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I am submitting herewith a thesis written by Lynn Meredith Deitrick entitled "The Occurrence and Interpretation of Trauma at the Larson Site, 39WW2, Walworth County, South Dakota." I recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Arts, with a major in Anthropology.

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THE OCCURRENCE AND INTERPRETATION OF TRAUMA AT THE LARSON SITE, 39WW2, WALWORTH COUNTY, SOUTH DAKOTA

A Thesis

Presented for the

Master of Arts

Degree

The University of Tennessee, Knoxville

Lynn Meredith Deitrick

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This thesis is dedicated to my mother,

Jane Roeting Deitrick

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ABSTRACT

Traumatic injury is one of the most common forms of pathology seen in skeletal collections. Because of its frequent occurrence and the types of behavior, such as warfare, athletics, and accidents, that cause these injuries, trauma is a useful indicator of the kinds of behavior of a study group.

The purpose of this research was to examine the skeletons from the Larson (39WW2) site cemetery and village in an attempt to determine the kinds of behavior patterns suggested by the traumatic injuries present in the samples.

A brief review of the demography of the Larson collections, age and sex determination using morphological criteria, and determination of the minimum number of individuals in the commingled village sample was undertaken prior to a discussion of the trauma present. Based on the etiology and appearance of the injuries, trauma was categorized into one of the following eight categories: fractures, scalping, projectile points, localized periostitis and osteosclerosis, traumatic dislocations, sprains and avulsions, heterotopic bone formations, and unknown trauma.

A summary of the findings shows that fractures were the most frequent form of injury in both of the Larson samples. Most were of probable accidental origin, and suggest regular participation by most of the injured in athletic or related activities. Scalping was of low frequency in the cemetery, and of much higher incidence in the village. This supports the reports of historians that the Arikara were

participants in the intermittent warfare reported for the late eighteenth century. Projectile point injuries occurred only in the cemetery and in very low numbers. This could be due to the skill with which such injuries were treated by Indian medicine men. These injuries offer further support for the participation of the Arikara in the intermittent warfare characteristic of the eighteenth century. Localized periostitis occurs in low frequencies in both Larson samples. This is not unexpected since only in cases of severe blows or similar injuries would periostitis be severe enough to be visible osteologically. Dislocations of traumatic origin are also low, which would be expected since only in severe cases or in joints repeatedly injured, would deformity occur. Also, it has been reported that the American Indian was very skillful in the reduction and treatment of traumatic dislocations. Sprains and avulsion injuries were also of low occurrence. Here too, only in cases of repeated or severe injury would these conditions be visible in osteological samples. Heterotopic bone formations were of rather high occurrence in both of the Larson samples, suggesting that victims were subjected to rather severe blows to extremities or other vulnerable sites. Unknown trauma was a category created by this researcher to account for those cases of probable trauma where the exact processes responsible for such injuries could not be identified. A large number of injuries from both Larson samples were classified into this category, and most are probably due to accidents.

From the previous review of the traumatic injuries occurring in both of the Larson samples it can be observed that most are probably

the result of accidents. Since the Arikara were reported to have been active in horseback riding and sports, it is reasonable to suggest that many of the accidental injuries seen in the cemetery were due to this. Many of the village injuries, especially scalping, suggested a war-related cause, and it is probable that the final village occupation ended in a massacre. Some of the cemetery injuries can also be attributed to warfare participation, which has been reported by historians of the eighteenth century.

From the present research it can be seen that pathology studies, particularly those of trauma, can yield useful information regarding the behavior patterns of skeletal populations. This approach can be especially useful in the absence of ethnographic records for a population.

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CHAPTER 1

INTRODUCTION

Background

Traumatic injury is one of the most common forms of pathology seen in skeletal collections (Steinbock, 1976). Trauma can be defined as any injury inflicted by force by some physical agent (Ubelaker, 1978). Because of its frequent occurrence and the types of behavior, such as warfare, athletics, and accidents, that cause traumatic lesions, it is a useful indicator of the kinds of behavior of a study group (Angel, 1971; Snow, 1974).

The last half of the eighteenth century was a period of cultural stimulation and change for the Indians of the Plains area. This period was a time of population movements, increasing contact with Europeans, and competition for the European trade goods that such contact produced (Lehmer, 1971; Meyer, 1971; Wedel, 1961). At this time we see the acquisition of the horse by some of the Plains groups, including the Arikara (Denig, 1961; Haines, 1976); the development of trade networks between the Europeans and the Indians, including the Arikara who usually served as middlemen (Ewers, 1968); and increasing conflict among Plains groups over horses, food stores, trade goods and routes, and hunting grounds (Ewers, 1968; Haines, 1976; Holder, 1970).

Included among the Indians of the Middle Missouri area who undoubtedly took part in many of these activities were the inhabitants

of the Larson site (39WW2), identified as Arikara (Jantz, 1973; Lehmer, 1971). This site consists of a fortified village site and associated cemetery. Approximately 36 percent of the burial artifacts recovered from cemetery burials are European in origin (Jantz, 1973), suggesting that at least some of the site inhabitants had contact with the Europeans. Such contacts were beginning to occur with regularity at this time, the latter half of the eighteenth century (Ewers, 1968). Historical literature further provides evidence of hostility and intermittent warfare between the Arikara and other groups, especially the Sioux, Mandan, and Hidatsa (Abel, 1939; Beauregard, 1912; Brackenridge, 1904; Holder, 1970; Larpenteur, 1962). Such conflict was usually over trade goods, horses, and hunting grounds, as well as other problems. The last residents of Larson appear to have been the victims of a massacre by a hostile tribe, probably the Sioux (Owsley, Berryman, and Bass, 1977).

The Site

The Larson site (39WW2) is located on the east bank of the Missouri River on a high terrace overlooking the river approximately two miles south of Mobridge, South Dakota. The site consists of a fortified earth lodge village and an associated cemetery, with the cemetery ascending a slope a few hundred yards northeast of the village.

Excavation of the village was carried out in 1963-64 by Dr. Alfred Bowers of the River Basin Survey, Smithsonian Institution. Further village excavation was undertaken by J. J. Hoffman in 1966,

also of the River Basin Survey (Bowers, 1967; Hoffman, 1966; Stephenson, 1963).

Cemetery excavation was initiated in 1966 by Dr. William M. Bass, of the University of Kansas, as part of a salvage operation in the Oahe Reservoir, and was continued through the field seasons of 1967 and 1968. The site, including the cemetery, is now inundated by the waters of the Oahe Reservoir (Bowers, 1967; Bass, n.d.a.).

Tentative assignment of the site to the Post-Contact Coalescent is suggested by Lehmer (1971) on the basis of the large amounts of European trade goods present (Bass, n.d.b.; Bowers, 1967). The percentage of the European trade goods at the site suggests proto-historic occupation circa 1750-1785 (Jantz, 1970; Lyon, 1970). Craniometric and archaeological data suggest Arikara tribal affiliation (Bass, n.d.; Jantz, 1973; Lehmer, 1971; Lin, 1973).

The Larson site (39WW2) collection was chosen as the study group because the well-preserved remains of 628 individuals from the cemetery represent the second largest skeletal collection from one site in the Northern Plains (Owsley, 1980, personal communication). The large sample size makes the Larson collection a good representation of the group living at Larson during the approximately thirty-five years of the site's occupation (Owsley, 1975; Owsley and Bass, 1979). Such completeness is important if an accurate picture of the trauma suffered by the Larson inhabitants is to be obtained.

The Arikara of the late eighteenth century were horticultural villagers characterized by a shifting settlement pattern (Abel, 1939; Brackenridge, 1904; Larpenteur, 1962; Nasatir, 1952; Thwaites, 1904).

Such a pattern involves moving seasonally, with hunting and fishing supplementing the diet in winter months. Usually, the women did the cultivation work, and the men hunted and fished. A base camp or village was maintained where the elderly and infirm remained during the off season (Denig, 1961; Haines, 1976; Holder, 1970; Lowie, 1954).

Although the main camp or village was often fortified, horticultural villages such as Larson were frequently subjected to attack by other, less agrarian tribes in the Missouri Valley. Raiders included the Crow, Assiniboine, Mandan, Hidatsa, and especially the Sioux (Abel, 1939; Brackenridge, 1904; Larpenteur, 1962; Nasatir, 1952; Thwaites, 1904). Many of these attacks were aimed at obtaining stored food, horses, and other bounty (Ewers, 1968; Haines, 1976; Holder, 1970).

Conflict between tribes as well as the spread of communicable disease among these groups was responsible for the reduction of the Arikara population prior to and during the early years of European contact (Hodge, 1907-10).

Demography

Demographic analyses of the cemetery and village samples from the Larson site were made by Owsley (1975), Owsley, Berryman, and Bass (1977), and by Owsley and Bass (1979). It is estimated (Bass, n.d.a.) that at least 90 percent of the skeletons present in the cemetery were recovered (n = 628). The skeletal distribution (Table 1), as determined by Owsley and Bass (1979), includes all ages and both sexes. There appears to be little evidence of sociocultural exclusion of selected age-sex classes in the cemetery sample (Bass and Rucker,

1976). This is not the case in the village since only a few of the lodges as well as a portion of the village area were sampled.

TABLE 1

AGE AND SEX DISTRIBUTION OF SKELETONS FROM THE LARSON CEMETERY

Age Interval	Male	Female	Total
0- 1	-	-	254
1- 4	-	-	94
5- 9	6	9	48
10-14	4	6	14
15-19	10	21	31
20-24	10	15	25
25-29	12	10	22
30-34	25	10	35
35-39	21	18	39
40-49	20	14	34
50-59	10	15	25
	118	118	621*

*Plus 7 skeletons for whom age could not be determined (n = 628).

Source: Owsley and Bass, 1979, Table 1, p. 148.

In paleopathological research, age and sex differences in mortality are important, especially when examining the effects of certain types of behavior such as warfare on the skeletal sample under analysis. Owsley and Bass (1979) suggest several significant mortality trends within the cemetery sample that would affect the way in which the paleopathologist views his study collection. These include the following trends seen in the cemetery collection:

1. The highest incidence of deaths occurred among the preadults. The highest mortality within this group involved infants less than a

year old. High preadult mortality patterns have been reported for other Arikara populations also (Bass, Evans, and Jantz, 1971).

2. High mortality continues into the 1-4 year age group. After this age, there is a marked decrease in mortality until adulthood (Owsley and Bass, 1979).

3. The next important trend occurs in the 15-19 and 20-24 age groups among females. In these categories there are more female than male deaths. This could be related to childbirth and postnatal complications, which would also help account for the high number of young infant deaths (Bass and Rucker, 1976).

4. Among males, low adult mortality is seen until the 30-34 age category. At this time there is a marked increase in male mortality, perhaps related to warfare and defense of the village. Krause (1972), Owsley (1975), and Owsley and Bass (1979) suggest that since the Arikara were horticultural villagers, most of the fighting they engaged in was probably related to defense of the village from outside attack. If this were the case, then males killed in such attacks would probably be interred in the village cemetery. Since the cemetery sex ratio did not differ significantly from a 1:1 ratio this assumption is plausible and might help explain the reason for the increase in adult male deaths at this age. Many of the deaths at this age and beyond could be due to old age.

