +2 (most masculine) based on the extremes in that populations, and the average score for all features was used to assign a sex to that individual (Acsadi and Nemeskeri 1970). In cases where subjective assessments were impossible, quantitative analyses of the skull (Giles 1970), the pelvic region (Kelley 1979; Taylor and DiBennardo 1984), the bones of the feet (Steele 1979), or teeth (Kieser et al. 1985) were used to assign sex.

Determination of Age

Age assignments were made using macroscopic techniques. In each case, as many different diagnostic criteria as possible were employed to insure the accuracy of the assessment. Fetal and neonate remains were aged using metric characteristics of the infracranial skeleton (Fazekas and Kosa 1978; Kosa 1989; Ubelaker 1989b). Juveniles were aged based on dental eruption (Ubelaker 1989), tooth formation (Moorrees et al. 1963a,b; Schour and Massler 1940), and epiphyseal closure (Krogman and Iscan 1986).

Adult ages were obtained using several indicators, including the morphology of the pubic symphysis (Gilbert and McKern 1973; Katz and Suchey 1989; McKern and Stewart 1957; Suchey and Katz 1986;), auricular surface (Lovejoy et al. 1985a; Meindl and Lovejoy 1989), sternal end of the fourth rib (Iscan et al. 1984), and obliteration of cranial sutures (Krogman and Iscan 1986; McKern 1970; Meindl and Lovejoy 1985). Age estimates for each individual were based on at least two of the above procedures, with the greatest weight given to those involving the os coxae. Degenerative disease and dental attrition were not used for age assignments.

Each of the above methods has limitations and each has been abused, requiring caution on the part of the analyst (see Buikstra and Mielke 1985 and Jackes 1992 for cautions regarding age and sex determinations). For many of the age assessment techniques outlined above, an exact age could not be determined even under the most cautious and careful of examinations. If an exact age could not be assigned, it often was possible to place an individual within an age *category* (El-Najjar and McWilliams 1978; Steele and Bramblett 1988):

Fetus:	Pre-birth (<9 lunar months)
Neonate:	0 - 1 year
Young Child:	2 - 5 years
Older Child:	6 - 12 years
Adolescent:	13 - 19 years
Young Adult:	20 - 29 years
Middle Adult:	30 - 39 years
Older Adult:	40 - 49 years
Old Adult:	50+ years
Adult (no exact age):	20 - 50+ years

Paleopathology

During the inventory of skeletal remains, elements and potions of elements affected by pathological conditions were coded in the FACS program and were illustrated on a line drawing of the human skeleton. For purposes of this report, data were recorded in two ways. First, each condition was coded as present or absent for each individual, regardless of whether lesions were localized or systemic. The seventeen variables include traumatic, infectious, lytic, and degenerative lesions as well as developmental defects and other skeletal anomalies following Rose et al. (1990) and Buikstra et al. (n.d.). Each lesion was recorded as healed or active at death.

Orodental lesions were recorded on standardized forms following a number of sources. Dental attrition was evaluated using both the Smith (1985) and Scott (1979) scoring methods. Scores for dental abscesses, dental calculus, and carious lesions followed Rose et. al. (1990). Enamel hypoplasia was noted for all teeth, and the number and position of lesions on maxillary and mandibular central incisors and canines was recorded following Rose et al. (1985) and Goodman et al. (1980). Age of first hypoplasia was determined using the upper canines, following suggestions by Skinner and Goodman (1992).

Metric data collection

Metric data were collected for the dentition, the skull, and the infracranial skeleton following standard methods and using a series of data forms. Odontometric dimensions were recorded following Wolpoff (1972), and were analyzed using the methods presented in Kieser (1990). Comparative odontometric data were obtained from raw data collected and summarized by Dockall (1987). Cranial metric traits were collected following Howells (1969, 1973, 1989), and analyzed following Howells (1989) and Steele and Powell (1992). Infracranial data were collected using the methods described in Bass (1987) and Steele and Bramblett (1988).

Discrete data collection

Although the Mitchell Ridge assemblage was adequate for discrete trait analyses, there were few comparative data sets available. Previous work by Comuzzie (Comuzzie 1987; Huebner and Comuzzie 1992) and Dow (1987) provided the comparative data. The data collection protocols differed slightly between these two studies, but the explicit trait descriptions provided by Dow (1987) made it possible to recode her data to conform to Comuzzie (1987). Subsequently, discrete data collection in the Mitchell Ridge population was limited to those variables common to the Comuzzie (1987) and Dow (1987) data sets.

Dental discrete traits were recorded following Turner et al. (1991), using the comparative plaques of the Arizona State University Dental Anthropology System. Because there were no Texas coastal comparative data, only limited analyses of dental discrete trait variability were possible, using comparative data from Turner (1985).

Dental Microwear

Dental microwear data were collected from high-resolution casts of the occlusal surfaces of maxillary first molars. First molars were cleaned using repeated ethanol and acetone baths. Teeth were impressed in a vinyl polysiloxane compound, and epoxy resin casts were created from each impression. Casts were sputtered with 200 Å of gold palladium and examined using a JEOL scanning electron microscope (SEM) at 15kev and a 30 degree beam angle. The protocones of each first molar were photographed at x100, x500, and x1500 magnifications and compared qualitatively and quantitatively following Teaford (1991).

The Burials

Burial descriptions presented here are based on the inventory and analysis methods described in the preceding section, and on data provided by special studies. Basic data on each feature are presented in Tables 9.2 - 9.6. Feature numbers correspond to those assigned in the field, including sub-features designated by numbers (i.e., 64-1) or upper-case letters (65-A). When a feature contained additional individuals not identified in the field, these remains were assigned an accession code using lower-case letters added to the feature designation (i.e., 92-1a). Feature descriptions are listed by excavation area and by interment type.

Table 9.2. Summary of Skeletal Remains at the Mitchell Ridge Site, Area 1

Feature Number	Time Period[a]	Burial Type	Skeletal Age Range	Sex	Completeness	Red Ochre	Grave Goods
3	Prehistoric?	Cremation	20 - 25 yrs	I	10%	No	No
24	Prehistoric?	Cremation	----------	-	---	--	--
25	Prehistoric	Primary	30 - 50+ yrs	M	26%	No	No
26	Prehistoric?	Secondary	8 - 15 yrs	I	1%	No	No
27-a	Prehistoric?	Primary	neonate	I	89%	Yes	No
27-b	Prehistoric?	Secondary	10 - 15 yrs	I	1%	Yes	No
28-a	Prehistoric?	Secondary	6 - 10 yrs	I	21%	No	No
28-b	Prehistoric?	Secondary	7 - 14 yrs	I	16%	No	No
30	Protohistoric	Primary	20 - 50+ yrs	F	5%	No	No
35	Prehistoric?	Primary	30 - 50+ yrs	F	84%	No	No
92-1a	Protohistoric	Secondary	30 - 50+ yrs	M	79%	Yes	No
92-1b	Protohistoric	Secondary	10 - 15 yrs	I	58%	Yes	No
92-2	Historic? Protohistoric?	Primary	40 - 50+ yrs	F	94%	No	No

a Question mark denotes burials whose temporal assignment was uncertain. Temporal assignments presented here do not necessarily correspond to those used in other sections of this volume. Some burials assigned here to the Prehistoric or Protohistoric belong to a "Late Prehistoric/Protohistoric" category (see Table __).

Area 1

Area 1 contained 10 burial features representing 13 individuals. The majority of these features date to the Late Prehistoric and Protohistoric periods, although one eighteenth-century interment was also present (Table 9.2). The commingled remains of five additional individuals were recovered by archaeologists from the U.S. Army Corps of Engineers from the area of the west pilot canal near Area One. These specimens were sorted to individual, when possible, based on gross differences in the size, sex, and age of elements as well as bone color and preservation. Some elements could not be assigned to a particular individual. These materials are described in element-by-element summaries, but were not used in analyses by individual following the method described by Powell (1989:5). Descriptions of the West Pilot Canal materials are presented separately below.

Primary Interments

Feature 25

This feature contained an fragmentary middle adult male approximately 30 to 50 years of age. The individual was poorly preserved, and many of the bones exhibited chemical weathering and root etching. The ribs, os coxae, and feet were missing during inventory, although these elements are illustrated in the burial plan. This individual was affected by mild porotic hyperostosis, and exhibited excessive dental attrition and periodontal disease.

Feature 27-a

Feature 27 contained two individuals, which were divided into 27-a (primary interment) and 27-b (secondary interment). Feature 27-a was a complete neonate skeleton recovered from one half of the circular feature. This individual was approximately 9.5 to 11 gestational months (birth to 2 months) at the time of death based on long bone size (Fazekas and Kosa 1978:240). Reactive bone deposition and resorption suggestive of otitis media (inner ear infection) was noted on the right temporal. Subperiosteal reaction was also present on the fibulae.

Feature 30

This feature contained the fragmentary remains of an adult female of indeterminate age that date to the Protohistoric period. Like Feature 25, this individual was poorly preserved flexed burial. The skull was affected by thickening of the diplöe that may represent healed porotic hyperostosis. The teeth were extremely worn and some were broken at the cervical margin during life.

Feature 35

Feature 35 had been partially damaged by heavy machinery operations at the Mitchell Ridge site prior to controlled excavations. The recovered remains exhibited numerous dry breaks. The os coxae and most of the bones of the feet had been removed by machine, and the bones of the lower body were very fragmentary. This individual was a middle adult female, 30 to 50 years, who suffered from degenerative joint disease and from a bilateral inflammation affecting the lower legs. Most of the upper teeth were worn to the root and all lower premolars and molars were lost antemortem, resulting in complete resorption of all but the incisor alveolus.

Feature 92-2

This unit contained the semi-flexed skeleton of an older adult female, 40 to 50 years of age at the time of her death. This individual suffered a severe trauma to the neck, resulting in a fractured third cervical vertebrae and alterations of the spinous processes of C4 to C6 on the left side of all vertebrae.

In addition to this injury, several vertebrae exhibited osteophytes, especially on the left sides. One left rib was rarified, and subperiosteal bone deposition was noted for the left iliac blade. The overall pattern of pathologies suggests a blow or other trauma to the left side of the head, with resulting alteration of bone from differential use of the left side of the body. The teeth of this individual, unlike those of Late Prehistoric burials of similar biological age, were only moderately worn and were affected by dental caries.

Secondary Interments

Feature 26

A single left subadult patella was recovered from this feature. Based on the size of the patella and the pattern of non-lamellar bone deposition, this represents an older child or adolescent approximately 8 to 15 years of age. Two fine, shallow cut marks approximately 4 mm long crossed the interior lateral border of the patellae and may represent intentional removal of attached connective tissue.

Feature 27-b

Feature 27 contained two individuals, which were divided into Feature 27-a (primary interment) and Feature 27-b (secondary interment). In addition to the complete neonate designated Feature 27-a, a second individual was also present, represented only by a right patella. Based on gross size of this element, the individual was probably an older child or adolescent at the time of death. No cut marks or other visible modifications of the patella were observed.

Feature 28-a and 28-b

Skeletal material from Feature 28 represented two lot numbers, Lot 29 and Lot 30, which were analyzed separately. A minimum of two subadults were represented based on differences in age and on the presence of two pairs of lunates. Lot 28 contained parts of both an older child (Feature 28-a) and an adolescent (Feature 28-b). Both individuals are represented by epiphyses of the humerus, distal epiphyses of the radii, carpals, metacarpals, and hand phalanges. Lot 30 contained elements of the hands of an adolescent and probably belong to Feature 28-b. No other skeletal elements were present.

Feature 92-1a

Like feature 35, this unit was also partially damaged by machinery. Feature 92-1 was a secondary bundle burial of two individuals, a middle adult male approximately 30 to 50 years of age (Feature 92-1a), and an adolescent of indeterminate sex (Feature 92-1b). The adult was represented by fragments of the skull, humeri, radius, femora, fibulae, hands, and feet. During life this individual was affected by compression fracture of cervical vertebrae, vertebral osteophytosis, arthritic degeneration of the knees, and a broken right humerus. All of the elements were heavily stained with ochre, and the proximal humerus and proximal ulna exhibit numerous fine, parallel cut marks. Rodent gnawing was observed on some long bone shafts.

Feature 92-1b

Feature 92-1b contained an adolescent of indeterminate sex interred as a bundle burial. The subadult was represented by bones of the lower body including os coxae, femora, tibiae, and tarsals, along with fragments of the ribs, hands, and distal forearms. Like Feature 92-1a, most of the recovered elements were slightly to heavily stained with red ochre. Rodent gnawing was observed on most long bone shafts, and fine, parallel cuts were noted on the left femoral midshaft, left distal tibiae, and left calcaneus. No pathologies were noted for this individual. The taphonomy of both Features 92-1a and 92-1b will be discussed in detail in the taphonomy section of this chapter.

Cremations

Feature 3

This feature contained burned human bone representing a single young adult. Many elements were highly calcined, especially the cranium and some long bone fragments, suggesting that these elements were exposed to temperatures in excess of 600° C. Twenty-four femoral specimens were uniformly black, with a glossy exterior. This pattern is indicative of burned defleshed, green bone. Other elements exhibited the warping and transverse fracture pattern typical of in-the-flesh cremations. Given the consistency of the pattern of burning in the femora compared to all other elements, it appears that Feature 3 may have contained the burned remains of an in-the-flesh cremation and pieces of another individual burned after decomposition had occurred. However, based on the more conservative MNI derived from replicate same-side elements, Feature 3 can only be said to represent *at least* one individual. This individual was a young adult (20-25 years), based on a rib epiphysis exhibiting recent fusion.

Feature 24

This feature is described in field notes as a human cremation that was a secondary deposit. However, no bone or ashes corresponding to this feature number was present in the assemblage of human skeletal remains examined by the author. No further information on this feature is available.

West Pilot Canal Materials

Between January 14 - 16, 1992, archaeologists from the U.S. Army Corps of Engineers recovered numerous human skeletal remains from the west side of pilot canal 1. These materials were accidentally disturbed during drag line operations and were collected from backdirt. Four adults and one subadult were identified in the commingled materials (Table 9.3). It is not known whether these represent primary or secondary interments, although most of the five individuals are relatively complete. Remains were assigned to each of the individuals through a seriation technique based on the age, sex, joint articulation, and preservation of elements. Each individual was then assigned an accession number in the laboratory.

Accession 235-a

A nearly complete skull, plus fragments of the humeri, radii, ulnae, femora, and tibiae were assigned to this individual. Based on dental eruption and cranial suture closure, this individual was an gracile, young adult female approximately 20 to 30 years old. The calvarium exhibited healed porotic hyperostosis, and the tibia was affected by striated bone deposition along its anterior margin. The teeth were less severely worn that those of young adults in the Late Prehistoric sample, and were affected by dental caries.

Accession 235-b

The fragmentary remains of an older child (7 - 10 years) were assigned to this accession number. Bones of the skull, thorax, lower arms, hands, and upper legs were present and were stained with ochre. Although it was not possible to determine if these remains were a primary or secondary burial, the pattern of element representation is more typical of subadult secondary burials than primary inhumations. No pathological conditions were noted for these remains.

Accession 235-c

This individual was an older adult female, based on the morphology of the pubic symphysis. Nearly all of the skeleton was present, and all joint surfaces articulated properly (i.e., all elements assigned to this individual matched). Vertebral osteophytosis and enthesopathies were present in the lower vertebrae and ox coxae. Both of the tibiae and fibulae presented a "bowed" appearance, although no reactive bone was observed. Squatting facets were noted on both tibiae. Several bones of the thorax were stained with red ochre.

Table 9.3. Summary of Skeletal Remains at the Mitchell Ridge Site, West Pilot Canal (Area 1) and Area 3.

Feature Number	Time Period	Burial Type	Skeletal Age Range	Sex	Completeness	Red Ochre	Grave Goods
West Canal:							
235-a	Unknown	Unknown	20 - 30 yrs	F	37%	No	---
235-b	Unknown	Unknown	7 - 10 yrs	I	31%	Yes	---
235-c	Unknown	Unknown	50+ yrs	F	84%	Yes	---
235-d	Unknown	Unknown	35 - 45 yrs	M	53%	No	---
235-e	Unknown	Unknown	30 - 50+ yrs	I	37%	No	---
Area Three:							
52	Prehistoric	Primary	50+ yrs	M	100%	Yes	No

Accession 235-d

This individual was an middle or older adult (35 - 45 years) of indeterminate sex. The bones were extremely fragmentary, discolored by a mottled dark red-brown stain along some diaphyses, and exhibited root etching and chemical weathering. Most of the joint surfaces were porous, and were bordered by marginal lipping. Vertebral bodies were affected by osteophytes.

Accession 235-e

The remaining materials were assigned to accession 235-e. This individual was a large and robust middle adult male, approximately 35 to 45 years old at the time of his death. The femora and hand phalanges of this individual were robust and exhibited several enthesophytes. Arthritic degeneration, including eburnation and marginal lipping, was noted for the elbows, knees, and hands. The cervical vertebrae were affected by osteophytes. Subperiosteal bone deposition was observed on the right scapula and on the left tibia. The tibia was also slightly bowed.

Additional Materials

A total of 390 specimens from the west pilot canal assemblage could not be assigned to an individual. These included 118 adult rib fragments, three adult patellae, 9 fragments of radii or ulnae, 181 unidentified long bone fragments, and 79 fragments of vertebral processes.

Area 3

Primary Interments

Feature 52

Feature 52 contained a tightly flexed Late Prehistoric burial (Table 9.3). This individual was unique not only because of its position away from the main group of Late Prehistoric burials, but also because it exhibited the most severe pathologies of any of the human remains at the Mitchell Ridge site. This individual was an old adult male approximately 50+ years of age. The skeleton was well preserved and complete, with only a few dry breaks on long bone metaphyses. The frontal bone exhibited seven gummatous lesions similar to *caries sicca* (characteristic of treponemal infections). The bones surrounding the nasal aperture were slightly resorbed. Subperiosteal bone deposition was present on both clavicles, both scapulae, the right femur, the right fibula, and both tibiae. The femur and both tibia also had multiple healed cloacae for pus drainage, and the right clavicle had several healed and one active cloacae. Both tibia are extremely bowed and compare favorably to illustrations of "sabre shin" associated with treponemal infection (Ortner and Putschar 1981:204). The overall pattern and severity of infection, the presence of nasal resorption, and characteristic *caries sicca* and saber shin support a diagnosis of treponemal infection.

In addition to the systemic infection, Feature 52 was affected by severe degenerative disease, including porosity and lipping of the joint surfaces of the knees and shoulders, and rarefaction of the vertebral bodies of the neck. Two traumas were noted, including healed fractures of two right lateral metatarsals and a torn pectoralis muscle. The latter trauma resulted in an extensive enthesophyte along the area of muscle insertion on the left arm. The teeth were extremely worn, and large apical abscesses were observed for nearly all of the maxillary and mandibular molars and the maxillary incisors.

Area 4

Twenty-three individuals were recovered from Area Four (Table 9.4). Burials in this area date to all three time periods, although the majority of individuals are from the Protohistoric and Historic (eighteenth century) periods. Several features contained multiple interments that were recognized in the field and assigned their own feature numbers. Others are secondary burials included with primary

Table 9.4. Summary of Skeletal Remains at the Mitchell Ridge Site, Area 4.

Feature Number	Time Period	Burial Type	Skeletal Age Range	Sex	Completeness	Red Ochre	Grave Goods
61-a	Protohistoric	Primary	25 - 35 yrs	F	100%	Yes	Yes
61-b	Protohistoric	Secondary	6 - 15 yrs	I	10%	No	Yes
61-c	Protohistoric	Secondary	20 - 50+ yrs	I	1%	No	Yes
62-1	Historic	Primary	25 - 35 yrs	F	100%	Yes	No
62-2	Historic	Primary	18 - 20 yrs	F	100%	Yes	No
63-1	Historic	Primary	25 - 35 yrs	M	89%	Yes	Yes
63-2a	Historic	Cremation	30 - 50+ yrs	I	84%	---	---
63-2b	Historic	Cremation	0 - 15 yrs	I	37%	---	---
63-3	Historic	Secondary	0 - 2 yrs	I	53%	No	Yes
63-4	Historic	Secondary	0 - 6 yrs	I	100%	No	Yes
64-1	Historic	Primary	12 - 15 yrs	F?	100%	Yes	Yes
64-2	Historic	Primary	6 - 7 yrs	I	100%	No	Yes
64-3	Historic	Primary	2 - 3 yrs	I	84%	Yes	Yes
64-4	Historic	Primary	18 - 20 yrs	M	100%	Yes	Yes

Table 9.4, cont.

Feature Number	Time Period[a]	Burial Type	Skeletal Age Range	Sex	Completeness	Red Ochre	Grave Goods
65	Historic	Primary	30 - 40 yrs	M	100%	No	Yes
65-A	Historic	Cremation	20 - 35 yrs	I	37%	---	Yes
82-a	Protohistoric	Primary?	20 - 50 yrs	I	42%	No	Yes
82-b	Protohistoric	Secondary	14 - 21 yrs	F	37%	No	Yes
83	Protohistoric	Primary	4 - 8 yrs	I	100%	Yes	Yes
84	Pre/Protohist.?	Primary	50 + yrs	M	68%	Yes	No
85	Historic?[b]	Cremation	20 - 50 + yrs	I	----	---	---
86	Prehistoric	Primary	35 - 45 yrs	M	100%	Yes	Yes
87	Prehistoric	Primary	35 - 39 yrs	M	100%	Yes	Yes

a Question mark denotes burials whose temporal assignment was uncertain. Assignment to time period does not necessarily correspond to assignments used in other sections of this volume. Some burials assigned here to the Prehistoric or Protohistoric belong to a "Late Prehistoric/Protohistoric" category (see Table __).

b This burial was originally assigned to the Historic period but was later reassigned as a Prehistoric cremation; data from this individual have only been used in the taphonomic analyses.

inhumations that were separated in the laboratory during analysis.

Primary Interments

Feature 61-a

Feature 61 was thought to represent a single adult burial dating to the Protohistoric period. During laboratory examination of the remains, two additional individuals were identified and assigned their own designations (Features 61-b and 61-c). Feature 61-a contained the complete skeleton of an adult female approximately 25 to 35 years of age. Unlike the remains assigned to Features 61-b and 61-c, these elements were well preserved and did not exhibit weathering. Red ochre staining was present on the sacrum and vertebral column, the feet, and the os coxae.

No pathologies were noted for this individual, and dental wear was less severe than expected for Late Prehistoric burials of the same skeletal age. However, it is perhaps the most morphologically atypical burial at the site. The nasal aperture and facial bones were narrow and dissimilar to other Protohistoric females at Mitchell Ridge. The facial, cranial, and dental morphology of Feature 61-a suggest European ancestry for this individual. Multivariate analyses of metric and nonmetric traits of the skull and teeth confirmed that this individual was more similar to modern Europeans than to Native Americans. A detailed discussion of the biological affinity of this individual and interpretation of these data are presented in proceeding sections of this chapter.

Feature 62-1

Feature 62 was an Historic period mortuary feature that contained two complete individuals buried during separate events. The first individual, Feature 62-1, was a primary interment of a young adult female approximately 25 to 35 years old. This individual was well preserved, and all skeletal elements, including the hyoid and auditory ossicles, were recovered. The skull of Feature 62-1 exhibited slight flattening at lambda and reactive porosity of the occipital that may be related to the modification of the cranium (McCormick, personal communication; Holliday 1993). Arthritic lipping and minor vertebral osteophytosis were observed, as well as misaligned fractures of two floating ribs. The trauma to the ribs appears to have resulted in arthritic degeneration of the distal sternum and xiphoid process. Dental wear was minimal and was less severe than that of Late Prehistoric burials of the same skeletal age. One carious lesion was present.

When the burial pit was reopened to accommodate Feature 62-2, the majority of skeletal elements were pushed out of their original positions. However, the right arm and hand and both feet of Feature 62-1 remained articulated. Given the proximity of Feature 62-2 to these articulated portions, it is unlikely that re-excavation of the burial pit did not affect them. It is more likely that Feature 62-1 was not completely skeletonized when Feature 62-2 was buried. The pattern of articulation of Feature 62-1 matches that of forensic cases in which the individual has been dead for less than eight months (Ubelaker 1974:66). The patellae and first two cervical vertebrae of Feature 62-1 were recovered from the top of the grave fill above Feature 62-2. Although it is possible that these elements worked their way upward through bioturbation, the unit excavators felt that this position represented intentional relocation of the patellae and cervical vertebrae at the time the burial pit was finally sealed.

The morphology of the skull and teeth indicate that this female was atypical for upper Texas coast populations, and may have biological affinities with Native Americans outside the region. Aboriginal populations from the upper Texas coast are generally characterized by massive browridges and mastoid processes, wide and flat zygomatic bones, dolichocranic to mesocranic braincases, and a general lack of facial angularity. Dentally, these populations exhibit excessive dental wear and have dental morphological features such as strong incisor shoveling and tuberculum dentale. The morphology of the skull and teeth of Feature 62-1 indicate that this female was atypical for upper Texas coast populations (i.e., very angular facial features, gracile, brachychranic, and lacking strong shoveling), and may have biological affinities with Native Americans outside the region. The assessment of biological affinity of Feature 62-1 will be discussed later in this chapter. Metric dimensions of the skull of Features 62-1 and 62-2 are remarkably similar, and in many cases are identical. This, plus the fact that both individuals were buried in the same feature at different times, may reflect a direct biological or familial relationship, although this is cannot be conclusively proven or disproved.

Feature 62-2

The second individual buried in Feature 62 was a robust young adult (18 - 20 years) female. Red ochre stains were visible on the tibiae, vertebrae, and os coxae. The skull of Feature 62-2 was extremely flattened at lambda, and exhibited reactive pitting of the occipital and parietal bones that is probably infectious in origin. Healed porotic hyperostosis, with concomitant expansion of the diplöe, was observed for both parietals. Partially healed cribrotic lesions were also present in the orbits. This individual suffered a crushing trauma to the right foot that resulted in fractured third and fourth metatarsals and in fusion of several phalanges. Dental wear was minimal and was less severe than the that of Prehistoric burials of the same skeletal age. The morphology of the skull and teeth indicate that this female was atypical of upper Texas coast populations, and may have had biological affinities with Native Americans outside the region. Metric dimensions of the skull of Features 62-2 and 62-1 are remarkably similar, and in many cases are identical. This, plus the fact that both individuals were buried in the same feature at different times, may reflect a direct biological or familial relationship, although this is cannot be conclusively proven.

Feature 63-1

This feature was described in field notes as an Historic primary burial that was disturbed by the later secondary bundle burial. The bones of the lower body and right arm of Feature 63-1 were disarranged and displaced to the east side of the pit, although this massive displacement of bone does not match the size of the bundle burial. The burial plan illustrates this displacement, and also shows a set of articulated, paired bones of a subadult which were not part of the bundle burial (Feature 63-4).

Feature 63-1 was a large, robust young adult male approximately 25 to 35 years old. This individual was well preserved and the bones lacked the extensive post-mortem dry breaks common in Protohistoric and Prehistoric inhumations. Despite the completeness of this individual, all bones of the right hand and all foot bones except the left talus were missing. The recovery of tiny, fragile bones such as the hyoid argue for a pre-excavation loss of elements, perhaps during the exhumation and disturbance associated with the secondary burial. Bones of the lower extremity were lightly stained with red ochre.

This male was recovering from some anemic reaction at the time of his death, suggested by healing porotic hyperostosis and cribra orbitalia. Schmorl's nodes were present on the lumbar vertebrae, and the first and second sacral elements had a healed, misaligned fracture. This trauma appears to have affected muscle use in the lower body, as evidenced by asymmetrical muscle markings on the ilia and femora. This injury also affected the position and orientation of the lumbar spine, and may have resulted in impaired mobility.

Feature 64-1

Feature 64 contained four primary burials that date to the Historic period. These individuals were extended and placed one above the other at approximately the same time. They were accompanied by numerous shell and glass beads, bone whistles, a brass bell, and other aboriginal artifacts. The feature itself is unique among the Historic burials at the site, and each of the individuals is physically unusual as well.

The uppermost burial of this group, Feature 64-1, was an older child or adolescent and probably female. The bones of this individual were well preserved. However, the articulated right foot had been detached from the body and was oriented across the right leg near the knee. The distal left arm was missing, and the phalanges and carpals of the left hand were scattered along the left side of the body. Although the disarticulation could have been due to bioturbation, the placement of the articulated right foot suggests that the individual was either partially dismembered or decomposed at the time of burial, since burrowing animals would have displaced individual elements rather than the whole foot. The entire body was treated with red ochre, although the staining was light on most elements.

Dental development in this individual suggested an adolescent of 13 to 15 years of age. However, epiphyseal fusion suggested a much younger individual. The coracoid epiphysis, normally fused at age 10, was separate. The anterior arch of the atlas, which normally fuses at age 6, was unfused. Since teeth tend to be less susceptible to environmental perturbation than bones (Tanner 1990: 79), the dental age was viewed as most reliable. The pubis and ox coxae of this individual exhibited some female characteristics which would have fully developed after about age 10 to 12. This discrepancy between dental age and skeletal age is typical of people suffering from environmental stresses or from some developmental defect that alters patterns of growth.

Some months or years prior to death, this individual suffered a massive trauma to the neck that fractured both the first and second cervical vertebrae, and probably altered the position of the skull on the vertebral column. The atlas had a healed fracture on the left lamina, and the axis had a transverse fracture through the body. The articular facets of both vertebrae exhibited lipping and were asymmetrical, and the left condyle of the skull formed a pseudoarticulation with the left lamina of the atlas. This trauma probably affected the mobility of this individual, and could have resulted in nerve damage. Given that only those epiphyses which fused at age six are united to long bone diaphyses, it may be that the trauma occurred early in the life of the individual. Resulting nerve damage probably retarded subsequent skeletal development in this individual. In addition to the trauma, Feature 64-1 also suffered from active cribra orbitalia and possibly porotic hyperostosis. The teeth of this individual exhibited only slight incisor shoveling and moderate Carabelli's cusps. The latter trait is most common in European populations and may reflect some degree of European ancestry.

Feature 64-2

Below the extended adolescent female (Feature 64-1) was the extended burial of a young child (6 - 7 years old) of indeterminate sex. The skeletal remains were well preserved and were complete except for the patellae, which are illustrated in the plan view but were not returned to the laboratory for analysis. No pathologies were noted for this individual.

Feature 64-3

Feature 64-3 consisted of fragmentary bones of a very young child (2 - 3 years of age) of indeterminate sex, just below Feature 64-2. The bones of this burial were eroded and the elements of the feet and the right hand were not present. No pathologies were noted for these remains.

Feature 64-4

At the bottom of the set of extended burials in Feature 64 was a young adult male, 18 to 20 years of age. The skeleton was extremely well preserved and all of the skeletal elements were recovered. Several bones, including the skull, vertebrae, arms, and legs, were stained with red ochre. Feature 64-4 was atypical compared to other human remains from this and other sites in the region. The skull displayed intentional fronto-occipital deformation, in contrast to other burials at the site that exhibit only slight (and probably unintentional) flattening at lambda. The cranial shape, pattern of deformation, and metric features of the skull and face indicate that this male was not a native of the upper Texas coast. It is possible that this individual had some European ancestry given the strong Carabelli's cusps and only slight incisor shoveling. The nasal shape of Feature 64-4 also conforms to the European pattern.

Several pathological conditions were observed for this individual. The parietal and the occipital bones exhibited the rarefaction and reactive pitting noted in other burials with cranial modification. Subperiosteal reactive bone was present on the dorsal side of the manubrium. The lamina of the first lumbar vertebrae had separated from the vertebral body (spondylolysis) and had formed a pseudoarticulation on one side. The spinous process of L1 exhibited a fracture callus, and arthritic lipping was observed on the articular facets of T12 and L1. The seventh thoracic vertebra had a large sclerotic cyst between the lamina and body resulting from extrusion of the intervertebral disk. This lesion may be related to the spondylolysis of the lumbar region. The teeth of Feature 64-4 were virtually unworn, which is also atypical of other young adults at the site.

Feature 65

One large, circular feature in Area 4 produced a primary interment and a secondary deposit of a cremated individual. The primary interment, Feature 65, was a middle adult male approximately 30 to 40 years of age. Preservation of the skeleton was excellent, and all bones (including the hyoid and auditory ossicles) were recovered. There were no red ochre stains on any of the skeletal elements.

Feature 65 was affected by severe degenerative arthritis of nearly every diarthrodial joint. Arthritic pitting and lipping of joints was observed in bones of the hands, wrists, ribs, left shoulder, knees, and distal legs. Flowing osteophytes were present on the anterior margins of all vertebrae. The severity of joint degeneration is beyond that documented for clinical patients of the same chronological age (Ortner and Putschar 1981:419). In addition to degenerative disease, this individual experienced a massive spiral fracture just below the radial groove of the left humerus. The upper humerus is spirally twisted and angled approximately 30 degrees from normal orientation due to misalignment of the fracture. This trauma most likely resulted in limited mobility of the left arm. The arthritic degeneration noted for the left scapula and clavicle may be associated with the trauma, since degeneration of the shoulders joint was not bilateral.

Severe apical abscesses were present in five maxillary and five mandibular teeth of Feature 65. In one case, the infection was so severe that the abscess perforated the alveolar bone on both the buccal and lingual sides of the tooth. Another tooth had been split longitudinally during life, resulting in the deposition of secondary dentin and cementum along the damaged portion of the tooth.

Feature 83

Feature 83 contained the heavily ochre-stained bones of a single subadult. Based on dental eruption and tooth formation, this individual was between 4 and 8 years old at death. It was not possible to assign sex for this juvenile. The skeleton of this individual was poorly preserved and exhibited numerous dry breaks. The left arm and os coxa, innominate, lumbar vertebrae, and sternal ends of ribs were coated in red ochre corresponding to the circular ochre stain illustrated in the burial plan. Severe, active cribrotic lesions were present in the left orbit, and both parietals had active porotic lesions. The deciduous teeth exhibited moderate wear.

Feature 84

Feature 84 contained the skeletal remains of an old adult (50+ years), probably a male. The burial was very shallow, and several elements had been damaged by heavy machinery. Most areas of the body were represented but were very fragmented, and elements labeled as "damaged by machinery" were bleached white from sun exposure. The left clavicle had a healed fracture at midshaft. Three hand phalanges displayed healed fractures due to crushing trauma. Other phalanges exhibited arthritic lipping which may be a result of the trauma. Three lumbar and one thoracic vertebrae had large, flowing osteophytes along the anterior borders of their bodies. Several other vertebrae had osteophytes on the inferior and superior articular facets.

Feature 86

This burial feature dates to the Late Prehistoric period. It contained a hyper-robust middle adult male, approximately 35 to 45 years old at the time of his death. The skeleton was complete, and bones of the thorax, right arm, lower legs, and pelvis were stained with red ochre. Morphometric analyses of the skull revealed that this male is atypical of other upper coastal males. The nasal aperture is wide and has moderate guttering, and the face is massive and prognathic, a picture confirmed by multivariate analyses.

The skull of this individual had occipital flattening and reactive porosity of the occipital. Extreme arthritic degeneration, including joint porosity and marginal lipping, was observed on the proximal and distal ulnae and radii, both sacroiliac joints, the medial patellate, the articular facets of the calcanei and tali, and the manubrium. Ossified cartilage was present on the manubrium, medial clavicles, and first ribs. Minor vertebral osteophytosis was present on the lower thoracic and lumbar vertebrae. Finally, both tibiae were bowed and had some striated bone apposition along their anterior margins. Enthesophytes were present at gonion, the superior iliac blades, and the calcanei. The teeth were moderately worn in a pattern typical of Late Prehistoric populations in the region.

Feature 87

This burial contained the skeletal remains of a middle adult male, with an age-at-death of 35 to 39 years based on the morphology of the auricular surface and pubic symphysis. The bones were well preserved and the skeleton was complete except for the distal femora and left patella. Very light red ochre staining was documented for the vertebrae and os coxae.

Feature 87 was affected primarily by degenerative disease and trauma, although a number of dental abscesses were noted. Rarefaction of joint surfaces and degenerative lipping was present in the knees, especially on the condylar surfaces of the tibiae. The right patella exhibited marginal lipping, as did five hand phalanges. Healed fractures were observed for a central rib and two foot phalanges. The sternum also was fractured near the xiphoid process, resulting in subluxation and luxation of several ribs. An ossified nodule was observed on the posterior portion of the left femoral neck, between the lesser trochanter and the head. This lesion cannot be attributed to muscular trauma (i.e., an enthesopathy) and is most similar to an ossified hematoma (Steinbock 1976). Dental wear in Feature 87 was extreme, but this is typical of Late Prehistoric middle-aged adults in the region. The maxillary alveolus, near the left and right molars, displayed extensive resorption. Apical abscesses were observed for a maxillary molar, premolar, and canine.

Secondary Interments

Feature 61-b

In addition to the bones of the primary burial, Feature 61 included two other individuals apparently interred as secondary burials. Feature 61-b included four carpals, two metacarpals, two metatarsals, and 13 unidentifiable bone fragments from a subadult approximately 6 to 15 years of age at death. Based on the lack of complete fusion of the metacarpal heads, this individual was an older child or adolescent of indeterminate sex. Like the elements in Feature 61-c, these remains are very heavily weathered and extremely fragmentary.

Feature 61-c

Feature 61-c appears to be an adult (20 - 50+ years) secondary burial included with the other interments in Feature 61. This burial was determined to be a secondary interment based on taphonomic patterns that are identical to other secondary burials at the site, and the fact that these elements could not be assigned to any other adult burial in the entire Mitchell Ridge assemblage. This individual is represented by only four carpals, two metacarpals, and one metatarsal fragment. These elements are more severely weathered than those of 61-a, and some are bleached from sun exposure.

Feature 63-3

Feature 63-3 was an extremely fragmentary partial skeleton of a neonate or young child (0 to 2 years old) of indeterminate sex. These remains appear to be part of the bundle burial and cremated remains placed in the pelvic area of Feature 63-1. The subadult was represented by fragments of the skull, the articular ends of the femora, bones of the hands and feet, and the unfused processes of cervical, thoracic, and lumbar vertebrae. Twenty-two unidentified bone fragments were assigned to this individual based on their size and ossification. No pathologies were noted for these remains, and no evidence of ochre staining was observed.

Feature 63-4

Feature 63-4 was another young child that appears to be part of the bundle burial and cremated remains placed in the pelvic area of Feature 3-1. The subadult was represented by a nearly complete skeleton. The burial plan illustrates an articulated subadult radius, ulna, and metacarpals to the north of the bundle burial that may part of this individual. However, several elements and areas of the body were conspicuously missing, including the smaller bones of the feet, tarsals, the distal ends of both tibiae, the ischia, and all elements of the left and right shoulder girdles (humeri, scapulae, clavicles). Seventy-one unidentified bone fragments were assigned to this individual based on their size and ossification. Most elements exhibited dry breaks, and rodent gnawing was present on a distal ulna and proximal femur. The elements present, breakage pattern, and rodent gnawing suggest that the body was partially decomposed when it was collected and buried above Feature 63-1. If the subadult elements in the burial plan belong to this individual, then death occurred only a few weeks to months prior to interment. The notable lack of the upper arms and distal legs is typical of human remains that have been scavenged by canids (Haglund 1991). However, none of bones showed signs of canid chewing.

Like Features 62-1 and 62-2, this subadult was affected by reactive porosity around lambda that is associated with occipital flattening, perhaps from scalp infections related to cradleboarding practices (Holliday 1993). The left mastoid process is perforated by a large cloaca, and the external auditory meatus and petrous portion of the temporals have small areas of subperiosteal reactive bone deposition. These sequelae are similar to those described as osteomyelitis of the inner ear ("otitis media") (Ortner and Putschar 1981:122).

Feature 82-a

Feature 82 contained the disarticulated remains of two individuals. Although the elements could have been displaced by a nearby telephone pole, there is no osteological evidence for modern disturbance of these remains. Instead, it appears that Feature 82 represents a secondary burial of two people. Feature 82-a was an adult (20 - 50+ years) of indeterminate sex. This individual is represented by several teeth, a right ulna, nine ribs, two cervical vertebrae, all carpals and metacarpals, most of the hand phalanges, and tarsals and foot phalanges from both feet. Minor arthritic lipping was noted for several rib heads. The incisors of Feature 82-a exhibited weak shoveling.