5. There is a difference in the male-female survivorship patterns that caused unequal sex ratios among the young adults (Owsley and Bass, 1979). Owsley and Bass (1979) further point out that between the ages of 15 and 34 males outnumber females. Male and female

survivorship proportions equalized only after an increase in male deaths during the 30-34 year age interval.

An important point regarding the demography of the cemetery collection is that the cemetery represents a short period of time, perhaps two or three generations, and as such is not the collective expression of mortality over many generations (Owsley and Bass, 1979). Owsley and Bass in the previously referenced research (1979) assumed a stationary population model for the purposes of their analysis although it is unlikely that stationary conditions prevailed. Life table analysis by Owsley and Bass (1979) further suggests that such conditions probably did not exist. Arikara villages of the eighteenth century were politically autonomous, endogamous communities comprised of matrilocal extended households.

Demographic interpretation of the Larson village sample was done by Owsley, Berryman, and Bass (1977). Age and sex distribution obtained as a result of that work appears in Table 2.

Human skeletal remains were found in only about half of the lodges sampled, and these remains were scattered on the lodge floors (Bowers, 1967). The minimum number of individuals was determined by Owsley, Berryman, and Bass (1977) to be 71. All ages and both sexes are present, suggesting that the massacre involved most of the villagers. The observed male-female sex ratio was approximately 3:2 (Owsley, Berryman, and Bass, 1977).

The above demography is important in the paleopathological analysis of the Larson site because it serves as a basis for understanding the mortality seen at different ages and between the sexes.

Mortality profiles may suggest causes of death that might be confirmed by skeletal examination and may be correlated with reports of early historians. Demography is therefore of value to the paleopathologist because it helps establish knowledge about the sample under study, to which the paleopathologist can contribute by elaborating upon the kinds of pathological processes that affected the group. Such pathology might include trauma, infection, neoplasms, and other processes that can be observed in the skeleton.

TABLE 2

AGE AND SEX DISTRIBUTION OF SKELETONS
AT THE LARSON VILLAGE

Age Interval	Male	Female	Unknown	Total
0- 4	-	-	8	8
5- 9	-	-	7	7
10-19	8	8	5	21
20-29	9	1	-	10
30-39	9	7	-	16
40-49	3	3	-	6
50-59	-	-	-	-
Age ?	2	-	1	3
	31	19	21	71

Source: Owsley, Berryman, and Bass, 1977, Table 1, p. 122.

Causes of Death

Causes of death are important in paleopathology since the age and sex groupings obtained for skeletal samples are reflections of mortality within the sample. While in many cases trauma does not contribute directly to the death of an individual, the trauma we do see is in those persons who died and were buried in the Larson cemetery.

At Larson, causes of death can be suggested from two sources of evidence—historic documentation of Arikara disease patterns, and pathological skeletal materials. Major causes of death observed at Larson appear to have been due to childbirth/postnatal care or complications, starvation, disease, and warfare (Owsley, Berryman, and Bass, 1977; Owsley and Bass, 1979). The Larson cemetery sample provides evidence for all four of the above causes of death. As expected, the village mortality appears to have been largely the result of warfare (Owsley, Berryman, and Bass, 1977). Accidents probably contributed little to the mortality figure in both Larson samples; whereas war-related trauma and resultant death are responsible for some of the Larson cemetery and most of the Larson village deaths.

Problem

The purpose of this research is to examine the skeletons from the Larson cemetery and village to see what kinds of trauma are present. A comparison of the trauma at Larson will be made with that found at other sites in the region, especially at Leavenworth (Shermis, 1969) and Mobridge (Palkovich, 1978) in an attempt to determine any regional or temporal behavioral trends suggested by the injuries present. Ultimately, it is hoped that the patterning of the trauma at Larson will reveal the kinds of behavior which were taking place there, especially the kinds of behavior mentioned in the ethnohistoric records (Abel, 1939; Beauregard, 1912; Meyer, 1977; Wedel, 1961).

Organization

The succeeding chapters deal with the following subjects: Chapter 2 outlines the research design used in this project as well as the methods used in the determination of age and sex and enumerates trauma categories used in the analysis of the samples. Chapter 3 defines the trauma categories selected for use in this project and provides background concerning the injuries. Chapter 4 examines the trauma seen in the Larson samples and categorizes the injuries, and Chapter 5 summarizes the findings, compares the findings from this research with that done on other Akikara collections, and suggests explanations for the patterns of trauma observed in the Larson collection.

CHAPTER 2

METHODOLOGY

The Samples

The Larson cemetery sample consists of the well-preserved remains of 628 individuals, and is the second largest skeletal collection from one site in the Northern Plains (Owsley, 1980, personal communication).

The village sample was handled separately since it most likely represents a single temporal period, probably during the terminal occupation of the village (Bowers, 1963). This sample, as noted above, most likely is the result of a massacre (Owsley, Berryman, and Bass, 1977). The sample was commingled, and many skeletons were disarticulated.

The condition of the village sample is only fair, because of the skeletal disarticulation, mutilation, and commingling. Also, since only three of the twenty-nine lodge depressions were sampled, the number of individuals represented (n = 71) is probably only a small percentage of the population present at the site at the time of the massacre. Because the village apparently was the target of a raid and subsequent massacre (Owsley, Berryman, and Bass, 1977), many of the bones exhibit traumatic lesions that can be directly associated with this kind of violence. Examples include decapitation, scalping, disarticulation, bludgeoning, and dismemberment.

Research Design

The classification and interpretation of the trauma observed in the Larson samples were accomplished using the following research design:

1. Examination of the skeletal remains from the Larson cemetery. The age and sex of each individual was determined where possible, as noted below. Pathological examination was also done on each skeleton, and those exhibiting trauma were noted and the trauma classified. Bones present and completeness were recorded for later use in the calculation of trauma incidence rates. Some of the trauma observed was x-rayed and photographed.

2. Examination of the village skeletal sample. Commingling of the sample precluded attempts to sort all of the bones into individuals. Records were made of bones present and their completeness, age and sex of skulls and pelves, and long bone lengths of subadults. Bones were sorted by lefts and rights into infant, subadult, and adult groupings. A minimum number of individuals was determined from the number of skulls, pelvic, and long bones present in each grouping. Pathological examination was made of each bone, and those exhibiting trauma were noted and the trauma classified. Some of the trauma observed was x-rayed and photographed.

3. Organization of data. The data were coded and punched onto computer cards. Two sets of cards were used for each of the samples. One set of cards indicated the bones present, completeness of the bones, age, sex, and catalog number. The second set of cards contained age,

sex, and catalog information as well as the kind of trauma seen and the bones affected.

4. Computer analysis. A catalog of the bones present and the breakdown of these into age, sex, and completeness categories was achieved through the use of SAS programs SORT, FREQ, and MEANS (Barr et al., 1976). Also obtained in this analysis was a breakdown of the bones by sample and geographical feature within each sample. Trauma analysis was also done with the SAS programs specified earlier. This catalog contains a breakdown and classification of the trauma observed by bone affected, age, sex, sample, and feature. Within each analysis the samples were analyzed both separately and together. Assistance with the coding and programs used in this project was provided by The University of Tennessee Computer Center. The results obtained from these programs are the basis for the conclusions made by this researcher and contained within this thesis.

Determination of Age and Sex

Preliminary to an examination and analysis of trauma, the age and sex distribution of the skeletal material from both samples was determined.

Sex. Subadult sexing was not attempted since there are at present no reliable methods for determining this. Owsley (1975) in his demographic study of the Larson cemetery collection attempted to determine the sex of the Larson subadults using dental discriminant functions. Results of that work were kindly made available to the author.

Adult sex determination is less of a problem since pronounced sexual dimorphic traits develop after puberty. Numerous reliable methods are available, and several were used in this research. Among those used were sex differences in cranial morphology (Bass, 1971), and pelvic morphology (Bass, 1971; Krogman, 1962; Phenice, 1967; Washburn, 1948). Cranial traits tend to be more variable and thus less reliable than those of the pelvis, but are of value especially when the pelvis is broken or absent.

Most of the individuals in the cemetery and village were initially sexed by Bass (n.d.) upon excavation and confirmed by later laboratory analysis. The cemetery collection was sexed again by Owsley (1975), and Owsley and Bass (1979, Table 1, p. 5). The village sample was sorted, aged, and sexed by Owsley, Berryman, and Bass (1977, Table 2, p. 7). For this research project the author independently sexed each individual and then checked the results against those obtained by earlier investigators. The sex estimates obtained by the author agree closely with those of earlier investigators (Tables 3 and 4).

Age. Age determination is difficult in many cases due to the high degree of overlap of age indicators within broad age categories.

Dentition provides the most reliable and accurate means of age determination for infants and subadults (Garn, Lewis, and Polacheck, 1959). Dental aging usually consists of an assessment of either dental calcification or dental eruption.

Ubelaker (1978) has devised a dental-aging standard for American Indians that is a combination of the calcification and eruption

TABLE 3

AGE AND SEX DISTRIBUTION OF INDIVIDUALS FROM THE LARSON CEMETERY

Age Categories	M	F	I	T
Fetus-1 year	-	-	261	261
1- 4	-	-	83	83
5- 9	-	-	49	49
10-14	-	-	10	10
15-19	12	14	7	33
20-24	14	20	1	35
25-29	12	10	1	23
30-34	25	10	-	35
35-39	21	12	-	33
40+	30	29	-	59
	114	95	412	621*

*Plus seven skeletons for whom age could not be determined (N = 628).

M = Males; F = Females; I = Indeterminate sex
T = Total individuals for each age category

TABLE 4

AGE AND SEX DISTRIBUTION OF INDIVIDUALS FROM THE LARSON VILLAGE

Age Categories	M	F	I	T
Fetus-1 year	-	-	3	3
1- 4	-	-	5	5
5- 9	-	-	7	7
10-14	-	-	4	4
15-19	6	7	1	14
20-24	7	1	-	8
25-29	3	2	-	5
30-34	5	3	-	8
35-39	5	3	-	8
40+	3	3	-	6
IA	2	-	1	3
	31	19	21	71

M = Males; F = Females; I = Indeterminate sex
T = Total individuals for each age category
IA = Indeterminate age individuals

standards of Moorrees, Fanning, and Hunt (1963); Anderson, Thompson, and Popovich (1976); and others. The chart compiled by Ubelaker (1978) is for American Indians, and is therefore suitable for use in this research project. Subadult dental age was determined using the eruption standards given in Ubelaker's tables (1978).

Long bone length for subadults, as investigated by Merchant and Ubelaker (1977) and Ubelaker (1978) provides another means of aging the subadults from the Larson samples. Long bone length, when correlated with dental calcification and/or eruption (Ubelaker, 1978), provides a fair estimate of age for infants and subadults. Long bone length is also of value when used without dental standards as a means of age determination when dentition is not available. Since the long bone length age standards of Merchant and Ubelaker (1977) and Ubelaker (1977) were devised using data from protohistoric Arikara samples, it is therefore of use in the age determination of the subadults from the Larson samples. The long bone standards of Ubelaker (1978) were used in this research as a means of determining the age of the subadults under study.

In older subadults, epiphyseal closure is also a useful age indicator. McKern and Stewart's (1957) American male estimates provide a rough estimation of age and are of particular value in the absence of dentition or complete long bones. This method was applied to the Larson subadults used in this research.

Age determination was done independently by the author on the Larson infants and subadults from the cemetery and village samples using the methods described above. Results were then compared with data

from earlier investigators who used different methods (Bass, n.d.; Owsley, 1975). This researcher's findings correspond to the earlier subadult age determinations.

A variety of techniques are available for the determination of adult age. One of the more reliable methods is based on the metamorphosis of the pubic symphysis. Techniques used in the present inquiry include McKern and Stewart's (1957) system for males and Gilbert and McKern's (1973) system for females. Ages obtained by use of these systems range from 17-40+. Beyond 40 the reliability of correct aging decreases. It should be noted, though, that precise ages cannot be determined since the above systems were developed for use on Caucasian samples; however, they do provide perhaps the best possible morphological estimates.

Osteon counting (Ahlqvist and Damsten, 1969; Kerley, 1965) is probably the most precise aging method available. This method was not used in the present research since analysis requires partial destruction of the specimen, and few laboratories are available that can do the procedure.

Epiphyseal closure is a useful technique for aging the young adult. The American male standards of McKern and Stewart (1957) and the female standards of McKern (1970) were used. Again, since these are Caucasian standards, they can be regarded only as general estimates on the samples under study.

Other aging methods were also employed in an effort to obtain the best estimate for each individual. These methods included analysis of

dental attrition, development of vertebral osteoarthritis, and cranial suture closure (Krogman, 1962).

Adult ages were determined independently by the researcher and then checked with the age estimates arrived at by earlier investigators, including Bass (n.d.b.) and Owsley (1975). There was a high degree of correspondence between the author's estimates and those of the earlier researchers. Ages for seven very fragmentary individuals from the cemetery could not be determined (Tables 3 and 4, p. 15).

With reference to the above, it is important to note that the age of an individual at the time of trauma occurrence is difficult to determine inasmuch as the injuries observed usually are healed. It should be noted, therefore, that the age and sex distributions given in the following tables are based on age at death, not on the age at which the trauma occurred. Only in cases where the injury was the probable cause of death, such as with certain skull fractures and warfare injuries, can we view the age at death as the age of trauma occurrence. Age as well as sex distributions for the trauma at Larson is presented in this report since it serves as a means of orienting each individual represented in terms of the sample as a whole.

Pathology Categories

Trauma was classified into the following eight categories: fractures, scalping, projectile point injuries, localized periostitis, dislocations, sprains and avulsions, heterotopic bone formations, and unknown trauma. The definition and composition of each of these categories will be the subject of Chapter 3.

CHAPTER 3

DEFINITION AND CATEGORIZATION OF TRAUMA

Trauma can be defined as damage to bones, joints, and ligaments that is produced by external forces such as a blow, twist, pinch, fall, or crush (Larson and Gould, 1978: 165). Included among the conditions that can result from trauma are fractures, lacerations, contusions and abrasions of the skin, lacerations and ruptures of the tendons, sprains of the ligaments, strains (partial or complete rupture) of the muscles, and joint dislocations (Miles, 1975: 19-20).

While all of the above conditions constitute physical trauma, there is some disagreement as to how many of these can be identified in skeletal material and whether such injuries can be used to infer how traumatic a life the study sample lived (Angel, 1971; Miles, 1975; Snow, 1974). Miles (1975) feels that since only evidence of fractures remains, it is impossible to tell through the examination of bones how traumatic were the lives of the people of a study group. Angel (1971) and Snow (1974) disagree. These researchers not only looked at the age and sex patterning of fractures and other trauma, but where in the body they were located. From the patterns that emerged the researchers tried to make deductions as to the kind of lifestyle each group experienced. No ethnohistoric information was available for the groups studied—the early Hawaiians from Mokapu, Oahu, and the early Greeks from Lerna, Crete. The conclusions reached were based solely on the distribution of trauma and other pathology found in the skeletal material, and comparisons of this information with that provided by archaeologists.

The approach of Angel (1971) and Snow (1974) was used in the present research project. That is, patterns of trauma were investigated with the view that inferences concerning lifestyle can be made.

In this research project, not only were fractures diagnosed, but significant patterning of certain kinds of trauma including osteosclerosis, sprains and avulsions, ossified ligaments, traumatic, dislocations, and wounds from weapons such as knives and projectile points were reviewed.

Before presentation of the data, it is necessary to define each of the trauma categories enumerated earlier, and the reasons for the selection of each.

The categories were chosen based upon the trauma classification systems of Morse (1978), and Steinbock (1976), with some modifications. Categories were modified to facilitate analysis.

Trauma Categories

Fractures and crushing injuries. This category includes depressed skull fractures, nasal fractures, incised wounds, especially in the cranial vault, from sharp objects such as axes and spears (except scalping), and postcranial fractures including those of the long bones (Figures 1 and 2, Appendix B). Also included are compression fractures of the vertebrae, and crushing injuries of the hands and feet.

According to Morse (1978), most crushing injuries and skull fractures of the depressed variety are caused by falls or blows from large, heavy objects and blunt weapons. Most crushing injuries occur

in the hands, feet, and skull. Also, most skull fractures are of the depressed variety, and while often referred to as fractures, are really of the same etiology as crushing injuries (Morse, 1978). Collapsing these injuries into the fracture category enables us to group together injuries caused by similar types of force. As a result, analysis is simplified, and the number of categories reduced.

No attempt was made to determine the age of healed fractures since the utility of fracture healing rates in the determination of how long prior to death a fracture observed archaeologically occurred is a subject of some debate. Steinbock (1976) and Morse (1978) both suggest that since there are a number of factors that influence fracture healing rates, the usefulness of this procedure in the determination of how long prior to death a fracture occurred is negligible in archaeological samples. Some of these factors include the victim's age, the type of fracture, the degree of vascularization of the fracture site, the amount of motion between the broken ends, and the presence of infection (Steinbock, 1976; Morse, 1978; Turek, 1977). These factors make it difficult if not impossible to arrive at a reasonable estimate as to when the injury occurred, since estimates can vary from as little as one month to as much as a year (Steinbock, 1976; Morse, 1978; Turek, 1977). Therefore, the estimation of the age of healed fractures was not attempted in this research project.

Scalping. Scalping can be defined as the process of removing the scalp. Cut marks on the skull vault are the best evidence of this kind of trauma (Figure 3, Appendix B). However, this category also

includes skulls that show areas of infection in the scalp area probably due to partial healing of scalping wounds (Hamperl, 1967); Morse, 1978; Owsley and Berryman, 1975).

Marks attributable to scalping usually follow a circular pattern on the skull that tends to follow the hairline in the front and may extend down as far as the mastoids and external occipital protuberance. Scalping is sometimes difficult to diagnose since traces on the skull may not be evident if sharp metal knives were used (Hamperl and Laughlin, 1959; Hamperl, 1967; Morse, 1978). Cut marks could also be visible if force was used in the scalp removal process, or if dull metal or stone knives were used (Hamperl and Laughlin, 1959; Morse, 1978). Inasmuch as death is not a necessary factor in scalping, there are cases which evidence infection or healing from such trauma.

While the subject of this report is the occurrence of trauma observable in the skeletons of living individuals, scalping was included since it can be carried out on living as well as dead victims. Also, this category of trauma represents obvious warlike behavior and can thus assist in the interpretation of behavior patterns occurring among the residents of the Larson site.

Projectile points. This category is limited to those cases of trauma in which a portion of the projectile point still remains embedded in the bone.

This category was separated from others since projectile point injuries are easily identifiable. Injuries of this type can be ascribed to aggression-related causes.

The presence of projectile points in skeletal body cavities is not considered here as evidence of trauma inasmuch as it is impossible to determine in these cases whether the points were the result of injury or were part of the burial cache (Lueck, 1979, personal communication). (See Figures 4 and 5, Appendix B.)

Localized periostitis/osteosclerosis. Localized periostitis is an inflammation or swelling in restricted areas of bone, especially in areas particularly accessible to blows (St. Hoyme, 1969). Bone changes resulting from this kind of trauma closely resemble those seen in infectious osteomyelitis, except they are confined to one limited area in a bone, and adjacent bones are not affected (St. Hoyme, 1969). Osteosclerosis is hypertrophy and an increase in bone density associated with traumatic insult to a part of the body (Morse, 1978; Turek, 1977). Both of these kinds of trauma are caused by similar kinds of force and are therefore grouped together in this analysis.

Since cases of traumatic localized periostitis and osteosclerosis are sometimes difficult to diagnose because they resemble periostitis due to infections, the area affected is important in the diagnosis (Turek, 1977). Areas generally accessible to blows, such as the shin, lower arm, and upper and mid-back are the main areas where these conditions are seen when due to trauma (Morse, 1978; St. Hoyme, 1969; Turek, 1977). According to Morse (1978), when only a single bone shows osteosclerosis, in the absence of fractures, such a condition can be assumed to be a response to some sort of unidentified trauma. Also useful in assigning a traumatic etiology to localized periostitis cases

includes criteria such as whether adjacent bones were affected. If adjacent bones were affected, the case was probably of infectious origin, and not included in this analysis (St. Hoyme, 1969). In cases of uncertainty, final diagnosis was based on other factors such as age, sex, and other trauma or pathology exhibited in the skeleton.

Traumatic dislocations. This category includes cases of trauma in which joints have been moved out of articulation or alignment due to force (Larson and Gould, 1978).

Traumatic dislocation injuries are due to trauma rather than disease. Such dislocations may only be visible in the skeleton if the joint remains unreduced for a long period of time (Morse, 1978; Turek, 1977). Diagnosis, therefore, is based on the formation of new articular surfaces or modifications of existing joint surfaces such as would occur during prolonged joint displacement.

In the Larson samples, dislocations are seen in the mandible and shoulder. Mandibular dislocations can be caused by blows to the chin, violent yawning, or violent yelling, and may be either unilateral or bilateral (Larson and Gould, 1978; Turek, 1977). Mandibular dislocations can be difficult to distinguish from cases of degenerative joint disease in the temperomandibular joint (TMJ). Diagnosis was based on age, with younger individuals more likely to show cases than individuals of advanced age. Also, the entire joint capsule appears out of correct alignment with corresponding heavier wear on the molars on the affected side (Larson and Gould, 1978; Turek, 1977). Few cases of mandibular dislocation were expected since only those that were

repeatedly injured or severely out of alignment would show the required bone changes.

Shoulder dislocations, which usually consist of humeral head displacement, are usually caused by falls on the outstretched arm (Larson and Gould, 1978) (Figures 6 and 7, Appendix B).