Feature 82-b

The second individual in Feature 82 was an older adolescent or young adult female. Recent fusion of several epiphyses suggests an age of 14 to 21 years for this person. The diameter of the humeral head was within the female range. Skeletal elements recovered included several thoracic vertebrae, two rib fragments, the distal left clavicle, the left humerus, left distal radius and ulna, right radius, and several carpals and phalanges from both hands. No pathological conditions were noted for this burial.

Cremations

Feature 63-2a

A bundle containing the remains of at least one cremated adult (Feature 63-2a) and one cremated subadult (Feature 63-2b), Feature 63-2 contained over 1700 pieces of burned human bone. This cremation was apparently incinerated at another location and buried as a secondary burial in Feature 63, since no burning was evident in the burial pit or on the elements of other individuals in this feature. A blue glass bead was separated from these remains during analysis. Most of the bone fragments were less that 3 mm wide, which limited the number of identified bones to 131 adult and 10 subadult specimens. Nearly the entire skeleton of an adult was present, and most of the bones were calcined. Several elements, such as the skull, ox coxae, fibulae, tibiae, and radii were warped and had transverse and longitudinal fractures. Fragments of left and right femora were completely blackened, with glossy exterior cortex, a pattern typical of burning in defleshed, green bones. Other femoral specimens were partially or completely calcined. The overall pattern of burning indicates that at least one adult individual was cremated in the flesh. The presence of "green bone" burning may reflect the presence of a second, defleshed individual in addition to the in-the-flesh cremation. An alternative explanation is that the pattern represents differential burning of a single adult, either due to partial decomposition of the body at the time of cremation, or due to protection afforded by overlying soft tissue. At present it is not possible to resolve this issue, though the latter explanation is most parsimonious given the MNI of one.

The individual was an adult of indeterminate sex. One calcined fragment of a parietal contained part of the sagittal suture. The suture was closed endocranially and only partially open ectocranially, indicating a middle or older adult (30 - 50+ years). This cranial fragment also exhibited expansion of the diplöe and porosity of the outer cranial table, conditions typical of healed porotic hyperostosis. No other pathological conditions were observed, but it is quite possible that other conditions were obscured by the extreme fragmentation of remains.

Feature 63-2b

The subadult in Feature 63-2 was represented by several elements including the skull, the upper body, and portions of the feet. It is likely that missing elements from this individual are represented in the 1600 or more unidentified fragments. All of the identified fragments were partially to completely calcined. Several exhibited transverse fractures typical of fleshed cremations. The age of the individual was difficult to determine given the lack of identified epiphyses or teeth in the recovered material. Based on the gross size of element, this individual was less than 15 and probably less than 10 years of age, although this determination is merely a suggestion given the degree of heat-related warping observed.

Feature 65-A

This cremation appears to have been poured into the burial pit for Feature 65 when the pit was back-filled. Feature 65-A consisted of over 1000 pieces of burned human bone. This feature represents a younger adult (20 to 35 years?) based on cranial suture closure, and included fragments of vertebrae, ribs, hands, feet,long bones, and teeth. The majority of elements were evenly and completely blackened from smoking, a condition that indicates burning of defleshed, green bone (Buikstra and Swegle 1991). Several specimens had tan exteriors with a black to grey endosteum and cortical interior, a pattern typical of burned dry bone. Several long bone fragments were calcined only on one side. The pattern of burning and element representation in Feature 65-A indicate that the individual was cremated after some decomposition of soft tissues had occurred. The ribs and femora exhibited differential burning which may be due to soft tissue protection or the degree of exposure to heat. The majority of elements presented a "defleshed, green bone" pattern while others appeared to have been completely desiccated before they were exposed to heat.

Feature 85

This cremation was in a shallow oval pit and was accompanied by five unburned bone beads. This body was apparently incinerated at another location and deposited as a secondary burial, since no burning was evident in the burial pit Skeletal materials illustrated in the plan view as "unburned" human bone were identified as unburned skull fragments of an adult white-tailed deer (*Odocoileus virginianus*). Human remains in Feature 85 consisted of over 1500 pieces of burned adult (20 - 50+ years) bone. All portions of the skeleton were present, and the largest fragment was no more than 5 cm long. Most of the bones exhibited a partially calcined, blue-grey exterior, some with warping and/or transverse fractures. Other elements were only slightly scorched or had light tan-to-grey external cortex with black inner cortex typical of burned dry bone (Table 9.1). This feature represents an MNI of one, although the pattern of burning indicates that elements were at different stages of decomposition and desiccation when incinerated.

Burials Recovered from Previous Excavations at the "Burial Area"

Between 1974 and 1978, field crews from Rice University, the Houston Archaeological Society, and the Texas Archeological Society (TAS) conducted large-scale excavations of the eastern portion of the Mitchell Ridge Site. Human remains were located in two areas designated as the "Burial Area" and the "Cross Area". The "Burial Area" consisted of five Late Prehistoric mortuary features that contained a minimum of six individuals. Summary data for the human skeletal remains from this area are presented in Table 9.5. The following descriptions are of the human remains only, although data from the field notes and the unpublished report by Atkins (n.d.) were used to determine whether each burial was a primary or secondary inhumation. Classification of burial features was based on the skeletal element

Table 9.5. Summary of Skeletal Remains at the Mitchell Ridge Site, "Burial" Area.

Burial Number	Time Period[b]	Burial Type	Skeletal Age Range	Sex	Completeness	Red Ochre	Grave Goods
1	Prehistoric?	Primary	50+ years	M	84%	No	No
2[a]	Prehistoric	Primary	50+ years	F	95%	No	No
3	Prehistoric	Primary	10 - 15 yrs	F	68%	No	No
4[a]	Prehistoric	Primary	25 - 45 yrs	M	95%	No	No
5	Prehistoric?	Primary	20 - 50+ yrs	F	84%	No	No
6	Prehistoric?	Primary	30 - 40 yrs	M	53%	No	No

a These burials were recovered from a single feature

b Question mark denotes burials whose temporal assignment was uncertain.

representations and on the spatial arrangement of skeletal material.

Primary Interments

Burial 1

Burial 1 was a nearly complete skeleton of an old adult male (50+ years). This individual was extremely robust, with enlarged muscle attachments on several bones. Active porotic lesions were present in both parietals, and active cribrotic lesions were observed in both orbits. Both tibiae were bowed, but no reactive bone was present. In addition to the porotic lesions, Burial 1 exhibited significant tooth loss of the mandibular cheek teeth, a pattern also documented in Feature 35. Dental wear was extensive, and all teeth were worn to below the cervical margin. Several teeth were nothing more than exposed root tips with polished surfaces.

Burial 2

The feature designated as "Burials 2 and 4" contained two individuals. The first, Burial 2, appears to be a primary burial that was interred in the same pit as Burial 4. The displacement of bones in Burial 4 suggests Burial 2 was interred in the same grave pit at some point after the interment of Burial 4. The presence of articulated elements in both burials suggests that these were primary interments.

Most of the skeletal elements in Burial 2, and old adult (50+ years) female, were well-preserved but fragmented. None of the skeletal elements were ochre stained. The only pathological condition was a series of small, remodeled lesions in the right orbital roof indicative of healed cribra orbitalia. Like Burial 1, all of this individual's teeth were worn to well below the cervical margin, and some resorption of the mandibular alveolus was noted.

Burial 3

Burial 3 contained the skeletal remains of an adolescent (10 - 15 year old) female. This individual was relatively well preserved, and all but the small skeletal elements (phalanges, carpals, etc.) were present. Ochre stains were not present on any of the bones. The cranium of Burial 3 is slightly modified, with slight flattening at lambda. The occipital and parietals exhibited a number of tiny pores that may represent remodeling related to the modification. This burial also had tibiae which were slightly bowed but showed no signs of subperiosteal reaction or sclerosis. The teeth of this individual were only slightly worn, and several were affected by linear hypoplastic defects.

Burial 4

This burial represents a primary interment that was later disturbed when the burial pit was reopened to accommodate the body of Burial 2. The skeleton of Burial 4 is nearly complete, and appears to have been a flexed or semi-flexed interment before the disturbance. None of the skeletal elements were ochre stained. Burial 4 was an young to middle adult (25 - 45 years old) male, based on the morphology of the pubis and auricular surface. The skull, especially the frontal bone, had approximately 15 gummatous lesions similar to those in Feature 52. All of the lesions were healed. Like Feature 52, the tibiae of this individual were extremely bowed and were comparable to "sabre shins" characteristic of treponemal infection. Subperiosteal bone deposition was also present on the distal clavicle. This individual was probably affected by treponemal infection; this diagnosis was also obtained by physical anthropologist Barbara Jackson during her inventory and analysis of the Mitchell Ridge burials (Burial Inventory Form on file, Texas Archeological Research Laboratory). The teeth of Burial 4 were extremely worn, and several were lost antemortem. Six maxillary teeth and three mandibular teeth have periapical abscesses.

Burial 5

This feature contained the skeletal remains of a adult female 20 to 50+ years of age at the time of death. Like other burials in this area, these remains were nearly complete but exhibited numerous dry breaks. None of the bones exhibited ochre staining.

This individual, like other prehistoric and protohistoric burials at Mitchell Ridge, exhibited slight flattening just to the left of lambda, with concomitant porosity of the occipital and left parietal. The third and fourth cervical vertebrae were fused by flowing osteophytes, as was the right sacroiliac joint. The bones forming the elbow all exhibited surface porosity and degenerative marginal lipping. Lipping was also present on the superior left patella. The midshaft of the left fibula exhibited cortical swelling and some minor subperiosteal bone deposition. Dental attrition in Burial 5 was severe, and the alveolus of both maxillae was partially resorbed. Periapical abscesses were noted for one upper molar, two lower premolars, and a lower canine and incisor.

The manuscript on Mitchell Ridge by Atkins (n.d.:39) suggests that Burial 5 died from a blunt trauma to the head, with related fracture of the ascending ramus of the mandible and the cervical vertebrae. Careful examination of the cranial material indicated that most of the fractures described by Atkins, with the possible exception of the fracture of the zygomatic arch, were dry breaks that occurred well after death. However, the fusion of the cervical vertebrae may be trauma-induced given the pattern of cervical trauma in other individuals from the site. Atkins (n.d.:40) also describes "... two small, rectangular pieces of shaped bone, devoid of decoration" that were recovered from below the mandible and were presumed to have been "in the mouth". This description appears to fit the small, flat, rectangular wings of the hyoid bone, which can be mistaken in the field for a modified bone or as a non-human element.

Burial 6

Burial 6 contained the fragmentary skeletal remains of a middle-aged adult (30 - 40 year old) male. The frontal bone of Burial 6 exhibits several pseudopathological perforations of the outer and inner tables which were probably a result of root damage. Remodeled lesions of cribra orbitalia were present in the left orbital roof. Dental abscessing was quite severe in this individual; five maxillary teeth and one mandibular tooth were affected. In the case of the maxillary right first molar, the abscess perforated the maxillary sinus and reactive bone had been deposited inside the sinus, resulting was slight malformation of the face.

Burials from the "Cross Area" Excavations

The "Cross Area" contained several Late Prehistoric burials. Five features contained a minimum of seven individuals. Summary data for the human skeletal remains from the "Cross Area" are presented in Table 9.6. As noted above, classification of burial features was based on the skeletal element representations, the spatial arrangement of skeletal remains, and on field notes and descriptions.

Primary Interments

Burial 7

Two individuals, Burials 7 and 8, were interred in a single pit. Burial 7 was described as a tightly flexed skeleton of an adult placed at the bottom of a small pit and covered by the secondary burial of a subadult (Burial 8). Osteological analyses revealed that Burial 7 was a middle adult male approximately 35 to 50+ years old at death. The skeleton was relatively complete, and ochre stains were not present on any of the bones. This individual experienced severe degeneration of the knees, including eburnation of the lateral condyles of both femora, osteophytes formation along the joint margins, and partial destruction of both patellae. Arthritic pitting and marginal lipping were also present on the distal radii and ulnae. Minor vertebral osteophytosis was present on three thoracic vertebrae. Larger osteophytes were present on four lumbar vertebrae. The third lumbar vertebra displayed a compression fracture, and concomitant collapse of the anterior portion of the vertebral body resulted in kyphosis of the lower spine. In addition to degenerative disease, Burial 7 exhibited healed cribrotic lesions in both orbits. Dental attrition was severe, and seven maxillary teeth had periapical abscesses.

Table 9.6. Summary of Skeletal Remains at the Mitchell Ridge Site, "Cross" Area.

Burial Number	Time Period[c]	Burial Type	Skeletal Age Range	Sex	Completeness	Red Ochre	Grave Goods
7[a]	Prehistoric	Primary	35 - 50+ yrs	M	84%	No	No
8[a]	Prehistoric	Secondary	5 - 10 yrs	I	37%	No	No
9	Prehistoric?	Primary	20 - 30 yrs	F	100%	No	No
10	Prehistoric	Primary	20 - 25 yrs	M	100%	No	Yes
11	Prehistoric?	Primary	5 - 10 yrs	I	79%	No	No
12[b]	Prehistoric	Primary	10 - 20 yrs	F	84%	No	No
13[b]	Prehistoric	Primary?	2 - 6 yrs	I	84%	No	No

a These burials were recovered from a single feature below a "shell floor"

b These burials were recovered from a single feature to the east of the "shell floor"

Burial 9

Burial 9 was an young adult (20 - 30 years) female. The skeleton was well preserved, had no ochre staining, and was missing only the right lower leg and foot. A distal phalanx of the left hand exhibited a healed fracture. Minor osteophytic activity was observed for the first lumbar vertebra. The left tibia exhibited slight bowing, subperiosteal reactive bone deposition, and cortical swelling. Reactive swelling and sclerosis was also present on the left distal fibula. Dental attrition was moderate, and no abscesses were observed.

This feature played an important role in Atkins' fanciful reconstruction of "Karankawa" lifeways. She noted that the lower right leg of Burial 9 was missing below the knee, and that the leg was extended to contact the edge of the burial pit. This fact was confirmed by the osteological analyses and by examination of the burial plan. However, she goes on to suggest that this individual lost the lower leg during "shark fishing" activities similar to those reported for a nineteenth-century Karankawa band (Atkins n.d.). Careful examination of these elements provide no data to support this interpretation. The tibia and fibula have postmortem dry breaks, not perimortem severance.

What is intriguing about this burial is that these missing parts were unaccounted for in the NISP counts for the entire site. It would appear that the lower leg of Burial 9 was either missing at the time of interment or was destroyed during an archaeologically unrecognizable post-depositional disturbance. Given the fact that Prehistoric and Historic primary interments from other areas are also missing body parts, it may be more likely that the individual was partially decomposed or dismembered at the time of burial. Since the remains did not exhibit signs of traumatic severence, cut marks, or tooth marks, it appears that partial decomposition is a more likely scenario to explain the loss of the leg elements.

Burial 10

Burial 10 was an extended burial of an young adult (20 - 25 year old) male. This feature was described as "...disturbed in antiquity" (Atkins n.d.:46), since the bones of the thorax and pelvic girdle were disassociated and scattered throughout the area of the thoracic cavity. Several stone/bone dart points were recovered from this jumble of bones, but could not be positively identified as intentional inclusions. This individual was recovering from porotic hyperostosis at the time of his death, as evidence by healed porotic pitting on both parietals. The medial and distal phalanges of one foot had healed fractures from what appears to have been a severe, crushing trauma. The proximal ulnae exhibited very slight arthritic lipping, and three lumbar vertebrae have small osteophytes. Dental wear was moderate, and the upper right canine had a periapical abscess.

Burial 11

Rice University field crews removed Burial 11 as a block, returned the remains to the Rice archaeological lab, and finished removal of the skeleton under more controlled conditions. This burial represents the primary inhumation of a young child of indeterminate sex. The individual was approximately 5 to 10 years of age at the time of death, as determined from patterns of dental eruption and calcification. Ochre stains and pathologies were not observed in these remains.

Burial 12

This feature represents a multiple interment in a single feature. Two individuals were recovered, including an adolescent or young adult (10 - 20 year old) female designated as Burial 12, and a young child (2 - 6 years old) of indeterminate sex designated as Burial 13. The nearly complete young adult skeleton was quite large and robust, with a massive face and infracranial skeleton similar to Feature 92-2. In the field, a Scallorn stone arrow point was recovered near the lumbar vertebrae of this individual (Atkins n.d.:47). During laboratory analyses, a second *Scallorn*-like point was found embedded in the posterio-lateral aspect of the body of the third lumbar vertebra. No remodeling was present around the point, and radiating fracture lines suggested that the bone was still fresh when the trauma occurred. Taken together, it would appear that these wounds were severe enough to have caused the death of the individual. An alternative explanation is that these wounds reflect a postmortem trauma/mutilation event that occurred while the bone was still fresh.

The lower thoracic and upper lumbar vertebrae were affected by osteophytes. Several small, unifocal ulcerous lesions were present on the anterior bodies of these vertebrae. The first lumbar vertebrae had several such lesions, and the anterior margin of this element had collapsed, resulting in minor kyphosis of the lower spine. Healed porotic hyperostosis was present in both parietals.

Burial 13

In the same pit with Burial 12 were the very fragmentary remains of a young child approximately, 2 to 6 years of age. Field notes indicated that this individual was very fragmentary but was felt to be a primary interment. Atkins (n.d.:47) notes that "... the thin bones of the skull had been crushed-- probably by the roots from a small tree that had grown up between the woman and child". However, not a single skull fragment was present among the inventoried remains. The taphonomy of the other skeletal elements indicates that the burial was an partially articulated individual at the time of interment. However, the lack of even the durable petrosal portion of the temporal suggests that the skull was, in fact, not present, and that Burial 13 is a secondary burial. The age of the individual, missing skull, element disarticulation, and pattern of bone fragmentation are consistent with the pattern documented for other secondary burials at this site. However, the present evidence is not sufficient to accept or reject either possibility. No ochre stains or pathological conditions were present in this Burial.

Possible Secondary Interments

Burial 8

Burial 8 was described by Atkins (n.d.:45) as "...the secondary burial of an adolescent child". Evaluation of the burial plan and the lack of several large elements such as the os coxae tend to confirm this assessment. Burial 8 was only 37 percent complete, and was represented by long bones, elements of the hands and feet, vertebral fragments, teeth, and portions of the skull. Ochre stains were not present on any of the bones. This individual was an older child, 5 to 10 years old based on dental development. The anterior diaphysis of the right tibia exhibited subperiosteal reactive bone deposition. Dental wear was minimal, and the incisors presented strong shoveling.

Taphonomic Analyses and Implications for Mortuary Behavior

Previous analyses of human skeletal remains from the Texas coast have focused on biological variability (Aten 1965; Dockall 1987; Wilkinson 1977), health status (Burnett 1990; Powell 1989; Reinhard et al. 1989), demographic reconstruction (Aten 1979, 1983a; Powell 1989; Steele and Olive 1989), or mortuary behavior (Aten et al. 1976). Although anecdotal data are available on bone preservation (Aten 1965; Aten et al. 1976; Steele and Olive 1989), only a few analyses of skeletal series in this region have even presented element inventories (Colby et al. 1992), and virtually none have explored the taphonomy of human remains. During the 1992 fieldwork, the excavators noticed several unique methods of corpse disposal, and recorded a relatively large number of secondary burials compared to other cemeteries in the Galveston Bay area. The purpose of this section is to document the sequence of events from the time of death to the time of excavation and recovery. The taphonomic data from Mitchell Ridge are tested against data from skeletal series for which post-mortem events and patterns of bone modification are known, in order to better understanding both pre-burial cultural transformations of human bone and post-depositional natural transforms.

Materials and Methods

The Mitchell Ridge site, including all 1970s excavated material, contained a minimum of 33 primary interments, 11 secondary burials, six cremated individuals, and five commingled individuals. Skeletal inventories and data on burning, cut marks, rodent gnawing, and fracture patterns were totaled by element and divided into primary and secondary burials. The inventories for the 1970s burials were not as detailed as those from more recently excavated skeletons, and were excluded from the taphonomic analyses presented below. However, the general pattern of element representation and preservation appears to be the same for the skeletons excavated in the 1970s and in 1992. Inventories for cremations were considered separately from the primary and secondary burials, and are presented later in this section.

The basic methods used here are similar to those employed in the analysis of non-human vertebrate faunal assemblages (Klein and Cruz-Uribe 1984). As noted below, the minimum number of individuals was determined by tabulating the number of replicate same-side elements. The total number of identified specimens (NISP) was used to generate several statistics following White (1992). The *observed element representation* was computed as the percentage of the NISP of primary and secondary burials. The *expected element representation* was derived from NISP expected for an element given the MNI for each burial type. The observed and expected representations were ranked from anatomically superior to inferior, and the Komolgorov-Smirnov test was used to determine if the distributions were significantly different.

Element survival was computed as the number of elements divided by the number expected for the MNI of that burial type. For example, there were 44 humeri from a minimum of 26 individuals interred as primary burials. The survival of humeri from primary burials is then $44/(26 \times 2) = 0.72$. Survival values below one indicate survival of fewer than expected elements, while values greater than one indicate more elements than expected.

Comparative data were used to test whether the pattern of representation and survival were similar to that of other human skeletal assemblages. Modern comparative samples include forensic cases from the Pacific Northwest (Haglund 1991; Haglund et al. 1989) that were either carnivore-scavenged (MNI = 30) and/or left to decay in an open-air setting (MNI = 16). Several types of prehistoric assemblages were also examined. The Norris Farms #36 site, located in central Illinois (Milner and Smith 1989 in Haglund 1991:171-184), represents a burial mound assemblage in which some of the 264 individuals were scavenged or mutilated before interment. Secondary burials (MNI = 52) at the Ayalán cemetery, Ecuador (Ubelaker 1981) represents remains which were partially or completely decomposed before burial. Finally, a fourteenth-century site from Crow Creek, South Dakota (Zimmerman et al. 1981) contained skeletal remains that may represent massacre victims exposed on the surface several weeks prior to burial.

Bone Taphonomy and Modification

Excluding all cremations and the 1970s materials, there were 2353 identified human specimens representing 21 primary burials, 10 secondary burials, and the remains of five commingled individuals. Most of the primary burials were complete, although some were missing smaller elements such as phalanges, carpals, and the hyoid. The NISP for primary burials was 2001 specimens, with an average of 95 specimens per individual. Primary burial completeness ranged from 5 to 100 percent, with a median of 84 percent. Secondary burials were represented by small bones of the hands and feet, the vertebral column, and a few long bones, and ranged from 1 to 100 percent complete with a median of 45 percent. Table 9.7 lists the element representations for each secondary burial. Several individuals were represented only by patellae or by hands and feet. The NISP for secondary interments was 352 specimens, with an average of 35 specimens per individual.

Element Representations

Figure 9.2 illustrates observed and expected element representation (as a percentage of the NISP) for both primary and secondary burials. Primary burials follow the expected values quite closely, although there appear to be slightly greater than expected numbers for elements of the arm and shoulder, pelvis, and legs. Hand and foot phalanges are under-represented as is typical of archaeological remains where small elements often pass through larger screen sizes. An alternative explanation is that fingers and toes were lost before interment through animal scavenging and decomposition. Secondary burials at the site have a completely different element representation profile. The scapula, ribs, thoracic and lumbar vertebrae are under-represented given the secondary burial MNI, while hand elements and hand phalanges are over-represented.

One question raised during the assessment of secondary burials was whether the element

Table 9.7. Elements Present in Secondary Burials, 41GV66

Feature Number	Elements or Body Areas Respresented	Preservation	Side
26	Patella	Complete	Left
27-b	Patella	Complete	Left
28-a	Carpals	Mostly complete	Both
	Metacarpals	Mostly complete	Both
	Hand phalanges	Mostly complete	Both
	Humerus (proximal only)	Fragments	Both
28-b	Carpals	Mostly complete	Both
	Metacarpals	Mostly complete	Both
	Hand phalanges	Mostly complete	Both
	Humerus (proximal only)	Fragments	Right
61-b	Carpals	Complete	Both
	Metacarpals	Complete	Both
	Metarsals	Mostly complete	Both
61-c	Carpals	Complete	Both
	Metacarpals	Complete	Both
	Metarsals	Mostly complete	Both
63-3	Cranium (frontal and parietals)	Fragments	-----
	Ribs	Fragments	Both
	Carpals	Mostly complete	Both
	Metacarpals	Mostly complete	Both
	Hand phalanges	Mostly complete	Both
	Cervical vertebrae	Fragments	-----
	Thoracic vertebrae	Fragments	-----
	Lumbar vertebrae	Fragments	-----
	Os coxa	Fragments	Left
	Femur (proximal only)	Fragments	Both
	Tarsals	Fragments	Both
	Metatarsals	Mostly complete	Both
	Foot phalanges	Mostly complete	Both

Table 9.7., cont.

Feature Number	Elements or Body Areas Respresented	Preservation	Side
63-4	Cranium (frontal, parietals, occipital)	Fragments	-----
	Scapula	Fragments	Right
	Clavicle	Mostly complete	Both
	Ribs	Fragments	Both
	Carpals	Mostly complete	Both
	Metacarpals	Mostly complete	Right
	Hand phalanges	Mostly complete	Right
	Cervical vertebrae	Fragments	-----
	Thoracic vertebrae	Fragments	-----
	Lumbar vertebrae	Fragments	-----
	Os coxa (ilium only)	Fragments	Both
	Femur (proximal/medial only)	Fragments	Both
	Tibia (proximal/medial only)	Mostly complete	Both
	Fibula (proximal/medial only)	Mostly complete	Both
	Metatarsals	Fragments	Both
	Foot phalanges	Mostly complete	Both
82-a	Ribs	Fragments	Both
	Ulna (proximal only)	Fragment	Right
	Metacarpals	Mostly complete	Both
	Hand phalanges	Mostly complete	Both
	Cervical vertebrae	Fragments	-----
	Thoracic vertebrae	Fragments	-----
	Lumbar vertebrae	Fragments	-----
	Metatarsals	Complete	Both
	Foot phalanges	Complete	Both
82-b	Clavicle	Fragment	Left
	Ulna (proximal only)	Fragment	Right
	Ulna (distal only)	Fragment	Left
	Radius (distal only)	Fragment	Left
	Ribs	Fragments	Both
	Carpals	Mostly complete	Both
	Hand phalanges	Mostly complete	Both
	Thoracic vertebrae	Fragments	-----

Table 9.7, cont.

Feature Number	Elements or Body Areas Respresented	Preservation	Side
92-1a	Mandible	Complete	-----
	Clavicle	Fragments	Right
	Ribs	Fragments	Both
	Ulna (proximal only)	Fragment	Left[a]
	Humerus (proximal only)	Fragments	Right
	Humerus (diaphysis only)	Fragment	Left[a]
	Carpals	Mostly complete	Both
	Metacarpals	Mostly complete	Both
	Cervical vertebrae	Fragments	-----
	Thoracic vertebrae	Fragments	-----
	Lumbar vertebrae	Fragments	-----
	Femur (medial/distal only)	Fragments	Both
	Fibula (medial/distal only)	Mostly complete	Both
	Tarsals	Complete	Both
	Metatarsals	Mostly complete	Both
92-1b	Clavicle	Fragments	Left
	Humerus (proximal only)	Fragments	Right
	Radius (distal only)	Fragment	Left
	Radius (diaphysis only)	Fragment	Right
	Carpals	Complete	Both
	Metacarpals	Mostly complete	Left
	Hand phalanges	Fragments	Both
	Os coxa (ischium and ilium)	Fragments	Both
	Femur (proximal/medial)	Fragments	Right
	Femur (proximal/medial)	Fragments	Left[a]
	Tibia	Complete	Right
	Tibia	Complete	Left[a]
	Fibula (medial/distal only)	Mostly complete	Both
	Tarsals	Complete	Both
	Metatarsals	Mostly complete	Both

a Element exhibits multiple cut marks

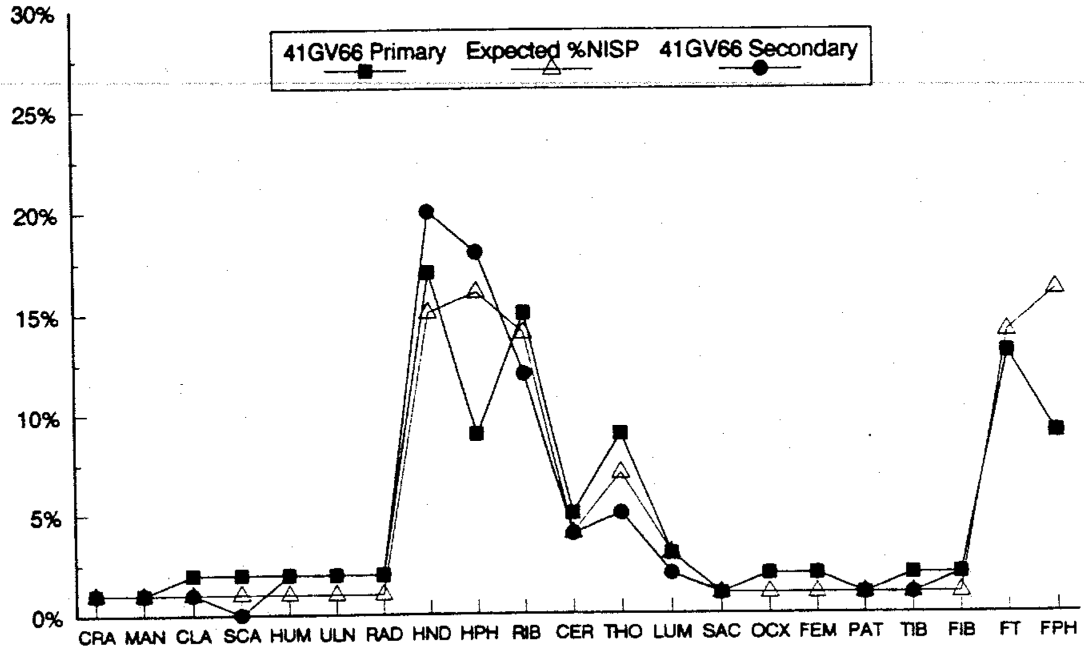

Figure 9.2. Skeletal element representations for primary and secondary burials at Mitchell Ridge compared to expected representation for complete individuals.

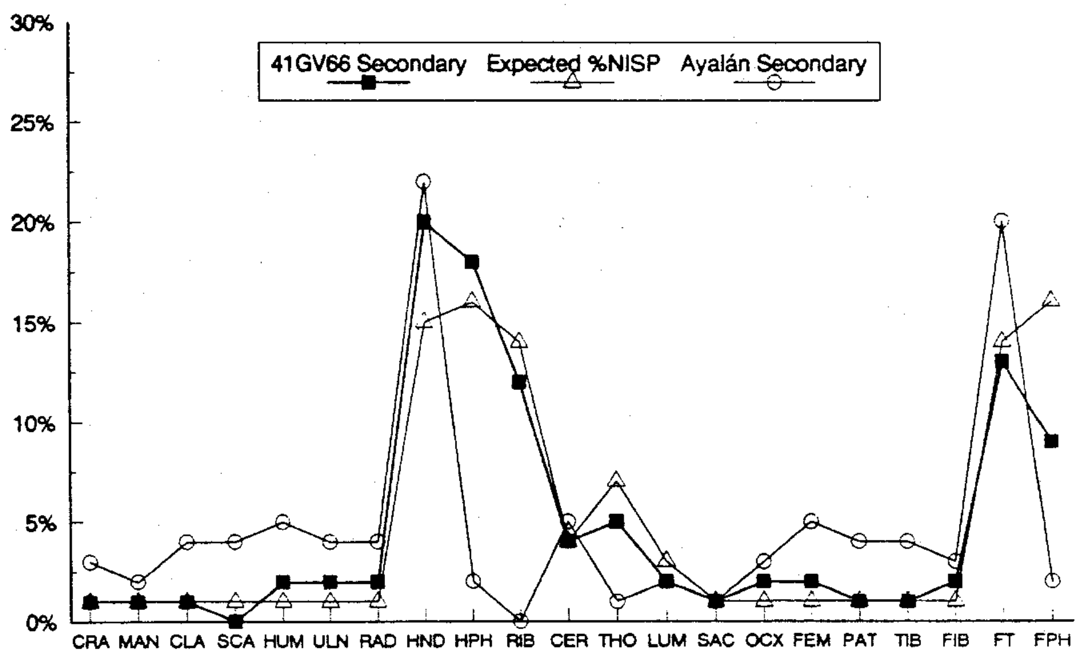

Figure 9.3. Skeletal element representations for secondary burials at Mitchell Ridge and Ayalán, Ecuador (data farom Ubelaker 1987).

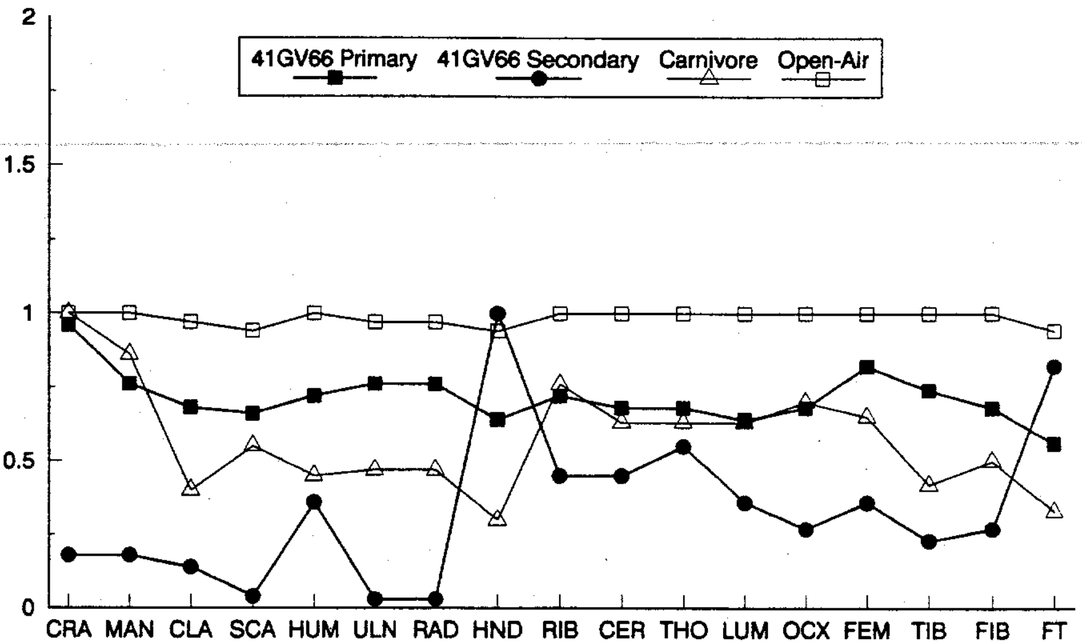

Figure 9.4. Skeletal element survival rates for Mitchell Ridge and forensic cases. Comparative data represent carnivore scavanged and unscavanged, open-air disarticulations (from Haglund 1991).

representations were typical of sites such as ossuaries, where bodies were curated for long periods of time,then buried *en masse* at some regular interval (Ubelaker 1974, 1987). Secondary burials at the Ayalán cemetery (Figure 9.3) have fewer hand phalanges, ribs, vertebrae, and foot phalanges and greater numbers of large bones, carpals, and metacarpals. Ubelaker (1981) felt that bodies at Ayalán buried in urns may have been collected after considerable decomposition had occurred, thus explaining the loss of smaller elements and greater than expected numbers of large bones. Although patterns of bone representation between Mitchell Ridge and Ayalán secondary burials appear to be distinct, the differences were not statistically significant based on Komolgorov-Smirnov tests.

Skeletal Element Survivals

Element survival rates for Mitchell Ridge and forensic cases are presented in Table 9.8 and Figure 9.4. Primary burials are more similar to carnivore scavenged remains than they are to open-air remains. Primary burials at Mitchell Ridge have more surviving arm and leg elements than is the case for scavenged bodies. Figure 9.4 also clearly illustrates that the secondary burials are quite unusual, with frequent survival and even over-survival (i.e., excess elements) of the hands and feet, followed by the thorax, pelvis, and legs.

Table 9.8 presents the survival values for all of the modern and prehistoric assemblages, and Table 9.9 presents the Spearman Rank Correlation Coefficients for element survival values among these groups. The primary and secondary burials at Mitchell Ridge display significant negative correlation by body part; that is, elements with low survival values in primary burials (i.e., hands, feet, and phalanges) have high survival in secondary burials. Comparisons with other assemblages resulted in a significant, positive correlation between primary burials and the carnivore-scavenged forensic cases. Secondary burials were not significantly correlated with any of the other death assemblages, although the only positive correlation was with the forensic open air cases. These data suggest that bone survival in secondary burials at

Table 9.8. Skeletal Element Survival for Mitchell Ridge (41GV66), Forensic Cases, and Archaeological Samples. See text for a discussion of each comparative sample.

	Mitchell Ridge		Forensic Cases		Archaeological	
Element	**Primary**	**Secondary**	**Carnivore**	**Open-Air**	**Norris**	**Crow Creek**
CRA	96.0	18.0	100.0	100.0	40.0	99.1
MAN	76.0	18.0	86.0	100.0	33.3	-----
CLA	68.0	13.6	40.0	96.9	53.3	24.0
SCA	66.0	4.5	55.0	93.7	61.1	53.6
HUM	72.0	36.4	45.0	100.0	61.6	42.5
ULN	76.0	2.7	46.7	96.9	53.3	25.1
RAD	76.0	12.0	43.8	93.7	65.5	21.2
HAN	64.0	100.0	30.0	93.7	16.0	6.8
RIB	72.0	45.4	76.0	100.0	51.6	-----
CER	68.0	45.4	63.3	100.0	55.7	48.9
THO	68.0	45.4	63.3	100.0	70.0	60.0
LUM	64.0	36.4	63.3	100.0	73.3	69.7
OCX	68.0	27.3	70.0	100.0	76.6	117.7
FEM	82.0	36.4	65.0	100.0	66.6	75.5
PAT	48.0	109.1	34.0	-----	40.0	4.0
TIB	74.0	22.7	41.7	100.0	68.3	54.6
FIB	68.0	27.2	50.0	100.0	53.3	30.8
FT	56.0	81.8	33.0	93.7	14.6	14.7

Table 9.9. Element Survival Correlations Among Mitchell Ridge Primary and Secondary Burials and Comparative Sample.

	41GV66 Primary	**41GV66 Secondary**	**Forensic Carnivore**	**Forensic Open-Air**	**Norris**
Secondary	-0.562				
	0.015				
Forensic Carnivore	0.525	-0.212			
	0.025	0.398			
Forensic Open-Air	0.348	0.191	0.675		
	0.171	0.464	*0.003*		
Norris	0.135	-0.206	0.245	0.379	
	0.592	0.411	0.328	0.134	
Crow	0.450	-0.235	0.900	0.747	0.682
	0.080	0.382	*<0.001*	*0.001*	*0.004*

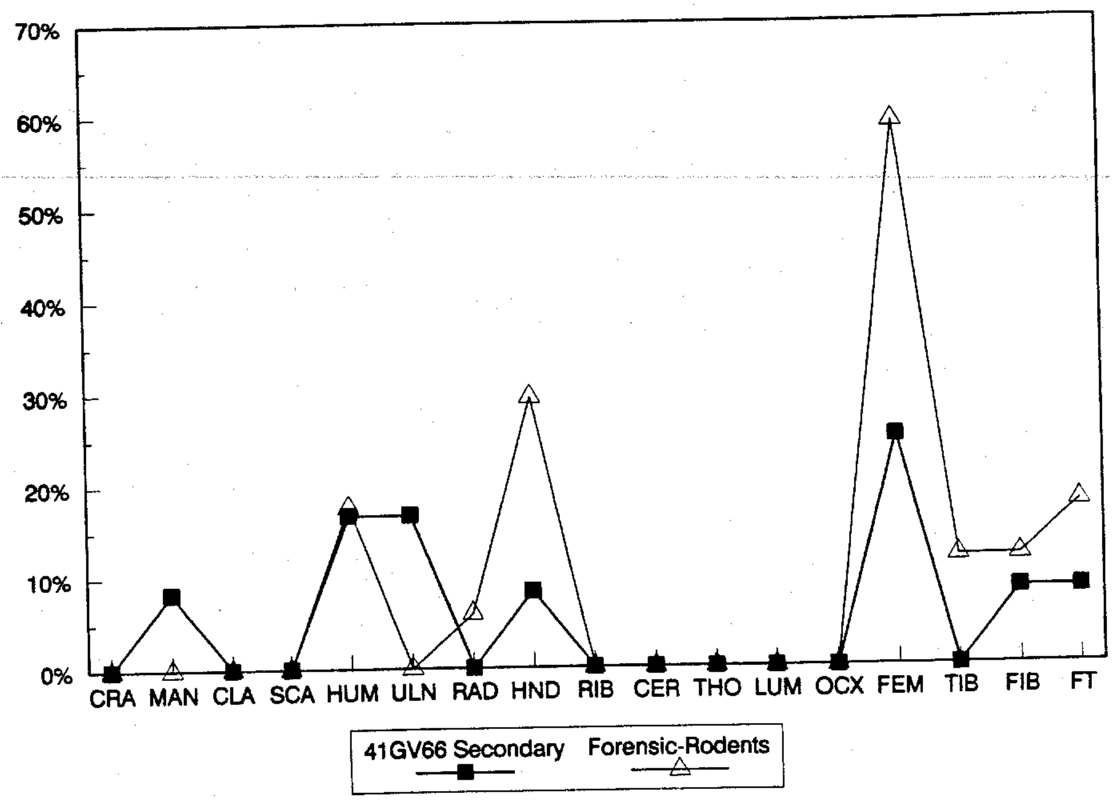

Figure 9.5. Frequency of rodent gnawing by element for Mitchell Ridge secondary burials and open-air forensic cases (data from Haglund 1991).