Sprains and avulsions. Sprains are injuries to the ligaments that result in a tearing of the ligament (Larson and Gould, 1978; Turek, 1977). Avulsions, also called avulsion fractures, result when an injury of such force occurs that the ligament is torn away from the bone at the site of its fixation (Larson and Gould, 1978; Turek, 1977). When the ligament is torn in this manner fragments of bone often adhere to the torn ligament, resulting in a minute fracture at the area where the ligament attached to the bone (Larson and Gould, 1978; Turek, 1977). When healed, evidence of the injury can sometimes be seen in the form of bony wedges or projections in areas of ligament attachment near a joint. Such injuries can sometimes be seen in archaeological specimens.

Avulsions and sprains are usually the result of force on a joint, often in the extremities. Such injuries can be the result of ankle twisting, tripping, wrenching of the extremities from falls, and other similar occurrences. Avulsion and sprain injuries are most often seen in the leg, especially in the proximal and distal tibae (Larson and Gould, 1978; Turek, 1977). Sprains are often difficult to diagnose in archaeological samples since they are primarily soft tissue injuries (Miles, 1975). Recurrent injury to one joint, for example, repeated spraining of the same ankle, sometimes results in avulsions.

Inasmuch as bones are damaged, such trauma can be observed in skeletons (Larson and Gould, 1978; Turek, 1977), and thus seen in archaeological samples.

Heterotopic bone formations. Injuries in this category consist of ossified bone spurs. Heterotopic bone formation is often the direct result of injury and subsequent irritation to the periosteum and muscle, which then initiates the formation of new bone in the injured area (Brothwell and Sandison, 1968; Steinbock, 1976). In some sprain cases where there is a lot of shredding and tearing of the muscle fibers, as well as from cases of severe blows, hematoma and inflammatory edema develop. As a result of the hematoma and edema, bone formation is initiated and bony masses can occur at the injury site (Turek, 1977) (Figures 8 and 9, Appendix B).

Injuries in this category can be the result of blows as well as sprains or muscle tears, but inclusion of a case in this category was based on the appearance of the injury and not its probable cause.

Diagnosis of cases in this category was based on the appearance of bony nodules in areas vulnerable to sprains and blows, especially the extremities, although a few ossifications were observed in other areas of the skeleton. Heterotopic bone formations are easily confused with benign bone tumors or congenital anomalies of similar appearance (Steinbock, 1976).

Unknown trauma. This category was reserved for those cases that exhibited lesions that were thought by the investigator to be of

traumatic origin but could not be more precisely classified. Cases were only included in this category when trauma appeared to be the most probable cause of the condition, or when other causes such as infection, could be ruled out. This category was created to deal with these cases so that they could be included in the analysis without affecting the composition of the other categories (Figures 10 and 11, Appendix B).

CHAPTER 4

ANALYSIS OF LARSON TRAUMA

An analysis by category of the trauma discovered through examination of the specimens from the Larson cemetery and village follows. Besides an examination of trauma by category, the injuries seen in the two samples comprising the Larson collection were sorted according to the feature in which each individual occurred. These features represent excavation seasons and not necessarily geographic or temporal locations in the Larson cemetery (Bass, n.d.a.). The village sample was excavated according to lodge or areas within the site (Bowers, 1967) (Table 5).

TABLE 5

DISTRIBUTION OF LARSON VILLAGE TRAUMA INDIVIDUALS BY FEATURE/LODGE

Feature Number	T	M	F	I
Lodge 23	2	2	-	-
21	26	18	4	4
1	3	1	1	1
Area 104	15	6	6	3
	46	27	11	8

T = Total number of individuals with trauma in each feature.
M = Males with trauma.
F = Females with trauma.
I = Indeterminate sex individuals with trauma.
Area 104 = Village salvage.

Classification of each of the affected individuals by age and sex for the Larson cemetery and village appears in Tables 6 and 7, respectively. A listing of the affected individuals by burial number and bone affected with trauma for each of the Larson samples appears in Appendix A.

From the age and sex distribution of individuals with traumatic injuries in the cemetery (Table 6), we can see that the numbers of affected males and females are quite similar. This is not unexpected since the observed sex ratio in the cemetery sample is approximately equal. Differences in the trauma distribution between the sexes do not become important until the sample is further subdivided according to trauma categories, as seen in Table 8.

The Larson village sample presents an overall different picture. In the village sample, Table 7 shows that twice as many males as females show traumatic injuries. Again, the observed sex ratio in this sample is unequal, approximately 3:2 (Owsley, 1980, personal communication). Therefore, the fact that more males than females show traumatic injuries is not unexpected in light of the sex ratio differences within the sample. The trauma distribution by category more clearly illustrates where the differences occur between the sexes with regard to the injuries seen (Table 9).

The trauma incidence rates in the following tables were calculated based on the total number of bones present or bones showing trauma observed in the collections. An exception to this was with vertebrae, ribs, hands, and feet. Bones from these locations were counted in terms of partial or complete sets, and in the case of ribs,

TABLE 6

AGE AND SEX DISTRIBUTION OF LARSON CEMETERY
INDIVIDUALS WITH TRAUMA

Age Categories	M	F	I	T
Fetus-1 year	-	-	7	7
1- 4	-	-	3	3
5- 9	-	-	2	2
10-14	-	-	-	-
15-19	3	4	-	7
20-24	7	11	1	19
25-29	4	1	-	5
30-34	19	9	-	28
35-39	17	6	-	23
40+	14	21	-	35
	64	52	13	129

M = Males
F = Females
I = Indeterminate sex
T = Total number of individuals with traumatic injuries for each age group.

TABLE 7

AGE AND SEX DISTRIBUTION OF LARSON VILLAGE
INDIVIDUALS WITH TRAUMA

Age Categories	M	F	I	T
Fetus-1 year	-	-	-	-
1- 4	-	-	-	-
5- 9	-	-	1	1
10-14	-	-	2	2
15-19	5	1	2	8
20-24	3	2	-	5
25-29	6	3	4	13
30-34	8	1	1	10
35-39	2	-	-	2
40+	1	3	-	4
	25	10	10	45

M = Males
F = Females
I = Indeterminate Sex
T = Total number of individuals with traumatic injuries for each age group.

TABLE 8

LARSON CEMETERY: TRAUMA FREQUENCIES BY CATEGORY AND SEX

Trauma Category	Total			Male			Female			Ind. Sex		
	TIn	TId	%T	#In	#Id	%TC	#In	#Id	%TC	#In	#Id	%TC
1. Fractures	124	92	47.1	65	48	52.0	40	31	32.0	19	13	15.3
2. Scalping	5	5	1.9	2	2	40.0	2	2	40.0	1	1	20.0
3. Proj. Pts.	6	6	2.3	4	4	67.0	2	2	33.0	0	0	0.0
4. Local. Periost.	23	13	8.7	12	6	52.2	8	5	34.8	3	2	13.0
5. Dislocations	9	6	3.4	5	3	55.5	4	3	44.5	0	0	0.0
6. Sprains/Avuls.	10	10	3.8	5	5	50.0	5	5	50.0	0	0	0.0
7. Heterotopic Bone	36	29	13.6	25	19	69.5	11	10	30.5	0	0	0.0
8. Unknown Trauma	50	27	19.0	31	15	62.0	15	10	30.0	4	2	8.0

TIn = Total number of injuries for each category. Multiple occurrences in some individuals.
TId = Total number of individuals with trauma for each category.
%T = Percent of total injuries that each category represents; TIn/263, for each category.
#Id = Number of individuals of each sex exhibiting trauma for each category.
#In = Number of injuries occurring in each sex by category. Multiple occurrences in some individuals.
%TC = Percent of total injuries that each sex represents by category; #In/TIn, for each sex.

Male and female sex categories include individuals 15 years and older.
Indeterminate sex category includes infants and children as well as adults.
N = 263 = Total number of injuries seen in the sample; not individuals.

TABLE 9

LARSON VILLAGE: TRAUMA FREQUENCIES BY CATEGORY AND SEX

	Total			Male			Female			Ind. Sex		
Trauma Category	TIn	TId	%T	#In	#Id	%TC	#In	#Id	%TC	#In	#ID	%TC
1. Fractures	31	23	45.6	16	11	51.6	10	7	32.2	5	5	16.1
2. Scalping	17	17	23.3	9	9	53.0	6	6	35.0	2	2	16.7
3. Proj. Pts.	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
4. Local. Periost.	2	1	2.7	0	0	0.0	0	0	0.0	2	1	100.0
5. Dislocations	1	1	1.4	1	1	100.0	0	0	0.0	0	0	0.0
6. Sprains/Avuls.	5	4	6.8	5	4	100.0	0	0	0.0	0	0	0.0
7. Heterotopic Bone	9	7	12.3	8	6	88.9	0	0	0.0	1	1	11.1
8. Unknown Trauma	8	7	10.9	2	2	25.0	3	3	37.5	3	2	37.5

TIn = Total number of injuries for each category. Multiple occurrences in some individuals.
TId = Total number of individuals with trauma for each category.
%T = Percent of total injuries that each category represents; TIn/73, for each category.
#In = Number of injuries occurring in each sex by category. Multiple occurrences in some individuals.
#Id = Number of individuals of each sex exhibiting trauma for each category.
%TC = Percent of total injuries that each sex represents by category; #In/TIn, for each sex.

N = 73 = Total number of injuries seen in the sample.

the total number of ribs represented. This was necessary since the degree of preservation of bones from these areas varied greatly. By counting these bones in terms of partial or complete sets, all could be accounted for regardless of their degree of preservation. Correspondingly, the incidence rates for these areas were calculated in terms of numbers of sets represented versus the number of injured bones.

Incidence rates were calculated on a by bone rather than a by individual basis except for those mentioned above, because it was felt by the author that rates calculated in this manner offered a more precise means of quantifying traumatic injuries. Also, it allowed comparison of the cemetery burials with the commingled village remains in units both had in common; bones instead of individuals. Age and sex distribution tables were prepared using the conventional methods elaborated upon in Chapter 2.

Fractures

Cemetery occurrences of fractures account for 47.1 percent of the trauma in this sample (Table 8). Fractures occur in almost all age groups, with the majority, or 52 percent, in adult males (Table 8).

Among cemetery adults, most fractures occur in the 30+ age categories. Seventeen subadults below age 19 exhibit fractures (Table 10). Further, almost all areas of the skeleton show some evidence of fracture within the cemetery sample (Table 11).

Fractures of the head area, especially the skull vault and face, are not very frequent in the cemetery sample. In adult males from the cemetery, 14 skull vault fractures occur in a total of 94 male skulls

TABLE 10

CEMETERY FRACTURE DISTRIBUTION BY AGE AND SEX

Age Categories	M	F	I	T
Fetus-1 year	-	-	6	6
1- 4	-	-	3	3
5- 9	-	-	2	2
10-14	-	-	-	-
15-19	2	4	-	6
20-24	3	7	1	11
25-29	3	-	1	4
30-34	15	4	-	19
35-39	13	3	-	16
40+	12	13	-	25
	48	31	13	92

M = Males
F = Females
I = Indeterminate sex
T = Total number of individuals with fractures for each age group.

TABLE 11

LARSON CEMETERY: TRAUMA INCIDENCE RATES BY CATEGORY, BONE AND SEX

Affected Bone	Male					Female					Indeter. Sex				
	C	P	T	#	%	C	P	T	#	%	C	P	T	#	%
1. Fractures															
Skull Vault	72	22	94	14	15.0	67	15	82	3	3.7	56	308	364	2	0.6
Skull Face	72	22	94	11	11.7	67	15	82	9	11.1	56	308	364	1	0.3
Mandible	66	19	85	0	0.0	57	16	73	0	0.0	93	180	273	0	0.0
Cervical Vertebrae*	34	53	87	1	1.2	31	48	79	0	0.0	10	20	30	0	0.0
Thoracic Vertebrae*	28	60	88	6	6.9	22	58	80	4	5.0	6	303	309	0	0.0
Lumbar Vertebrae*	34	55	89	1	1.1	33	43	76	2	2.6	7	24	31	0	0.0
Sacrum	53	35	88	0	0.0	42	35	77	1	1.3	6	75	81	0	0.0
Sternum	54	23	77	0	0.0	40	36	76	1	1.3	3	47	50	0	0.0
Left Scapula	47	37	84	0	0.0	47	27	74	0	0.0	129	107	236	0	0.0
Right Scapula	45	37	82	1	1.2	44	31	75	0	0.0	139	96	235	0	0.0
Left Clavicle	68	16	84	2	2.4	60	14	74	0	0.0	134	72	206	1	0.5
Right Clavicle	73	32	105	1	0.9	60	14	74	3	4.1	136	69	205	1	0.5
Left Ribs*	-	-	85	4	4.7	-	-	82	4	4.9	-	-	333	4	1.2
Right Ribs*	-	-	87	4	4.6	-	-	82	4	4.9	-	-	333	2	0.6
Left Humerus	61	24	85	1	1.2	68	13	81	1	1.2	182	103	285	0	0.0
Right Humerus	68	16	84	2	2.4	58	18	76	1	1.3	188	93	281	1	0.4
Left Radius	60	20	80	0	0.0	60	15	75	2	2.7	149	85	234	2	0.9
Right Radius	55	22	77	1	1.3	64	11	75	2	2.7	153	85	238	3	1.3
Left Ulna	57	25	82	2	2.4	56	20	76	2	2.6	145	94	239	0	0.0
Right Ulna	63	21	84	0	0.0	60	16	76	1	1.3	145	94	239	1	0.4
Left Hand*	6	46	52	0	0.0	6	51	57	0	0.0	0	55	55	0	0.0
Right Hand*	6	46	52	0	0.0	7	51	58	0	0.0	0	55	55	0	0.0
Left Innominate	50	32	82	2	2.4	45	37	82	0	0.0	35	223	258	0	0.0
Right Innominate	45	35	80	0	0.0	43	37	80	0	0.0	50	230	280	0	0.0
Left Femur	69	21	90	0	0.0	62	21	83	0	0.0	189	123	312	0	0.0
Right Femur	70	23	93	0	0.0	60	23	83	0	0.0	192	122	314	0	0.0

TABLE 11 (continued)

Affected Bone	Male					Female					Indeter. Sex				
	C	P	T	#	%	C	P	T	#	%	C	P	T	#	%
Left Tibia	70	24	94	0	0.0	59	25	84	0	0.0	162	128	290	0	0.0
Right Tibia	71	20	91	0	0.0	61	21	82	0	0.0	171	109	280	0	0.0
Left Fibula	64	20	84	2	2.4	52	26	78	0	0.0	154	100	254	1	0.4
Right Fibula	65	20	85	2	2.4	53	21	74	0	0.0	112	90	202	0	0.0
Left Patella	66	1	67	0	0.0	65	0	65	0	0.0	20	1	21	0	0.0
Right Patella	75	1	76	1	1.3	66	0	66	0	0.0	26	1	27	0	0.0
Left Foot*	10	52	62	4	6.5	8	53	11	0	0.0	0	61	61	0	0.0
Right Foot*	66	19	85	0	0.0	57	16	73	0	0.0	93	180	273	0	0.0
2. Scalping															
Skull Vault	72	22	94	2	2.1	67	15	82	2	2.4	56	308	364	1	0.3
3. Proj. Pt. Inj.															
Thoracic Vertebrae*	28	60	88	0	0.0	22	58	80	1	1.3	6	303	309	0	0.0
Lumbar Vertebrae*	34	55	89	2	2.3	33	43	76	0	0.0	7	24	34	0	0.0
Sternum	54	23	77	1	1.3	40	36	76	0	0.0	3	47	50	0	0.0
Left Scapula	47	37	84	1	1.2	47	27	74	0	0.0	129	107	236	0	0.0
Left Humerus	61	24	85	0	0.0	60	12	72	1	1.4	182	103	285	0	0.0
4. Loc. Perio.															
Right Clavicle	73	32	105	0	0.0	60	14	74	1	1.4	134	72	206	0	0.0
Right Humerus	68	16	84	0	0.0	58	18	76	0	0.0	188	93	281	1	0.4
Left Femur	69	21	90	1	1.1	62	21	83	0	0.0	189	123	312	0	0.0
Right Femur	70	23	93	0	0.0	60	23	83	0	0.0	192	122	314	0	0.0
Left Tibia	70	24	94	2	2.1	59	25	84	1	1.2	162	128	290	1	0.3
Right Tibia	71	20	91	3	3.3	61	21	82	3	3.7	171	109	280	0	0.0
Left Fibula	64	20	84	3	3.6	52	26	78	1	1.3	154	100	254	1	0.4
Right Fibula	65	20	85	3	3.5	53	21	74	2	2.7	112	90	202	0	0.0

TABLE 11 (continued)

Affected Bone	Male					Female					Indeter. Sex				
	C	P	T	#	%	C	P	T	#	%	C	P	T	#	%
5. Dislocations															
Mandible	66	19	85	3	3.5	57	16	73	2	2.7	93	180	273	0	0.0
Left Scapula	47	37	84	1	1.2	47	27	74	0	0.0	129	107	236	0	0.0
Right Scapula	45	37	82	0	0.0	44	31	75	1	1.3	139	96	235	0	0.0
Left Humerus	61	29	90	1	1.1	68	13	81	0	0.0	182	103	285	0	0.0
Right Humerus	68	16	84	0	0.0	58	18	76	1	1.3	188	93	281	0	0.0
6. Sprains/Avul.															
Right Femur	70	23	93	1	1.1	60	23	83	0	0.0	192	122	314	0	0.0
Left Fibula	64	20	84	2	2.4	52	20	72	4	5.6	154	100	254	0	0.0
Right Fibula	65	20	85	2	2.4	53	21	74	1	1.4	112	90	202	0	0.0
7. Hetero. Bone															
Left Clavicle	68	16	84	1	1.2	60	14	74	0	0.0	134	72	206	0	0.0
Right Clavicle	73	32	105	0	0.0	60	14	74	0	0.0	136	69	205	0	0.0
Left Scapula	47	37	84	0	0.0	47	27	74	0	0.0	129	107	236	0	0.0
Right Scapula	45	37	82	1	1.2	44	31	75	0	0.0	139	96	235	0	0.0
Left Radius	60	20	80	0	0.0	60	15	75	0	0.0	149	85	234	0	0.0
Right Radius	55	22	77	0	0.0	64	11	75	1	1.3	153	85	238	0	0.0
Left Ulna	57	25	82	0	0.0	56	20	76	1	1.3	145	94	239	0	0.0
Left Innominate	50	32	82	1	1.2	45	37	82	0	0.0	35	223	258	0	0.0
Left Femur	69	21	90	1	1.1	62	21	83	0	0.0	189	123	312	0	0.0
Left Tibia	70	24	94	3	3.2	59	25	84	1	1.2	162	128	290	0	0.0
Right Tibia	71	20	91	6	6.6	61	21	82	2	2.4	171	109	280	0	0.0
Left Fibula	64	20	84	3	3.6	52	26	78	1	1.3	154	100	254	0	0.0
Right Fibula	65	20	85	8	9.4	53	21	74	5	6.8	112	90	202	0	0.0
Right Patella	75	1	76	1	1.3	66	0	66	0	0.0	26	1	27	0	0.0
8. Unknown Trauma															
Face	72	22	94	1	1.1	67	15	82	0	0.0	56	308	364	0	0.0
Mandible	66	19	85	1	1.2	57	16	73	0	0.0	93	180	273	0	0.0

TABLE 11 (continued)

Affected Bone	Male					Female					Indeter. Sex				
	C	P	T	#	%	C	P	T	#	%	C	P	T	#	%
Cervical Vertebrae*	34	53	87	0	0.0	0	0	0	0	0.0	10	20	30	1	3.3
Sacrum	53	35	88	1	1.1	42	35	77	0	0.0	6	75	21	0	0.0
Left Clavicle	68	16	84	2	2.4	57	15	72	1	1.4	134	72	206	0	0.0
Right Clavicle	64	22	86	3	3.5	60	14	74	0	0.0	136	69	205	0	0.0
Left Scapula	47	37	84	0	0.0	47	27	74	1	1.4	129	107	236	0	0.0
Right Scapula	45	37	82	0	0.0	44	31	75	0	0.0	139	96	235	1	0.4
Left Humerus	61	24	85	1	1.2	68	13	81	1	1.2	182	103	285	0	0.0
Right Humerus	68	16	84	0	0.0	58	18	76	1	1.3	188	93	281	0	0.0
Left Radius	60	20	80	1	1.3	60	15	75	0	0.0	149	85	234	0	0.0
Right Radius	55	22	77	0	0.0	64	11	75	0	0.0	153	85	238	0	0.0
Left Ulna	57	25	82	2	2.4	56	20	76	0	0.0	145	94	239	0	0.0
Right Ulna	63	21	84	2	2.4	60	16	76	3	3.9	145	94	239	0	0.0
Left Hand*	6	46	52	0	0.0	6	51	57	0	0.0	0	55	55	0	0.0
Right Hand*	6	46	52	1	1.9	7	51	58	0	0.0	0	55	55	0	0.0
Left Innominate	50	32	82	2	2.4	45	37	82	0	0.0	35	223	258	0	0.0
Right Innominate	45	35	80	0	0.0	43	37	80	0	0.0	50	230	280	1	0.4
Left Femur	69	21	90	0	0.0	62	21	83	1	1.2	189	123	312	0	0.0
Right Femur	70	23	93	0	0.0	60	23	83	2	2.4	192	122	314	0	0.0
Left Tibia	70	24	94	2	2.1	59	25	84	1	1.2	162	128	290	0	0.0
Right Tibia	71	20	91	5	7.0	61	21	82	1	1.2	171	109	280	0	0.0
Left Fibula	64	20	84	2	2.4	52	56	78	2	2.6	154	100	254	0	0.0
Right Fibula	65	20	85	2	2.3	53	21	74	0	0.0	112	90	202	1	0.5
Left Patella	66	1	67	1	1.5	65	0	65	0	0.0	20	1	21	0	0.0
Right Patella	75	1	76	0	0.0	66	0	66	0	0.0	26	1	27	0	0.0
Left Foot*	10	52	62	2	3.2	8	53	61	1	1.6	0	61	61	0	0.0
Right Foot*	9	52	61	0	0.0	8	53	61	0	0.0	0	61	61	0	0.0

*Bones designated were counted in terms of partial or complete sets, due to widely varied degrees of preservation. Number affected represents single injuries.