Mitchell Ridge is not unlike the pattern associated with carnivore scavenging, open-air loss, mutilation practices (Norris Farms), or a combination of factors (Crow Creek). Instead, some other mechanism must be invoked to explain the observed pattern of element survival.

Fragmentation

Seventy-five percent of non-cremated remains at the site exhibited dry bone breaks. There was no evidence of dynamic loading or spiral bone fracture among primary or secondary interments. In general, bone fragmentation was greater for Late Prehistoric than for Protohistoric and Historic burials.

Rodent Gnawing and Carnivore Damage

None of the skeletal elements in the Mitchell Ridge assemblage exhibited defects related to large carnivore chewing. Eight percent of burials recovered during the most recent site excavations exhibited rodent gnawing. All affected individuals were secondary burials (Features 63-4, bundle burial, 92-1a and 92-1b). Figure 9.5 illustrates the percentage of elements with rodent gnawing compared to rodent gnawing in 16 forensic cases from the Pacific Northwest. The pattern of rodent gnawing is similar between these samples, although the forensic cases have more gnawing on hands, legs, and feet than individuals at Mitchell Ridge.

Ochre Stains

Ochre stains were present in both primary and secondary burials of all ages and sexes. Thirteen primary interments (34%) exhibited ochre stains, as well as two commingled burials and three secondary interments (27%). During the Late Prehistoric period, ochre staining is present in 21 percent of primary burials and in 25 percent of all Late Prehistoric secondary interments. Stains were observed in 56 percent of Protohistoric and Historic primary burials, and in 33 percent of secondary burials from later periods. Regardless of the age, sex, or temporal assignment of individuals, ochre stains were most common on the vertebrae and ox coxae, followed by the upper legs and lower arms. The pattern of staining in most individuals represents application of pigment to the thoracic and pelvic regions at some point prior to soft tissue decomposition.

Cut Marks

Special care was taken to distinguish between excavation damage from metal tools and perimortem cut marks on bone. Trowel damage typically leaves a single deep defect which is not filled with matrix. Multiple defects from excavation damage are rare, and are usually randomly oriented on the bone. Intentional cut marks, as defined by Binford (1981), are more shallow, finer, and have a "chevroned" (V-shaped) appearance. They are often repeated in the same area of the bone and typically have a common orientation. Dual grooves produced by the irregular edge of stone tools are sometimes present within intentional cut marks. These criteria were used to eliminate some bone defects from consideration as perimortem cut marks.

Only two individuals deposited as Protohistoric secondary interments present clear and unmistakable perimortem marks on long and irregular bones. Long and irregular bones from Feature 92-1b (Table 9.7), a subadult, displayed repeated parallel cut marks. The medial border of the distal left tibia had 21 short, parallel marks across the shaft in an area 38.7 mm by 7.9 mm (Figure 9.6). The shortest cut was 1.6 mm and the longest was 7.9 mm. These cuts were placed across the area covered by the tendon of the peronius longus. On the opposite side of the distal tibia were 12 shorter, parallel cut marks on the posterio-lateral border of the tibial shaft. These cuts are more shallow than those on the medial border, and are more closely spaced. They range in length from 12.0 to 2.1 mm long and cover an area 17.4 mm by 12 mm, and would have severed the tendon of the flexor hallicus longus. Five very shallow, chevroned cut marks were observed on the medial side of the left calcaneus just posterior to the articular facets and sustentaculum tali. Parallel cuts, ranging from 2.17 to 10.0 mm in length, were positioned diagonally across the body from posterior to anterior. These incisions could have severed a number of muscles and tendons including the posterior talus-calcaneus ligament, the bursa of the flexor hallicis longus, and the internal head of the accessorius.

Feature 92-1b also exhibited 11 short, parallel cut marks on the anterior shaft of the left femur directly opposite the nutrient foramen (Figure 9.7). Cuts on this element were very dense, and covered an area of 9.0 by 4.3 mm; the shortest cut was 1.0 mm and the longest was 4.3 mm. The position of these cuts is more difficult to interpret. Depending on the state of soft tissue preservation at the time of bone modification, the cuts could have severed the superficial rectus femoris, the tendons and fascia of the cureus muscle, or in a case of advanced skeletonization, the periosteum.

Cut marks were also noted for Feature 92-1a, a middle-aged adult male. Eleven short, parallel, diagonal cuts were observed across the shaft of the left humerus on the anteriomedial aspect, just inferior and medial to the crest of the greater tuberosity. This area corresponds to the area crossed by the tendon of the teres major. The defects are closely spaced in an area of 17.5 by 4.5 mm, and range from 1.0 to 4.5 mm in length. Deeper parallel cuts were also observed on the anteriolateral aspect of the left humerus just inferior to the outlet of the bicipital groove. Cuts are widely spaced and cover an area 17 by 5 mm. These cuts would have severed the pectoralis major muscle.

A series of more ambiguous defects were present on the shaft of the left distal ulna of Feature 92-1a. The defects were diagonally oriented across the anteriomedial aspect, and were very shallow, while deeper defects were oriented in the cross-diagonal direction. These marks are distinct from rodent gnawing, but are not as deep and clear as cut marks on other specimens. These defects cross the area occupied by the tendon of the flexor digitorus profundus. These marks, combined with those of the humerus, suggest detachment of the arm from the body and possibly dismemberment of the lower arm

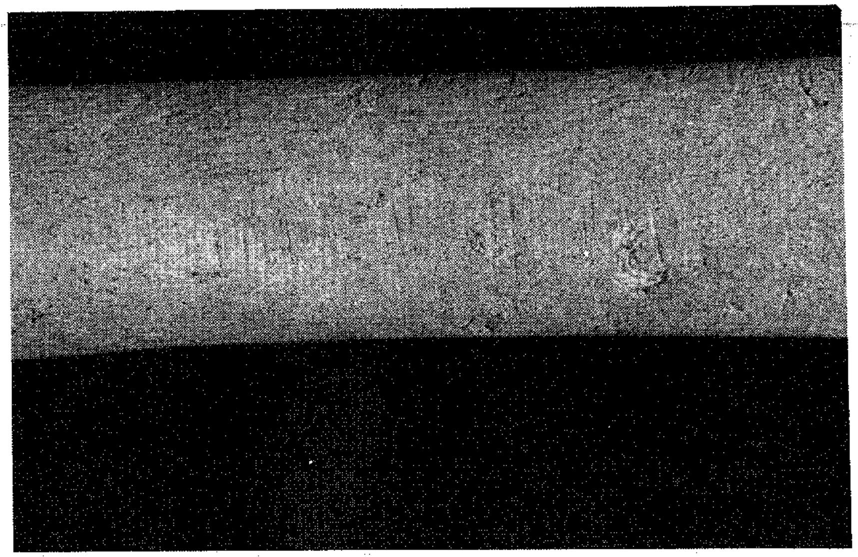

Figure 9.6. Photograph showing cut marks on the left tibia of Feature 92-1b.

and hand.

All of the cuts are extremely fine, chevroned, and are filled with matrix and red ochre. Nearly all of the marks observed in Feature 92-1b have dual grooves inside the main cut groove indicative of cutting with stone tools. Marks in this individual can be classified as "filleting marks" following Binford (1981), although they are not positioned in such a way to indicate removal of large muscle masses. Raemsch (1993:221,227) found that cut marks associated with disarticulation tended to be more V-shaped, short, relatively dense, and oriented perpendicular or oblique to the bone's longest axis, while defleshing marks tend to be U-shaped, longer, and parallel to the long axis. Given that the cuts on Mitchell Ridge specimens would have severed the tendons which attach the foot to the lower leg, it is more likely that they represent intentional dismemberment of the leg which may be related to the pattern of element representation discussed above.

The discovery of cut marks in an assemblage of human skeletal remains from the Texas coast could be interpreted as signs of cannibalism, a behavior noted and mythologized for post-contact Karankawa bands on the upper and central coast (Day 1971; Newcomb 1983). As a means of testing such an interpretation, the distribution of cut marks in the Mitchell Ridge material was compared with a butchered artiodactyl assemblage from the American Southwest, and with an assemblage of human skeletal remains from Mancos Pueblo which are now thought to represent the results of cannibalism (White 1992). Figure 9.8 depicts the frequency of cut marks by element in these three samples. It is clear that cut marks in the Mitchell Ridge assemblage are less common than in the Mancos and artiodactyl samples, and follow a pattern that differs from the Mancos assemblage (i.e., tibiae and cancani are more frequently affected). Komolgorov-Smirnov tests indicate that cut marks in the Mitchell Ridge sample had a distribution which was significantly different ($p < .001$) that cut marks in Mancos or artiodactyls. These data indicate that cut marks in the Mitchell Ridge secondary burials cannot be attributed to butchery for consumption, but

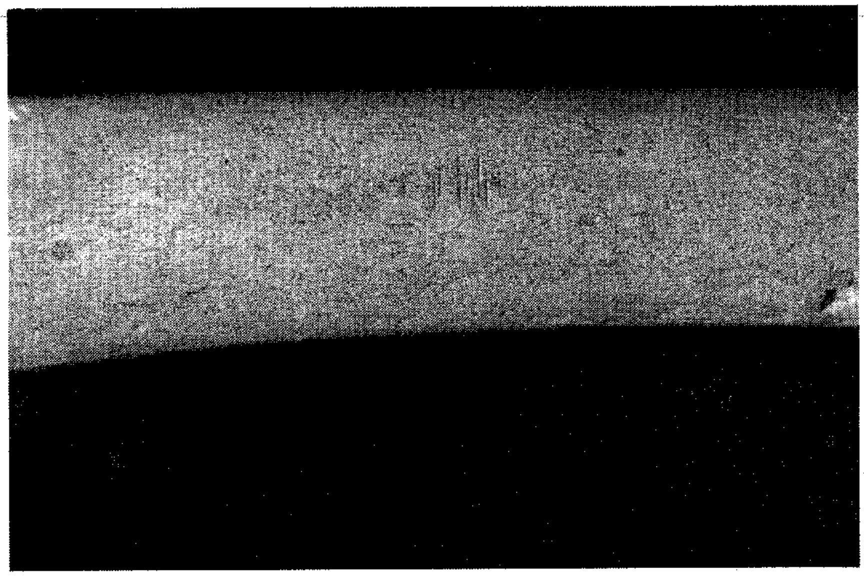

Figure 9.7. Photograph showing cut marks on the left femur of Feature 92-1b.

may instead reflect post-mortem processing and distarticulation of remains for secondary burial (see discussion below).

Burning

Burned bone was limited to the six cremated individuals at the site. Burning was classified following the categories presented in Table 9.1. Although the number of bone fragments per cremation ranged between 151 and 1708, the NISP range was only 10 to 131. The average ratio of NISP to total specimens for all six individuals was 0.039. Summary data for each cremation are presented in Tables 9.10 - 9.12.

Pre-incineration body condition

The extreme fragmentation of remains made analysis of these features difficult and time consuming. Inconsistencies in the interpretation of bone burning by previous researchers further added to the problems of taphonomic analysis. Buikstra and Swegle (1989) were used as the reference, since they provide the best experimental data using human bone. Bone burning ranged from slight discoloration of the outer cortex to complete calcination of bone with transverse and longitudinal splitting (see Table 9.1). Color, texture, and molecular structure of the bone are related to the temperature of the fire, duration of heat exposure, proximity to the source of heat, and protection afforded by overlying soft tissues (Buikstra and Swegle 1989; Shipman et al. 1984). Three basic pre-incineration conditions, based on the data presented in Buikstra and Swegle (1989), can be determined from burned bone. Dry bone burning

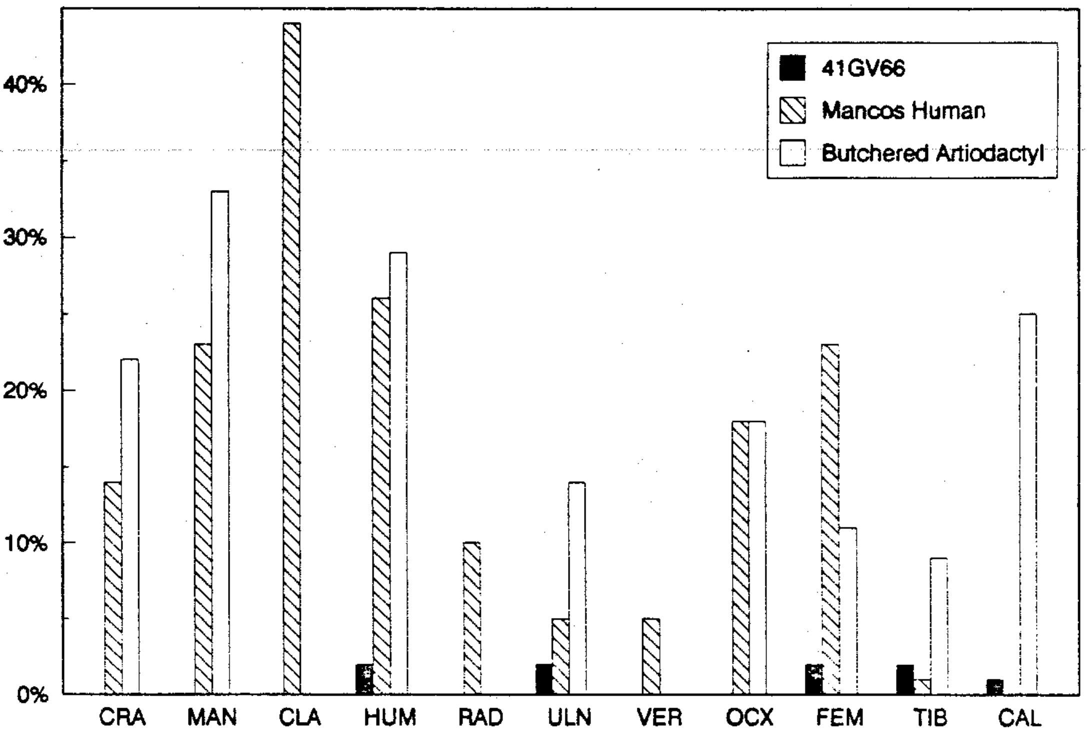

Figure 9.8. Frequency of cutmarks by element for sedondary burials, Mancos Pueblo, and artiodactyls. Comparative data from White (1992).

typically results in slight discoloration of the outer cortex, with blackening of the inner cortex. Dry bone burning was present in only two features (65-A and 85). Green and fleshed bone often have similar appearances after incineration. Warping, longitudinal splitting and transverse fissures, calcination, and blackening all occur in fleshed and green bone cremations, depending on heat intensity and duration of exposure (Buikstra and Swegle 1989). One possible indicator of defleshed, green bone is the presence of uniformly blackened bone which has a slight glossy patination on the external cortex. This type of bone was present in nearly every cremation, but was most common in Features 3, 65-A, and 85 (Tables 9.12 - 9.14). Calcinated bone was also present in every cremation, but was most common in the adult and subadult remains from Feature 63-c. The extreme warping and high frequency of transverse fracturing of elements in these two individuals suggests that they may represent incineration of in-the-flesh bodies. With the exception of individuals in Feature 63-2, it appears that most cremated individuals were incinerated some time after decomposition had begun but before all bone was completely dry. The implications of this will be discussed below.

Body position

Determining body position at the time of incineration is also quite difficult, given that all of the cremations were secondary deposits. Increased calcination on the posterior sides of some bones (especially the cranium) of both individuals from Feature 63-2 suggest that both individuals were placed on or over a fire rather than the fuel placed over the body.

Table 9.10. Adult Burned Skeletal Elements from Feature 63-2a.

	Calcination Stage					
Element/NISP	Stage 2-3 Transverse fractures	Stage2-3 No fractures	Stage 1	Burned Black/Blue	Gloss Black (Green bone)	Tan/Black (Dry Bone)
Cranium (41)	3	18	12	7	1	0
Mandible (1)	0	0	1	0	0	0
Rib (8)	1	3	4	0	0	0
Vertebra (6)	0	1	0	5	0	0
Humerus (10)	5	2	2	1	0	0
Radius (4)	0	0	2	1	1	0
Ulna (3)	1	0	1	1	0	0
Os coxa (9)	5	0	1	3	0	0
Femur (36)	9	20	6	1	0	0
Tibia (4)	3	0	0	1	0	0
Fibula (7)	3	0	0	1	1	0
Foot Elements (2)	0	0	2	0	0	0
Total: (131)	31	46	32	20	2	0

Table 9.11. Subadult Burned Skeletal Elements from Feature 63-2b.

	Calcination Stage					
Element/NISP	Stage 2-3 Transverse fractures	Stage2-3 No fractures	Stage 1	Burned Black/Blue	Gloss Black (Green bone)	Tan/Black (Dry Bone)
Cranium (2)	1	1	0	0	0	0
Clavicle (1)	1	0	0	0	0	0
Rib (2)	0	0	0	2	0	0
Humerus (1)	0	0	0	1	0	0
Radius (1)	0	0	1	0	0	0
Femur (2)	0	1	1	0	0	0
Foot Elements (1)	0	0	0	0	1	0
Total: (10)	2	2	2	3	1	0

Table 9.12. Adult Burned Skeletal Elements from Feature 3.

	Calcination Stage					
Element/NISP	Stage 2-3 Transverse fractures	Stage2-3 No fractures	Stage 1	Burned Black/Blue	Gloss Black (Green bone)	Tan/Black (Dry Bone)
Cranium (6)	0	2	4	0	0	0
Teeth (14)	3	9	1	1	0	0
Hand Elements (5)	0	1	2	2	0	0
Rib (1)	0	0	0	1	0	0
Femur (32)	0	0	6	2	24	0
Patella (1)	0	1	0	0	0	0
Foot Elements (3)	0	1	2	0	0	0
Total: (62)	3	14	15	6	24	0

Table 9.13. Adult Burned Skeletal Elements from Feature 65-A.

	Calcination Stage					
Element/NISP	Stage 2-3 Transverse fractures	Stage2-3 No fractures	Stage 1	Burned Black/Blue	Gloss Black (Green bone)	Tan/Black (Dry Bone)
Cranium (18)	0	7	0	0	9	2
Teeth (11)	0	0	0	0	11	0
Rib (9)	2	5	1	0	1	0
Radius (1)	0	0	0	0	0	1
Hand Elements (13)	0	0	1	0	10	2
Femur (6)	0	0	3	0	1	2
Foot Elements (5)	0	0	0	0	4	1
Total: (63)	2	12	5	0	36	8

Table 9.14. Adult Burned Skeletal Elements from Feature 85.

	Calcination Stage					
Element/NISP	Stage 2-3 Transverse fractures	Stage2-3 No fractures	Stage 1	Burned Black/Blue	Gloss Black (Green bone)	Tan/Black (Dry Bone)
Cranium (16)	3	1	7	1	1	3
Mandible (3)	0	2	1	0	0	0
Rib (5)	0	2	1	1	1	0
Vertebra (7)	0	0	0	0	0	7
Humerus (7)	2	1	3	0	0	1
Radius (3)	0	0	0	2	0	1
Ulna (5)	1	1	1	1	1	0
Os coxa (10)	2	0	3	2	0	3
Femur (55)	13	10	14	9	3	6
Tibia (9)	0	0	1	3	2	3
Fibula (5)	1	1	0	0	2	1
Foot Elements (4)	0	1	1	0	1	1
Total: (129)	22	19	32	19	11	26

Methods of Corpse Disposal

Primary Interments

Primary interments at the site appear similar to what is expected for burial of whole, articulated individuals. Representations and element survivals suggest than only smaller elements or distal ends of appendages were lost. Bone preservation was excellent in most cases with only dry bone breaks that probably occurred well after skeletonization. No cut marks were observed on any primary burials.

Correlations between the primary burials and human death assemblages whose history and taphonomy are well documented revealed that primary interments are most similar to carnivore-scavenged remains. However, there was no evidence of carnivore damage to any of the bones at the site. At present it is not possible to state that carnivores account for the elements represented in primary burials.

Several primary burials have indications that the body had undergone partial decomposition. For example, Feature 64-1 had one foot placed across the leg, although the foot elements were all articulated. Such disassociation could only have occurred if the foot had been intentionally severed (see discussion of secondary burials below) or if the foot had separated from the leg through decomposition. Similar disassociation was observed for Feature 63-4 and Burial 3. Based on regression formulae to estimate postmortem interval from total number of elements present (Haglund 1991) and on subjective descriptions of decomposition (Micozzi 1991), primary burials at Mitchell Ridge were interred between 0 and 31 days after death.

Ethnohistoric Data

Direct observation of primary interments on the upper Texas coast are not available. Most authors presume that burials were primary, although this is not explicit in any ethnohistoric documents. Newcomb (1983:365) summarized these data by stating that "...ordinary persons were buried in shallow graves on or near campsites; few tools or ornaments were interred with them." Deaths of young men and boys were accompanied by a prolonged period of mourning and possibly by taboos regarding food procurement. Aged individuals were not accorded any special mortuary treatment or prolonged mourning (Newcomb 1983).

Secondary Interments

Secondary burials were the second most common form of corpse disposal at the Mitchell Ridge site. This interment type is represented by four Late Prehistoric, five Protohistoric, and two Historic individuals, which reflects a shift through time from 40 to 50% of all burials in the Late Prehistoric and Protohistoric, to a mere 18.2% of Historic interments. All but three secondary burials are subadults, and all of the adults occur in the Protohistoric period. The mean age at death of secondary interments is 10.5 $\pm$ 1.9 years for the Late Prehistoric, 20.8 $\pm$ 12.2 years in the Protohistoric, and 2.0 $\pm$ 1.0 years for the Historic period.

All of the secondary burials at the site are missing some elements. Loss of some elements can hypothetically be attributed to bone preservation or losses in the field and laboratory. However, the presence of smaller elements and absence of larger ones indicates a pattern of selectivity that is not typical of either carnivore or rodent scavenging, skeletal preservation, or excavation losses. Skeletal elements for most secondary burials are extremely well preserved, and show no signs of weathering typical of loss through diagenesis. The disproportionate number of hand and foot bones (and associated phalanges) and lack of larger, more durable elements is not typical of losses due to scavengers (Figure 9.4), excavation, or inadequate archaeological curation. The recovery of lone patellae or distal arms and complete hands from undisturbed features (i.e., Features 26, 27-b, 28a, and 28b) precludes the argument that secondary burials are actually disturbed primary interments. Skeletal representations and element survivals are best explained as human-mediated rather than post-depositional patterns.

Based on the taphonomic data, it appears that secondary burials at the Mitchell Ridge site represent differential selection of body parts, curation of remains, and body processing, especially of younger individuals. Four secondary burials are represented primarily by hands and/or feet and two by patellae. Two others reveal a series of cut marks suggesting intentional detachment of the left arm (Feature 92-1a) and left foot (Feature 92-1b). These data suggest that in some cases, hands and/or feet and patellae appear to have either been removed (as in the case of Feature 92-1b) or collected during the first stages of decomposition, then buried separately from the body. In Late Prehistoric secondary interments, bodies or bones were treated with red ochre.

Other secondary burials of both subadults and adults appear to represent partially or totally decomposed complete bodies that were collected for reburial. These individuals are typically represented by crania, the vertebral column, proximal long bones, and hands and feet. This corresponds to Stage 2 of Haglund's (1991) description of canid-assisted disarticulation. Although it is unlikely that scavenging by canids occurred since carnivore damage to bones was not observed, the pattern of elements does appear to represent attrition due to long-term surface exposure. If we presume that prehistoric people collected all bones present for burial, then the estimated postmortem interval derived from Haglund's (1991:160-164) regression formulae ranges from 80 days to 541 days.

Ethnohistoric Data

Only limited ethnohistoric information is available regarding corpse curation and secondary burial. Cremated remains of shaman were kept for a period of a year before they were used in rituals involving endocannibalism (Newcomb 1983:365), thus establishing that at least some human remains were curated for long periods of time. Cabeza de Vaca described the mortuary rituals involved in the deaths of boys and young men, who were mourned by the community for a period of one year (Newcomb 1983:365). If the one-year mourning period for subadults described by Cabeza de Vaca was accompanied by corpse curation during mourning, then secondary burials at Mitchell Ridge may be related to such a practice. The connection is even more striking given that the average age of 8.5 years for subadults and 27 years for adults (grand mean= 13.5 years), which corresponds nicely to "boys" and "men" from Cabeza de Vaca's account. However, this is a speculative connection and will require further analyses and a larger data set for testing.

The selection of hands, feet, and patellae may also have an ethnohistoric correlate, though the connection here is more tenuous. In 1822 some of Austin's colonists noted that hands and feet were removed as trophies by a band of Karankawa at Little Cedar Bayou. While the skeletal remains from Mitchell Ridge cannot necessarily be interpreted as evidence for such trophy-taking, they *may* possibly reflect the socioreligious importance of certain body parts among upper Coastal cultures which was still present as late as the early nineteenth century.

Cremations

Cremations represent the third form of corpse disposal at the site. Cremations include two Late Prehistoric and four Historic individuals. All of the cremations had been fired at another location, collected, and deposited in features in Area 1 and 4. Because of redeposition, it was not possible to determine state of articulation of any of these individuals. However, data on burning do provide minimal evidence for the pre-incineration condition of the bodies.

Both individuals in Feature 63-2 were probably cremated "in-the-flesh," before significant decomposition had occurred. Both appear to have been placed over the fire, but the exact body position could not be determined from the skeletal remains. Extreme calcination of many elements indicates incineration temperatures in excess of 600 degrees Centigrade. Feature 3 has a large number of burned bones that fit the description of defleshed, green bone. Features 65-A and 85 contained large amounts of dry-burned bone as well as green bone, and probably represent incineration of bodies after considerable decomposition and desiccation of soft tissues. Taphonomic data indicate that after curation of remains, some decomposed individuals (mostly adults) were accorded separate treatment through cremation. In both the fleshed and green/dry bone cremations, most parts of the body were incinerated and collected for reburial. There is no evidence for cultural selection of certain body parts for inclusion or exclusion from cremation deposits.

Ethnohistoric Data

Cremations are described in the ethnohistoric record as a specialized form of corpse disposal accorded to shamans, who were usually older adult males (Newcomb 1983:366). Cremations occurred during a special ceremonial dance. Afterward, the ashes were curated for up to a year, then used in some type of mourning or magical ritual that involved endocannibalism of the cremated remains and scarification of relatives (Day 1971; Newcomb 1983). The state of preservation of cremated individuals precludes assignment of sex for individuals. At least one young adult and one child were cremated, which does not correspond to descriptions of the age and sex of the shamans among Native American groups from the Texas Coast (Newcomb 1983).

Regional Mortuary Behavior

Three important mortuary features of the Mitchell Ridge assemblage have been documented through human bone taphonomy. Body curation, with subsequent interment, is documented for primary and secondary burials and for cremated remains. Primary burials may have been curated for up to a month, while secondary inhumations and some cremations may have been curated for over a year. These data generally correspond to ethnohistoric data on mourning behavior and may be related to mortuary rituals carried out over a period of several months. The taphonomic evidence suggests that rodents had access to bodies while carnivores did not, based on the lack of carnivore chewing and bone damage in the assemblage compared to damage by rodents. Curated remains may have been protected by means of charnel houses, scaffolds, or other structures which kept certain scavengers out. An alternative explanation is that carnivores were not present on the island. However, early ethnohistoric accounts of dog sightings by the Narváez expedition argue against this possibility. Cremated remains were also curated after incineration, at least temporarily, to allow for burial away from the firing location. Again, the ethnohistoric record provides supporting evidence for this type of behavior (Newcomb 1983), as does the presence of human bone decorative artifacts recovered from sites along the Texas coast (Hester 1969).

Another documented feature is post-mortem processing of human remains. In two cases, arms and feet of individuals were removed by repeated cutting of connective tissues, a process that left cut marks on the underlying bone. Other forms of processing include application of red ochre to the body, and cremation. The final mortuary feature documented in this collection is the intentional selection of certain body parts for secondary burial. Several features contained hands, feet, distal arms, or patellae. The recovery of these items and lack of larger bones is atypical for assemblages produced by carnivores, natural weathering, mutilation by humans, or a combination of factors. Instead, some importance or special treatment was accorded these body parts. They may have been intentionally removed from intact or partially decomposed corpses. A second possibility, and one which fits with known patterns of corpse disposal and body curation, is that these elements represent bones left behind after a charnel house or other curation facility in cleaned (Milner 1983; Ubelaker 1974). These elements are often missing from bundle burials derived from curation facilities, and are collected from the floor of the charnel house or curation locale and buried separately, as was the case at the Namejoy Creek Ossuary (Ubelaker 1974). However, small elements left over from charnel houses often represent multiple individuals of different ages or sizes, since multiple individuals are processed in the charnel house before cleaning. At Mitchell Ridge, all of the isolated elements can be attributed to a single individual (i.e., no repeated elements and all bones are of the same skeletal age). If these remains represent small elements collected after the cleaning of a curation facility, then it is unlikely that such facilities were used by several different individuals. Instead, it may be that individual bodies were enclosed or placed on scaffolds for decomposition, and that the hands, feet, and other small elements were later collected after the larger elements were interred as bundle burials.

Comparative Data

Secondary burials have been noted at a number of sites, including Harris County Boys' School (41HR80) (Aten et al. 1976), Caplen (41GV1) (Campbell 1957), Blue Bayou (41VT94)(Comuzzie 1987; Huebner and Comuzzie 1992), and other sites in the region. Although Aten dismissed secondary burials as "... probably the result of disturbances due to subsequent grave excavations" (Aten et al. 1976:99), reexamination of the burial records indicates otherwise. At the Caplen site, prehistoric over-use of the cemetery and modern looting appear to have contributed to the number of "disturbed" burials. However, several features contain single or multiple skulls all resting on the cranial base (Campbell 1957:456). This position is unusual, and few looters can resist at least removing a human skull from a site. Even more intriguing is a feature containing four skulls all resting upright, all arranged in a circle and facing one another. Beyond these doubts, the element inventories presented in Campbell (1957) are, in some instances, remarkably similar to the secondary burial inventories at Mitchell Ridge. These data suggest that some curation of remains also occurred at Caplen. However, the overall pattern of body part selection and the age/sex distribution of curated remains was entirely different from that observed at Mitchell Ridge.

At the Harris County Boys' School site (41HR80), the field excavations identified 27 primary burials. Subsequent osteological analyses identified a minimum of 52 individuals at the site. The additional skeletal materials, plus those described by Aten et al. (1976) as "disturbed by subsequent burials" most likely represent secondary burials included with primary interments. The lack of solid taphonomic data for this site make comparisons difficult, but what little we do know supports the contention that human remains were curated. Jeter and Williams (1989) recently summarized mortuary and archaeological data for sites in the Lower Mississippi Valley, and found evidence for "storage of bodies in charnel houses followed by secondary bundle reburial" (Jeter and Williams 1989:219) in prehistoric Plaquemine sites. This pattern is also present in protohistoric and historic Natchez sites in the Lower Mississippi Valley (Jeter 1989:245). Several of these mortuary sites contain clusters of bundle burials and arranged groups of skulls similar to those described at the Caplen site (Campbell 1957). Given the taphonomic data from Mitchell Ridge and the anomalous data from Caplen and Harris County Boys' School, it is likely that secondary burial was practiced in some form at other sites on the upper Texas coast.

The human skeletal material from the Mitchell Ridge site provide a new line of evidence regarding human mortuary behavior on the upper Texas coast. Although these results have only been obtained at this site, other locations such as Caplen and Harris County Boys' School provide indications that this type of behavior was rather wide-spread in the region. Taphonomic reevaluations of these collections are needed in order to better understand the complexities of mortuary behavior in the Galveston Bay area.

Paleodemographic Analyses

The determination of demographic parameters from skeletal populations has been the focus of considerable and lively debate during the past decade. Some researchers have been quick to identify the abuse of many of the assumptions of paleodemography (Bocquet-Appel and Masset 1982; Sattenspiel and Harpending 1983), while others, recognizing the methodological and theoretical difficulties of this kind of research, have shown that the methods have research potential if used responsibly (Buikstra and Konigsberg 1985; Jackes 1992; Roth 1992; van Gerven and Armelagos 1983). The fundamental and, unfortunately, most difficult task of paleodemographic analysis is recovering or assembling an adequate sample of remains to constitute a population (Buikstra and Konigsberg 1985). It must be demonstrable that the individuals whose remains are under examination lived close enough together in culture, politics, social organization, geography, and time to justify their inclusion in a single unit of demographic analysis. Other impediments to paleodemographic analysis include biases in aging and sexing techniques (Buikstra and Konigsberg 1985; Buikstra and Mielke 1985; Jackes 1992; Lovejoy 1971; Miendl et al. 1983; Suchey et al. 1979; Weiss 1972), and the assumption of a stationary and stable population which is closed to migration and unaffected by environmental perturbations (Coale and Demeny 1983).

The Mitchell Ridge skeletal series suffers from a number of inadequacies which make paleodemographic analysis difficult and suspect. Foremost is the small sample size of each of the three temporal samples, none of which are adequate for generating life table statistics. Furthermore, the morphological differences between adults in the Late Prehistoric and Historic samples suggest that migration and gene flow did occur, at least during the final phase of cemetery use. The presence of European trade goods also implies an open cultural system which could have been affected by epidemic disease or changes in subsistence, economy, mobility, technology, and kinship-- factors that in turn can alter the demographic structure of populations.

Given these problems, this section presents some of the basic paleodemographic parameters for the Mitchell Ridge population from a diachronic perspective. Because of the small size of this sample and the fact that some individuals could not always be assigned to a discrete time period, only the most basic demographic data were computed. More elaborate statistics and life tables were not generated in order to avoid over-interpretation of such a small data set. Estimated parameters include age and sex distributions, mean age-at-death, and demographic aspects of mortuary behavior. Comparative data were obtained for upper and central coast populations from Powell (1989) and other sources.

Age and Sex Distributions

The distributions of adults and subadults, by sex, for each of the three Mitchell Ridge samples are presented in Tables 9.15 - 9.16. In cases where an individual's age range overlapped two classes, the individual was assigned to an age class based on the median for their age range; For example, an adult 20 - 50+ has a median of 37.5, and would fall in the middle adult range. This method tends to exaggerate the death distribution for adults, especially middle adults. The majority of the Late Prehistoric sample is composed of older adult males, and older children (Table 9.15), with a peak number of individuals falling in the 40 - 49 year age class. The small number of Protohistoric burials are generally either adolescents and teens, or middle adult females (Table 9.16), while the Historic period data presents a wide range of sexes and ages (Table 9.17). None of the profiles is typical of a normal living population, since infants and old adults are, for the most part, missing. This loss could reflect differential burial practices for some age groups, poor preservation of very young and very old individuals, osteological methods that underage older adults (Jackes 1992), or a combination of factors.

Mean Age at Death

Estimates of the mean age-at-death for each individual were calculated from the median of each age range (Table 9.18). The mean age declines in subadults and adults from the Prehistoric to Historic period, but the change in adult ages from the Protohistoric to Early Historic is quite dramatic. Male mean age-at-death declines by ten years, and female means are reduced by almost 5 years. Another change is revealed in the mean ages of males compared to females. During the Prehistoric and Protohistoric periods, there is an eight to 10 year difference in age by sex, with males older than females. In the Historic period, there are no apparent differences. The data in Table 9.17 and Table 9.18 suggest that age declined dramatically during the Historic period.

Sex ratios

Sex ratios change dramatically from the Prehistoric to later periods (Table 9.18). Males constitute 66.7 percent of the Late Prehistoric sample, with a male/female ratio of 2:1, compared to 0.75 males per female in the Historic period. The difference in males compared to females was found to be statistically significant only for the Late Prehistoric sample ($p < 0.01$). The sex ratio for the pooled Mitchell Ridge sample (combining all time periods) is 1.23 males per female (Table 9.19), which is a nearly equal sex ratio and is not statistically significant. The proportion of males and females in the pooled Mitchell Ridge sample is similar to other coastal populations except the small sample from Shell Point (41BO76) and the larger Caplen (41GV1) series. At Caplen, females outnumber males almost two to one. Other lesser deviations from an equal sex ratio may reflect sampling error or biases in skeletal sexing methods (Weiss 1972).

Adults vs. Subadults

Weiss (1973) found that normal human populations are composed of between 30 and 70 percent subadults, depending on parameters of growth, fertility, and mortality. Unfortunately, the demographic life tables generated by Weiss using both living and prehistoric samples may reflect the biases inherent such data-- especially the undernumeration of subadults (Roth 1992). The ratio of subadults to adults at Mitchell Ridge is at the low end for modern hunter-gatherers, but within tolerable limits (Table 9.18), and may reflect only slight undernumeration of subadults. Skeletal series from other coastal sites exhibit significant deviations from the expected number of subadults (Table 9.19), ranging from 10.5 to 25 percent subadults. The pooled Mitchell Ridge assemblage has two to four times the proportion of subadults compared to Late Prehistoric coastal groups, and is a much closer approximation of a normal human population than most other skeletal series in the region.

Model Tables

Weiss suggests that the "...proportions of the young, *C(0,15)*, the fertile adults, C(15,50), and the

Table 9.15. Age and Sex Distributions for the Mitchell Ridge Prehistoric Sample

Age Category	Age Range[a]	Males	Females	Sex Indeterminate Adults	Sex Indeterminate Subadults	Total	Percentage
Neonate	0 - 1	--	--	--	1	1	3.3
Young Childhood	2 - 5	--	--	--	1	1	3.3
Older Child	6 - 12	--	--	--	5	5	16.7
Adolescent	13 - 19	0	1	0	3	4	13.3
Young Adult	20 - 29	1	2	0	--	3	10.0
Middle Adult	30 - 39	3	1	1	--	5	16.7
Older Adult	40 - 49	5	0	1	--	6	20.0
Old Adult	50+	3	2	0	--	5	16.7
Total:		**12**	**6**	**2**	**10**	**30**	

a: In cases where an individual's age range overlapped two class, an individual was assigned to an age class based on the median for their age range; For example, and adult 20 - 50+ has a median of 37.5, and would fall in the middle adult range. This method tends to exaggerate the death distribution for adults.

Table 9.16. Age and Sex Distributions for the Mitchell Ridge Protohistoric Sample.

Age Category	Age Range	Males	Females	Sex Indeterminate Adults	Sex Indeterminate Subadults	Total	Percentage
Neonate	0 - 1	--	--	--	0	0	0.0
Young Child	2 - 5	--	--	--	0	0	0.0
Older Child	6 - 12	--	--	--	3	3	33.3
Adolescent	13 - 19	--	1	--	0	1	11.1
Young Adult	20 - 29	0	0	0	--	0	0.0
Middle Adult	30 - 39	0	2	1	--	3	33.3
Older Adult	40 - 49	1	0	1	--	2	22.2
Old Adult	50+	0	0	0	--	0	0.0
Total:		**1**	**3**	**2**	**3**	**9**	

Table 9.17. Age and Sex Distributions for the Mitchell Ridge Historic Sample.

				Sex Indeterminate			
Age Category	**Age Range**	**Males**	**Females**	**Adults**	**Subadults**	**Total**	**Percentage**
Neonate	0 - 1	--	--	--	1	1	6.7
Young Childhood	2 - 5	--	--	--	2	2	13.3
Older Child	6 - 12	--	--	--	2	2	13.3
Adolescent	13 - 19	1	2	--	0	3	20.0
Young Adult	20 - 29	0	0	2	--	2	13.3
Middle Adult	30 - 39	2	1	1	--	4	26.7
Older Adult	40 - 49	0	1	0	--	1	6.7
Old Adult	50 +	0	0	0	--	0	0.0
Total:		3	4	3	5	15	

Table 9.18. Subadult and Adult Summary Statistics for Texas Coastal Samples.

	SUBADULTS			ADULTS					
	Indeterminate			Males			Females		
Time Period	N	%[a]	Age-at-Death	N	%[b]	Age-at-Death	N	%[b]	Age-at-Death
41GV66:									
Prehistoric (n=30)	10	33.3	8.3 ± 4.0	12	66.7	40.2 ± 7.8	6	33.3	30.4 ± 15.3
Protohistoric (n=9)	3	33.3	9.8 ± 3.4	1	25.0	40.0 ± ---	3	75.0	32.1 ± 7.8
Historic (n=15)	6	40.0	5.67 ± 4.6	3	42.8	28.0 ± 8.2	4	57.1	26.9 ± 13.9
Total (N=54)	**19**	**35.2**	**21.7 ± 13.3**	**16**	**55.2**	**31.0 ± 9.0**	**13**	**44.8**	**27.1 ± 11.1**

a: Based on the percentage of individuals < 15 years old.
b: Does not include adults of indeterminate sex.

post-menopausal adults, C(50, ∞) are general measures which are easy to take in the field and reasonably insensitive to missing infants" (Weiss 1973:65). Using the proportion of subadults and adults, the mean age of adults, and the proportion of adults older than 50 years, the demographic statistics in Tables 9.15 - 9.18 were matched to Weiss' model tables by means of index of dissimilarity (Δ). Best fits were determined as those with $\Delta < 0.10$. The best fit for the Late Prehistoric sample was Weiss' model table MT:35-70, which has a life expectancy at birth (E_0) of 36.1 years. If we account for undernumeration of subadults (compared to mean age-at-death) in the Protohistoric sample, the best model tables include MT:27.5 - 50 to MT:27.5 - 70, all of which are rough approximations, and provide E_0 values ranging from 22.7 to 30.8 years. Finally, the model table MT:25.0 - 60.0 is the best fit for the Historic sample, and provides a life expectancy at birth of 25.3 years.

None of the selected model tables violate Weiss' criteria for stationarity (Weiss 1973:46-47). Although the matches are encouraging, it is not valid to assume that the skeletal series represent a stationary and stable populations. However, the data do provide a very general idea of the composition of living populations during the Prehistoric and Historic periods. The Late Prehistoric E_0 values from the model table exceed life expectancies of most hunter gatherers, which range from 18.6 to 31.4 (summary data from Powell 1989:88 and Weiss 1973:49), while those of the Protohistoric and Historic are in line with estimates for Late Prehistoric and Historic Texas native Americans (Powell 1989:88). The E_0 values provided in Weiss (1973) tend to be lower than those estimated by regression using subadults to adults (Bocquet-Appel and Masset 1982).

Demographic Aspects of Mortuary Behavior

The demographic data also provide some clues to differential corpse disposal presented above. The sample of Late Prehistoric interments is dominated by males (Tables 9.15, 9.18), with a male/female ratio of 2.0. Older individuals, especially males, dominate, as do older children. Infants and younger subadults appear to be undernumerated. During the Protohistoric and Historic periods, the sex ratio shifts, with more females represented. Also, infants and young children appear. These data, combined with the mean age-at-death and life expectancy estimates, suggest that Late Prehistoric interment practices were selective. Older males and older subadults were included in the sample while females and infants tend to be excluded. Ethnohistoric accounts of special grieving rituals accorded young men and boys provide tantalizing parallels to the archaeological record (Newcomb 1983). Also of note is the observation of Aten and coworkers (1976) that infant remains occasionally appear in Late Prehistoric midden deposits rather than in the organized cemetery areas, which may reflect differential disposal practices for infant remains or the lack of recognition of "token" burials in midden deposits.

Cemetery Use and Rate of Accumulation

The range of radiocarbon dates for interments at the Mitchell Ridge site provide an estimate of the duration of cemetery use. Based on 14C intercepts, the Late Prehistoric component (excluding 1970s Burial 10) spans approximately 558 years (Table 9.20), while the other components reflect shorter periods of use. Late prehistoric cemetery use is comparable to that at the Harris County Boys' School (41HR80). The Protohistoric use of the site is comparable to Caplen (41GV1), which includes Protohistoric to Historic period interments (Campbell 1957; Aten 1976).

The number of burials per year of use is similar in the Prehistoric and Protohistoric periods at Mitchell Ridge (median= 0.03 burials/year), but is ten times higher in the Historic period (Table 9.20). Historic use of the Mitchell Ridge cemetery intensified, either because of changes in mortuary practices (see below), increasing sedentism or shifts in mobility, increased mortality, or a combination of these factors.

Demography of Interment Type

Multiple Interments

The term multiple interment describes the inclusion of more than one individual (both primary and secondary deposits) in a feature. At Late Prehistoric cemeteries on the upper and central Texas coast,

Table 9.19. Percentage of Subadults, Males, and Females for Selected Upper and Central Texas Coast Samples

Site	SUBADULTS N	SUBADULTS %	MALES N	MALES %	FEMALES N	FEMALES %	Male/Female Sex Ratio
41GV66 (N=54)	23[a]	42.6	16	55.21	3	44.8	1.23
41GV5 (N=19)[b]	2	10.5	7	50.0	7	50.0	1.00
41GV53 (N=9)[c]	2	22.2	3	60.0	2	40.0	1.50
41GV1 (N=48)[d]	12	25.0	12	38.7	19	61.3	0.63
41HR80 (N=52)[d]	3	15.0	9	45.0	11	55.0	0.82
41BO76 (N=10)[d]	2	22.2	5	71.4	2	28.6	2.50
41VT94 (N=44)[d]	9	25.0	14	58.0	10	42.0	1.40
41AS80 (N=12)[f]	1	14.3	3	60.0	2	40.0	0.75

a: In order to make the data comparable to other samples, subadult percentage for Mitchell Ridge was recomputed using individuals < 20 years old.

Sources:
b: Unpublished notes (Powell n.d.); c: Colby et al. 1992; d: Powell (1989); e: Comuzzie 1987; Powell 1989; f: Comuzzie et al. 1986.

Table 9.20. Mortuary Statistics for Mitchell Ridge and Comparative Coastal Sites.

Site	Cemetery Age Range (years B.P)	Use (Max. years)	Burial Data MNI	Burial Data Features	Burials/Year	MNI per Feature	Multiple Interments N	Multiple Interments %
41GV66:								
Prehistoric	1078 - 520	558	29	20	0.052	1.45	9	31.0
Protohistoric	520 - 190	330	9	5	0.027	1.80	4	44.4
Historic	190 - 140?	50	15	6	0.300	2.50	9	60.0
Total:	**1078 - 140?**	**938**	**53**	**30**	**0.056**	**1.77**	**28**	**52.8**
41GV5:	830 - 450	380	19	16	0.050	1.19	3	15.8
41GV1:	1090 - 650	440	85	66	0.193	1.29	19	22.3[a]
41HR80:	2140 - 640	1500	48	34	0.032	1.41	14	29.2

[a]: Number of multiple interments is estimated by subtracting the number of identified features from the MNI.

the average number of individuals per feature ranged from 1.19 to 1.41; the average for Prehistoric interments at Mitchell Ridge (mean = 1.43) falls just outside this range (Table 9.20). The mean number of individuals per feature steadily increases though time, with 2.5 persons per feature during the Historic period. A similar pattern is apparent in the percentage of interments containing multiple individuals, which doubles during the Historic period.

Secondary Interments

Throughout the history of the Mitchell Ridge cemetery, secondary burial appears to be a mortuary treatment reserved for subadults and a few adults. Of 11 secondary burials, nine were under the age of 20 (81.8%). During the Late Prehistoric period, secondary burial was limited to older children and adolescents. The MAAD for secondary burials was 10.5 ± 1.9 years, compared to the total sample mean age-at-death of 28.0 years. In the Protohistoric period, two older children, one teenager, and two adults were treated as secondary burials (MAAD = 20.8 ± 12.2 years). Only two secondary burials were recovered from the Historic component of the site, but both are very young children (MAAD = 2.0 ± 1.0 years).

Cremations

Very little can be said of the cremations at the site, except that both adults and subadults are represented. The one cremated subadult was incinerated in the flesh, while adults were either in-the-flesh or partially defleshed or decomposed. The skeletal remains from cremations were too fragmentary for sex determinations.

Paleodemographic Interpretations

Life expectancy estimates, as derived by matching to model tables, declines from 36.1 in the Prehistoric to 25.3 years in the Historic period. The mean age at death for males shifts from 40.2 years to 28.0 years during the time spanned by the cemeteries. The change for females, from 30.4 years to 26.9 years, is less dramatic. The shift in both of these demographic parameters reflects the increased presence of subadults, especially younger children, in later samples. The problem here is how to interpret this change. One plausible explanation is that changes in mortuary behavior account for the pattern observed. A second is that the skeletal data accurately reflect the parameters in the living populations, and thus reflect an increase in mortality during later periods. The third possible explanation is that Historic populations experienced increased fertility, which in affect increased the number of children (and thus number of children included in the death assemblage). Each of these possibilities will be considered separately.

Burial practices

There is no doubt that mortuary practices at the Mitchell Ridge site changed during the period of site use. In the Prehistoric period, cemetery use was limited, but older males and subadults were more likely to be interred at the site. The basic program of primary and secondary burials and cremations is not altered, but the demography of those being accorded such treatment does change. The average age of secondary burials fluctuates wildly through time, from 10 to 20 to 2 years old. Sex ratios also shift significantly, from male-dominated burials to nearly equal numbers of males and females during the Historic. Finally, the mean age at death of adults shifts from a high of 38.9 years in the Late Prehistoric to 32.9 years in the Historic.

The most important feature of mortuary change is the increased rate of cemetery use. The rate of inhumation increases ten-fold, and the number of individuals per feature doubles. One possibility is that increased sedentism, due to constraints imposed by shifts in group territory and to significant economic changes accompanying the French fur trade (Gregory 1973), is responsible for the increased use of the cemetery. However, the change in mean age-at-death cannot be explained by this mechanism. It may also be that Historic populations on Galveston were members of (or influenced by) a radically different culture whose burial practices were significantly different from those of Late Prehistoric groups (Aten 1983a:96).

Support for this comes from the presence of individuals whose craniofacial morphology is significantly different from Late Prehistoric populations in the area. However, there is certainly continuity in the overall burial program through time (i.e., continued use of secondary burial and cremation as forms of corpse disposal), though the demography of the death assemblage and some features of mortuary behavior do change. This explanation also does not account for the increased presence of younger males, and younger individuals in general, in the Historic period mortuary assemblage.

Fertility or Mortality?

The downward trend in life expectancy and mean age of interments, combined with a fundamental change in the mean family size from 6.4 persons to a mere 4.0 persons (Aten 1983a:321) point to an increase in mortality levels. This is the traditional interpretation of life expectancy and other demographic estimates, and is an interpretation supported by ethnohistoric reconstructions of population demography presented in Aten (1983a:43-66, 319-325), in which epidemic disease and culturally-mediated stress contributed to population decline during the first half of the eighteenth century. Research by Sattenspeil and Harpending (1983) pointed out that previous paleodemographic interpretations of changes in mean age-at-death rely too heavily on the assumption that mortality is the major factor contributing to the structure of death assemblages. They suggested that paleodemographic estimates may reflect increased fertility rather than increased mortality. If populations experienced increased fertility, one would expect to see a greater number of young individuals in the skeletal assemblage as is the case in the Historic period. Horowitz and Armelagos (1988) note that in stable populations the mean age at death will decrease as the fertility of a population increases. On a cautionary note, the ratio of adults and subadults, as well as the data on life expectancy and mean age-at-death, is significantly affected by sampling error, and should be interpreted with a critical eye (Jackes 1992).

Buikstra et al. (1986) proposed that the ratio of adults over 30 to individuals older than five (D_{30}/D_{5+}) has a strong *negative* relationship with fertility, and can be used as a general estimate of fertility in a skeletal population. They used the proportion of young children to all children (D_{1-5}/D_{1-10}) as an estimate of juvenile mortality, presuming that deaths of young children constituted the bulk of juvenile deaths. They found that among Woodland populations, the D_{1-5}/D_{1-10} ratio ramained stable, while the D_{30}/D_{5+} ratio declined through time. They postulated that in this instance, the changes in demographic structure were not due to increased mortality, but to increased fertility.

Using the formulae for the D_{30}/D_{5+} 95 percent confidence interval provided in Buikstra et al. (1986), the values change from .571 $\pm$ .18 in the Late Prehistoric, to .555 $\pm$ .23 in the Protohistoric, to .416 $\pm$ .23 in the Historic period. While these data appear to support the contention that the decrease in mean age-at-death in the Mitchell Ridge is due to an increase in fertility, the juvenile mortality data do not. Pooling the Prehistoric and Protohistoric samples, the value of D_{1-5}/D_{1-10} was 0.25; in the Historic period, this value increases to 0.60. These results indicate that the population changes mimic an increase in fertility, but that juvenile deaths rise as well. It is likely that factors such as increased mortality and population amalgamation played an important role in structuring the Mitchell Ridge death assemblage.

None of the three explanations can be excluded on the basis of the demographic data alone. Fundamental change in both burial practices and in the demography of interments occurred during the Historic period. Such changes have a tremendous affect on paleodemographic estimates, since values such as life expectancy and proportion of subadults are determined by who is, and is not, buried in a cemetery. The downward trend in life expectancy and mean age-at-death may reflect changes in mortuary behavior, increased mortality, or increased fertility, or some combination of these. Demographic data will be considered again, in light of the paleodemographic and bioaffinity results, in the concluding section of this chapter.

Paleopathological Analyses

This section presents the results of paleopathological analyses of the human skeletal remains from the Mitchell Ridge site. Statistical analyses were not conducted. However, the data will be used in future statistical examinations of health and disease among upper Texas coast populations.

The interpretation of paleopathological data has changed radically since the earliest studies. Bioarchaeologists are now more aware of how death assemblages are created, and how the distribution of lesions in a skeletal series is related to the prevalence of disease in the past. There are several basic problems in paleopathological analyses of skeletal series. One such problem is representation of the health of a living population in the past. Eisenberg notes that

> Since frequency data for skeletal lesions are not easily translated into the proportion of a past population that may have been ill at any one time, it is more likely that disease frequencies obtained from this palaeopathological study represent a conservative estimate of the actual number of individuals within the population who were similarly affected (Eisenberg 1991:116).

Added to this underrepresentation is the problem of interpreting skeletal lesions. Wood et al. (1992) noted that "good health makes for poor skeletons." While this seems counter-intuitive, it makes good biological sense because skeletal samples are a subset only of those who die at any given age, and thus represent only the individuals whose risk for death was maximized at that time. Surviving individuals do eventually end up in the death assemblage (provided that they are buried at the site and eventually recovered), but they constitute an older cohort than those who die at any particular age (Wood et al. 1992). Take, for example, a group of five-year-olds with a heterogeneous risk for death (i.e., some are healthier than others) who are exposed to a pathogen. Some develop an acute form of the disease and enter the death record at age five, without having had time to develop skeletal manifestations of the disease. Other five-year-olds develop the disease but are able to fight back and overcome this stressor, only to succumb to some other mortality hazard later in life. These individuals would appear in the death assemblage as either older children or adults with skeletal lesions. Thus "hidden heterogeneity" in the living produces two subsets in the death assemblage-- the remains of lesion-free but unhealthy individuals and those of lesionous but healthy individuals (Wood et. al 1992). Individuals with skeletal lesions may represent those in the population who were rallying from physiological insults rather than those who were in poor health (Ortner 1991).

This section takes two separate approaches in interpreting morbidity data, following Waldron (1991). First, the frequency of a condition that does not appreciably contribute to the risk for death-- i.e., degenerative diseases, fractures, enthesopathies, developmental anomalies-- is thought to represent the prevalence of that condition for all individuals in the living population, taking into account the non-random nature of death assemblages. In cases where the pathological condition could be directly or indirectly linked to the risk for death, the frequency of lesions will at least underestimate the prevalence of the disease in the living, and in some cases may represent individuals who were healthier than those without lesions. Because the protohistoric sample was so small (n=3 to n=7), the percentages of affected individuals should be regarded with extreme caution. Discussion will focus on the larger Late Prehistoric and Historic samples, although differences between them also should be viewed with some caution since the samples represent only a small number of individuals (n=25 and n=15, respectively) and because the Historic cemetery reflects a shorter period of accumulation than the other samples.

Comparative Samples

A number of reviews and overviews of the bioarchaeology of the upper Texas coast have been useful in summarizing the distribution of sites with human skeletal remains and for placing the data in a theoretical framework (Burnett 1990; Steele and Olive 1990; Rose and Burnett 1990; Reinhard et al. 1990). Unfortunately, in most cases these data were not derived from direct observation of skeletal remains but were obtained from burial records at various facilities. To avoid problems of interobserver error, comparative data were drawn primarily from collections examined by the author (with the exception of the Shell Point and Jamaica Beach materials). Upper Texas coast skeletal series used here include 48 individuals from the Caplen Site (41GV1), a Late Prehistoric to Historic period cemetery on the Bolivar Peninsula (Powell 1989); 10 individuals salvaged from the Shell Point site (41BO76), a Late Prehistoric site on the mainland adjacent to West Bay (Hole and Wilkinson 1973; Powell 1989; Wilkinson 1973); 52 individuals from the Harris County Boys' School site (41HR80), a Preceramic to Late Prehistoric cemetery near Clear Lake (Aten et al. 1976; Powell 1989); and 19 individuals from the Jamaica Beach site (41GV5), a Late Prehistoric site just west of Mitchell Ridge on Galveston Island (Aten 1965; Powell, unpublished notes). Comparative data on lower and central coast populations were obtained from 46 individuals from

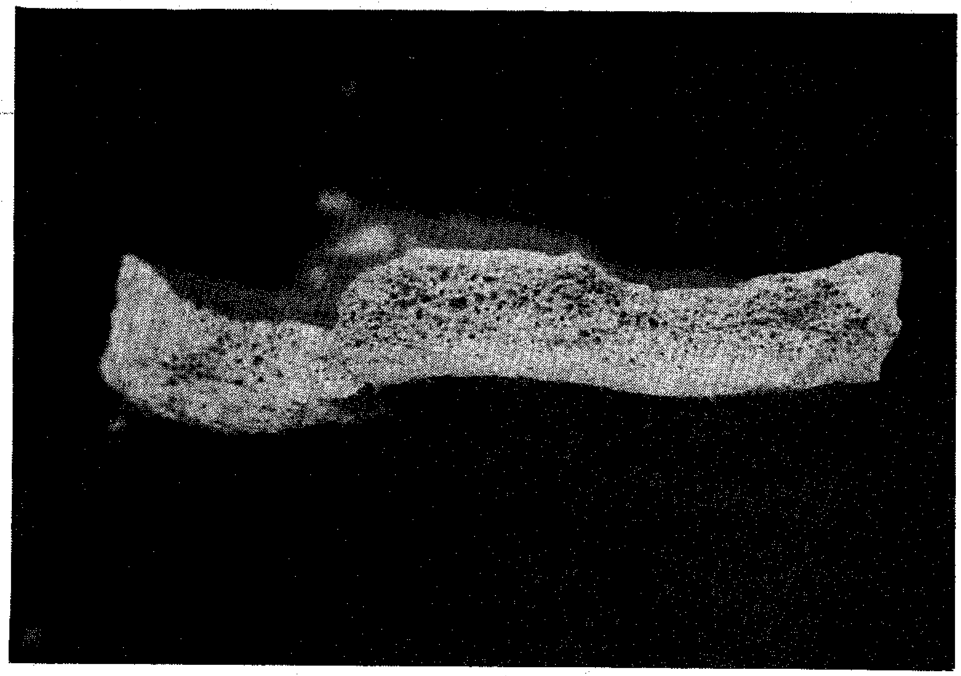

Figure 9.9. Photograph of porotic hyperstosis in adult male skull, Mitchell Ridge.

Blue Bayou site (41VT94), a Late Prehistoric upland cemetery in Victoria County (Comuzzie 1987), and Palm Harbor (41AS80), a Late Prehistoric mortuary site near Rockport, Texas (Comuzzie et al. 1986). Both of these collections were re-examined for this study.

Results

Hematological Disorders

Two basic hematological disorders were recorded. Porotic hyperostosis, also known as spongy hyperostosis, appears as a visible thinning of the outer table of the cranial vault which exposes the hypertrophied diplöe (cancellous bone) (Figure 9.9). Skeletal lesions can appear as small to large pores in the outer cranial table, thickening of the diplöe of the frontal, parietals, and occipital, or a combination of these features. Cribra orbitalia is similar to porotic hyperostosis, but appears as lesions on the roof of the orbit (Figure 9.10). Both porotic hyperostosis and cribra orbitalia are considered to be anemic responses, but the etiology of the anemia is unknown. Several plausible causes have been proposed, ranging from genetic disease (Angel 1969; El-Najjar 1976), diet-induced iron deficiencies (El-Najjar 1976; El-Najjar et al. 1976), parasitic infections (Walker 1986), or factors associated with population aggregation (Kent 1986). Stewart-Macadam (1989) concludes that regardless of the cause, anemic lesions reflect childhood episodes of anemia and not adult-onset disease.

Within the Mitchell Ridge sample, the frequency of cribra orbitalia is the same in the Historic and Prehistoric samples. (Table 9.21). The Historic and Protohistoric samples had a greater frequency of individuals with active lesions. Cribra orbitalia is not reported for most of the Late Prehistoric and early Historic samples, although it is quite high among individuals interred at the Caplen site. Porotic hyperostosis appears to decrease from the Prehistoric to Historic (Table 9.22). The Prehistoric and

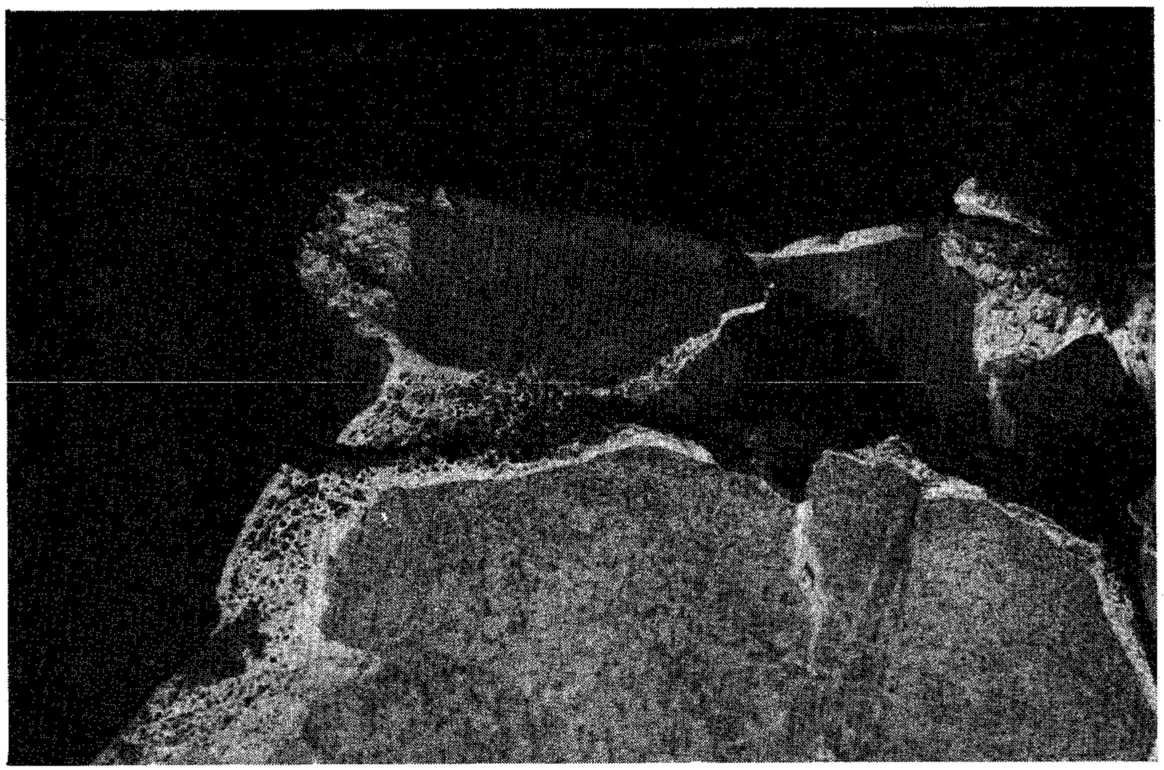

Figure 9.10. Photograph of active cribra orbitalia in an older child, Mitchell Ridge.

to other upper coastal populations than to those on the central coast (Table 9.22).

Abnormal Bone Loss

Abnormal bone loss included focal and non-focal lytic lesions of the skull and infracranial skeleton. Focal resorptive lesions were observed in only three Protohistoric and Historic individuals (Table 9.23), for a total of 9.4 percent of the pooled sample. In once case (Feature 64-4), the focal bone loss may be related to a spinal trauma, resulting in extrusion of the vertebral disk and concomitant bone resorption around the defect. Non-focal bone loss included porosity and cortical thinning of bone. Most examples were located in the lambdoidal region of the cranium (Table 9.23), although non-focal bone loss was noted for the ribs, cervical vertebrae, and femur (Figure 9.11) All of the cases with cranial involvement exhibited cranial modification of the occipital and parietals. These lesions are identical to those described by Holliday (1992) and are attributable to osseous reaction to scalp infections resulting from cradleboarding infants and children.

Abnormal Bone Formation

Proliferative lesions take a number of forms, including subperiosteal bone deposition, cortical swelling, formation of cloacae and drainage sinuses, and the presence of an involucrum (Steinbock 1976). Abnormal bone formation in the Mitchell Ridge sample was categorized as subperiosteal or cortical. Subperiosteal bone formation typically appears as new bone deposited over the existing cortex through

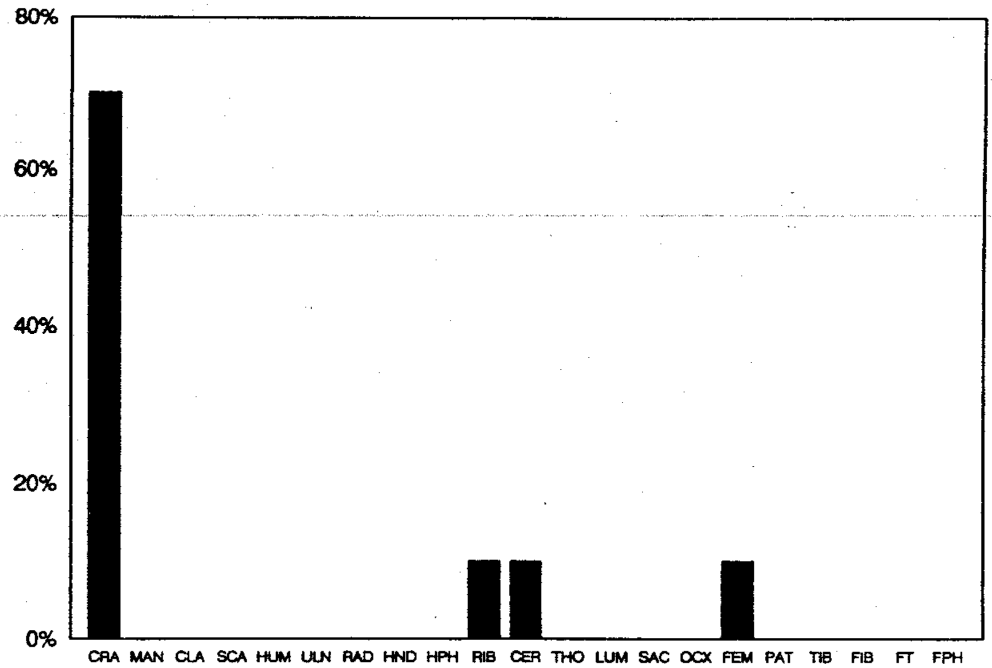

Figure 9.11. Distribution of abnormal bone loss by region.

Table 9.21. Percentage of Cribra Orbitalia by Site.

	Remodeled Lesions		Active Lesions	
Site	**N**	**Percentage**	**N**	**Percentage**
41GV66				
Prehistoric	21	14.3	21	4.8
Protohistoric	3	0.0	3	66.7
Historic	14	14.3	14	7.1
Total	**38**	**18.4**	**38**	**10.5**
41GV5	13	0.0	13	0.0
41GV1	28	28.6	28	3.6
41HR80	30	3.3	30	0.0
41BO76	6	0.0	6	0.0
41VT94	29	0.0	29	0.0

Table 9.22. **Percentage of Porotic Hyperostosis by Site.**

Site	Remodeled Lesions N	Remodeled Lesions Percentage	Active Lesions N	Active Lesions Percentage
41GV66				
Prehistoric	9	37.5	1	4.7
Protohistoric	2	66.7	0	0.0
Historic	3	21.4	0	0.0
Total	**14**	**33.3**	**1**	**2.4**
41GV5	12	0.0	12	0.0
41GV1	29	24.1	29	10.3
41HR80	31	16.1	31	6.5
41BO76	10	10.0	--	----
41VT94	29	3.4	--	----

Table 9.23. Percentage of Resorptive Lesions at Mitchell Ridge (41GV66).

Site	Focal Lesions N	Focal Lesions Percentage	Nonfocal Lesions N	Nonfocal Lesions Percentage
Prehistoric	9	0.0	13	15.4
Protohistoric	9	33.3	9	0.0
Historic	14	7.1	13	46.1
Total	**32**	**9.4**	**35**	**24.2**

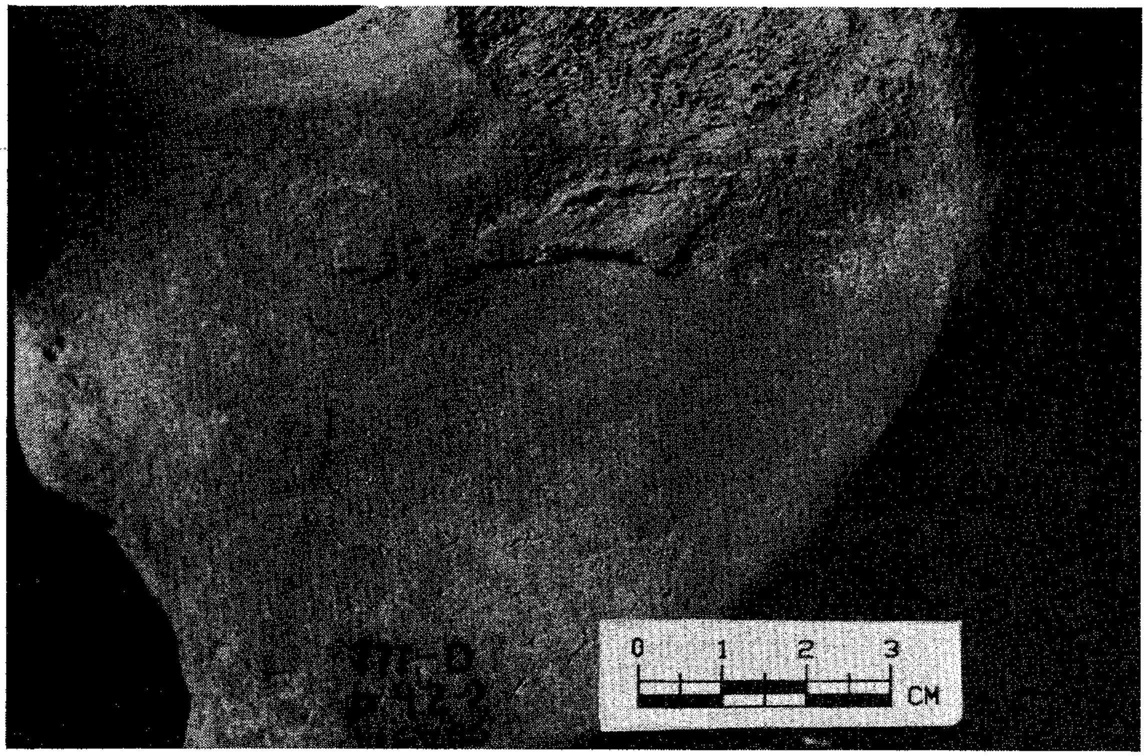

Figure 9.12. Photograph of periostitis on an adult illium from Mitchell Ridge.

Figure 9.13. Osteomyelitis (trepanematosis) in an adult femur from Mitchell Ridge.

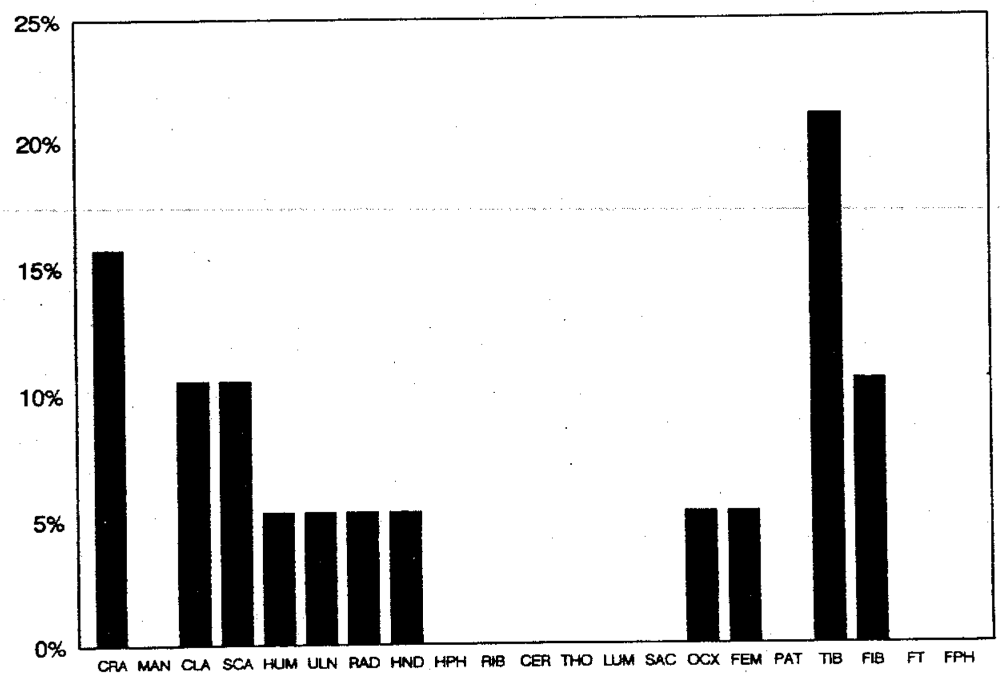

Figure 9.14. Distribution of abnormal bone formation by element (relative percentages).

Table 9.24. Percentage of Proliferative Lesions by Site.

	Subperiosteal		Cortical	
Site	N	Percentage	N	Percentage
41GV66				
Prehistoric	25	32.0	25	32.0
Protohistoric	4	0.0	4	0.0
Historic	15	20.0	15	13.3
Total	**44**	**27.3**	44	**22.7**
41GV5	13	27.7	18	22.2
41GV1	45	46.7	45	37.8
41HR80	42	21.4	42	16.7
41BO76	7	44.4	9	22.2
41VT94	33	6.1	33	3.0

inflammation of the periosteum ("periostitis"; Figure 9.12), while cortical bone formation includes the more severe alterations such as sclerosis, woven bone formation, medullary involvement, cloacae, and sequestration ("osteomyelitis"; Figures 9.13). Because of the difficulty in assigning lesions to particular categories, only the descriptive terms are used here following Buikstra et al. (n.d.) and Rose et al. (1991).

Abnormal bone formation was most common in the cranium and tibia, followed by the clavicle, scapulae, fibulae, and other long bones (Figure 9.14). Two of the cranial lesions involved the area around the external auditory meatus and the mastoid processes (Features 27-a and 64-3) and is similar to severe infections of the inner and middle ear (otitis media) with drainage into the mastoid air cells. Proliferative lesions appear to decrease slightly from the Prehistoric to Historic periods (Table 9.24), and are nearly identical to those found at the Jamaica Beach site and the Harris County Boys' School site (Table 9.24).

In addition to abnormal bone formation of a non-specific etiology, there was evidence of treponemal infection among the human skeletal remains at the Mitchell Ridge site. Treponemal infections include venereal and congenital syphilis, and non-venereal forms such as bejel, pinta, and yaws. This disease typically appears in the hard tissues as caries sicca (nodular, gummatous lesions) of the frontal bone, nasal resorption, cortical changes in the clavicle, femur, tibia, and fibula, and characteristic bowing ("sabre shin") of the tibial diaphysis (Ortner and Putschar 1981:180-201; Steinbock 1976:136-160).

Although there has been some debate of whether treponemal infections were originally an Old World disease which returned to the Old World in mutated form (Baker and Armelagos 2988; Ortner and Putschar 1981:203-207), present data which suggest that there is a New World treponematosis present prior to European contact. A number of overviews and case studies of New World treponematosis have been presented in the literature, most recently by Baker and Armelagos (1988), Bogdan and Weaver (1992), Hutchinson (1993), Milner (1992), Powell (1992), Reichs (1989), Saunders et al. (1992), and Stodder and Martin (1992). One are curiously missing from these overviews is Texas, despite that fact that researchers here have noted treponemal lesions in both pre-contact and peri-contact sites on the Texas coast (Jackson et al. 1986; Powell 1989). Jackson et al. (1986) found evidence for treponematoses among the human skeletal remains at the Oso Burial Site (41NU2). Powell (1989) documented the presence of possible cases in 8.3% of his sample, including individuals at Caplen (41GV1), Harris County Boys' School (41HR80), and Shell Point (41BO76). Currently these data and other Texas skeletal series exhibiting treponematosis are under review (Dockall and Steele 1995), with publications in preparation (Dockall et al. n.d.)

Two adult males from the Prehistoric sample at Mitchell Ridge exhibited reactive sequelae that fit the diagnostic criteria for treponemal infection (see Hackett 1976 for a summary of the differential diagnosis of this disease). More importantly, both individuals are well-dated and fall squarely in the Late Prehistoric period, several hundred years before the arrival of Cabeza de Vaca. These examples provide evidence to support for a postulated pre-Columbian presence of treponemal infections in the New World (Baker and Armelagos 1988; Reichs 1989; Gogdan and Weaver 1992; Milner 1992; Powell 1992; Saunders et al. 1992; Stodder and Martin 1992; Hutchinson 1993). Burial 4 exhibits numerous healed, gummatous lesions of the frontal bone identical to caries sicca. Subperiosteal bone was deposited on the distal clavicle and anterior tibia of this individual, and both tibia have a slight "sabre shin" appearance. Feature 52 exhibits nearly every diagnostic criterion for a treponemal diagnosis. The frontal bone of this individual contains seven stellate lesions similar to healed caries sicca (Figure 9.15). These lesions range in size from 7.5 to 12.5 mm in diameter. The nasal sill and lateral borders of the nasal aperture are remodeled and exhibited cortical porosity. The distal right and left clavicles have cortical expansion, the right has two active and three healed cloacae (Figure 9.16). Subperiosteal bone was also deposited on the right scapula. The proximal left femur exhibits extreme expansion and sclerosis of the cortex, with evidence of several healed cloacae (Figure 9.13). Both tibiae have the characteristic "sabre shin" appearance, with subperiosteal bone deposition, sclerotic lesions, and healed cloacae, especially the right tibia. The right fibula is similarly affected and also is bowed.