TABLE 11 (continued)

C = Number of complete bones for each sex.
P = Number of partial bones for each sex.
T = Total number of bones present for each sex.
# = Number of bones for each sex with trauma.
% = Percent of total number of bones that are traumatic, #/T.

for an incidence rate of 15 percent (Table 11). Eleven fractures of the nose and face are also seen in the 94 male skulls observed for an incidence rate of 11.7 percent (Table 11). Fractures in males in these two areas of the skull alone occount for 25 of the 65 fractures among individuals of this sex group.

Of the 25 males with head injuries, 11 have other injuries as well (Appendix A). Of these, one has a facial fracture, was scalped, and has a projectile point in the sternum (Fea. 301 B62B). Another individual (Fea. 201 B120B, Figure 2, Appendix B) has a skull vault fracture and was scalped, and yet another cemetery male (Fea. 201 B55I) had a fractured face and a projectile point in a lumbar vertebra. A fourth male (Fea. 301 B29C) had a fractured face and a projectile point in the left scapula.

Adult females exhibit three skull vault and nine face and nasal fractures (Table 11) out of 82 skulls for incidence rates of 3.7 percent and 11.1 percent, respectively. Five of these women exhibit other injuries as well (Appendix A), including two cases of scalping along with skull fractures.

Two skull vault fractures occur in cemetery individuals of indeterminate sex, one of whom is a child who was also scalped (Fea. 301 B53, Appendix A). One facial fracture occurs in an adult of indeterminate sex.

In order to examine the skull fracture patterns seen in the village sample, it is first necessary to examine the age and sex distribution of individuals with any kind of fracture in the village as a whole. The data are presented in Table 12.

TABLE 12

VILLAGE FRACTURE DISTRIBUTION BY AGE AND SEX

Age Categories	M	F	I	T
Fetus-1 year	-	-	-	-
1- 4	-	-	-	-
5- 9	-	-	1	1
10-14	-	1	-	1
15-19	1	1	2	4
20-24	-	-	-	-
25-29	4	2	2	8
30-34	4	1	-	5
35-39	1	-	-	1
40+	1	2	-	3
	11	7	5	23

M = Males
F = Females
I = Indeterminate sex
T = Total number of individuals with fractures for each age group.

A total of 19 village inhabitants exhibit skull fractures. Of these, eight vault and two face fractures occur in adult males out of a total sample of 22 male skulls, with incidence rates of 36.4 percent and 9.1 percent, respectively (Table 13). Adult females from the village exhibit five vault and two face fractures out of a total of 16 skulls, with incidence rates for vault fractures of 31.3 percent and face fractures of 12.5 percent (Table 13). Two additional vault fractures were observed in children of indeterminate sex (Table 13 and Appendix A).

Four village individuals show other trauma along with skull fractures (Appendix A). One male (Lodge 21 B18B) had three additional healed skull fractures, and four skull fractures occur in individuals who had also been scalped.

TABLE 13

LARSON VILLAGE: TRAUMA INCIDENCE RATES BY CATEGORY, BONE, AND SEX

Affected Bone	Male					Female					Indeter. Sex				
	C	P	T	#	%	C	P	T	#	%	C	P	T	#	%
1. Fractures															
Skull Vault	13	9	22	8	36.4	7	9	16	5	31.3	5	24	29	2	6.9
Skull Face	13	9	22	2	9.1	7	9	16	2	12.5	5	24	29	0	0.0
Mandible	16	10	26	0	0.0	12	2	14	0	0.0	6	24	30	0	0.0
Cervical Vertebrae*	13	18	31	1	3.2	6	4	10	0	0.0	9	23	32	0	0.0
Thoracic Vertebrae*	11	23	34	1	2.9	7	6	13	0	0.0	11	32	43	0	0.0
Lumbar Vertebrae*	10	20	30	1	3.3	5	7	12	1	8.3	15	15	30	0	0.0
Sacrum	12	11	23	0	0.0	7	4	11	0	0.0	12	8	20	0	0.0
Sternum	6	14	20	0	0.0	0	8	8	0	0.0	5	13	18	1	5.6
Left Scapula	5	13	18	0	0.0	3	5	8	0	0.0	6	25	31	0	0.0
Right Scapula	8	12	20	0	0.0	6	3	9	0	0.0	18	11	29	0	0.0
Left Clavicle	11	6	17	1	5.9	5	3	8	0	0.0	11	9	20	1	5.0
Right Clavicle	9	10	19	0	0.0	6	3	9	0	0.0	12	8	20	0	0.0
Left Ribs*	-	-	27	1	3.7	-	-	12	1	8.3	-	-	53	0	0.0
Right Ribs*	-	-	27	1	3.7	-	-	12	1	8.3	-	-	53	0	0.0
Left Humerus	13	4	17	0	0.0	6	2	8	0	0.0	24	15	39	0	0.0
Right Humerus	13	6	19	0	0.0	10	4	14	0	0.0	33	13	46	0	0.0
Left Radius	12	5	17	0	0.0	6	2	8	0	0.0	16	8	24	0	0.0
Right Radius	13	6	19	0	0.0	7	3	10	0	0.0	24	15	39	0	0.0
Left Ulna	10	5	15	0	0.0	6	0	6	0	0.0	15	9	24	0	0.0
Right Ulna	13	6	19	0	0.0	7	3	10	0	0.0	22	13	35	0	0.0
Left Hand*	0	3	3	0	0.0	0	3	3	0	0.0	0	4	4	0	0.0
Right Hand*	0	3	3	0	0.0	0	3	3	0	0.0	0	6	6	0	0.0
Left Innominate	11	17	28	0	0.0	7	5	12	0	0.0	8	16	24	0	0.0
Right Innominate	11	15	26	0	0.0	7	5	12	0	0.0	7	19	26	0	0.0
Left Femur	20	9	29	0	0.0	5	4	9	0	0.0	25	20	45	0	0.0
Right Femur	14	12	26	0	0.0	6	4	10	0	0.0	24	13	37	0	0.0

TABLE 13 (continued)

Affected Bone	Male					Female					Indeter. Sex				
	C	P	T	#	%	C	P	T	#	%	C	P	T	#	%
Left Tibia	11	7	18	0	0.0	6	3	9	0	0.0	29	9	38	0	0.0
Right Tibia	13	10	23	0	0.0	6	4	10	0	0.0	24	9	33	0	0.0
Left Fibula	14	9	23	0	0.0	6	5	11	0	0.0	18	21	39	0	0.0
Right Fibula	10	9	19	0	0.0	6	4	10	0	0.0	12	11	23	0	0.0
Left Patella	4	0	4	0	0.0	4	0	4	0	0.0	19	0	19	0	0.0
Right Patella	9	0	9	0	0.0	3	0	3	0	0.0	8	0	8	0	0.0
Left Foot*	0	13	13	0	0.0	0	10	10	0	0.0	2	32	34	1	2.9
Right Foot*	0	18	18	0	0.0	0	8	8	0	0.0	0	18	18	0	0.0
2. Scalping															
Skull Vault	13	9	22	9	41.0	7	9	16	6	38.0	5	24	29	2	7.0
3. Proj. Pt. Inj.	There are no projectile point injuries in the village sample.														
4. Loc. Perio.															
Left Tibia	11	7	18	0	0.0	6	3	9	0	0.0	29	9	38	1	2.6
Right Tibia	13	10	23	0	0.0	6	4	10	0	0.0	24	9	33	1	3.0
5. Dislocations															
Mandible	16	10	26	1	3.9	12	2	14	0	0.0	6	24	30	0	0.0
6. Sprains/Avul.															
Right Clavicle	9	10	19	1	5.3	6	3	9	0	0.0	12	8	20	0	0.0
Right Radius	13	6	19	1	5.3	7	3	10	0	0.0	24	15	39	0	0.0
Left Innominate	11	17	28	0	0.0	7	5	12	0	0.0	8	16	24	0	0.0
Right Innominate	11	15	26	1	3.9	7	5	12	0	0.0	7	19	26	0	0.0
Left Fibula	14	9	23	1	4.4	6	5	11	0	0.0	18	21	39	0	0.0
Right Fibula	10	9	19	1	5.3	6	4	10	0	0.0	12	11	23	0	0.0
7. Hetero. Bone															
Left Innominate	11	17	28	1	3.6	7	5	12	0	0.0	8	16	24	0	0.0
Left Femur	20	9	29	1	3.5	5	4	9	0	0.0	25	20	45	0	0.0
Right Femur	14	12	26	2	8.7	6	4	10	0	0.0	24	13	37	0	0.0

TABLE 13 (continued)

Affected Bone	Male					Female					Indeter. Sex				
	C	P	T	#	%	C	P	T	#	%	C	P	T	#	%
Right Tibia	13	10	23	2	8.7	6	4	10	0	0.0	24	9	33	0	0.0
Left Fibula	14	9	23	2	8.7	6	5	11	0	0.0	6	5	11	1	9.1
8. Unknown Trauma															
Cervical Vertebrae*	13	18	31	0	0.0	6	4	10	0	0.0	9	23	32	1	3.1
Lumbar Vertebrae*	10	20	30	0	0.0	5	7	12	1	8.3	15	15	30	0	0.0
Right Clavicle	9	10	19	0	0.0	6	3	9	1	11.1	12	8	20	0	0.0
Right Innominate	11	15	26	1	3.9	7	5	12	1	8.3	7	19	26	0	0.0
Left Femur	20	9	29	0	0.0	5	4	9	0	0.0	25	20	45	1	2.2
Left Tibia	11	7	18	0	0.0	6	3	9	0	0.0	29	9	38	1	2.6
Left Fibula	14	9	23	1	4.4	6	5	11	0	0.0	18	21	39	1	0.0

*Bones designated were counted in terms of partial or complete sets due to widely varied degrees of preservation. Number affected represents single injuries

C = Number of complete bones for each sex.
P = Number of partial bones for each sex.
T = Total number of bones present for each sex.
# = Number of bones for each sex with trauma.
% = Percent of total number of bones that are traumatic, #/T.

Vertebral and leg fractures in the cemetery indicate sex differences (Table 11, p. 35). Eight males and six females show evidence of vertebral fractures, the majority of which were compression fractures and probably due to falls (Miles, 1975). This pattern is interesting because the numbers of vertebral fractures between the sexes are so similar, suggesting that both sexes were subjected to similar situations that could produce back injuries such as those seen here.

All but one of the leg fractures seen in the cemetery sample occur in males age 14 and older, suggesting that these males were participating in some activity particularly conducive to injuries of the lower leg. There are no leg fractures among females (Table 11). A total of four leg fractures occurs in males, two each in the left and right fibulas. These occur out of a total of 84 left and 85 right fibulas, producing incidence rates of 2.4 percent and 2.4 percent, respectively (Table 11). Actually, this number is quite low considering the sample represents almost thirty-five years of site occupation. The fracture patterns and incidence rates for each sex in the cemetery sample are presented in Table 11. Cemetery fracture patterns in other parts of the skeleton are not remarkable and therefore do not warrant further discussion.