Degenerative Joint Disease

Degenerative joint disease (DJD) is typically an age-related process that results from the gradual deterioration of articular cartilage in synovial joints rather than from inflammatory response such as rheumatoid arthritis or gout. DJD sequelae include pitting, erosion, and eventual eburnation (bone-on-bone contact) of the articular surface, combined with progressive formation of lipping and osteophytosis

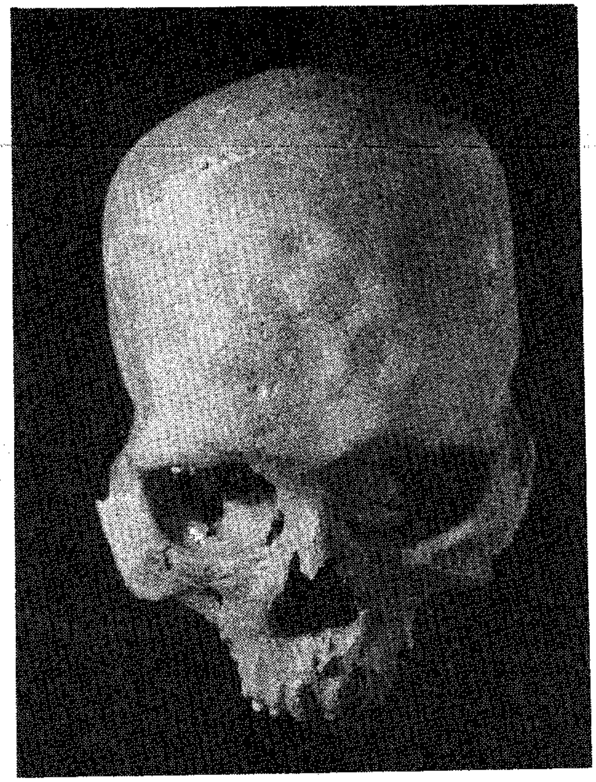

Figure 9.15. Photograph of caries sicca, adult male, Feature 52.

Figure 6.16. Photograph of cloacae in the clavicle of Feature 52.

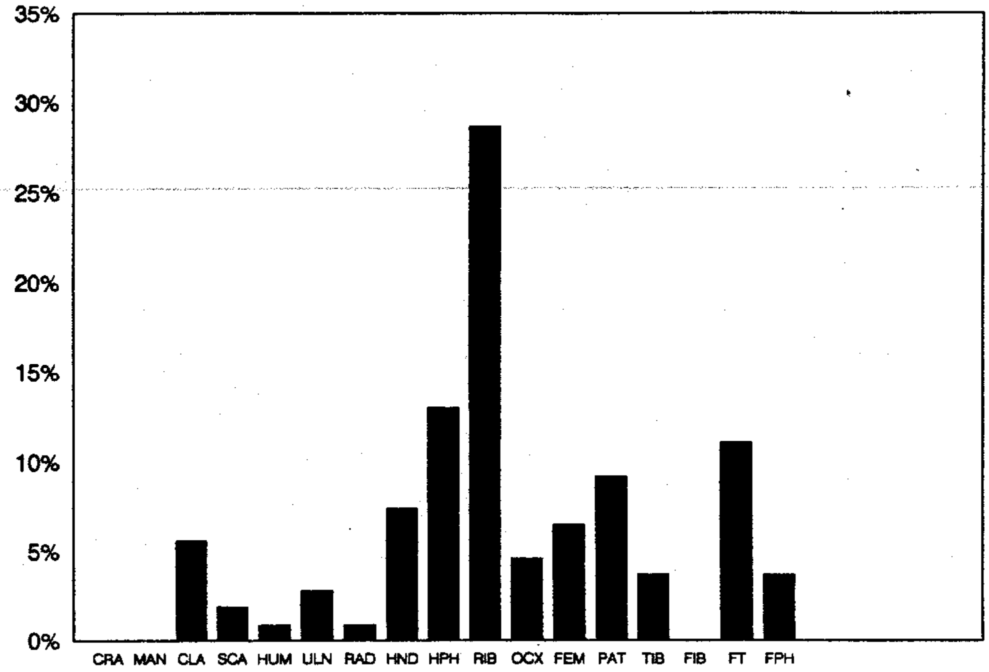

Figure 9.17. Distribution of degenerative joint disease by element.

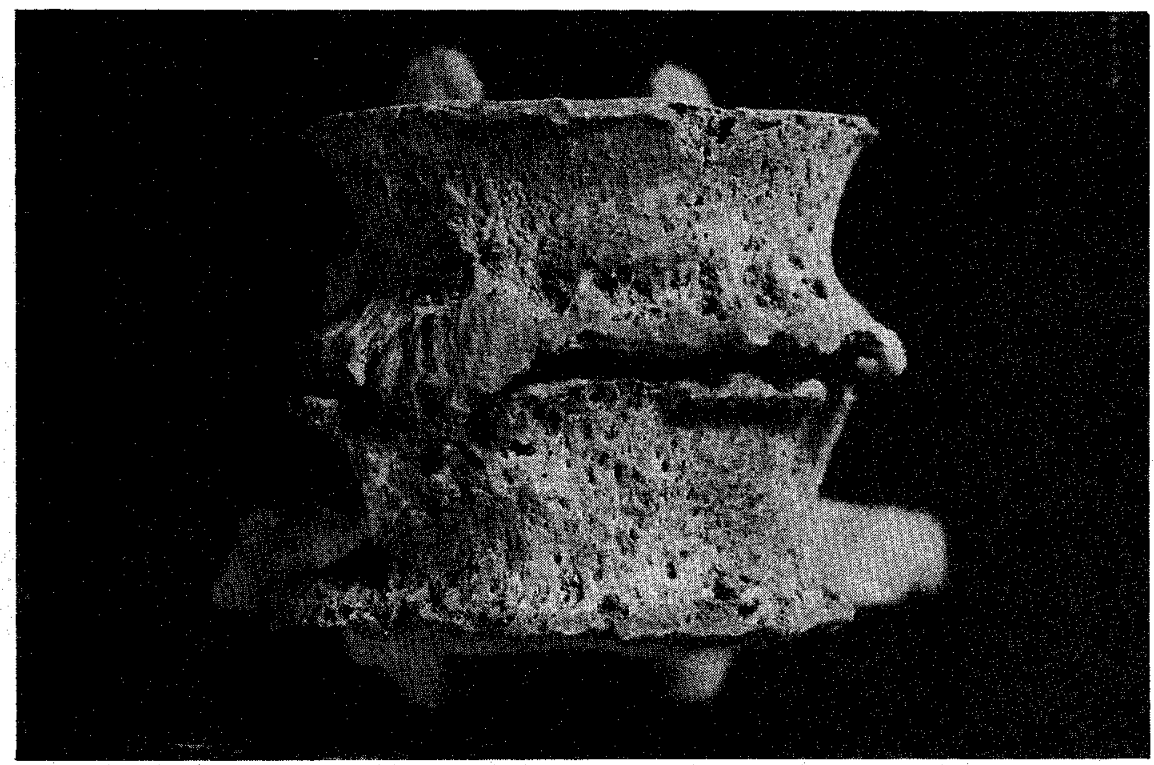

Figure 9.18. Photograph of flowing osteophytes in a series of vertebrae, Mitchell Ridge.

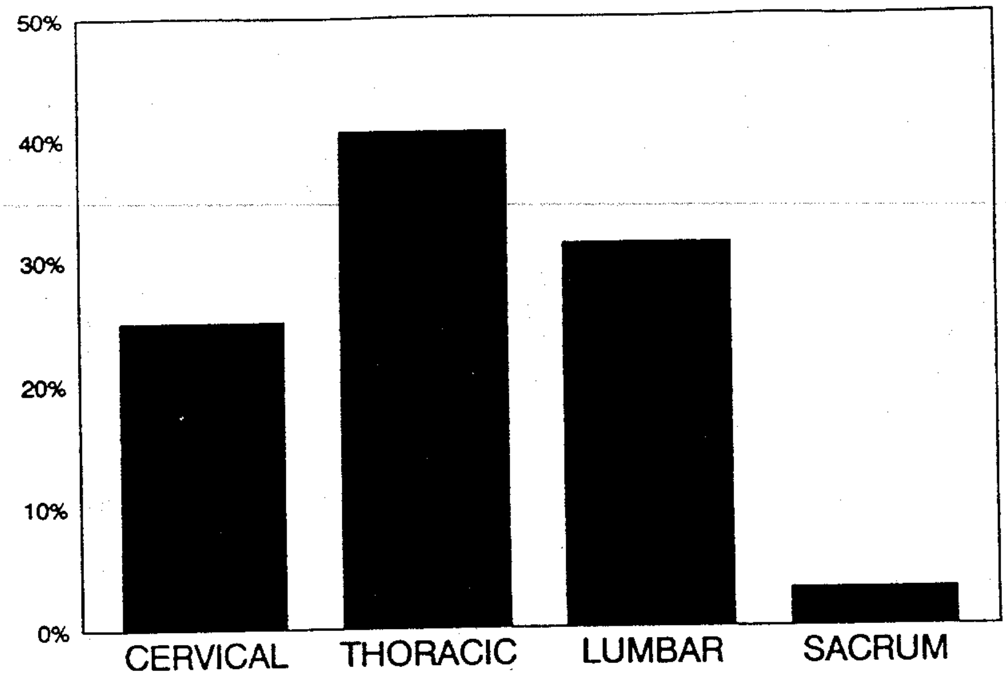

Figure 9.19. Distribution of vertebral osteophytes by vertebra type.

Table 9.25. Percentage of Arthritic Lipping of Joint Margins by Site.

Site	Exostoses < 5 mm N	Exostoses < 5 mm Percentage	Exostoses > 5 mm N	Exostoses > 5 mm Percentage
41GV66				
Prehistoric	25	32.0	25	20.8
Protohistoric	7	28.6	7	0.0
Historic	11	27.3	11	18.2
Total	**43**	**30.2**	**43**	**16.7**
41GV5	--	----	--	----
41GV1	34	11.8	34	2.9
41HR80	39	0.0	39	7.7
41BO76	6	33.3	--	----
41VT94	22	9.1	--	----

Table 9.26. Percentage of Arthritic Pitting of Joint Surfaces by Site.

Site	Pits < 2 mm N	Pits < 2 mm Percentage	Pits > 2 mm N	Pits > 2 mm Percentage
41GV66				
Prehistoric	25	24.0	25	12.0
Protohistoric	7	0.0	7	0.0
Historic	11	18.2	11	9.1
Total	**43**	**18.6**	**43**	**9.3**
41GV5	--	----	--	----
41GV1	34	8.8	34	0.0
41HR80	38	2.6	38	0.0
41BO76	9	11.1	9	0.0
41VT94	22	0.0	22	0.0

Table 9.27. Percentage of Vertebral Osteophytosis (Spondylitis Deformans) by Site.

Site	Osteophytes < 2 mm N	Osteophytes < 2 mm Percentage	Osteophytes > 5 mm N	Osteophytes > 5 mm Percentage
41GV66				
Prehistoric	23	30.4	21	9.5
Protohistoric	4	50.0	4	25.0
Historic	11	27.3	11	9.1
Total	**38**	**31.6**	**36**	**11.1**
41GV5	14	14.3	--	----
41GV1	34	14.7	34	8.8
41HR80	739	17.9	39	12.8
41BO76	4	25.0	--	----
41VT94	22	9.1	--	----

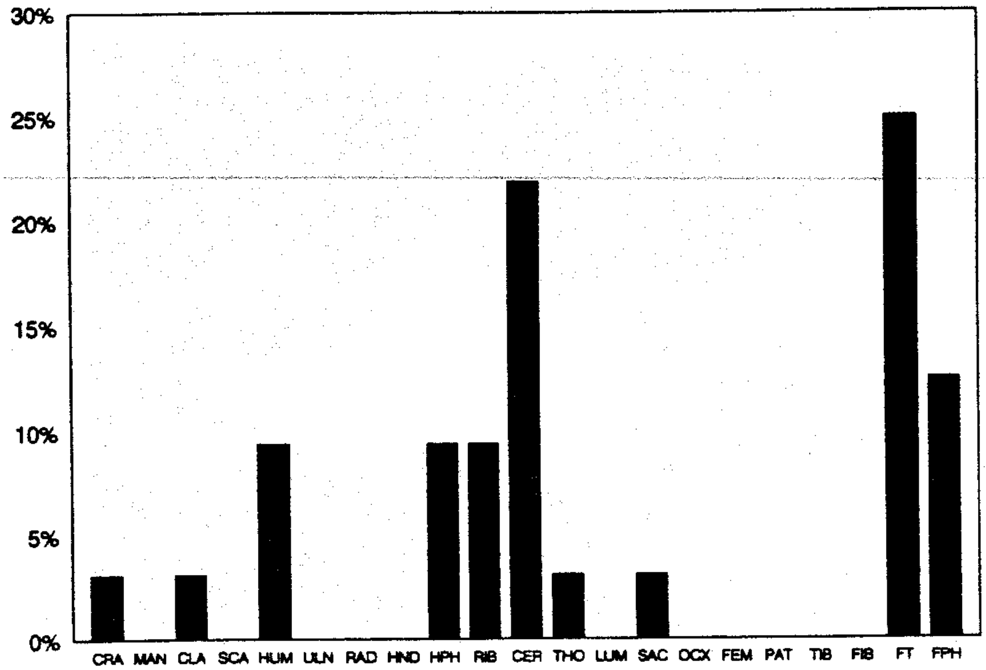

Figure 9.20. Distribution of fractures by element.

of the joint margin. For this study, degenerative lipping and pitting were considered separately, and analyzed by lesion severity. Table 9.25 presents the results for lipping. There appears to be a slight reduction in the number of moderate and severe lesions from the Prehistoric to the Historic period. However, the lower mean age-at-death for the Historic sample accounts for the differences. The rate for the pooled sample is higher than that of the Caplen and Harris County Boys' School series, which have similar age-at-death distributions. The distribution of lesions in the pooled sample (Figure 9.17) indicates that the ribs, hands, feet, and knees were the areas most commonly affected. The percentage of individuals affected by degenerative pits also appears to decline from Prehistoric to Historic (Table 9.26), which reflects the differences in age-at-death. However, the percentage for the pooled Mitchell Ridge population is nearly double that of any other population from the upper or central Texas coast.

Vertebral Osteophytosis

Vertebral osteophytosis (spondylitis deformans) is also an age-related process produced by gradual deterioration of diarthrodial joints. It results in "shelf-like bony protrusions on the cortex of the vertebral body" (Ortner and Putschar 1981:421) along the anteriolateral border (Figure 9.18). Vertebral osteophytes were also classified as either moderate or severe based on the length of bone spicules. Osteophytes were most common in the thoracic vertebrae, followed by the lumbar, cervical, and sacral elements (Figure 9.19). The percentage of affected individuals is nearly the same in both the Prehistoric and Historic samples (Table 9.27), but given a higher mean age-at-death for Prehistoric burials, the data indicate that in the Historic period individuals may have experienced spondylitis deformans at an earlier age than their Late Prehistoric predecessors.

Trauma

Trauma includes fracture, luxation and subluxation (dislocation), and sharp trauma resulting from penetrating wounds. The relative frequency of fractures and dislocations in the pooled sample (Figure 9.20) indicates that the hands and feet, ribs, and vertebrae were the most common locations for this type of trauma. Nearly 30 percent of the Late Prehistoric burials at the site exhibited fractures or dislocations,

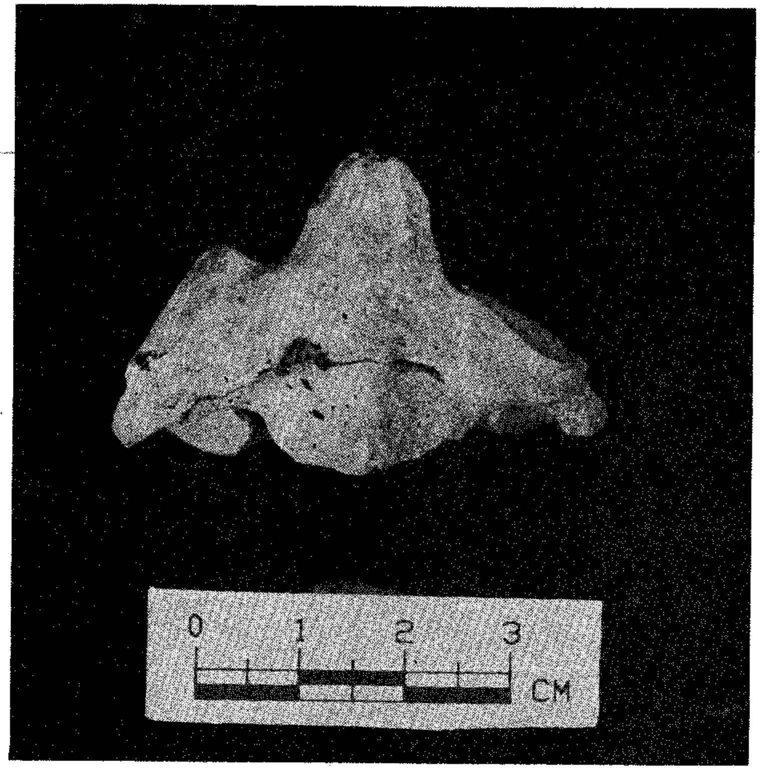

Figure 9.21. Photograph of fractured vertebrae in Feature 64, Burial 1.

which is most similar to the percentage of affected individuals at the Caplen site (Table 9.28). The most common fracture type among Late Prehistoric individuals was crushing trauma to the metatarsals and metacarpals, which in several cases resulted in fusion of elements or severe arthritic degeneration of articular facets. This type of fracture has been observed in other coastal samples (Powell 1989). One Late Prehistoric individual (Burial 12) had a Scallorn arrow point imbedded in a thoracic vertebra (Burial 12), and probably reflects interpersonal violence. A second TAS burial had an arrow point near the spine, but could not be classified as definite trauma. Less convincing evidence of trauma due to interpersonal violence was documented in Feature 25. Here, the maxilla exhibited a healed depressed fracture which may have resulted from a blow to the face. Only one fracture, a compression fracture to a thoracic vertebra, was observed in the Protohistoric sample

The pattern and frequency of trauma in the Historic sample is strikingly different compared to the Late Prehistoric sample at Mitchell Ridge and at other sites (Table 9.28). Twice as many of the Historic individuals were affected by trauma, and the percentage of trauma is greater than at any other site. Hands and feet were commonly affected, but several individuals exhibited healed fractures to the neck, arm and thorax. Feature 62-1 had fractured ribs and apparent dislocation of the sternal ends of several ribs. Feature 64-1 had a healed fracture of the first and second cervical vertebrae (Figure 9.21) which resulted in subluxation of the cranial condyles. The head of this subadult would have been inclined, and locomotion probably would have been more difficult than for a normal individual. The trauma appears to have affected the growth of the infracranial skeleton. Several epiphyses that normally fuse at age 6 were unfused despite the complete eruption and partial wear evident on the second (12 year) molars. Another individual in Feature 64 has an unusual spinal fracture. The adult male (Feature 64-4) has spondylolysis of the lamina of the first lumbar vertebra (Figure 9.22), and apparent trauma-related changes in the sternum that resulted in ossification of costal cartilage in the ribs. Also associated with the spondylolysis

Table 9.28. Percentage of Fractures and Sharp Trauma by Site.

Site	Fracture/Disolcation N	Fracture/Disolcation Percentage	Sharp Trauma N	Sharp Trauma Percentage
41GV66				
Prehistoric	24	29.2	24	4.2
Protohistoric	6	16.6	6	0.0
Historic	11	63.6	11	0.0
Total	**45**	**36.6**	**41**	**2.4**
41GV5	18	22.2	18	5.5
41GV1	48	10.4	48	2.6
41HR80	52	19.2	52	0.0
41BO76	9	0.0	9	0.0
41VT94	-	---	-	---

are Schmorl's nodes in several vertebrae, which result from herniation of the intervertebral disk, and a small resorptive lesion which also may be related to disk herniation. Feature 65 had massive trauma to the shaft of the left humerus (Figure 9.23) The unaligned fracture resulted in a deformity of the arm, and is probably associated with arthritic degeneration of the left sides of several vertebrae, the left ribs, the left scapula, and the left clavicle.

Enthesopathies

Enthesopathies are a response of hard tissues to muscular hypertrophy and microtrauma at the site of muscle insertion or origin. Enthesophytes appear as roughened bone or bony spicules along areas of muscle attachment, and can range from roughened cortical bone (such as along the linea aspera of the femur) to large osteophytes (Kennedy 1989). Figure 9.24 illustrates the distribution of enthesophytes in the pooled Mitchell Ridge sample. The most commonly affected areas are the insertions of the flexor muscles of the hand, the iliac crest, linea aspera of the femur,, followed by the patella, radius, mandible (gonial region), and humerus. The percentage of individuals exhibiting enthesopathies decreases from Prehistoric to Historic (Table 9.29), although the overall distribution of enthesophytes by element does not appreciably change through time.

Cultural Modification

Intentional and unintentional modification of hard tissues in the living constitute a special form of chronic, low-grade trauma (Ortner and Putschar 1981:90). Seven individuals (18.9%) in the pooled sample exhibited cranial modifications. In the Prehistoric sample, four skulls (19.0%) present evidence of modification, while three Historic skulls (27.3%) are modified. In all but one case (Feature 64-4), modifications appear as slight flattening at lambda perpendicular to the sagittal plane of the skull. Similar cranial modifications have been noted by Maples and Goldstein for the Oso Creek and Caplen skeletal series (unpublished data on file at the Texas Archeological Research Laboratory), and in the Jamaica Beach materials (Aten 1965). However, these authors do not agree on whether modification reflects natural

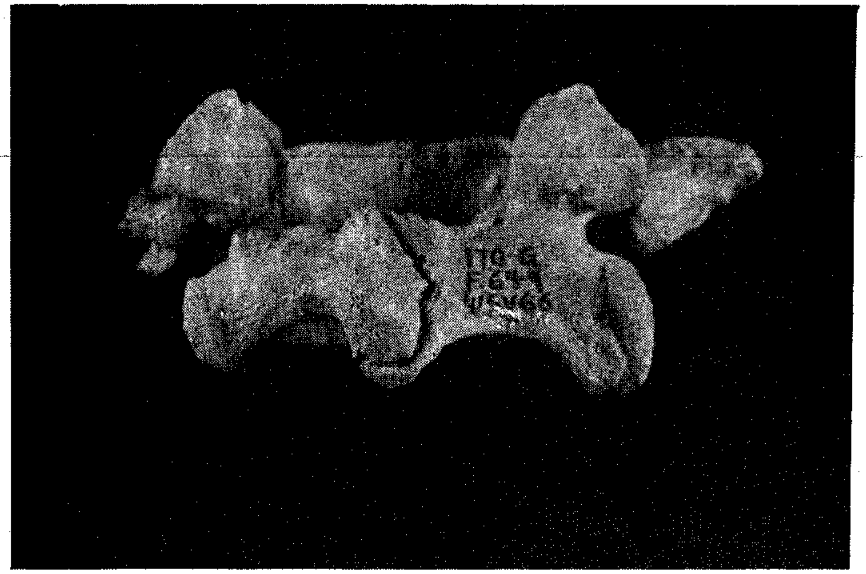

Figure 9.22. Photograph of spondylolysis in Burial 4, Feature 64.

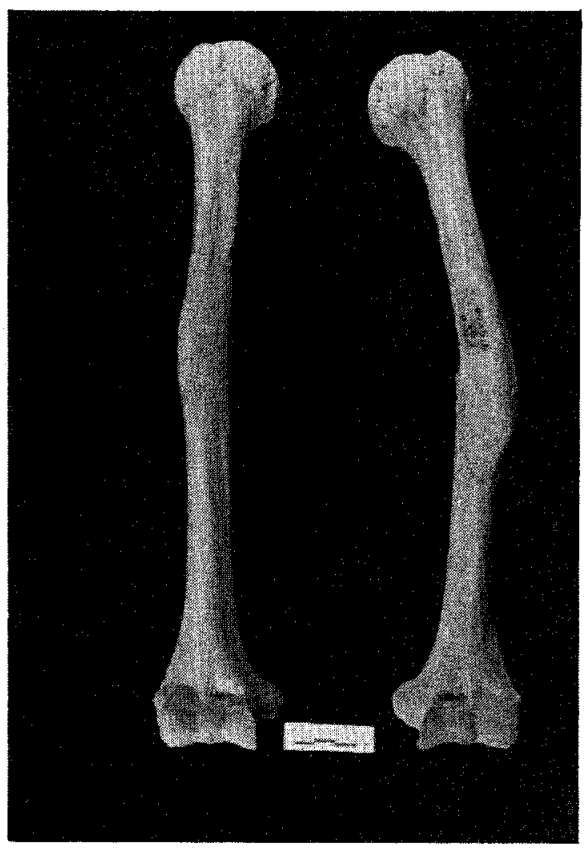

Figure 9.23. Photograph showing spiral fracture of left humerus, adult male, Feature 25.

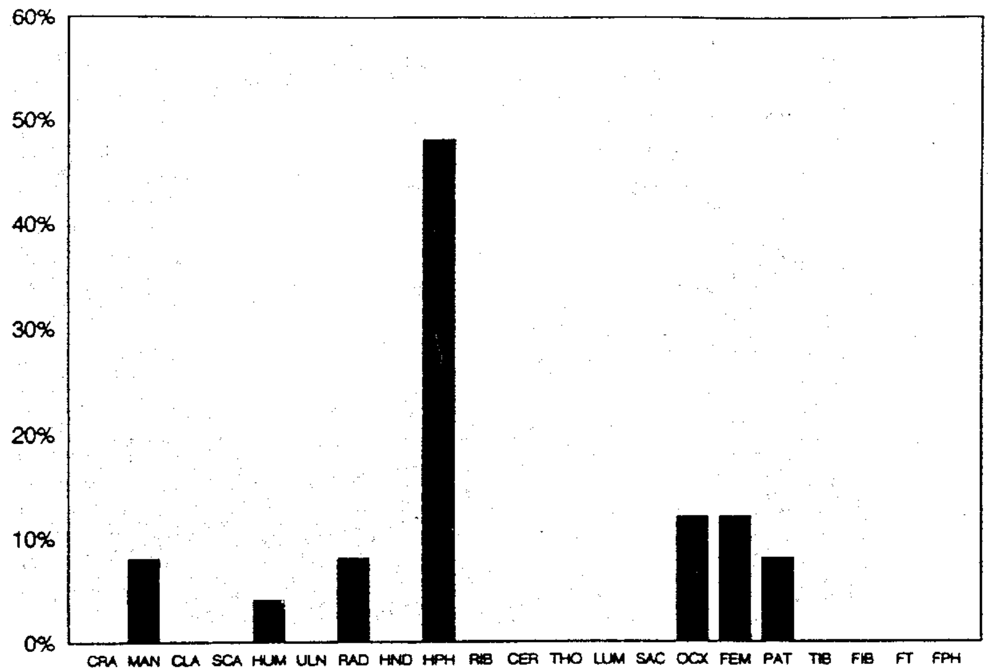

Figure 9.24. Distribution of enthesophytes by element.

Table 9.29. Percentage of Enthesopathies at Mitchell Ridge (41GV66).

	Moderate: < 5 mm		**Severe: > 5 mm**	
Site	**N**	**Percentage**	**N**	**Percentage**
12				
Prehistoric	12	66.6	12	8.3
Protohistoric	6	50.0	6	0.0
Historic	11	18.2	11	0.0
Total	**29**	**44.8**	**29**	**3.4**

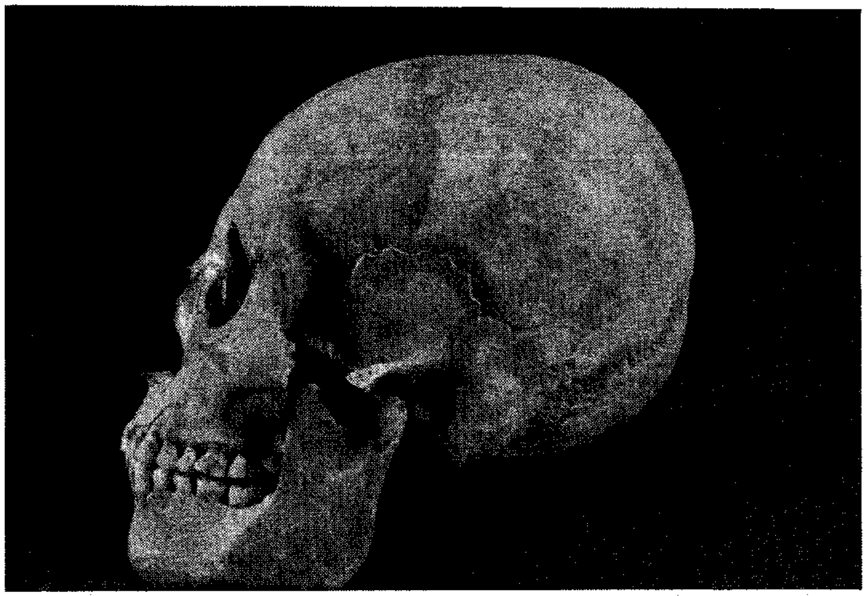

Figure 9.25. Photograph showing fronto-occipital cranial modification in adult male, Burial 4, Feature 64.

phenomena or human behavior that affected the shape of the skull. A re-examination of the Caplen series by McCormick (pers. comm.) revealed at least two examples of definite cranial modification which appear similar to changes associated with cradleboard practices. The Caplen examples were later examined by the author, and were found to be identical to six of the seven affected skeletons at Mitchell Ridge.

The adult male in Feature 64-4 presents an unmistakable case of cranial modification which is unlike the other examples from Mitchell Ridge or other upper and central coast samples. Like the other cases, this individual has lambdoidal flattening that affected the superior occipital and posterior parietals. The flattened area is porous, especially at the margins of the flat area. Unlike the other affected skulls, the frontal bone of Feature 64-4 presents definite flattening in the area of the frontal bosses and near bregma (Figure 9.25), typical of fronto-occipital deformation. Similar cranial modification has been observed in Caddoan and other Mississippian samples, but has not been reported for any Historic or Prehistoric skeletons from the Texas coast. This type of modification may represent intentional shaping of the skull rather than unintentional changes resulting from cradleboard practices.

Orodental Health and Diet

This section presents a brief summary of preliminary investigations of orodental health and enamel microdamage among the Mitchell Ridge skeletal remains. These results are based on research at the level of the individual, and will not consider rates of disease and attrition on a tooth-by-tooth basis. This method tends to overestimate the number of affected individuals since the number of teeth per individual is not taken into account. More in-depth analyses which do consider tooth representation are currently underway, and will be presented as a separate publication.

The basic approach here is the "Dental Pathology Profile" suggested by Luckacs (1989). This method has been widely applied in dental anthropological research, and it a useful tool that allows "more precise reconstruction of dietary patterns for skeletal series whose diet and/or mode of subsistence is unknown from cultural, botanical, or zoological remains" (Luckacs 1989:274). Pathological conditions of the teeth and related structures were classified as either infectious, metabolic, or traumatic in origin.

Infectious Disease and Related Conditions

Caries

Dental caries are a progressive disease process in which affected teeth experience localized demineralization caused by the fermentation of sugars by acidogenic bacteria attached to the enamel. Carious lesions were located by low power (10x) visual examination. A dental probe was used to detect demineralization and to distinguish natural pits and fissures from lesions.

Dental caries affected only one individual in the Prehistoric group (Feature 235-a), and the dating of this individual is at best a guess. In the Protohistoric sample, half of the males and one third of females exhibited at least a single carious lesion, while in the Historic group only females (50%) are affected (Table 9.30). None of the Prehistoric comparative samples observed by Powell (1989) display carious lesions. At Mitchell Ridge, caries is more prevalent in females in general, in increases from 0.189 lesions per mouth in the Prehistoric to 0.286 lesions per mouth in the Historic period (Table 9.30). This represents a significant increase in carious activity which is partially related to other masticatory factors discussed below.

Resorption

Alveolar resorption is an osseous response to inflammation of the gingival and periodontal tissues, and appears as porous bone which recedes in a direction opposite the cementoenamel junction of the tooth. Care was taken to distinguish between true resorption and the age-related processes of atrophy and continual eruption of teeth. Alveolar resorption was scored only if the bone presented no well-defined margins, was more than 3 mm from the cementoenamel junction of the tooth, and had a porous appearance. Resorption is higher in the Prehistoric sample than later groups, and is more common in males than females until the Historic period. The number of resorbed teeth/alveoli is greater in the Prehistoric (12.0 per mouth) than in the Protohistoric (3.0 per mouth) or Historic (9.42 per mouth) periods, though age differences between temporal samples accounts for some of the discrepancy.

Abscessing

Dental abscessing occurs when bacteria enter the pulp chamber via carious lesions or severe attrition, and results in pus drainage and destruction of the supporting alveolar bone. At Mitchell Ridge abscessing is associated with dental attrition in the Prehistoric sample and dental caries in the Historic and Protohistoric samples. In both the Prehistoric and Protohistoric samples, males tend to be more affected by periapical and cervical abscesses (Table 9.30), and have nearly four times as many abscesses as females. This, in part, is due to the fact that older males dominate the Prehistoric samples, so that progressive diseases such as attrition and abscessing appear to be more severe in these individuals. The overall number of abscesses per mouth decreases from 5.37 in the Prehistoric period to 2.86 in the Historic period. Again, the age composition of the samples may account for some of the temporal differences, but the data do suggest that a change in dental infection occurred over time.

Hypercementosis

Hypercementosis is a condition in which additional cementum is deposited along the root of the tooth, typically as a response to attrition, alveolar resorption, or periodontal disease. Hypercementosis was recorded only for those teeth with part or all of the root exposed. The Mitchell Ridge dental remains show a relatively high frequency of hypercementosis, with more males affected (Table 9.30) Generally, the prevalence of hypercementosis declines through time, which is probably related to the decline in resorption and attrition (see below). The average number of affected teeth per mouth also declines through time.

Enamel Hypoplasia

Linear enamel hypoplasia is a condition associated with physiological disruption of normal tooth

Table 9.30. Distribution of Orodental Pathology at Mitchell Ridge by Sex and Time Period.

	FEMALES			MALES			TOTAL[c]		
Mean Affected	N	Percent[a]	Mean Affected Teeth	N	Percent	Mean Affected Teeth	N	Percent	Teeth
Caries									
Prehistoric	0	----	----	1	16.7	0.50	1	6.2	0.19
Protohistoric	1	33.3	0.33	1	50.0	0.50	2	33.3	0.33
Historic	2	50.0	0.50	0	----	----	2	28.6	0.27
Calculus									
Prehistoric	5	83.3	5.00	10	100.0	8.00	14	93.3	8.21
Protohistoric	3	100.0	5.00	1	50.0	4.00	3	100.0	3.83
Historic	4	100.0	7.75	3	100.0	16.30	7	100.0	11.42
Resorption									
Prehistoric	5	83.3	5.50	10	100.0	14.00	15	93.7	12.00
Protohistoric	1	33.3	1.33	2	100.0	7.00	3	50.0	3.00
Historic	3	75.0	8.50	2	66.7	10.70	5	71.4	9.42
Abscess									
Prehistoric	3	50.0	2.16	7	70.0	7.30	10	62.5	5.37
Protohistoric	1	33.3	0.33	1	50.0	2.50	2	33.3	1.00
Historic	3	75.0	2.25	2	66.7	3.67	5	71.4	2.86
Hypercementosis									
Prehistoric	5	83.3	2.83	10	100.0	13.30	15	93.7	9.69
Protohistoric	2	66.7	4.67	2	100.0	7.00	4	66.7	4.67
Historic	1	25.0	0.25	2	66.7	4.30	3	42.8	2.00

a: Percentage of individuals with one or more affected teeth

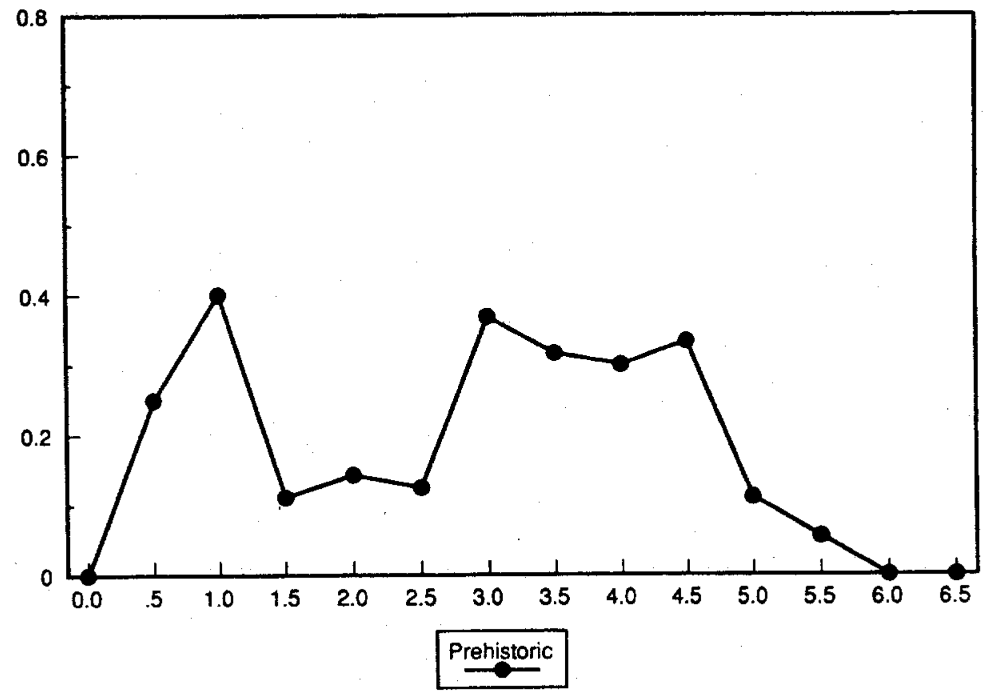

Figure 9.26. Distribution of enamel hypoplasia by developmental age for the Prehistoric sample at Mitchell Ridge.

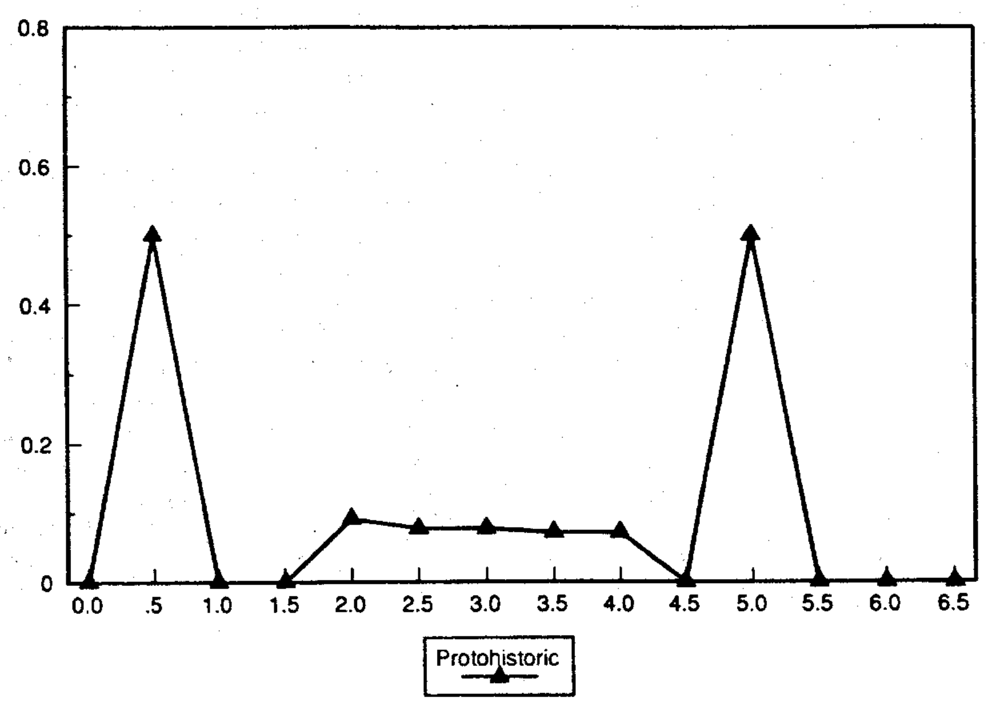

Figure 9.27. Distribution of enamel hypoplasia by developmental age for the Protohistoric sample at Mitchell Ridge.

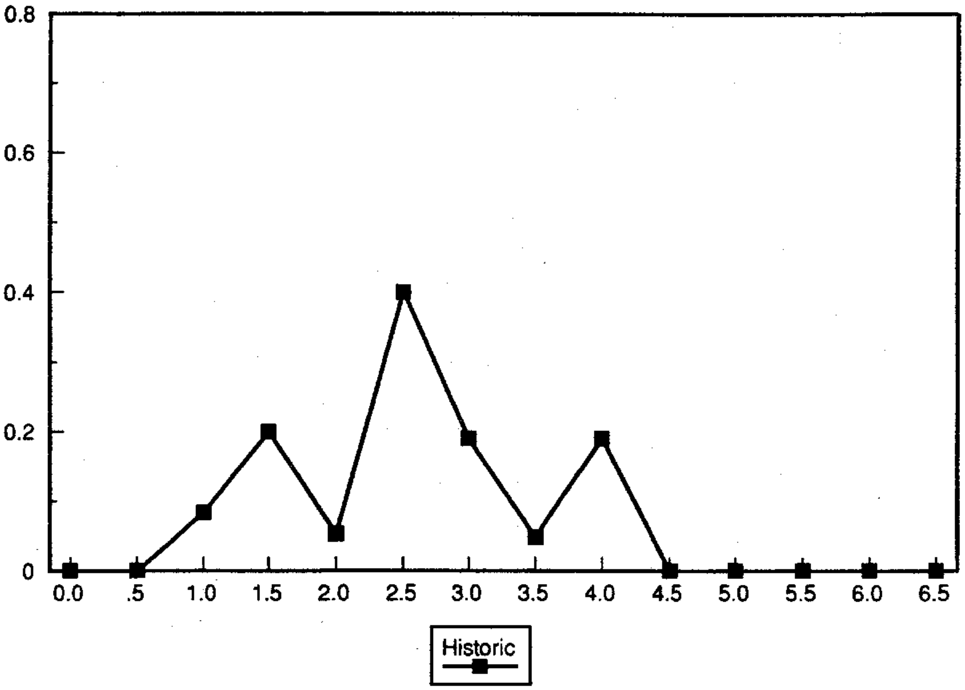

Figure 9.28. Distribution of enamel hypoplasia by developmental age for the Historic sample at Mitchell Ridge.

development, which retards ameloblasts (enamel-producing cells) and results in irregular, horizontal linear grooves or pits in the enamel. Linear enamel hypoplasia was recorded following the methods of Goodman et al. (1980). Only the central incisors and canines were used for this study following the suggestions of Rose et al. (1985). Further, the frequency of age of onset in individuals, using only the upper canine, was calculated following the suggestions of Skinner and Goodman (1992).

Figure 9.26 shows the distribution of hypoplastic defects in the Prehistoric assemblage by age of occurrence, reported in developmental years (enamel units). Two peaks in the distribution, at one year and between 2.5 and 4.5 years, suggest that Late Prehistoric individuals, on average, experienced a period of disruption in enamel formation at around age one, and again during early childhood. This is similar to the distribution of defects in the Protohistoric sample (Figure 9.27), which also is bimodal but has peaks occurring slightly earlier (0.5 developmental years) and later (5.0 developmental years) than those of the Prehistoric group. These figures are in contrast to that for the Historic sample (Figure 9.28), which has a near-normal distribution with a peak at 2.5 developmental years. The distribution of age at onset in the Prehistoric and Protohistoric samples is relatively uniform, ranging from 2.0 to 4.0 years of age for first hypoplasia. This suggests that during earlier periods, the onset of childhood stress was idiosyncratic rather than a regular part of the life cycle. In the Historic sample, virtually every individual experienced their first enamel disruption at age 3.0 years. This result suggests that for Historic children, some systematic stressor such as weaning, exposure to a new pathogen, or decrease in maternal antibodies (related to weaning) affected all children in sample at the same dental age.

Dental Attrition

Macroscopic dental wear provides some clues to the diet and dental function of prehistoric groups. Smith (1985) found that the dental wear of hunter-gatherers was more extreme, and that incisor wear matched or exceeded molar wear during the last stages of life. Among agriculturalists, distal dental wear (molars and premolars) tends to exceed anterior wear. The Mitchell Ridge dental attrition was recorded for maxillary first molars and central incisors following Smith (1985). Mean dental wear scores are

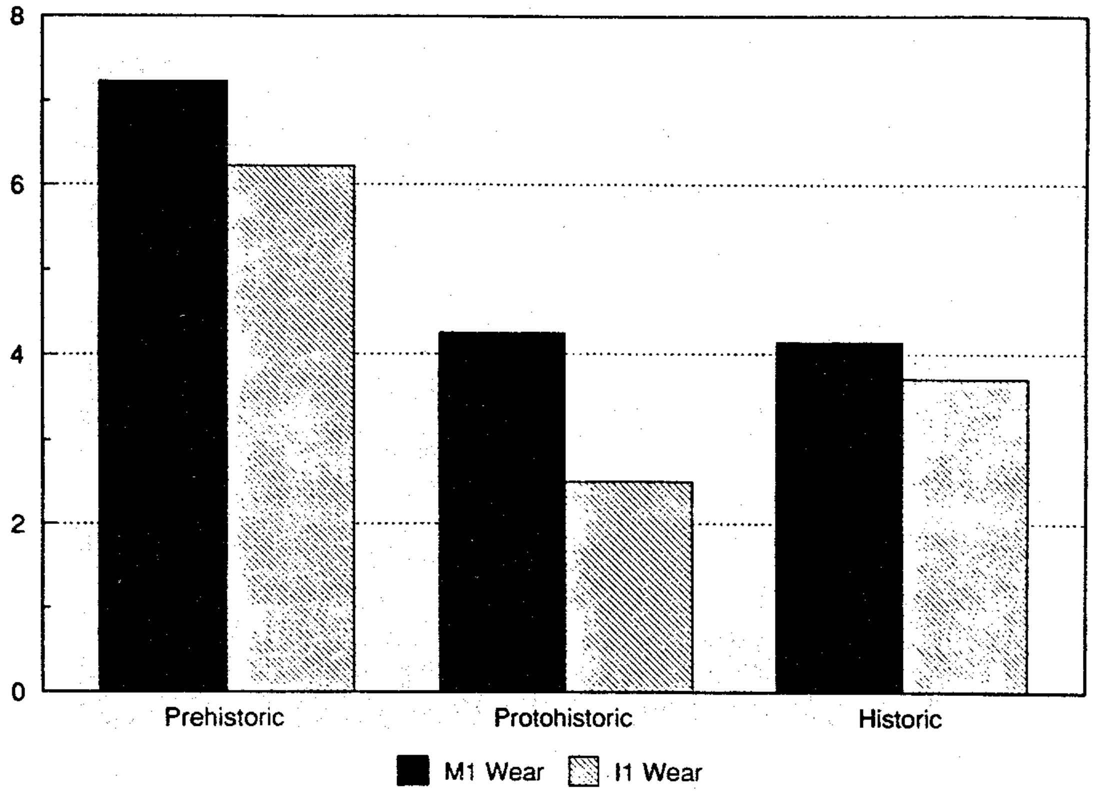

Figure 9.29. Mean dental wear scores for Mitchell Ridge by time period.

presented in Figure 9.29.

Dental wear is more extreme in Late Prehistoric groups, especially males, but the latter is a reflection of age-biases in the assemblage. Anterior wear matches but does not exceed molar wear in this group. In the Protohistoric sample molar wear exceeds incisor wear only slightly, while the difference is greater in Historic burials. These data tentatively suggest that Historic groups follow a pattern of dental wear that is not quite typical of hunter-gatherers. The overall rates of wear appear to decrease through time as well. The mean molar wear for Prehistoric individuals is nearly double the mean wear for Historic burials.

Dental Microwear

Dental microwear offers a more useful means of assessing dental wear, and has been used to document changes in subsistence and technology in peri-contact skeletal series from the Georgia coast (Teaford 1991) Three types of microscopic enamel damage are typically observed for human teeth: pits, scratches, and polish. Pitting, or "compression fracturing," of enamel occurs when hard materials are processed in the mouth. Scratches are associated with grit introduced either through a coarse diet, accidental food contamination, or the use of stone grinding implements (Marks et al. 1985, Walker et al. 1978), where the widths of striations indicate the relative size of particles consumed. Enamel polishing, and the smoothing of margins in striations and pits, is associated with the consumption of dietary fiber (Marks et al. 1988; Walker et al. 1978).

Pits are quite common in the Late Prehistoric and Protohistoric samples (Figures 9.30 and 9.31), and indicate the oral processing of hard objects which resulted in extensive enamel damage. In the

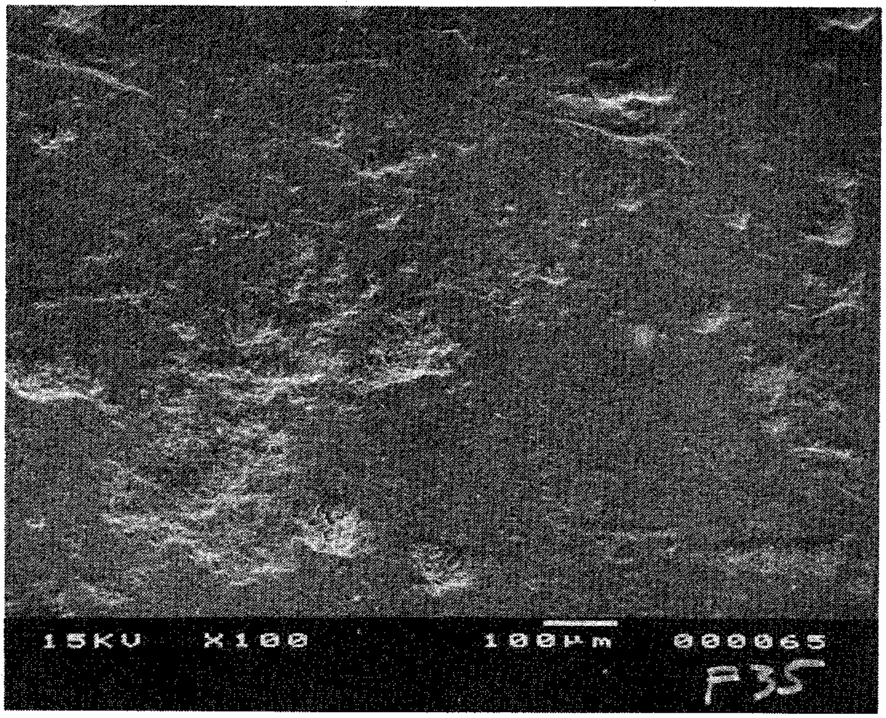

Figure 9.30. Photograph of dental microwear in a Prehistoric burial (Fea. 35) at Mitchell Ridge.

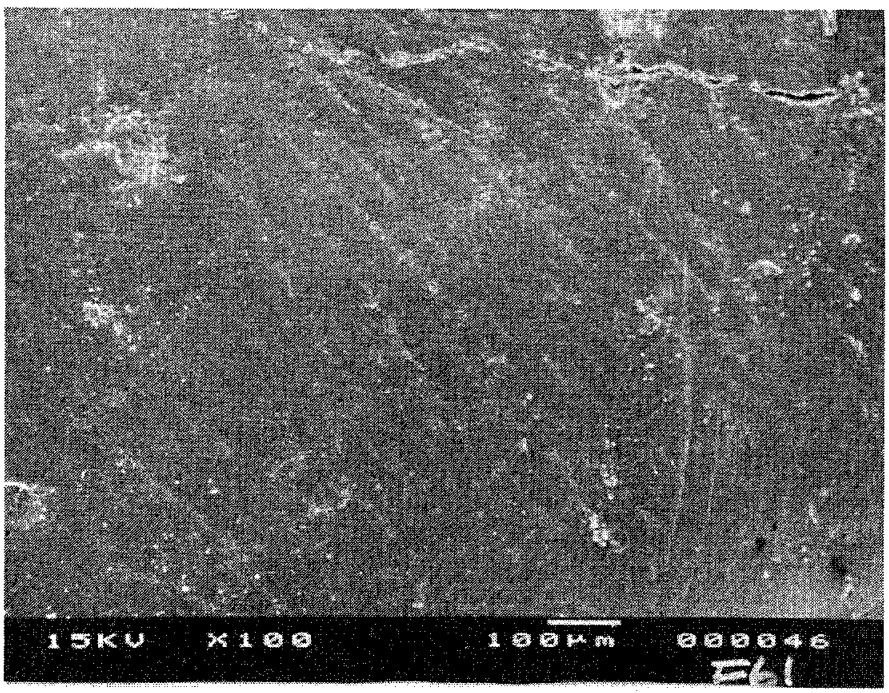

Figure 9.31. Photograph of dental microwear in a Protohistoric burial (Fea. 61) at Mitchell Ridge.

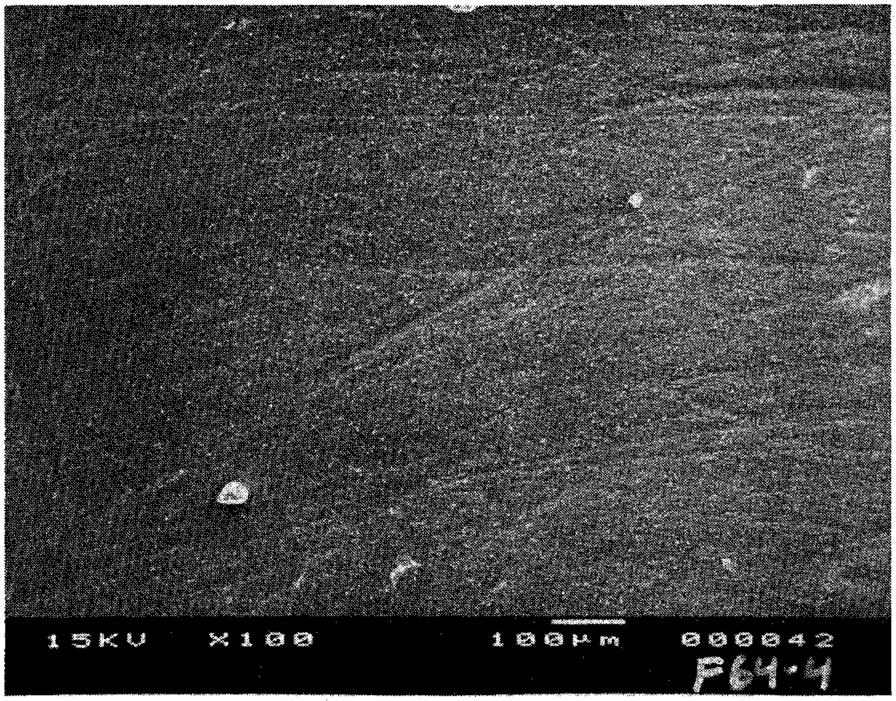

Figure 9.32. Photograph of dental microwear in a Historic burial (F. 64, Burial 4) at Mitchell Ridge.

prehistoric samples, although some individuals such as Feature 35 (Figure 9.30) exhibit relatively little enamel polish. Scratches and polish are quite abundant in the Historic samples (Figure 9.32), and the general pattern of microwear is significantly different from that of earlier groups. However, the Historic groups exhibits greater variation in the type of proportion of pits and striation. The range of Historic frequencies is 50 (pit frequencies between 10 to 60 percent), compared to a range of 40 (pit frequencies between 40 to 80 percent) in Protohistoric samples and 10 (pit frequency between 80 to 90 percent) in Prehistoric samples.

Two Historic specimens, Features 63 and 65, have dental microwear that is qualitatively more similar to the wear observed in Late Prehistoric groups. The remainder of the sample (Features 64-4, 62-1, and 62-2) have enamel surfaces covered with numerous, fine striations. These individuals are qualitatively more similar to late Contact mission populations (Teaford 1991: Figure 4). The relative frequencies of pits and scratches are presented in Figure 9.33. The relative frequency of pits declines through time, suggesting that hard object mastication is less frequent in Historic individuals. This follows the pattern documented for pre-contact and post-contact populations on the Georgia Coast (Teaford 1991).

Summary of Orodental Results

The data presented here indicate that definite changes in orodental health occurred in the post-contact period. Dental caries appears to increase, as does carbohydrate-related dental calculus. Dental infection, in the form of abscesses and resorption decreases during the Historic period, as does dental attrition. Attrition, infection, and dental caries are inter-related variables. In the Prehistoric period, more severe dental attrition led to increased pulp exposure and increased gingival and periapical infections. However, the attrition also decreased the rate of caries by acting to cleanse the mouth of cariogenic plaque. These relationships changed during the Historic period, where attrition (and consequently abscessing and

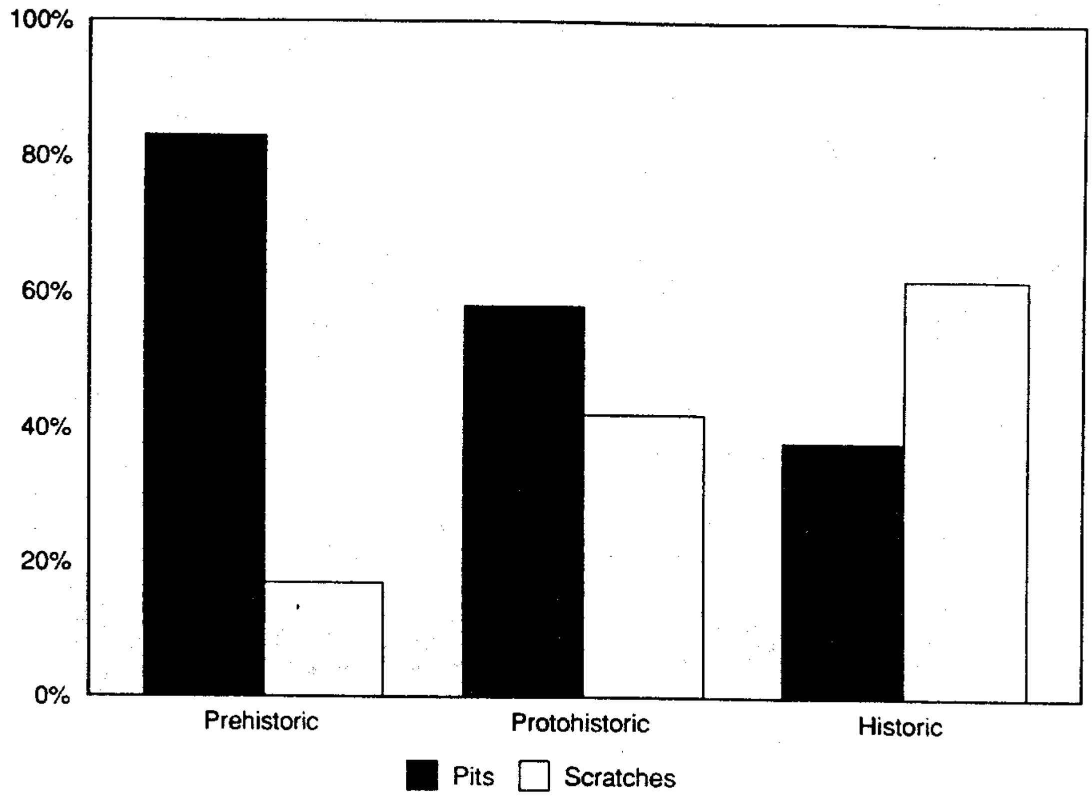

Figure 9.33. Relative frequency of pits and scratches in the Mitchell Ridge sample, by major time period. Based on percentage of total features on a x500 micrograph.

resorption) decreases but caries and calculus increase. Dental microwear data indicate that later populations experienced less severe enamel damage, which may reflect a shift in diet or food processing technologies. Finally, the Historic group differs in the age of onset for linear enamel hypoplasia, and may indicate that eighteenth century children experienced a different set of stresses then their Late Prehistoric counterparts.

Metric and Nonmetric Traits and Patterns of Biological Affinity

This section presents results of metric and nonmetric analyses of the Mitchell Ridge skeletal series. One of the problems in previous analyses of human skeletal remains from the Texas coast is the over-emphasis on presenting raw data without synthesis (Woodbury and Woodbury 1935; Comuzzie et al. 1986). While the presentation of raw data and data summaries is worthwhile, it should not be the main focus of research. This section will summarize the existing data sets, and interpret patterns of metric and nonmetric variation within a regional and extra-regional framework.

Body Size and Sexual Dimorphism

Early ethnographic accounts of encounters with native populations on the upper and central Texas coast are filled with references to the body size of these groups. Ethnohistoric estimates of Karankawa body size are summarized by Hester:

As to the question of physical stature, we can refer to Beranger's 1720 account of the

> Karankawa he visited at present-day Aransas Pass (Carroll 1983:21). Beranger measured several of these people and stated "some of them [are] six feet two inches tall. They are *usually* five and a half feet [tall]." Gatschet (1891:53) reports witnesses who described Karankawa males as very tall, though his best informant, Mrs. Oliver, reported that "they measured about five feet and ten inches" (Hester 1989:82).

This section briefly explores body size in upper coastal groups, with special focus on infracranial dimensions and estimated stature. Cranial and dental dimensions will not be treated here except where they shed light on infracranial patterns of variability. Metric data collection included 31 infracranial dimensions, 61 cranial measurements, and 24 dental dimensions.

Secular Trend in Metric Traits

Before examining differences in body size between sexes, it was necessary to examine other body size trends that might skew the data. Foremost among these is the possibility that differences in infracranial and other metric traits could be affected by differences in sample composition over time. Summary data for long bone measurements are presented by time period in Tables 9.32, 9.33 and 9.34. The Prehistoric sample (Table 9.31) is virtually identical to the small collection of remains from the Palm Harbor site (41AS80) (Comuzzie et al. 1986). The Historic period remains from Mitchell Ridge are also similar to the Palm Harbor data, but mean dimensions tended to be slightly smaller.

The presence of secular trend in infracranial, cranial, and dental dimensions was tested using both Student's t-tests and two-tailed F tests for differences in variance. In general, there is a trend for decreasing size, with only 33.2% of infracranial traits larger in the Historic sample (Tables 9.31 - 9.33). None of these differences are statistically significant. The Historic sample does, however, exhibit a marked increase in variability for the majority of infracranial traits. None of the dental or cranial traits present statistically significant differences by time. Despite the lack of statistical significance, a visual examination for time trends revealed that in 69 percent of traits compared over time, female size decreases while male size increases. Generally, changes are no more than 5 mm in the case of cranial measurements and 1 mm for dental dimensions. Significant differences in variance between temporal samples were observed for the female prosthion radius, male and female upper central incisor buccolingual diameter, and male mandibular corpus breadth. In all but the latter case Prehistoric samples exhibited greater variance.

Sexual Dimorphism

The infracranial data were pooled by sex for examinations of sexual dimorphism (Table 9.34). Most of the infracranial, cranial, and dental traits in the sample exhibit significant sexual dimorphism, but only the infracranial traits are considered in detail. Only clavicle length, humerus anterio-posterior diameter, and tibial circumference were not significantly dimorphic at the $p = .05$ level. Variances were not dimorphic except for tibia circumference, where males were more variable. Percent sexual dimorphism in infracranial dimensions, expressed as the male value divided by the female value, ranged from 106 percent to 118 percent.

Stature Estimates

As noted in the above quote, ethnohistoric descriptions of body size in coastal Texas populations differ from account to account, but generally suggest that coastal aborigines were quite tall compared to European colonists. Data on maximum femur length were used to estimate stature following Trotter (1970). The femur was selected because of its reliability, and because virtually all of the Mitchell Ridge burials contained complete or reconstructible femora. The Trotter formulae for White females and Mongoloid males were used instead of the Genoves (1967) formulae because the latter tend to underestimate living stature (Bass 1987:28-29).

Given that secular trends are not present in the infracranial data, stature estimates were pooled by sex. Males at Mitchell Ridge averaged 171.6 cm, or 5 feet 7 inches tall. Females averaged 158.5 cm in height, or 5 feet 2 inches. Compared to inland Texas populations, the Mitchell Ridge individuals were extremely tall (Table 9.35), but were only slightly taller than other coastal groups and the Blue Bayou

Table 9.31. Infracranial Metric Data for Prehistoric Burials at Mitchell Ridge, Sexes Pooled.

	N	Maximum Values		Mean	Standard Deviation
Humerus:					
Length	10	284.0	329.0	307.80	15.433
Cirumference	14	56.0	90.0	65.57	9.378
Anterior-Posterior Diameter	14	15.0	26.0	19.78	3.017
Transverse Diameter	14	15.0	25.0	20.92	2.921
Vertical Head Diameter	9	38.0	45.0	42.22	2.386
Radius:					
Lenth	11	233.0	268.0	244.90	12.549
Circumference	14	33.0	62.0	43.14	8.583
Anterior-Posterior Diameter	14	10.0	19.0	12.64	2.437
Transverse Diameter	14	10.0	16.0	13.42	1.827
Ulna:					
Length	10	252.0	292.0	265.50	14.089
Circumference	15	38.0	73.0	49.80	9.236
Anterior-Posterior Diameter	15	14.0	23.0	16.67	2.319
Clavicle:					
Length	7	133.0	163.0	148.71	11.842
Circumference	7	31.0	47.0	38.71	5.851
Anterior-Posterior Diameter	7	9.0	16.0	13.28	2.214
Transverse Diameter	7	9.0	12.0	10.28	1.253
Femur:					
Length	10	404.0	481.0	440.60	22.623
Circumference	17	76.0	118.0	93.88	10.804
Anterior-Posterior Diameter	17	25.0	37.0	30.94	3.699
Transverse Diameter	17	23.0	36.0	27.23	3.152
Maximum Head Diameter	11	38.0	49.0	42.66	3.202
Epicondylar Breadth	9	62.0	85.0	76.67	7.858
Tibia:					
Length	6	343.0	410.0	380.33	23.398
Circumference	12	23.0	110.0	93.41	23.712
Anterior-Posterior Diameter	12	29.0	43.0	37.50	3.729
Transverse Diameter	12	18.0	29.0	25.00	3.074
Fibula					
Length	4	337.0	377.0	357.75	16.760
Circumference	6	37.0	68.0	50.16	12.639
Maximum Diameter	7	14.0	19.0	16.85	1.864
Anterior-Posterior Diameter	7	13.0	17.0	14.57	1.718
Transverse Diameter	7	9.0	17.0	12.71	2.870

Table 9.32. Infracranial Metric Data for Protohistoric Burials at Mitchell Ridge, Sexes Pooled.

	N	Maximum Values		Mean	Standard Deviation
Humerus:					
Length	2	288.0	304.0	296.00	11.313
Circumference	3	51.0	71.0	58.67	10.785
Anterior-Posterior Diameter	3	13.0	18.0	15.67	2.516
Transverse Diameter	3	18.0	25.0	20.67	3.785
Maximum Head Diameter	3	37.0	47.0	41.33	5.131
Radius:					
Length	1	245.0	245.0	245.00	.
Circumference	1	32.0	32.0	32.00	.
Anterior-Posterior Diameter	1	10.0	10.0	10.00	.
Transverse Diameter	1	12.0	12.0	12.00	.
Ulna:					
Length	2	242.0	264.0	253.00	15.556
Circumference	2	37.0	38.0	37.50	0.707
Anterior-Posterior Diameter	2	14.0	15.0	14.50	0.707
Clavicle:					
Length	1	142.0	142.0	142.00	.
Circumference	2	27.0	39.0	33.00	8.485
Anterior-Posterior Diameter	2	10.0	14.0	12.00	2.828
Transverse Diameter	2	9.0	12.0	10.50	2.121
Femur:					
Length	1	432.0	432.0	432.00	.
Circumference	2	77.0	97.0	87.00	14.142
Anterior-Posterior Diameter	2	26.0	30.0	28.00	2.828
Transverse Diameter	2	24.0	30.0	27.00	4.242
Maximum Head Diameter	1	39.0	39.0	39.00	.
Epicondylar Breadth	1	70.0	70.0	70.00	.
Tibia:					
Length	1	374.0	374.0	374.00	.
Circumference	1	78.0	78.0	78.00	.
Anterior-Posterior Diameter	1	30.0	30.0	30.00	.
Transverse Diameter	1	21.0	21.0	21.00	.
Fibula:					
Length	1	361.0	361.0	361.00	.
Circumference	2	35.0	57.0	46.00	15.554
Maximum Diameter	2	13.0	18.0	15.50	3.535
Anterior-Posterior Diameter	2	13.0	17.0	15.00	2.828
Transverse Diameter	2	10.0	15.0	12.50	3.535

Table 9.33. Infracranial Metric Data for Historic Burials at Mitchell Ridge, Sexes Pooled.

	N	Maximum Values		Mean	Standard Deviation
Humerus:					
Length	6	296.0	348.0	317.00	21.743
Circumference	6	55.0	72.0	61.67	6.501
Anterior-Posterior Diameter	6	15.0	20.0	17.83	1.722
Transverse Diameter	6	19.0	25.0	22.17	2.228
Maximum Head Diameter	6	38.0	49.0	42.67	4.320
Radius:					
Length	6	225.0	271.0	245.67	18.326
Circumference	6	34.0	55.0	41.00	7.974
Anterior-Posterior Diameter	6	9.0	20.0	13.17	3.763
Transverse Diameter	6	12.0	16.0	13.83	1.722
Ulna:					
Length	6	244.0	291.0	266.50	17.896
Circumference	6	39.0	58.0	47.17	6.735
Anterior-Posterior Diameter	6	15.0	19.0	16.67	1.632
Clavicle:					
Length	5	125.0	159.0	148.00	13.928
Circumference	6	27.0	41.0	33.50	5.576
Anterior-Posterior Diameter	6	9.0	14.0	11.17	1.940
Transverse Diameter	6	8.0	11.0	9.17	1.169
Femur:					
Length	6	412.0	487.0	448.17	30.524
Circumference	6	77.0	97.0	84.67	8.778
Anterior-Posterior Diameter	6	26.0	34.0	29.17	3.544
Transverse Diameter	6	23.0	29.0	25.33	2.250
Maximum Head Diameter	6	39.0	48.0	43.67	4.226
Epicondylar Breadth	5	70.0	83.0	77.60	6.503
Tibia:					
Length	6	344.0	414.0	373.17	30.294
Circumference	6	11.0	99.0	73.33	31.506
Anterior-Posterior Diameter	6	29.0	40.0	33.17	4.167
Transverse Diameter	6	18.0	26.0	21.33	3.141
Fibula:					
Length	5	333.0	395.0	357.00	26.935
Circumference	6	33.0	46.0	42.00	4.732
Maximum Diameter	6	14.0	17.0	15.83	1.471
Anterior-Posterior Diameter	6	13.0	17.0	14.33	1.751
Transverse Diameter	6	9.0	16.0	11.83	2.786

Table 9.34. Sexual Dimorphism in Infracranial Dimensions, Pooled Sample.

Variable	Sex	N	Mean	Std.	Significance T-Test	F-test
Humerus Length	F	9	296.000	7.297	0.0001	0.0749
	M	9	323.111	4.286		
Humerus Circumference	F	12	59.000	6.124	0.0055	0.2429
	M	11	68.724	8.844		
Humerus A-P Diameter	F	12	18.000	3.618	0.2127	0.0548
	M	11	19.545	1.916		
Humerus Transverse Diam.	F	12	19.333	2.1030	0.0001	0.6918
	M	11	23.272	1.848		
Radius Length	F	9	235.111	6.050	0.0004	0.0713
	M	9	255.222	11.955		
Ulna Length	F	9	253.111	7.457	0.0002	0.1924
	M	9	275.778	12.101		
Clavicle Length	F	7	140.428	10.517	0.0580	0.1559
	M	6	156.667	5.316		
Femur Length	F	8	422.500	11.588	0.0001	0.2922
	M	9	460.778	17.526		
Femur Circumference	F	12	84.333	9.745	0.0012	0.4953
	M	13	97.384	7.953		
Femur A-P Diameter	F	12	27.917	3.528	0.0006	0.0690
	M	13	32.461	2.025		
Femur Transvers Diam.	F	12	24.667	1.669	0.0002	0.1252
	M	13	28.692	2.689		
Femur Epicond. Breadth	F	7	69.857	3.891	0.0000	0.1824
	M	8	82.375	2.263		
Tibia Length	F	6	355.667	13.691	0.0009	.06691
	M	7	394.428	16.811		
Tibia Circumference	F	11	91.091	12.381	0.4461	0.0017
	M	8	79.625	39.082		
Tibia A-P Diameter	F	11	33.909	4.570	0.0294	0.1951
	M	8	38.250	2.764		
Tibia Transverse Diam.	F	11	22.454	3.933	0.0563	0.0545
	M	8	25.250	1.832		
Fibula Length	F	6	344.667	11.673	0.0034	0.7458
	M	4	377.250	13.275		

Table 9.35. Stature Estimates for Selected Prehistoric Skeletal Series. After Steele and Powell n.d.

	MALES			FEMALES			Sexual
Population	N	Stature	Std	N	Stature	Std.	Dimorphism
Coastal Texas:							
41GV66 (Mitchell Ridge)	9	171.6	3.8	8	158.5	2.9	108.0
41GV1 (Caplen Mound)	5	167.4	5.4	12	159.5	4.4	104.9
41HR80 (Harris Co. Boys' School)	6	167.4	5.3	5	161.4	3.9	103.7
41BO76 (Shell Point)	1	176.6	---	5	170.1	4.7	103.8
41VT94 (Blue Bayou)	7	164.9	5.8	3	154.7	4.3	106.6
Central Texas:							
41WM230 (Loeve-Fox)	12	168.7	---	5	162.0	---	104.1
41BX5 (Mission San Juan Capistrano)	8	167.9	---	9	162.6	---	103.2
East Texas:							
Caddoan Agriculturalists	14	169.0	---	8	158.0	---	107.0
West Texas:							
Trans-Pecos	6	167.4	2.6	5	155.4	3.5	107.7
Lower Pecos	21	166.0	4.2	14	158.5	4.9	104.7
Tamualipas	9	166.7	4.8	14	158.1	5.3	105.4

Table 9.36. Mean Measure of Divergence Values for Nine Native American Series from Texas. MMDs based on seven cranial discrete traits.

	Prehistoric	Historic	Prehist-TAS	Lower Coast	Mission	Upper Coast	Central Texas	Sanders
Prehistoric	0							
Historic	0.000366	0						
Prehist-TAS	0.056879	0.001868	0					
Lower Coast	0.126748	0.126689	0.001511	0				
Mission	0.035686	0.066387	0.207351	0.230146	0			
Upper Coast	0.004574	0.009844	0.000014	0.093661	0.072287	0		
Cent. Texas	0.000384	0.010518	0.007768	0.303877	0.068344	0.000154	0	
H-M Caddo	0.023074	0.027205	0.009447	0.485379*	0.242429	0.002888	0.000605	0
Sanders Caddo	0.001321	0.001713	0.000765	0.152291	0.122009	0.000000	0.002446	0.005544

*: Significant divergence based on the criteria of Sjovold (1973).

sample. Perhaps more interesting than the stature estimate itself is the degree of sexual dimorphism in stature. Table 9.36 also presents the percent sexual dimorphism for estimated stature. Mitchell Ridge is the most dimorphic of all samples considered here.

Intra-site and Inter-site Analyses of Biological Affinity

In recent years, skeletal biologists have rekindled their interest in the study of biological affinity and human population phylogeny (Armelagos et al. 1982). Research has focused on the determination of phyletic relationships among modern and prehistoric populations using phenotypic traits of bone and teeth (Brace and Hunt 1990; Saunders 1978; Sciulli 1990; Steele and Powell 1992; Turner 1985; van Vark 1976). These analyses proceed under the assumption that differences in the size and shape of skeletal features are at least in part genetically controlled, and that the application of principles and methods of quantitative genetics or phylogenetics to skeletal populations will provide accurate estimates of genetic similarities.

At the level of the individual, the question addressed simply may be "to which population did this individual belong?" Forensic research in particular has focused on techniques for assigning an unknown individual to one particular biological population or another (Brues 1990; Giles and Elliot 1962; Gilbert and Gill 1990; Gill 1984). However, excessive phenotypic heterogeneity among and between populations makes the assessment of general biological affinity extremely difficult. Traditional subjective methods suffer from a tendency to ignore individual and population-level variation (Gill 1984) and are often decried as racist and typological, contributing little to our understanding of human genetics and evolution. However, there do appear to be some general geographic trends in phenotypic variation among human populations, though the overlap between groups and regions is considerable and should not be ignored. Quantitative traits have the advantage of being less subjective, and have been used with modest success for determining the biological affinity of unknown individuals (Gill et al. 1988), especially in the case of fossil and subfossil specimens (Steele and Powell 1992).

Human remains recovered from the Mitchell Ridge Site offer a chance to examine population-level within-group heterogeneity using both quantitative and discrete trait methods. The focus of this report is the assignment of each individual at the site to a modern geographic population, and to determine the nature of morphometric relationships among coastal aboriginal populations. Ethnohistoric accounts of population dynamics among Texas coastal populations during the 18th and 19th centuries suggest that native populations were greatly affected by disease and demographic disturbances (see Aten 1983; Powell 1989; Ricklis 1990). During the historic period, various non-coastal populations entered the region from the east as a response to European territorial expansion (Aten 1983a). The result was an amalgamation of numerous biologically and socially distinct groups into a single heterogeneous coastal "population". Native American biological heterogeneity in the region was further enhanced by gene flow from French and English populations who were present in the area as early as the late seventeenth century. Given these historical events, two important hypotheses can be tested using the human remains from the protohistoric and historic period at Mitchell Ridge:

Hypothesis 1: Individuals at Mitchell Ridge are a biologically homogeneous group.

Hypothesis 2: There is evidence for admixture with non-Native American populations during the protohistoric or historic periods.

Sixty-one craniometric dimensions were recorded for each of the Mitchell Ridge individuals following the methods and variable definitions of Howells (1973). Comparative data for 63 females and 81 males representing 10 Prehistoric and Historic sites in Texas were compiled from published literature (Aten 1965; Benfer and McKern 1968; Butler 1982; Comuzzie et al. 1986; Comuzzie 1987; Hole and Wilkinson 1973, 1977; McCormick and Steele n.d.; Navey 1975; Powell 1989; Woodbury 1937; Woodbury and Woodbury 1935) and from the notes of Dr. M.S. Goldstein and Dr. W.R. Maples (on file at the Texas Archeological Research Laboratory, The University of Texas at Austin). Dental data for 24 odontometric dimensions were recorded for the Mitchell Ridge sample. These measurements were compared to odontometric data for 44 Prehistoric and Historic females and 32 Prehistoric and Historic males (Aten 1965; J. Dockall unpublished data; Dockall 1987). A summary of site locations and proveniences, sample sizes, and dates for the comparative samples is beyond the scope of this volume. A more detailed

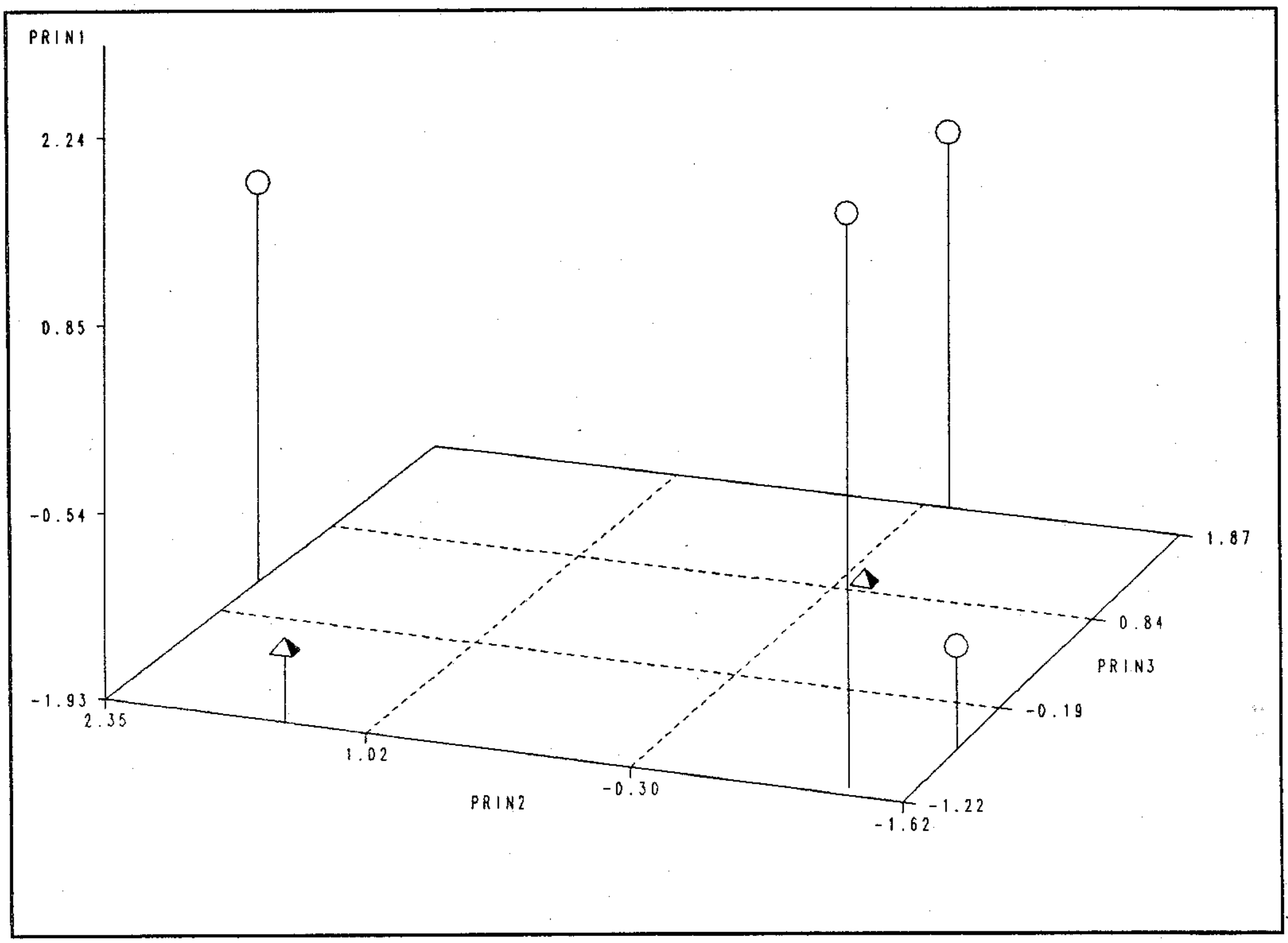

Figure 9.34. Principal component analysis of craniometric shape vectors for Mitchell Ridge males. Pyramids represent Historic burials, spheres represent Prehistoric burials.

presentation of the Mitchell Ridge and comparative samples is in preparation.