The Larson village sample presents a notable post-cranial fracture pattern (Table 13) in that all such injuries occur in the spine, shoulder girdle, and ribs, except for one foot fracture in an adult of indeterminate sex. Four vertebral fractures are found in the village sample, three in males, and one in a female. All of these appear to be compression type fractures. Other fracture sites within the village

sample are noted in Table 13. It is unusual that there are no observable fractures of the extremities in this sample. This may be due to the small sample size, or to the fact that if such fractures did occur, healing was so complete that no skeletal evidence remains.

Scalping

Scalping in the Larson cemetery sample is uncommon. Five cases, or 1.9 percent of the total cemetery trauma, fall within this category (Table 8, p. 31). Of these, two cases occur in males out of a total of 94 skulls, producing an incidence rate of 2.1 percent (Table 11, p. 35). Two female cases occur out of a total of 82 skulls for an incidence of 2.4 percent, and one case of indeterminate sex out of 364 skulls for a rate of 0.3 percent (Table 11). Four of the five victims are over age 15 (Table 14). All cases are associated with skull vault and/or facial fractures (Appendix A). One of the cemetery females (F201 B6B) who was scalped evidently survived for a time after the injury was incurred. The crown of the skull exhibits necrosis and infection, with partial destruction of the outer table.

Scalping in the village sample is much more common than in the cemetery. Seventeen cases, or 23.3 percent of the total trauma, fall into this category (Table 9, p. 32, and Table 12, p. 41). Of these, nine cases occurred in males out of 22 skulls observed for 41 percent incidence. Six cases in 16 skulls were seen in females for a 38 percent incidence rate. Two cases in 29 skulls were of indeterminate sex for a 6.9 percent rate (Table 13). Twelve of the scalping cases were seen in adults aged 20+, and five occurred in subadults between the ages of 5

TABLE 14

LARSON CEMETERY SCALPING DISTRIBUTION BY AGE AND SEX

Age Categories	M	F	I	T
Fetus-1 year	-	-	-	-
1- 4	-	-	1	1
5- 9	-	-	-	-
10-14	-	-	-	-
15-19	-	1	-	1
20-24	1	-	-	1
25-29	-	-	-	-
30-34	1	1	-	2
35-39	-	-	-	-
40+	-	-	-	-
	2	2	1	5

M = Males; F = Females; I = Indeterminate sex
T = Total number of scalped individuals for each age group

and 19 (Table 15). Since many of the village skulls were broken, it was difficult to determine definitely whether cut marks were present on any other skulls (Figure 3, Appendix B).

Projectile Point Injuries

The cemetery sample from the Larson site includes six cases of projectile point injuries, four in males, and two in females, all of whom were over age 15 (Table 8, p. 31; Table 11, p. 35; Table 16). The male cases include two points in lumbar vertebrae out of 89 sets for an incidence rate of 2.3 percent, and one each in the sternum and left scapula for an incidence rate of 1.3 percent and 1.2 percent, respectively. The two projectile point occurrences among females were in a thoracic vertebra and left humerus with incidence rates of 1.3 percent and 1.4 percent, respectively. Three of the six projectile

point cases seen occur with other injuries in the affected individuals (Fea. 201 B551 and Figure 5, Appendix B; Fea. 301 B29C and Figure 4, Appendix B; and Fea. 301 B62B). All three of these are in adult males who show facial fractures, with one also having been scalped (Appendix A).

TABLE 15

LARSON VILLAGE SCALPING DISTRIBUTION BY AGE AND SEX

Age Categories	M	F	I	T
Fetus-1 year	-	-	-	-
1- 4	-	-	-	-
5- 9	-	-	1	1
10-14	-	1	-	1
15-19	2	-	1	3
20-24	1	2	-	3
25-29	2	1	-	3
30-34	3	1	-	4
35-39	-	-	-	-
40+	1	1	-	2
	9	6	2	17

M = Males; F = Females; I = Indeterminate sex
T = Total number of scalped individuals for each age group

Lueck (1979, personal communication), in his analysis of the Larson archaeological material, points out that there might be eight additional cases of probable projectile point injuries in the cemetery sample. However, it is difficult to be certain inasmuch as the points are in body cavities and not bones; thus the evidence could be archaeological and not pathological.

TABLE 16

LARSON CEMETERY PROJECTILE POINT DISTRIBUTION
BY AGE AND SEX

Age Categories	M	F	I	T
Fetus-1 year	-	-	-	-
1- 4	-	-	-	-
5- 9	-	-	-	-
10-14	-	-	-	-
15-19	1	-	-	1
20-24	2	-	-	2
25-29	-	1	-	1
30-34	1	-	-	1
35-39	-	-	-	-
40+	-	1	-	1
	4	2	-	6

M = Males
F = Females
I = Indeterminate sex
T = Total number of individuals with projectile point injuries for each age group

There were no cases of embedded projectile points in the village sample. It is likely, though, that at least some of the residents of the final village occupation were wounded or killed by arrows. Such victims may have had soft tissue injuries only, or possible victims may have been located in a part of the village that was not excavated. It is also possible, of course, that points were removed from the injured area.

Localized Periostitis/Osteosclerosis

The Larson cemetery exhibits 23 cases of localized periostitis in 13 individuals, six males, five females, and two individuals of indeterminate sex (Table 17; Table 8, p. 31; Table 11, p. 35). Most of the cases occur in adults, with two cases in a child in the 5-9 age

category. Many of the cases seen in this sample show periosteal reaction in one or more leg bones or in both legs (Table 11, p. 35). Only two cases occur in areas of the skeleton other than the legs.

TABLE 17

LARSON CEMETERY AND VILLAGE LOCALIZED PERIOSTITIS DISTRIBUTION

	M		F		I		T	
Age Categories	C	V	C	V	C	V	C	V
Fetus-1 year	-	-	-	-	-	-	-	-
1- 4	-	-	-	-	-	-	-	-
5- 9	-	-	-	-	1	-	1	-
10-14	-	-	-	-	-	-	-	-
15-19	-	-	-	-	-	-	-	-
20-24	1	-	1	-	-	-	2	-
25-29	-	-	-	-	1	-	1	-
30-34	1	-	2	-	-	1	3	1
35-39	2	-	-	-	-	-	2	-
40+	2	-	2	-	-	-	4	-
	6	-	5	-	2	1	13	1

M = Males
F = Females
I = Indeterminate sex
T = Total number of individuals with localized periostitis by age group
C = Cemetery individuals
V = Village individuals

The village sample includes two cases of localized periostitis, both of which are in one individual of indeterminate sex (Table 17). Both the left and right tibias of this individual are affected, with incidence rates of 2.6 percent and 3.0 percent, respectively (Table 13 p. 42). This limited number of cases in the village sample may be due to the small sample size, fragmentary condition of the bones, or both.

Traumatic Dislocations

Nine traumatic dislocations were present in six cemetery individuals (Table 8, p. 31). Three males and three females were affected, all of whom were over age 20 (Table 18). The mandible was the most frequent site of injury, with three in males out of 85 mandibles for an incidence rate of 3.5 percent, and two in females out of 73 mandibles for an incidence of 2.7 percent (Table 11, p. 35). Injuries to the mandible are confined to one tempero-mandibular joint (TMJ) per individual, and do not have the appearance of being due to tooth loss or arthritis. Further, in each case the affected TMJ shows some remodeling and dislocation from its correct alignment.

TABLE 18

LARSON CEMETERY AND VILLAGE TRAUMATIC DISLOCATION DISTRIBUTION

	M		F		I		T	
Age Categories	C	V	C	V	C	V	C	V
Fetus-1 year	-	-	-	-	-	-	-	-
1- 4	-	-	-	-	-	-	-	-
5- 9	-	-	-	-	-	-	-	-
10-14	-	-	-	-	-	-	-	-
15-19	-	-	-	-	-	-	-	-
20-24	1	1	-	-	-	-	1	1
25-29	-	-	-	-	-	-	-	-
30-34	-	-	2	-	-	-	2	-
35-39	1	-	1	-	-	-	2	-
40+	1	-	-	-	-	-	1	-
	3	1	3	-	-	-	6	1

M = Males
F = Females
I = Indeterminate sex
T = Total number of individuals with dislocations for each age group
C = Cemetery individuals
V = Village individuals

Three of the cemetery mandibular dislocations appear in conjunction with other injuries (Appendix A), and one occurs along with a shoulder dislocation. Another can be associated with a facial fracture in a 35-39 year old male (Fea. 201 B85).

The other cases of traumatic dislocations in the cemetery (Appendix A) are in the left shoulder of a 40+ male (Figure 7, Appendix B), and the right shoulder of a 30-34 year old female (Figure 6, Appendix B). The male also has a mandibular dislocation, which may have occurred at the same time as the shoulder injury, although the age of occurrence of both of these dislocations is unknown.

The village sample contains only one probable TMJ dislocation out of 26 male mandibles, for an incidence rate of 3.9 percent (Table 13, p. 42). This TMJ dislocation occurs in a male age 20-24 (Table 18). The presence of other injuries in this individual is uncertain since the affected mandible was not found in association with a skeleton (Appendix A).

Sprains and Avulsions

Ten cases of sprains and/or avulsions are evident in the cemetery sample (Table 19). Five occur in males, and five in females, all of whom are adults over age 20. These cases represent 3.8 percent of the total number of traumatic injuries seen in the entire cemetery sample (Table 8, p. 31). The right femur and left and right fibulas are the bones exhibiting this kind of injury (Table 11, p. 35). In males, both the left and right fibulas have incidence rates of 2.4 percent, while females show left fibulas with four sprains out of

72 for a 5.6 percent incidence rate, and one right fibula affected out of 74, or a 1.4 percent incidence. Five of the cemetery cases occur with other leg injuries (Appendix A).

TABLE 19

LARSON CEMETERY AND VILLAGE SPRAIN AND AVULSION DISTRIBUTION BY AGE AND SEX

	M		F		I		T	
Age Categories	C	V	C	V	C	V	C	V
Fetus-1 year	-	-	-	-	-	-	-	-
1- 4	-	-	-	-	-	-	-	-
5- 9	-	-	-	-	-	-	-	-
10-14	-	-	-	-	-	-	-	-
15-19	-	1	-	-	-	-	-	1
20-24	-	-	1	-	-	-	-	1
25-29	-	-	-	-	-	-	-	-
30-34	1	2	3	-	-	-	4	2
35-39	3	1	-	-	-	-	3	1
40+	1	-	1	-	-	-	2	1
	5	4	5	-	-	-	10	4

M = Males
F = Females
I = Indeterminate sex
T = Total number of individuals with sprains and avulsions by age group
C = Cemetery individuals
V = Village individuals

The village sample contains five cases of sprain and/or avulsion injuries in four individuals, all of whom are males (Table 9, p. 32). Of these, one is a subadult aged 15-19, and the rest are adult males over age 30 (Table 19). Three of the five cases occur in the upper portion of the skeleton (Table 1, p. 5); and two involve left and right fibulae.