One problem in assessing morphological similarities derived from metric data is the effect of similarities in size compared to similarities derived from shape alone. Scaling effects were limited by first separating samples by sex, centering the matrices, and applying Q-mode correction of the data following Corruccini (1973). The Q-mode correction involves dividing each measurement in a case by the arithmetic average across all measurements for that particular case, and is similar to the geometric correction of Darroch and Mosimann (1985). The intra-site assessments of morphological similarity were made using a principal components analysis (PCA) of the shape vectors for each sex. Inter-site comparisons were obtained using a canonical discriminant function analysis. Each individual was assigned to one of five major geographic areas based on a presumably common cultural and biological history: Upper Coast, Lower Coast, East Texas, Central Texas, Mission Population (amalgamated coastal and central Texas), and West Texas. These *a priori* classes were entered into the canonical discriminant analysis, where the algorithm attempts to best summarize the differences between classes and partition them through a linear combination of the variables. The Mitchell Ridge individuals were not assigned to a particular geographic group, so that their positions among the regional samples could be better assessed. Since the principal components analysis is based on individuals rather than sample means, the inclusion of possible outliers (i.e., the early Historic materials) provides a means of assessing the within-group variability of the Mitchell

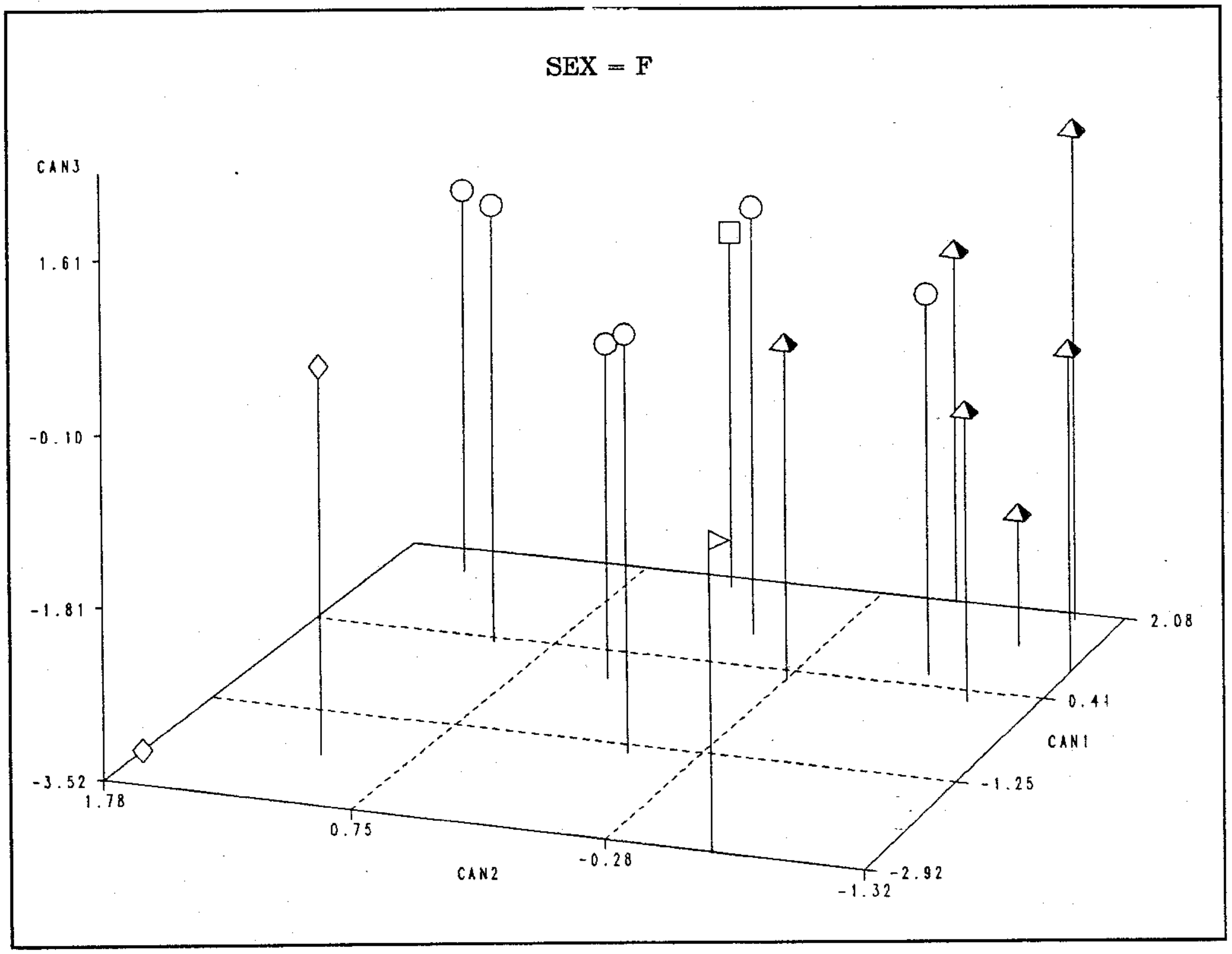

Figure 9.35. Canonical discriminant anlaysis of craniometric shape vectors for females, various areas in Texas. Pyramids= Mitchell Ridge; spheres= upper Texas coast; flags= lower Texas coast; Diamonds= central Texas; squares= east Texas.

Ridge collection compared to other Native American groups.

Discrete cranial and dental traits were also examined. Thirteen discrete cranial traits were collected for 29 individuals at Mitchell Ridge following the methods used by Comuzzie (1987). Discrete trait data for 138 individuals from five Late Prehistoric and Historic Texas populations were compiled from published literature (Comuzzie 1987; Dow 1987) and from the notes of Dr. M.S. Goldstein (on file at the Texas Archeological Research Laboratory, The University of Texas at Austin). A small subset of the comparative sample (n=10) was reanalyzed by the author in order to minimize the effects of inter-observer error. A final set of eight traits-- coronal ossicles, sagittal ossicles, lambdoidal ossicles, os inca, supraorbital notch, frontal notch, metopic suture, and parietal foramen-- was used to generate a Mean Measure of Divergence (MMD) statistic using the Tukey-Freeman transformation for small samples. Standard deviations of the MMD were generated and used for tests of significant divergence following Sjovold (1973): pair-wise divergences were significant at p=.05 when the MMD value was greater than or equal to twice the standard deviation. This essentially duplicates the methods used by Dow (1987). Values of the MMD were entered into a weighted pair-group clustering algorithm for final presentation. Dental discrete traits were not used for multivariate analyses, but were employed in assessments of gene flow and extra-regional morphological variation.

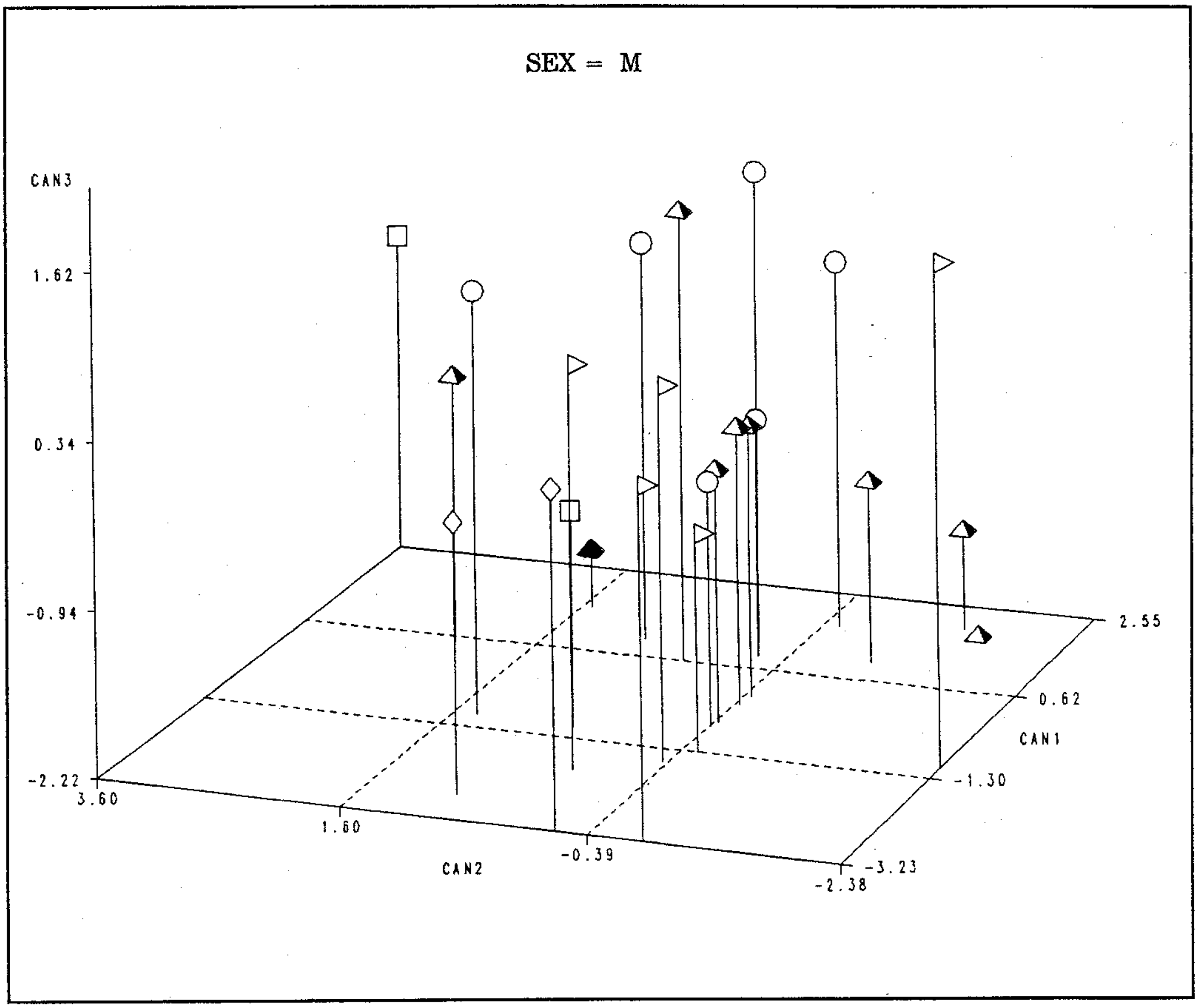

Figure 9.36. Canonical discriminant anlaysis of craniometric shape vectors for males, various areas in Texas. Pyramids = Mitchell Ridge; spheres = upper Texas coast; flags = lower Texas coast; diamonds = central Texas; squares = east Texas.

Metric Trait Analyses

Craniometric Results

Intrasite examinations of craniometric variability revealed that the Prehistoric and Protohistoric burials were morphologically dissimilar to Historic period individuals at the site. Figure 9.34 presents the PCA scores for male samples (females are not shown here) derived from six variables: maximum cranial length and breadth, mandibular symphysis height, biasterionic breadth, basion-frontal chord, and parietal chord. These variables maximized the number of fragmentary skulls that could be included in the analysis while providing a wide range of cranial and mandibular dimensions. The first three principal components represented 85.8 percent of cranial shape variance in males and 79.2 percent of cranial shape variance in females. Prehistoric males (spheres) differ from Historic males (pyramids) along the first principal component, which reflects the relatively large and robust mandibles and longer skulls of the Prehistoric

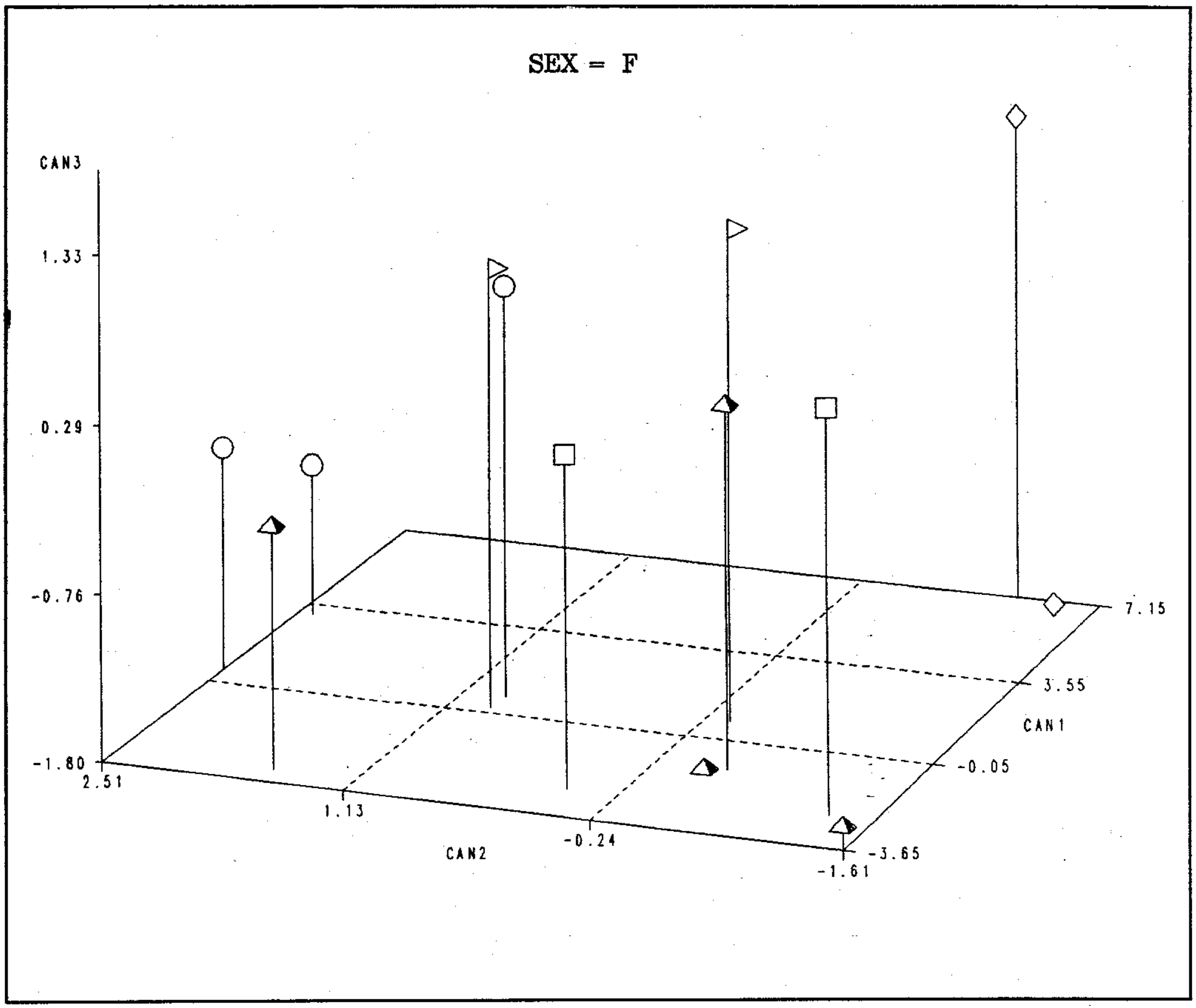

Figure 9.37. Canonical discriminant anlaysis of odontometric (buccolingual) shpae vectors for females, various Texas locales, areas. Pyramids = Mitchell Ridge, spheres = upper Texas coast; flags = lower Texas coast; diamonds = central Texas; squares = Mission San Juan Capistrano.

sample. Feature 65 (right side of Figure 9.34) falls closer to the Prehistoric groups than does Feature 64-4 (left side of Figure 9.34). Female data present a similar picture, with Features 61, 62-1, and 62-2 diverging from other females at the site.

Intersite craniometric analyses used a canonical discriminant analysis (CDA), which tends to minimize within-group variation and maximize between-group variation. Four groups were defined here by region. Upper coastal samples included the Caplen and Jamaica Beach skeletal series. Central Texas was represented by the Loeve-Fox site, east Texas by materials from sites near Lake Lavon, and the lower Texas coast by skulls from the Oso Creek site. Mitchell Ridge individuals were entered into the analysis as "unknowns," so that their relationship to other groups could be better understood. Male and female samples were analyzed using only six out of 61 cranial dimensions: maximum cranial length and breadth, orbital height and width, and mandibular corpus length and breadth. While limited, these variables represent the basic shape of the braincase, face, and jaw, and provide the largest number of individuals without missing values. Among the 168 individuals, only 16 females and 24 males were complete enough

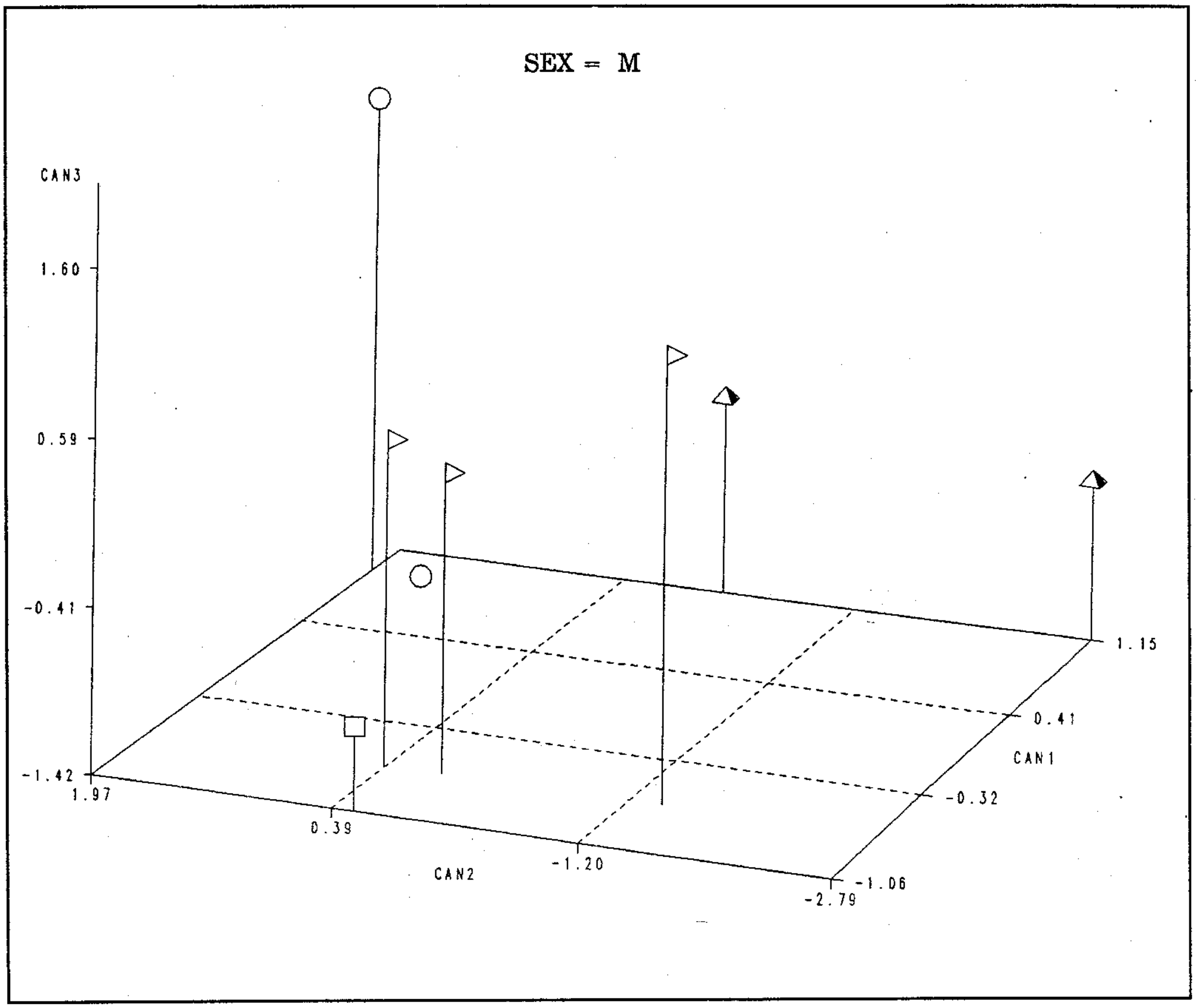

Figure 9.38. Canonical discriminant anlaysis of odontometric (buccolingual) shpae vectors for males, various Texas locales, areas. Pyramids = Mitchell Ridge, spheres = upper Texas coast; flags = lower Texas coast; diamonds = central Texas; squares = Mission San Juan Capistrano.

to include here.

Figure 9.35 displays the plot of the first three canonical variates for females, which accounts for 99.8 percent of female shape variance. The first variate reflects The Mitchell Ridge sample (pyramids), and clusters together nicely, and is closer to upper coastal (spheres) and east Texas (squares) samples than to lower coastal (flag) or central Texas (diamond) groups. This may be partially due to inadequacies in the latter two samples, or it may reflect a genuine morphological affinity between the upper coastal females and females at Mitchell Ridge.

Male samples exhibit greater heterogeneity and overlap (Figure 9.36). Males from Mitchell Ridge tend to be scattered among the upper (spheres) and lower coastal (flags) samples. Three Historic period males (far right pyramids, Figure 9.36) are distinguished by shorter cranial lengths and shorter mandibles (first canonical axis), though they too fall closer to Caplen and Jamaica Beach than to Oso Creek. Here, Feature 64-4 (shaded pyramid) is farther away from the main cluster of Mitchell Ridge males. A lone male from east Texas has maximum values for all three canonical variates (far left square in Figure 9.36), with the next closest male being Feature 64-4. Not surprisingly, both of these individuals exhibit fronto-occipital cranial modification which has placed them as outliers for male cranial shape.

Odontometric Results

Odontometric analyses proceeded in the same manner as the craniometric assessments, except that different comparative data were used. In this case, comparative samples were drawn from the lower coast, including Blue Bayou (41VT94), Palm Harbor (41AS80), and Oso Creek (41NU2), and a mission sample from San Juan Capistrano (41BX5). No upper coast data were complete enough for comparison because of significant dental attrition in most skeletal series. Of the 24 odontometric dimensions recorded, only buccolingual diameters of the upper and lower first molars, upper and lower canines, and lower first premolars were used for multivariate analyses. Buccolingual dimensions are better than mesiodistal dimensions for accurately reflecting tooth size and shape because they are not subject to interstitial wear.

Only 15 of 54 females and 9 of 41 males were included in the final analysis. Figure 9.37 presents the results of the CDA for buccolingual shape vectors among females. The first three components account for 98.7 percent of total variance in buccolingual dimensions. The first canonical axis represents the size of lower cheek teeth relative to canines, while the second and third axes reflect the contributions of canines and upper cheek teeth, respectively. The Prehistoric samples (Burials 3, 9, and 12) are separated from protohistoric and historic groups along the second canonical axis. One of the protohistoric females (Features 61) is an extreme outlier on all three canonical axes, and appears to represent a dentally divergent individual. Among Historic females, Feature 62-1 is most similar to Prehistoric females on the basis of canine dimensions, while the remainder of Historic females (Features 64-1, 62-1, and 92-2) are at the opposite extreme and more like females from San Juan Capistrano.

In males, the first three canonical axes account for 100 percent of buccolingual variance (Figure 9.38). The first axis represents the contributions of upper canines and lower premolars; the second axis represents contributions of upper versus lower cheek teeth, while the third axis represents the size of molars relative to anterior teeth. Again, the Prehistoric samples (spheres in Figure 9.38; Burial 10 and Feature 86) stand apart from others at Mitchell Ridge, by virtue of their large cheek teeth (axes 1 and 2). Historic samples (pyramids) include Feature 64-4 and 65, the latter being the most extreme outlier. None of the males at Mitchell Ridge tend toward lower coastal or mission populations.

Discrete Trait Comparisons

Because of the nature of discrete trait analysis, comparisons on an individual basis were not possible. However, cranial traits were compared with those from Late Prehistoric and early Historic populations from Texas. The Sanders (41LR2) and Hatchell-Mitchell (41BW3) series represent a total of 69 Caddoan agriculturalists from east Texas. The Loeve-Fox site (41WM230) provides a representative sample (n=20) of central Texas hunter-gatherers. The Caplen site (41GV1) represents an upper Texas coastal hunter-gatherer sample (n=22), and the Palm Harbor (41AS80) and Blue Bayou (41VT94) collections represents a combined total of 10 lower coastal hunter-gatherers. Finally, 12 burials from Mission San Juan Capistrano were used as an early Historic composite of native groups from central and coastal Texas. The samples from the Mitchell Ridge cemetery were divided into three groups to provide a better assessment of intra-group variation while maximizing sample size. All Protohistoric and Historic period burials were combined into an "Historic" group, while the Prehistoric burials from the 1970s excavations were denoted as "Prehist-TAS" (for Texas Archeological Society and other groups involved). All other Prehistoric burials are identified as "Prehistoric".

Table 9.36 presents the results of the MMD statistics. Because of the very small sample sizes and limited set of variables used here, the data should be interpreted with some caution. The Prehistoric and Historic populations at Mitchell Ridge appear to be similar to one another, though it is surprising that the MMD values for the 1970s burials indicate that this population is more like the Historic population than the other Prehistoric sample. However, differences within the site are not statistically significant. The only statistically significant difference in the seven cranial discrete traits was between the "Lower Coast" and Hatchell-Mitchell Caddo samples.

Figure 9.39 displays the results of clustering performed on the MMD data. Three clusters are formed for nine populations examined. First is a cluster of central Texas, Upper Coast, east Texas, and

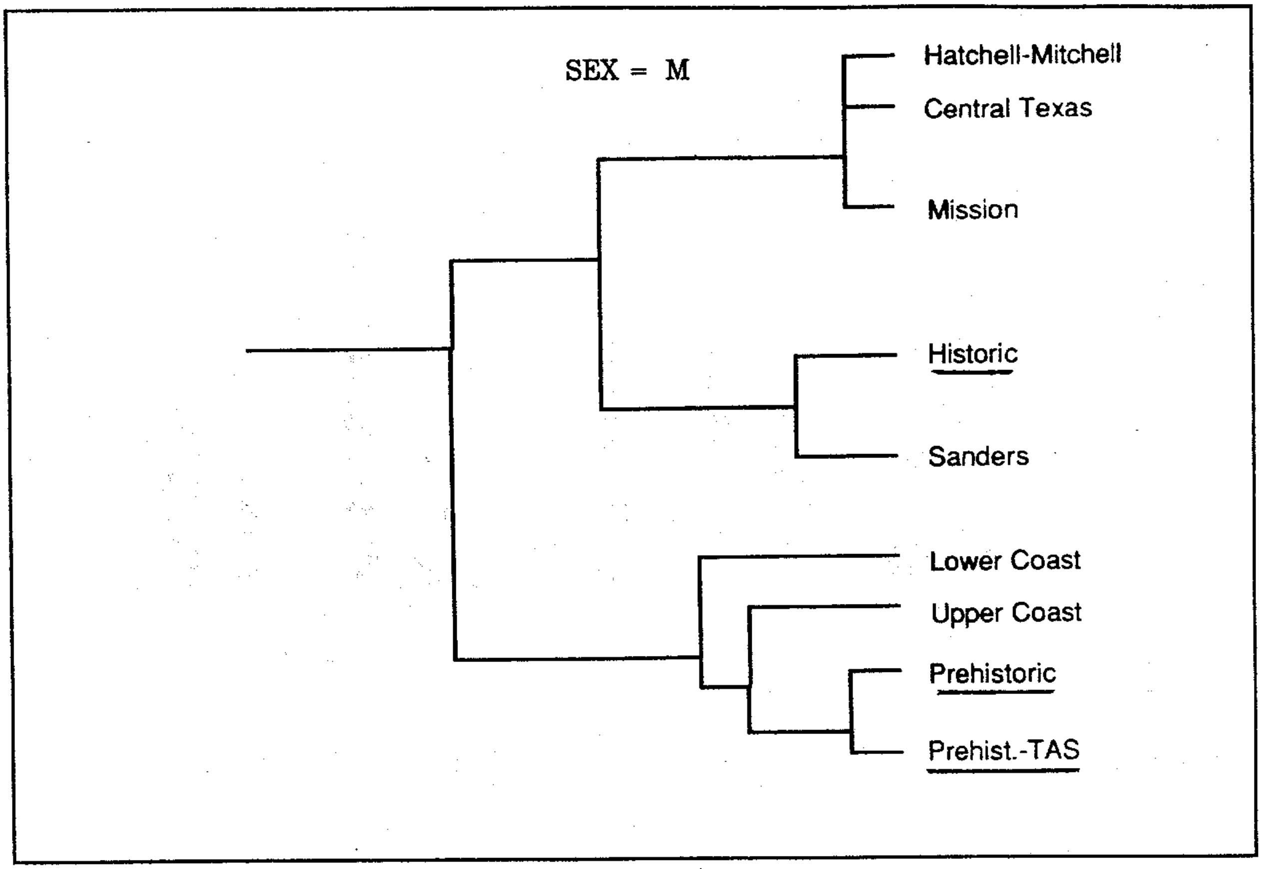

Figure 9.39. Unweighted pair group clustering of MMD scores for Texas aboriginal populations. Mitchell Ridge specimens (underlined) are divided according to major time periods (see text).

Mission populations. While this does not appear to make much sense, the results do conform to those of Dow (1987), who found the Hatchell-Mitchell to be more similar to the Loeve-Fox population than to individuals buried just a few miles away at the Sanders site. The placement of the Historic burials with the Sanders site reinforces results obtained for dental microwear, craniometric analyses, mortuary variability, and other studies. It appears that at least some Historic burials were morphologically (and possibly behaviorally) similar to Caddoan or perhaps other Southeastern agricultural populations.

Analyses of Genetic Admixture

Nasofacial Discriminant Functions

The nasofacial region is one of the best anatomical areas for determining general biological affinity (Gill 1986). Gill and coworkers (Gill 1984, 1986; Gill et al. 1988; Gill and Rhine 1990) have developed a metric technique for separating European "caucasians" from Native Americans using American whites and northwest Plains Native Americans as the basis for discriminant function coefficients. These coefficients were then applied to 125 American whites and 173 Native Americans (Arikara, Dakota, N.W. Plains, Omaha, Minnesota, Peru, Mimbres). Correct classification of Euro-Americans occurred in 84.8 to 88.8 percent of cases, while correct assignment of Native Americans occurred in 75 to 90.3 percent of cases. The technique is more accurate in females than in males (Gill et al. 1988:97).

The methods of Gill et al. (1988) were applied to the Mitchell Ridge sample only in cases where the nasal and maxillary regions were well preserved and in articulation (n = 11). Discriminant scores were

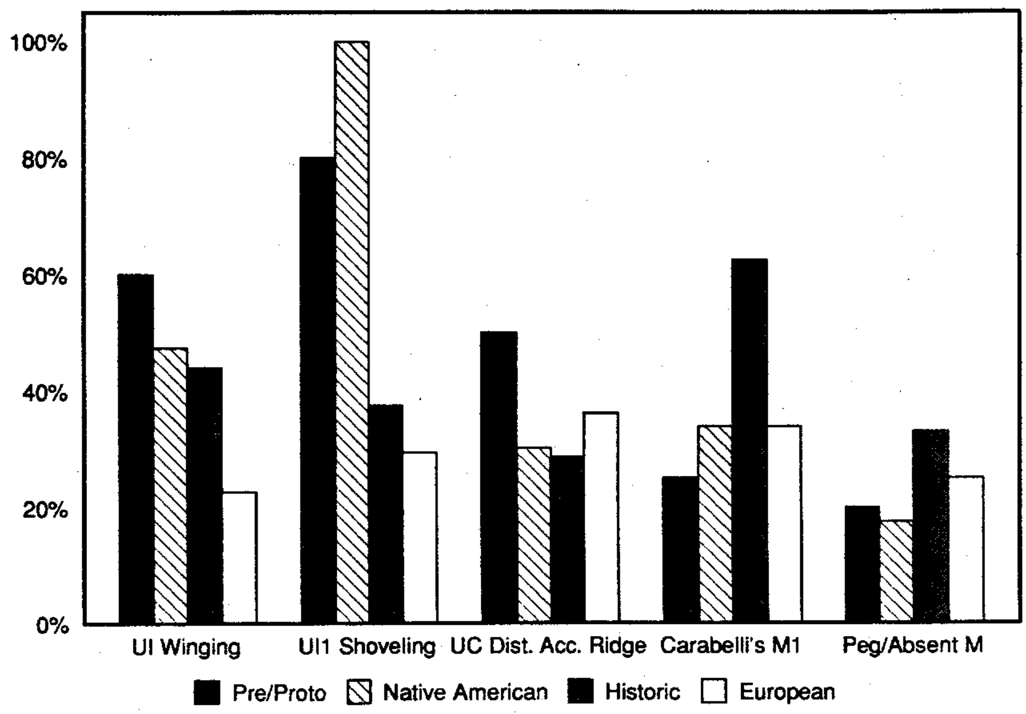

Figure 9.40. Dental discrete trait frequencies for Prehistoric and Historic Mitchell Ridge, Native Americans, and Europeans (data from Turner 1985).

generated for the alpha, maxillo-frontal, and zygo-orbital indices, with the best two of three indices used to assign an individual to either Native American or European category. Individual values for these indices were cross-plotted to show relationships among the samples.

Craniofacial Discriminant Functions

Giles and Elliot (1962) also presented craniometric discriminant function techniques for assigning unknown individuals to either European, African, or native American populations. Their technique is based on cadaveral samples and on a limited number of prehistoric Native American crania. Unfortunately, because of sample limits, the Giles and Elliot technique tends to misclassify Native Americans in many cases. This method, though flawed, does offer the advantage of greater objectivity compared to non-quantitative assessments of cranial shape (see 1.2.3 below). Given these limitations, craniometric data for each complete Mitchell Ridge cranium (n=8) were entered into the Giles and Elliot formulae as a means of confirming assignments derived from the Gill et al. (1988) method.

Dental Discrete Traits

Dental discrete traits provided a measure of similarity between the Prehistoric and Historic individuals at Mitchell Ridge and other modern populations. Typically, native Americans have a greater frequency of upper central incisor (UI1) winging and shoveling compared to Europeans, and a lesser frequency of traits such as upper canine distal accessory ridge, Carabelli's cusp on the upper first molars, and peg or congenitally absent molars (Dahlberg 1963; Turner 1985). Figure 9.40 displays the frequency of the five diagnostic dental traits in the Mitchell Ridge Prehistoric and Protohistoric sample (n=11), Mitchell Ridge Historic (n=7), Prehistoric native North Americans, and modern northwest European populations. Comparative data were obtained from Turner (1985).

In many instances, the difference between Prehistoric and Historic burials follows the pattern of differences noted between Native American and European samples (Figure 9.40). For example, Native Americans have a higher frequency of winging and shoveling than do Europeans; likewise, the Prehistoric sample has a higher frequency of winging and shoveling than does the Historic sample. These data indicate that Historic individuals at the Mitchell Ridge site, as a group, appear more similar to Europeans than to modern native Americans.

Subjective Criteria

Finally, traditional subjective assessments of craniofacial shape were conducted using a trait list compiled from Gill (1984), Brues (1990), and Gill and Rhine (1990). Many of the traits listed in Table 9.39 have a continuous range of variation, making them extremely difficult to classify. Furthermore, no single population from a geographic area can be said to have all of the traits typical of that region, and individuals within a population can express a wide variety of trait forms. However, there is a general trend for individuals from a particular region to express a greater number of traits typical of that region. Each of the Mitchell Ridge burials was scored for all 23 traits listed in Table 9.37. However, greater weight was given to craniofacial features whose frequency of expression is known to separate modern humans in 70 to 80% of cases: nasal profile, nasal sill, nasal bridge, zygoorbital suture form, and the expression of the oval window of the auditory meatus. Each of these traits was counted twice if present, for a possible score of 28. The total score for Asian (i.e., Native American, East Asian, and Polynesian) traits was divided by the total possible score to produce a frequency of Asian traits. Individuals with fewer than 65% Asian traits were assigned to the group with the next greatest frequency of features observed.

Best Estimates of Biological Affinity

After completing the quantitative and subjective assessments, a preliminary best estimate of biological affinity was produced for each individual (Table 9.38). Greatest weight was give to nasofacial shape and cranial shape, with the least emphasis on subjective scoring. Burial were then separated into prehistoric, protohistoric, and historic groups for final interpretation and final assessment of biological affinity.

Results of the nasofacial indices are presented in Figures 9.41 and 9.42. The solid boxes in the lower left corners represent the area occupied by Native Americans. In Figure 9.41, a significant number of individuals are outside the Native American cut-off point for the maxillo-frontal index, while only two (Features 61 and 64-4) are in the European range for the Alpha Index. In Figure 9.42, only burials Features 61, 87 and 64-4 are outside the Native American range of values for the zygo-orbital index. However, one individual (Features 61 and 65) falls near the cut-off point for this index. Many of the Prehistoric specimens (Features 62-2, 52, and 86) are clearly grouped in the Native American range, while the protohistoric and historic specimens are more widely distributed across each graph. Ignoring the temporal provenience of specimens, there is considerable nasofacial heterogeneity in this sample.

The Giles and Elliot (1962) discriminant values should be viewed with greater caution, given the problems inherent in this technique. Instead of using the method as an absolute assignment, I chose to use it to discern tendencies among the Mitchell Ridge burials. Among the males (Figure 9.43), prehistoric specimens (Features 52 and 86) tend more toward Africans in cranial shape (see discussion, below), while the protohistoric and historic individuals (Features 64-4, and 65) tend to be more like Europeans. These data generally conform to those for nasofacial indices. Results for the Protohistoric/Early Historic females (Figure 9.44) indicate that Features 61 and 62-2 tend more toward Europeans than does Feature 92-1, again supporting the nasofacial plots (Figures 9.41 and 9.42).

All of the individuals buried at the Mitchell Ridge site have at least some structural features indicative of Native American ancestry. Most exhibit modest to marked incisor shoveling, a trait rarely expressed in Europeans (Dahlberg 1963; Gill 1986; Turner 1990). However, each individual also expresses some traits typical of Europeans or Africans. Most common are a wide, "guttered" nasal aperture and alveolar prognathism (see Table 9.39), features typically associated with African populations. *This is not to say that these individuals are of African descent*; instead, it is more likely that upper coastal and African populations express these features because of similar environmental conditions (hot, humid, subtropical

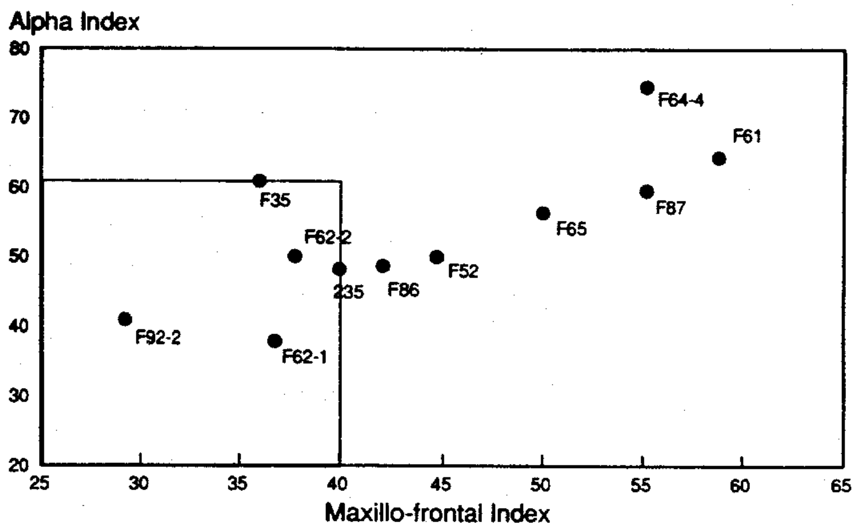

Figure 9.41. Alpha and maxillo-frontal indices for the Mitchell Ridge (41GV66) sample, based on methods of Gill et al. 1988.

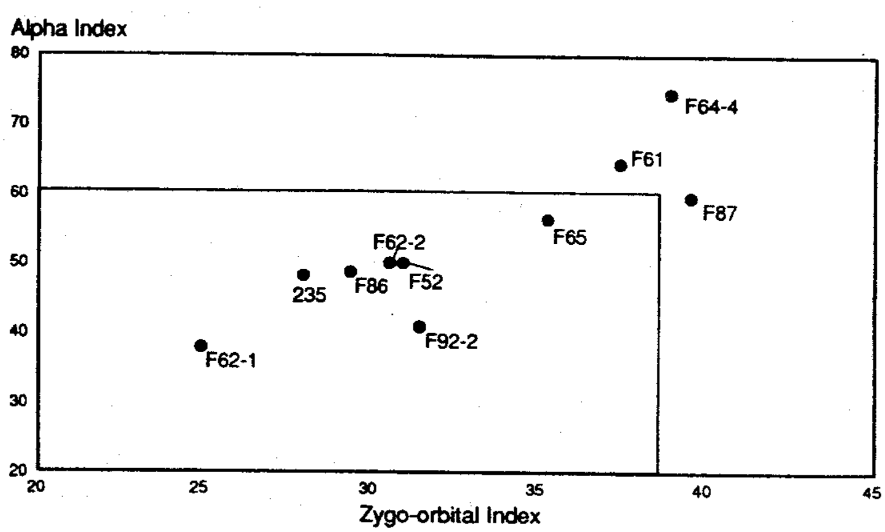

Figure 9.42. Alpha and zygo-orbital indices for the Mitchell Ridge (41GV66) sample, based on methods of Gill et al. 1988.

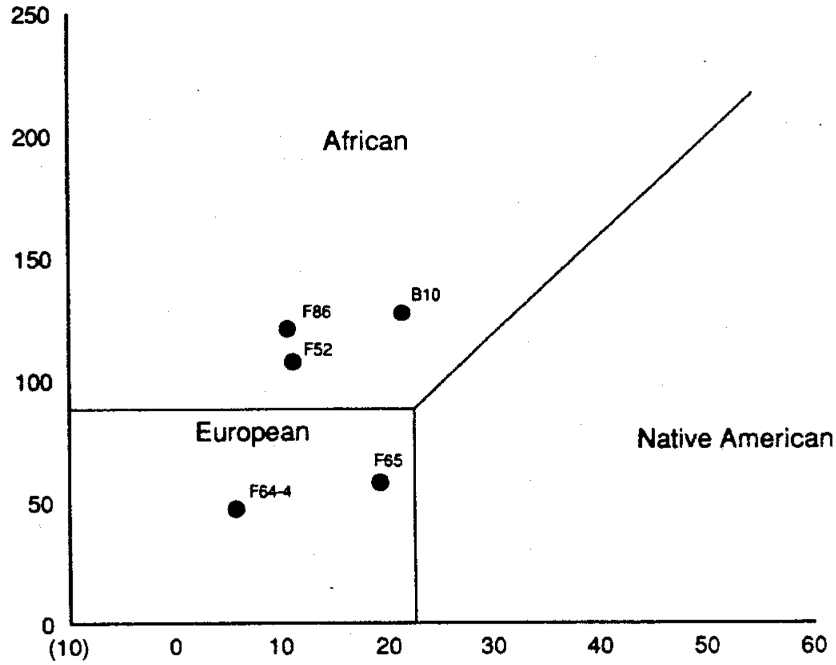

Figure 9.43. Giles and Elliot (1992) discriminant functions for male cranial shape for the Mitchell Ridge (41GV66) sample.

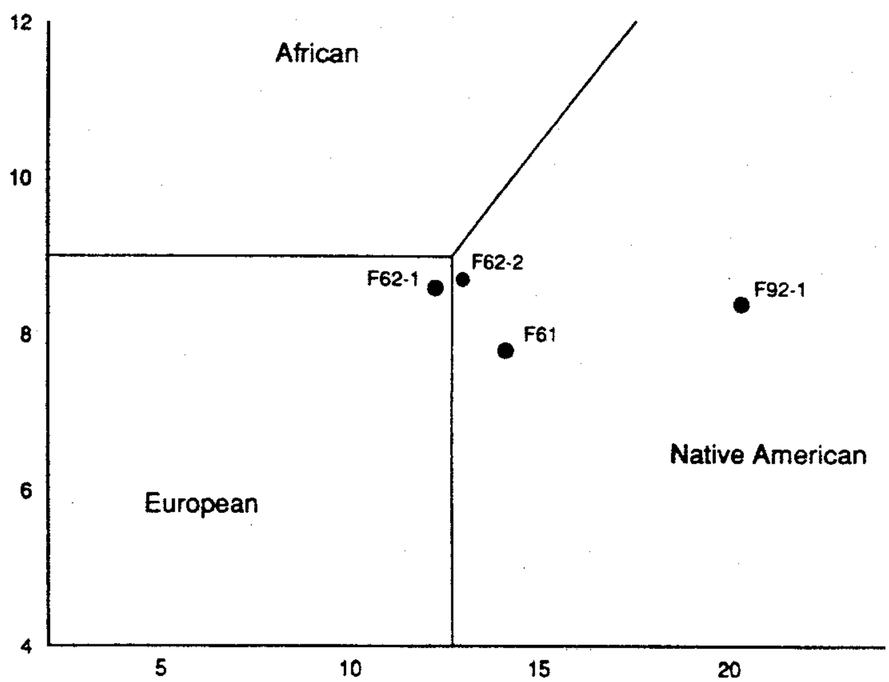

Figure 9.44. Giles and Elliot (1992) discriminant functions for female cranial shape for the Mitchell Ridge (41GV66) sample.

Table 9.37. Craniofacial characteristics of major geographic populations (after Gill 1984).

Character	East Asian	Native American	European	Polynesian	African
Cranial Form	broad	medium-broad	medium	highly variable	long
Sagittal Outline	high, globular	medium-low sloping frontal	high, rounded	medium	highly variable post-bregmatic depression
Nose Form	medium	medium	narrow	medium	broad
Nasal Bone Size	small	medium/large	large	medium	medium/small
Nasal Profile	concave	concavo-convex	straight	concave/concavo-convex	straight to concave
Nasal Spine	medium	medium, tilted	prominent, straight	highly variable	reduced
Nasal Sill	medium	medium	sharp	dull/absent	dull, absent
Nasal Bridge	straight-sided "tent shaped"	straight-sided "tent shaped"	pinched "steeple"	straight-sided "tent shaped"	low, curved "quonset hut"
Mid-facial Prognathism	moderate	moderate	reduced	moderate	extreme
Alveolar Prognathism	moderate	moderate	reduced	moderate	extreme
Malar Form	projecting	projecting	reduced/receeding curvate	reduced/receeding curvate	reduced curvate

Table 9.37, cont.

Character	East Asian	Native American	European	Polynesian	African
Zygomaxillary Suture Form	angled	angled	non-angled	non-angled	non-angled,
Orbital Form	round	rhomboid	rhomboid	rhomboid	round
Mandible	robust	robust	medium	robust rocker form	gracile oblique gonial
Chin Projection	moderate	moderate	prominent	moderate	reduced
Chin Form	median	median	bilateral	median	median
Incisor Form	strong shovel	moderate/strong shovel	spatulate	weak shovel	spatulate to weak shovel
Carabelli's Cusp	absent	absent	present	absent	absent
Dental Crowding	absent	absent	present	absent	absent
Palatal Form	parabolic/ elliptical	elliptical	parabolic (triangular)	parabolic/ elliptical	hyperbolic (parallel sides)
Palatal Suture	sharp angles at midline	straight	sharp angles at midline	highly variable	rounded at midline
Mastoid Form	wide	wide	narrow, pointed	wide	oblique with tubercle
Oval Window	Unobservable	Unobservable	Observed	Observed	Observed

Table 9.38. Summary of Biological Affinity Data for Mitchell Ridge Burials.

Feature	Sex[1]	Naso-facial Shape[2] (Gill et al. 1988)	Cranial Shape[3] (Giles and Elliot)	Subjective Scoring[4] (Gill 1984)	Best Estimate[5]
F25	M	---	---	Native American	**Native American**
F30	F	---	---	Native American	**Native American?**
F35	F	Native American	---	Native American	**Native American**
F52	M	Native American	Native American	Native American	**Native American**
F61	F	European	Native American	European/Native American	**Possibly Admixed European-Native American**
F62-1	F	Native American	European?	Native American	**Native American**
F62-2	F?	Native American	European	Native American	**Atypical Coastal Native American**
F63	M	---	---	Native American	**Native American**
F64-4	M	European	European	European/Native American	**Possibly Admixed European-Native American**

Table 9.38, cont.

Feature	Sex[1]	Naso-facial Shape[2] (Gill et al. 1988)	Cranial Shape[3] (Giles and Elliot)	Subjective Scoring[4] (Gill 1984)	Best Estimate[5]
F65	M	Native American	Native American	Native American	**Native American**
F83	I	---	---	Native American	**Native American**
F86	M	Native American	African	Native American/ African	**Atypical Coastal Native American**
F87	M	European	---	Native American/ European	**Atypical Coastal Native American**
F92-1	F	Native American	Native American	Native American	**Native American**
235-A	F	---	---	Native American	**Native American**
235-B	F	Native American	---	Native American	**Native American**

1: Sex assessments based on craniometric discriminant functions. Assessment may not match other sexing criteria.
2: Assessments listed here based on best two of three discriminant function results.
3: Determined using Americans of African and European descent, and prehistoric Plains Native Americans.
4: Based on 28 scorable nonmetric features. Individuals with duel affinity are those with more than 35% non-Native American features.
5: Estimates take into account date of specimen, accuracy of discriminant functions, and variation in Texas coastal populations

to tropical environment). It also reflects the fact that these features are expressed in varying frequency among geographic groups and are not strictly present or absent for all members of a particular region.

Figure 9.45 presents the frequency of Asian structural features in all adult individuals. Four individuals (Features 86, 87, 64-4, and 61) are atypical of Native Americans, in the most extreme case with only 37% Asian features (Feature 61). For Features 61 and 64-4, the degree of trait expression and overall constellation of craniofacial features suggests individuals of mixed Native American-European descent, which corresponds to the quantitative assessments presented above.

Table 9.38 presents the results of the nasofacial, craniofacial, and structural assessments for each individual. Based on these results, and given the temporal provenience of each specimen, individuals were assigned to either a Native American, atypical Native American, or admixed status. Features 86 and 87, both dated to the Late Prehistoric period, have craniofacial features that are not typical of upper coastal populations. Features 61 and 64-4 tend to be extremely European in many, if not most, cranial and facial dimensions or traits and were assigned to the admixed category based on their relatively late radiocarbon dates.

Population Dynamics on the Upper Texas Coast

The assessment of general biological affinity in the Mitchell Ridge sample is extremely difficult, give the lack of population-specificity of quantitative methods, the lack of comparative data on variation in other upper coastal populations, and the need for a better understanding (or clarification of our *misunderstanding*) of human variation in general. However, there are some curious patterns which arise from these individuals. The data can now be applied to the two hypotheses presented at the beginning of this chapter.

The individuals at Mitchell Ridge are a biologically homogeneous group. This hypothesis can be rejected based on both the multivariate analyses and the subjective assessments. Ignoring the temporal assignment of individuals, this sample is extremely heterogeneous and appears to exceed the range of variation of typical breeding populations on the upper Texas coast. Even when viewed in synchronic units, there is much more phenotypic heterogeneity than one would expect. Each of the three burial groups included individuals which are atypical of upper Texas coastal populations. In the Prehistoric sample, Feature 87 is unusual, with a robust browridge, massive zygomatics, pronounced prognathism, and nasal and palatal features more typical of Africans than Native Americans. In the Protohistoric group, differences are even more pronounced. Feature 92-1 is typical of the variation in prehistoric upper Texas coast individuals (robust, mesocranic, with typical Amerindian cranial and facial features), while Feature 61 is extremely gracile and more typical of Europeans than of Native Americans. Among the Historic burials, Feature 64-4 stands out as atypical both in craniofacial shape and in the fronto-occipital cranial modification exhibited. Discrete traits of the skull and teeth also reveal that Prehistoric populations are more like local Native American groups than are the Historic samples.

Metric analyses suggest that some of the Historic Period individuals are more similar to more gracile non-coastal populations than to samples such as Palm Harbor (41AS80) or Oso Creek (41NU2). Female samples tend more toward upper coastal groups than lower coastal groups, although this also reflect temporal trends among the comparative samples. Males, both dentally and craniometrically, exhibit a wider range of variation than females. In all of the multivariate analyses, Historic males and females are unlike Prehistoric individuals in cranial and dental shape.

There is evidence for admixture with non-Native American populations during the protohistoric or historic periods. Here the hypothesis can be accepted. Of the two most variable and atypical individuals, one is from the Protohistoric or possibly early Historic (Feature 61) and one is from the Historic period (Feature 64-4). Both have biological and cultural traits suggesting Native American ancestry. However, both tend to appear more like Europeans than Native Americans in nasofacial, craniofacial, structural morphology. Both express dental and cranial features of Europeans (dental crowding, molar reduction, Carabelli's trait, pinched nasals, narrow nasal apertures, triangular palates, etc.). Furthermore, the lack of macroscopic dental attrition in these individuals is atypical of the excessive wear typical of Texas coastal populations, and would suggest a softer diet. Similar data on skeletal morphology were obtained by Gill (1976) for a Historic female skeleton from the Plains. Gill also concluded that the presence of both Native American and European traits in a single individual represented the effects of gene flow from Europeans to Native Americans.

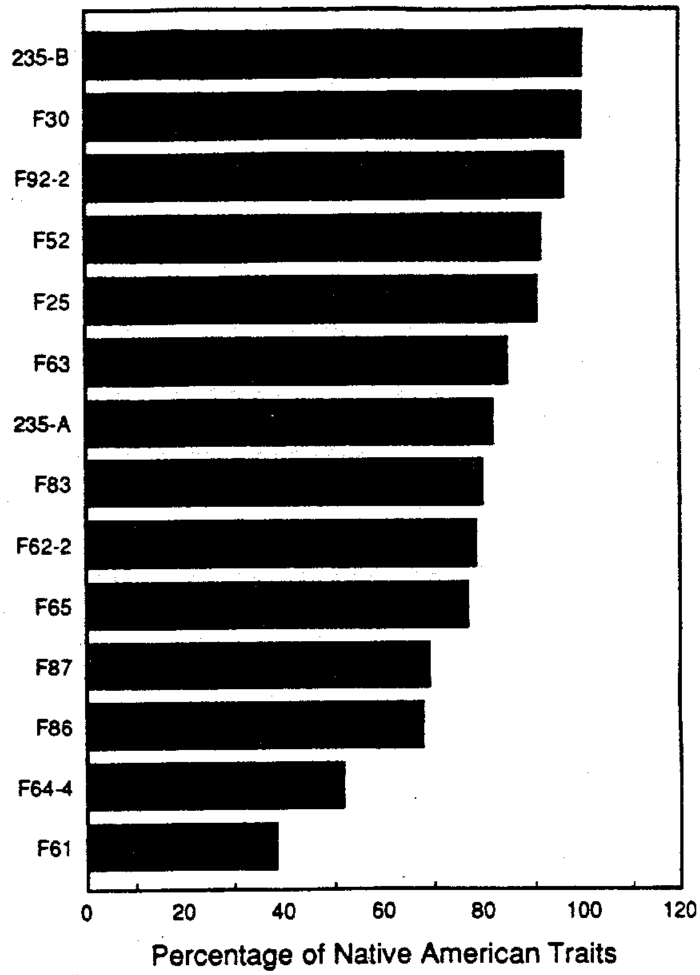

Figure 9.45. Frequency of Asian structural features in Mitchell Ridge sample. Burials F. 35 and 62-1 are not shown.

Given these data, it is likely that Feature 64-4 and F61 represent Native Americans who traced some part of their genotype to Europeans and may have had a diet more similar to Europeans. Other individuals from the protohistoric and historic periods, such as F65, F62-1 and F62-2, also exhibit European traits or tend to be like Europeans in some aspects of cranial and nasal morphology. As early as 1528, Cabeza de Vaca and other survivors of the Naváez expedition were living for extended periods with upper coastal groups. It is unlikely that no interbreeding occurred between European males and native females given the nature and record of Spanish and French exploration in other areas of North America (Gregory 1973; Jeter 1989). By 1685, the French had established a small outpost which increased the likelihood of gene flow. In 1687 or 1688 one of LaSalle's men, Sieur de Barbier, married a native Karankawa woman (Day 1971:82). During the Early Historic period in the Lower Mississippi Valley, French traders lived with (Jeter 1989:239) and married into Indian families, thus solidifying trading relationships (Gregory 1973:282ff). These events suggest that gene flow, primarily from Europeans to native coastal populations, was quite possible if not probable during the early eighteenth century.

Conclusions and Interpretations

Life on the Upper Texas Coast

The following discussion focuses on interpretations of the results obtained for paleodemography, biological variability, health, and diet of the Mitchell Ridge population.

Paleodemography

The data suggest that during the seventeenth and eighteenth centuries there were changes taking place in the composition of those interred at Mitchell Ridge. This may or may not reflect changes in the living population. The shift from an abundance of older males and adolescents to a relatively more "normal" demographic profile are suspicious. The presence of multiple interments, and the increased rate of cemetery use, combined with evidence for a greater number of deaths from acute causes (i.e., skeletons without lesions) suggest that the decreases in mean age-at-death reflect increased mortality, perhaps from the effects of acute disease.

Several key lines of evidence point to instability in population structure during the eighteenth century. The mean age of death decreases significantly, while the proportion of juvenile deaths increases. Multiple interments in the same feature increase, and the number of burials per unit time increases as well. The proportion of individuals affected by skeletal lesions decreases through time, which may have resulted from an increase in acute, virulent disease (and subsequent increase in mortality). While the changes in mean age at death are suggestive of increased fertility rather than increased mortality, shifts in juvenile mortality do not substantiate this conclusion.

Less objective support for an increase in mortality comes from the nature of Historic burial features themselves. For example, the age-sex composition of individuals interred in Feature 64, and the taphonomic evidence for differing states of decay among them, is suggestive of a massive mortality episode. These individuals may represent a family or other social unit who died over a short period of time and were interred together. Features 62-1 and 62-2 were also interred together in a period of less than eight months, and are also probably closely related, given their nearly identical craniofacial morphology. While speculative, these data also lend support to an inference of increased mortality.

However, while mortality was likely one of the factors contributing to the demographic structure of the Historic burials at the site, it is not the only factor to be considered. Population amalgamation, in response to drastic declines in population size, has been documented among Native American groups in the region:

> In the early 19th-century period, we see territorial pressures of three basically different sorts working on the upper Texas coast. First, there was the general southward movement of the Tonkawa and possibly other bands, that had its most severe impact west of Galveston Bay; second, there was increasing pressure in east Texas from migrant Indian groups and individuals fleeing the eastern United States long before the U.S. Congress had set Indian removal policy in 1830...; and third, there was the most severe pressure of all emanating from within the area as a result of the establishment of Anglo settlers in the new colonies. These factors of territorial pressure working in concert with another major factor--decimation of native populations by infectious diseases-- essentially eliminated the territorial structure of the protohistoric period... (Aten 1979:86-87).

The data from Mitchell Ridge substantiate the effects of population amalgamation; supporting data are discussed below under the heading "Biological Affinity". In general, Historic individuals at the site are biologically distinct from earlier burials at the site. Furthermore, aspects of their behavior (i.e., intentional cranial modification and the use of extended burials) indicate a cultural affinity with populations in the Lower Mississippi Valley and/or Caddoan areas (Jeter 1989) rather than natives of the upper Texas coast. Obviously, the presence of migrants would have dramatically affected the demographic structure of the population living on the island, and would have produced an unstable population structure. Regardless of whether mortality, fertility, or population aggregation were the major factor, the demographic data from Mitchell Ridge point toward significant changes in population structure and stability during the early eighteenth century.

Health

As noted earlier, the interpretation of skeletal lesions as a reflection of the health and well-being of a prehistoric population is hampered by a number of methodological and theoretical factors. Furthermore, the small size of the Mitchell Ridge skeletal sample contributes to these problems, especially when considering differences between early and late samples. The following discussion will focus on alternative explanations for the patterns observed.

Several skeletal disorders do not appear to be related to an increased or decreased risk of death and offer a rather straight-forward interpretation. In the Late Prehistoric sample at Mitchell Ridge, individuals appear to have the same types of problems found in other hunter-gatherer groups. Prehistoric trauma appears to be activity-related, occurring primarily in the hands and feet. The frequency of trauma among the Late Prehistoric burials at Mitchell Ridge is comparable to that of other upper coastal Prehistoric groups, and is slightly higher than that of central coastal populations. The presence of an arrow wound suggests that a least one Late Prehistoric individual experienced interpersonal violence. By the Historic period, the frequency of trauma increases dramatically. While the hands and feet are still commonly affected, the upper body and vertebrae also become involved.

One explanation for this change in frequency and patterning of trauma is that Historic period trauma represents an increase in violence from levels experienced during the Prehistoric period. Vertebral and upper body fractures, especially those to the ribs, might have been sustained during interpersonal conflicts in which participants were struck in the head, upper arms, or back. The alternative explanation is that a fundamental change in activities took place, in which the risk of fracture increased for the bones of the upper body. Increased functional loads on bones of the shoulder girdle and back (from activities such as strenuous pulling or lifting) could result in increased risk of trauma due to stress (fatigue) fractures. Stress fractures occur when bone is exposed to repeated microtrauma through repetitive, strenuous activities (Merbs 1989:168-169); the longer the bone experiences increased functional load, the more likely it is to eventually fail. Spondylolysis of vertebrae is also associated with stress fracturing, and is common among hunter-gatherers whose activities and postures combine to increase stress on the lower back (Merbs 1989:170). Furthermore, there is no direct evidence of interpersonal violence in the Historic sample-- no arrow wounds, blunt trauma, or parry fractures-- while two to three Prehistoric individuals had both sharp and blunt traumas. Historic period males and females are equally affected by fracture, as are some children, which is not consistent with the age-sex distribution of trauma from interpersonal violence.

Data on degenerative disease provide additional support to the argument that activity patterns changed from the Late Prehistoric to Historic periods. The frequency of degenerative joint disease and vertebral osteophytosis decrease slightly from Prehistoric to Historic, although this is probably an artifact due to differences in the age-at-death profiles of the two groups. When age differences are accounted for, the individuals in the Historic sample experienced degenerative lesions at a much earlier age, and with somewhat greater severity than persons during the Late Prehistoric.

Cranial modification was evident in Prehistoric and Historic period skeletons. Most cases are attributable to unintentional modification of the skull resulting from infant cradleboarding. Most individuals with lambdoidal flattening are female (only one Prehistoric male was affected), and have associated non-focal lytic lesions. Holliday (1992) advanced the notion that similar lesions in an agricultural population from New Mexico represent untreated scalp infections among cradleboarded infants. The etiology of such an infection is unknown, but plausible explanations include skin abrasion (chafing), vascular damage to the scalp, and infected bites from lice, fleas, or mites. One Historic male (Feature 64-4), on the other hand, exhibits intentional fronto-occipital deformation. This individual is morphologically atypical of Texas coastal males and appears to represent to have been culturally and biologically unrelated to the Prehistoric individuals at the site.

Lesions related to abnormal bone loss and hematological disorders are more difficult to interpret. Cribra orbitalia has an equal frequency in Prehistoric and Historic burials, although the number of individuals with active lesions increases through time. The frequency of lesions at Mitchell Ridge is greater than for Prehistoric burials at other sites except Caplen (41GV1) (Table 9.21). Within Mitchell Ridge, lesions attributed to porotic hyperostosis appear to decrease through time, but again both the Historic and

Prehistoric individuals at the site are more frequently affected than those from other coastal populations (Table 9.22).

The traditional view of lesion frequency is that individuals with lesions were in ill health, and therefore at greater risk for death. This viewpoint would interpret the data from Mitchell Ridge as indicating progressively better health through time, since the frequency of hematological and proliferative lesions decreases. An alternative view is that individuals with lesions represent the healthier segment of the population, since they lived long enough to fight off infection and the factors contributing to lesion formation. According to this scenario, Historic individuals at Mitchell Ridge were in worse health and died at an earlier age than persons living in the Late Prehistoric. This interpretation is supported by the mean age at death of the total samples (Prehistoric = 28 years; Historic = 20 years), and by differences in mean age-at-death (MAAD) between individuals with and without hematological lesions. For example, the difference in MAAD (calculated as MAAD of affected - MAAD of unaffected) is 4.7 years for the Late Prehistoric sample and 1.7 years in the combined Protohistoric/Historic sample, which suggests that at this site, individuals with hematological lesions lived longer than those without lesions. The demographic and paleopathological profile of Historic burials is similar to what would be expected of populations experiencing acute disease. Individuals die at earlier ages, but their skeletons are unaffected by disease.

The cause of hematological disorders can not be determined from this sample, but several possible factors can be eliminated. The frequency of porotic and cribrotic lesions at Mitchell Ridge is high compared to other hunter-gatherers, but is similar to rates derived from Mississippian populations (Eisenberg 1991). Walker (1986), in examining a coastal population in California, ruled out diet-induced anemia since the levels of iron in the marine-based diet of his sample would have been adequate. He postulates that other factors, such as parasitic infections, food preparation techniques, and chronic infections, figure prominently. These factors are typically found among populations affected by increasing sedentism and population aggregation.

Infectious disease appears to follow the same pattern as anemic response. Proliferative lesions decrease through time, perhaps reflecting the inability of Historic groups to rally from infection (Ortner 1991). Prehistoric populations were affected by treponemal disease, or a pathogen that produced similar osseous lesions. Previous research by Powell (1989:109-112) and Jackson et al. (1986) indicates that the treponeme affecting Texas coastal groups was similar to Yaws, a disease common to tropical and subtropical areas.

The paleopathological data all point to a change in the health of the Mitchell Ridge population during the time spanned by the cemeteries. Following the new model of lesion interpretation offered by Wood et al. (1992), Ortner (1991), Eisenberg (1991), and others, Prehistoric populations at Mitchell Ridge may have been better able to rally from bouts of infection and anemia compared to their Historic descendants. This interpretation is consistent with the demographic data and with the ethnohistoric evidence for rapid population decline in the Galveston Bay area during the eighteenth century (Aten 1983).

Biological Affinity

Based on the data presented here, several preliminary statements on biological affinities of the Mitchell Ridge sample can be supported. First, there is no statistically significant secular trend in body dimensions, although in most instances male dimensions increase slightly and female dimensions decrease slightly through time. This holds true for cranial and dental variables, as well as for some infracranial metric traits. Larger samples may provide greater statistical power in determining the direction, if any, in body size through time. Considerable sexual dimorphism in cranial, dental, and infracranial dimensions is present at Mitchell Ridge, but the samples are insufficient to determine if dimorphism changed through time. Sexual dimorphism in stature is much greater in the pooled Mitchell Ridge sample than in any other sample in Texas, but within the normal human range of 104 to 111 percent (Stini 1985). If the changes in cranial, dental, and infracranial size do represent increasing size divergence between sexes, then sexual dimorphism probably increased during the Historic Period. Similar patterns noted for pre- to post-contact coastal populations in Georgia were attributed to differences between sexes in activity patterns and in access to protein following the introduction of agriculture in the region (Larsen 1987).

A second point is that there is both diachronic and synchronic variability in craniofacial form, suggesting that either a) two or more human populations were depositing their dead at the site as early as the Late Prehistoric period or b) upper Texas coastal populations are more variable than previously documented (Wilkinson 1973, 1977; Woodbury and Woodbury 1938). Having made a subjective examination of over 100 crania from the upper and central coast, and presuming that between-group variation normally exceeds within-group variation, it appears that several biologically and/or morphologically distinct human populations were depositing their dead in the Mitchell Ridge cemetery.

Finally, it appears that during the protohistoric and historic periods, individuals were buried in the cemetery who were either non-coastal Native Americans, individuals of mixed Native American and European ancestry, or both. This finding is consistent with seventeenth and eighteenth century descriptions of Native American population amalgamation and European gene flow (Aten 1979, 1983a; Day 1971; Gregory 1973; Jeter 1989; Newcomb 1983). Numerous individuals exhibit some European dental traits such as Carabelli's cusp and dental reduction, while others tend toward Europeans in their quantitative and qualitative craniofacial features. At least two individuals (Features 61 and 64-4) are clearly within the range for Europeans. These data suggest that the population or populations burying their dead at Mitchell Ridge were not typical of other groups along the Texas Coast, and that such heterogeneity only increased during the process of European colonization and acculturation.

Diet, Nutrition, and Food Preparation

Three main dental variables-- physiological disturbance, infection, and dental attrition-- provide considerable information on the diet and nutritional health of the population burying its dead at the site. Enamel hypoplasias are typically associated with some type of physiological insult-- poor nutrition, infection, or weaning stress-- which is so severe that normal growth processes are stunted. Hypoplasias have been associated with diarrheal disease and nutritional status of children in clinical studies (Dobney and Goodman 1991). According to these authors, peaks in the age distribution of enamel hypoplasias indicate that "stimulus events are occurring at particular times in tooth development" (Dobney and Goodman 1991:87-88). The problem, they point out, is that an identical source of stress affects individuals differentially based on their health and nutritional status.

The similar pattern of age of onset for hypoplasia in the Prehistoric and Protohistoric suggests that these groups had similar patterns of health and a similar set of stressors affecting the dental development of children. The distributions could reflect increased risks for disease at weaning, changes in nutritional status during the life of the child, or other unknown factors. The pattern is very similar to that of children at Tezonteopan, Mexico (Dobney and Goodman 1991:99), in which the peaks in hypoplasia reflect nutritional deficiencies during breastfeeding (before two developmental years) and greatest risk for diarrheal infection (after two developmental years). The age of onset for Historic children reflects a single event between two and three developmental years that increased the risk of enamel disturbance. Most likely this reflects the point at which immunity from maternal antibodies ceases to be effective. Historic children *may* have been nutritionally adequate, but more at risk for infection as their own immune systems took over at about age two.

The Dental Pathology Profile (Table 9.39) provides some information about diet and oral health, as do the dental microwear data. Late Prehistoric populations experienced significant levels of dental attrition. At a macroscopic level, dental attrition was extreme, and was probably responsible for the high degree of periapical abscessing, and alveolar resorption due to exposure of the pulp chamber. The positive side of attrition was the fact that cariogenic bacteria were probably abraded off the tooth, along with a significant portion of the enamel. At the microscopic level, these individuals were masticating hard objects or grit which created extensive pitting on the occlusal surfaces of their teeth. Hard objects could include: 1) grit introduced through improper cleaning of food or intentional inclusion of dirt during cooking; 2) opal phytoliths in plants; or 3) hard seeds and nut hulls. The pattern of wear suggests that some polishing was present, a pattern associated with populations masticating fibrous plants (Marks et al. 1988). The presence of dental calculus suggests that carbohydrates were present in the prehistoric diet, and again starchy plants may have been a source for both. Early ethnohistoric accounts of upper coastal diets document that an "underwater root" was a staple item of these groups, which may account for some of the dental microwear patterns and levels of calculus. Berries and other foods with hard particles were also known to have been eaten by natives of the Texas coast (see data summarized in Powell 1989). These items could also introduce sugar and grit into Late Prehistoric mouths.

The Protohistoric sample is quite small, which makes for difficult interpretation of the data. For most dental pathologies, Protohistoric individuals are unlike Prehistoric or Historic groups. This most

Table 9.39. Dental Pathology Profiles for Three Subsistence Patterns (following Lukacs 1989). Data for each pattern were obtained from world-wide surveys of prehistoric populations.

Dental Pathology	Hunter-Gatherers	Transitional Mixed	Agricultural
Dental Caries	Low	**Medium**[a]	High
Enamel Hypoplasia	Low	**Medium**	High
Dental Calculus	Low	Medium	**High**
Dental Crowding	Low	**Medium**	High
Alveolar Resorption	Low	**Medium**	High
Severity of Attrition	High	**Medium**	Low
Caries-induced Abscess	Low	Medium	**High**
Caries per tooth[b]	0.0 - 5.3	**0.4 - 10.3**	2.3 - 26.9

a: Highlighted values represent the position of the Historic period burials from Mitchell Ridge in the Dental Pathology Profile.

b: Data from Table 7 in Lukacs (1989); original data in Turner (1979) for N = 62 populations prehistoric populations with different economies.

likely reflects the inadequacy of the sample, but may also indicate that peri-contact groups were experiencing changes in diet, food processing, and oral health. Changes in dental attrition were certainly occurring as evidenced by macro- and microwear studies. Some individuals appear identical to Prehistoric burials in dental wear, while others (such as Feature 61) are most similar to the Historic groups. The variance in number of pits and striations is large for the Protohistoric sample. Again, sampling error must be suspected. If the increased variance reflects real changes, then individuals buried at the cemetery may have followed slightly different dietary regimens or used slightly different food-processing technologies.

The Historic sample provides a clearer picture of dietary and health changes. Several individuals (Features 62-1 and 62-2, 64-1 and 64-4) have dental microwear patterns suggesting uniform processing of foods with minimal hard object ingestion. This change could have been brought about by changes in food processing technologies (i.e., use of wooden mortars and pestles) or new foods and/or food preparation methods. These individuals lack the significant dental attrition of Late Prehistoric groups, and as a result have a slightly greater prevalence of dental caries. The prevalence of dental calculus is probably related to a significant increase in carbohydrate consumption or to changes in dental wear and mastication (which removed dental calculus in the teeth of Late Prehistoric individuals). One unresolved question is why Historic teeth appear so different from those of earlier populations. One explanation is that local groups adopted the foods or food processing technologies of either Europeans or other agricultural populations. An alternative explanation is that these individuals represent a new population who brought with them new technologies, and other material and behavioral traits that affected their diet and dental wear.

In order to distinguish between these two alternatives, the Historic sample was compared to the Dental Pathology Profile for populations following different subsistence economies (Table 9.39). While the Late Prehistoric and Protohistoric burials at Mitchell Ridge have profiles which are similar to the general profile of hunter-gatherers, the Historic population does not. The Historic population is most similar to prehistoric populations whose diets were partially supplemented by horticultural or agricultural foods. The prevalence of dental caries in the Historic sample, calculated as the number of carious teeth out of the total number of teeth, was 2/216, or 0.9 percent. This value is within the acceptable range for caries (0.0 - 5.3%) in a world-wide sample of hunter-gatherers, but also falls above the lower range for mixed subsistence populations. It may be that Historic individuals supplemented their diets with agricultural products on occasion. The alternative explanation, that the observed changes resulted from technological change and not dietary change, cannot be eliminated on the basis of these data. It may be that given the evidence for admixture with Europeans and/or non-coastal populations, Historic populations were borrowing foodstuffs from neighboring groups including Europeans, or were at least using new food cleaning, preparation, and processing methods that reduced the amount of grit in the diet to the level seen in eastern agriculturalists.

Death on the Upper Texas Coast

Death among Prehistoric groups on the upper coast appears to have been a much more complicated event than indicated by previous research (Aten 1983a; Aten et al. 1976). Based on the taphonomic data, Prehistoric and Protohistoric populations appear to have practiced differential burial practices, and appear to have followed a mortuary program not previously documented on the upper Texas coast. Older adult males dominate the Prehistoric sample, as do older children and adolescents. At the death of an individual, the body was either interred immediately, cremated, or curated for later burial. In the case of children, the deceased was either interred or cremated shortly after death or the body was curated for some period of time, perhaps as long as 1.5 years. The interval between death and corpse disposal, as inferred from the taphonomic data, parallel early ethnohistoric accounts of sixteenth-century rituals used during the death of "boys" and young men (Newcomb 1983).

One unexplained phenomenon is the presence of certain body parts-- hands, feet, and patellae-- in some features. The recovery of these elements cannot be attributed to excavation losses, poor preservation, or carnivore distribution, and strongly suggests intentional burial. This could have occurred if bodies were curated, the larger bones collected and buried after decomposition, followed by a collection of smaller parts during periodic "cleaning" of the storage area (Ubelaker 1974). Bodies were probably protected from carnivores by either a scaffolding or a charnel house, but rodents had access to the deceased. Once the body was defleshed or disarticulated by the survivors, it was either interred with another primary burial, or cremated and then buried.

The mortuary data present some measure of continuity between the Late Prehistoric and Historic periods, at least as far as general patterns of behavior are concerned. The practice of primary and secondary burial continues in the Protohistoric and Historic, but during later periods young adults and young children are also included. Cremations of in-the-flesh corpses also occurred in all three periods, as did cremation of partially or completely decomposed bodies. These data suggest that some type of continuity in behavior is present at the site in spite of other dramatic evidence for biocultural change--though the particulars of the mortuary program changed slightly through time.

Conclusions

Aten (1979, 1983a) described a model for the dynamics of pre- and post-contact populations on the upper Texas coast. The bioarchaeological data from the Mitchell Ridge site help to clearly define this model. The introduction of epidemic disease, encroachments by Europeans and other native American groups, and drastic changes in subsistence and economy have been documented in the archaeological and ethnohistoric records. The population or populations using the cemetery reflect these changes, through biology and mortuary behavior.

Genetic admixture and population amalgamation appear to have played a part in the complex dynamics of the Historic period, with evidence of gene flow into native groups from Europeans, and the possibility of arrival of aboriginal populations from outside the region. Health and possibly nutrition decreased through time while mortality increased, perhaps as a reflection of epidemic disease or stress from socioeconomic change. During the Historic period the diet or food processing methods of local groups were somehow altered, either through the introduction of new foods, new technologies, or new preparation methods. The behavior and physical activities of Historic populations were significantly different from those of earlier groups, as evidenced by increased rates of fracture to the spine and upper body. Finally, mortuary behavior was altered to include extended burials, a greater number of individuals per grave, and a more formal organization of the cemetery. These changes may be a reflection of demographic shifts in response to social stress or epidemic disease, alteration of the belief system and world view of native groups, or other factors.

The drama of native American contact with outside societies was played out with hundreds of thousands of actors across countless stages in the New World, and the living populations who occupied Galveston Island were just one small part of that drama. The human skeletal remains from the Mitchell Ridge stand as a final reminder of how humans in the past lived their lives and experienced death during a turbulent period in North American history. But more than that, they help to inform us about the effects of culture change on our biology and behavior, which we need to better understand the effects our own behavior has on ourselves and on others in a changing and often chaotic world.

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John Dockall conducted one of the only studies of odontometric variation in prehistoric populations of the Texas coast, and I have benefited greatly from my discussions with him. He very generously offered his complete and unpublished data for comparative purposes. Access to these data made possible interpretation of dental metric variation in the Mitchell Ridge assemblage.

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