Heterotopic Bone

The cemetery sample shows 36 cases of heterotopic bone formations, as characterized by bony nodules (Figure 8, Appendix B), in 29 individuals (Table 8, p. 31). Nineteen of these are males aged 20 or over, and 10 are females also aged 20 or over (Table 20). All but two male and two female cases occur in lower limb bones (Table 11, p. 35). Fifteen of the male cases occur in conjunction with other injuries (Appendix A). Among the females, three show multiple injuries (Appendix A).

TABLE 20

LARSON CEMETERY AND VILLAGE HETEROTOPIC BONE DISTRIBUTION BY AGE AND SEX

	M		F		I		T	
Age Categories	C	V	C	V	C	V	C	V
Fetus-1 year	-	-	-	-	-	-	-	-
1- 4	-	-	-	-	-	-	-	-
5- 9	-	-	-	-	-	-	-	-
10-14	-	1	-	-	-	-	-	1
15-19	-	1	-	-	-	-	-	1
20-24	2	1	4	-	-	-	6	1
25-29	3	2	-	-	-	1	3	3
30-34	6	1	-	-	-	-	6	1
35-39	4	-	1	-	-	-	5	-
40+	4	-	5	-	-	-	9	-
	19	6	10	-	-	1	29	7

M = Males
F = Females
I = Indeterminate sex
T = Total number of individuals with heterotopic bone by age group
C = Cemetery individuals
V = Village individuals

Only nine cases of heterotopic bone are seen in the village sample in seven individuals (Table 9, p. 32). Six occur in males aged 10 and up, and one is in an individual of indeterminate sex aged 25-29 (Table 20). The lack of a female category for this injury is noted, with the small sample size perhaps accounting for this fact. Two of the village cases occur in conjunction with other injuries (Appendix A). All of the injuries in this category from the village sample exist in the pelvis or lower limbs (Table 13, p. 42).

Unknown Trauma

Fifty cases of unknown trauma occur in 27 cemetery individuals comprising 19.0 percent of the total number of injuries observed in the cemetery (Table 8, p. 31). Fifteen males, ten females, and two indeterminate sex individuals are affected, with all but one case occurring in adults aged 20 and above (Table 21). Many of these injuries occur in conjunction with others (Appendix A), and may have been general body reactions to traumatic injury. Kinds of injuries seen in this category in the cemetery include a fused finger (Figure 10, Appendix B), abrasion type injuries of bone that may have resulted from an undetectable healed trauma, and bone shafts that appear to be slightly out of shape and may be very well-healed fractures. Almost all areas of the skeleton are affected by injuries of unspecific but probable traumatic origin (Table 11, p. 35).

The village sample exhibits only eight cases of unknown trauma in seven individuals (Table 9). These occur in two males, three females, and two individuals of unknown sex. Three of these individuals,

two males and one of indeterminate sex, are aged 15-19, while the remainder are adults (Table 21). Bones affected include a fused right sacrum and innominate in a 15-19 year old male (Figure 11, Appendix B), as well as other injuries of an unspecific origin, but most likely traumatic (Appendix A).

TABLE 21

LARSON CEMETERY AND VILLAGE UNKNOWN TRAUMA
DISTRIBUTION BY AGE AND SEX

	M		F		I		T	
Age Categories	C	V	C	V	C	V	C	V
Fetus-1-year	-	-	-	1	-	1	-	
1- 4	-	-	-	-	-	-	-	-
5- 9	-	-	-	-	-	-	-	-
10-14	-	-	-	-	-	-	-	-
15-19	-	2	-	-	-	1	-	3
20-24	-	-	2	-	-	-	2	-
25-29	1	-	-	1	1	1	2	2
30-34	7	-	2	-	-	-	9	-
35-39	6	-	3	-	-	-	9	-
40+	1	-	3	2	-	-	4	2
	15	2	10	3	2	2	27	7

M = Males
F = Females
I = Indeterminate sex
T = Total number of individuals with unknown trauma by age group
C = Cemetery individuals
V = Village individuals

CHAPTER 5

DISCUSSION AND CONCLUSIONS

Trauma Summary

From the preceding chapters it is evident that the residents of the Larson site suffered from trauma during the period of the site's occupation. Different kinds of injuries occurred in different proportions (Table 8, p. 31; Table 9, p. 32), and seem directly related in some cases to specific activities that the Arikara were engaged in, such as sports, trade, subsistence, accidents, and warfare.

Fractures account for the greatest amount of trauma seen in both samples, as would be expected due to their ease of observation osteologically. In both samples, the majority of fractures occur in the skull vault and face (Table 11, p. 35; Table 13, p. 42), suggesting that the Arikara at Larson were at least part of the time engaged in activities conducive to fractures in this area. Most of these injuries were probably due to blows either from objects or fists, suggesting a violence, probably warfare, etiology.

Post-cranial fracture patterns in the cemetery suggest accidental causes for the most part. All of the vertebral fractures observed are of the compression variety, and are probably the result of falls (Miles, 1975). Eight occurred in males and six in females. Extremity fractures, especially in the arm, are limited in number, and again, most appear to be of accidental cause. All of the ulna fractures occur in the distal shaft near the head, in a pattern that is not unlike the

Colle's fractures derived from falls on the outstretched arm (Wells, 1964). Two are in males, three in females, and one in indeterminate sex. Radial fractures are mostly in the mid-shaft, and while probably due to falls, some could be attributed to parrying (Wells, 1964) in an effort to fend off blows to the head. One is in a male, four in females, and 5 in indeterminate sex. Humerus fractures are observed, three in males, two in females, and one in indeterminate sex, and again, are probably due to falls. The five fibula fractures observed in the cemetery sample all conform to the Pott's pattern described by Wells (1964). Four are in males and one in indeterminate sex. This kind of fracture is characteristic of a fall in which the foot is twisted on the leg (Wells, 1964), and most are probably accidental in cause. The unpatterned fractures seen in the cemetery infants and children are difficult to explain, and may be due to accidents in the home as well as to poor preservation.

To summarize the fracture patterns observed in the cemetery sample, it appears that most of the post-cranial fractures were due to accidents, and few, if any were related to the cause of death. Cranial fractures, on the other hand, appear to be evidence of violence, and a number of these injuries could have contributed to the death of the individuals affected.

With the village sample, the head injuries related to the massacre point up the victim role of the Arikaras. Post-cranial fractures unexpectedly involve parts of the skeleton other than the extremities, due, probably, to the small sample size. Also, since the villagers were the victims of a massacre, much post-mortem mutilation

and dismemberment occurred, creating disarticulation of many of the skeletons, and perhaps obliterating evidence of well-healed fractures sustained earlier. Thus it is difficult to draw meaningful conclusions concerning the patterning of the fractures seen in the Larson village.

Scalping differs greatly in occurrence between the two Larson samples. In the cemetery, only 1.9 percent of the total trauma observed was due to scalping (Table 8, p. 31), while in the village 23.3 percent of the total trauma was due to scalping, the second most frequent form of trauma occurring in that sample (Table 9, p. 32). Scalping is obviously the result of warfare from outisde aggressors, and its high occurrence in the village sample supports the contention (Owsley, Berryman, and Bass, 1977) that the terminal occupation of the Larson village ended with a massacre of the villagers, with some of the victims being scalped. The few cases of cemetery scalping suggest that the Larson inhabitants were the victims of warfare at some time prior to the final massacre, supporting the contention of historians (Abel, 1939; Beauregard, 1912; Brackenridge, 1904; Holder, 1970; Larpenteur, 1962), that the Arikara were participants in the intermittent warfare that took place among the Plains tribes during the late eighteenth century.

In reference to scalping, it is important to note that one of the female scalping victims from the cemetery exhibits infection at the injury site. She survived for some time after injury, although how long cannot be determined. The fact that she was buried in the cemetery is significant since it has been reported that males who survive scalping become self-imposed exiles from the village

(Gilmore, 1933). After death, these exiles are not buried in the village cemetery (Gilmore, 1933). There is no information regarding the treatment of female survivors of scalping. This female, at least, was cared for and buried in the cemetery. The lack of males with healing scalping wounds may be due to the exile reported by historians (Gilmore, 1933).

The occurrence of projectile point injuries was found to be restricted to the cemetery sample at Larson. The vertebral cases all occur in the anterior vertebral body, suggesting entry of the point from the front. In these cases, death was probably the outcome, since internal organs were pierced. These few cases of embedded projectile point injuries do not account for those cases in which the injury was confined to soft tissue, or in which the point was easily removed. The lack of embedded projectile point injuries in the village sample can also be ascribed to the above reasons. It has been reported (Stone, 1962; Vogel, 1970), that certain American Indian groups were quite adept in the removal and treatment of projectile point injuries.

Localized periostitis is not very frequent in either of the Larson samples (Table 8, p. 31; Table 9, p. 32). These frequencies, although low, are not unexpected since only in cases of severe blows or similar injury would localized periostitis be seen osteologically.

Dislocations of traumatic etiology are also low in occurrence in both of the Larson samples. Again, these frequencies, while low, are not unexpected since only those dislocation injuries that remained unreduced over a period of time, or those that recurred, would show any signs of deformity osteologically. Such injuries as those occurring

in the shoulder and mandible in the cemetery, and in the mandible only in the village can be attributed to falls on the outstretched arm, and to blows to the chin or to extreme yelling or yawning, in the mandibular cases (Larson and Gould, 1978; Turek, 1977). Undoubtedly, other cases of dislocation from trauma occurred, but they were probably in easily reduced joints (Stone, 1962; Vogel, 1970); so no traces of such injuries would remain archaeologically.

Sprains and avulsion injuries were also of low occurrence in both of the Larson samples. Since these injuries would have to have been severe or recurrent in a single joint in order to show in osteological samples, the low frequencies of these injuries at Larson is expected.

Heterotopic bone formations are the third highest category of trauma occurring in the Larson cemetery sample (Table 8, p. 31). Village occurrences of this injury category are also rather high (Table 9, p. 32). Injuries in this category could be the result of blows or other similar trauma to an extremity or other vulnerable site.

Unknown trauma accounts for 19 percent of the cemetery sample (Table 8), and 11.8 percent of the village sample (Table 9). The injuries in this category are all of unknown etiology but appear to have been caused by trauma. Many of these injuries were undoubtedly minor, but some, such as the fused finger (Figure 10, Appendix B), or the fused right innominate (Figure 11, Appendix B) are more dramatic responses to repeated or severe injury.

Arikara Ethnohistory

Many facets of Arikara behavior have been reported by the traders and explorers active in the Plains area during the late eighteenth and nineteenth centuries (Catlin, 1913; Abel, 1939; Lowie, 1913).

Activities of interest to the present investigation of trauma include sports, domestic activities, and medical knowledge and procedures of the Arikara.

Both sexes are reported to have been active in athletic contests (Catlin, 1913). Games and athletics enjoyed by males included ball games, hoop and pole games, archery contests, foot and horse races, and swimming (Catlin, 1913; Lowie, 1954; Abel, 1931). Besides games, males also participated in conditioning exercises designed to prepare them for their roles in village defense. Boys as young as age 12 were expected to participate in these war-training exercises (Lowie, 1954; Abel, 1939). Lacrosse, a native American game, was played by both sexes (Abel, 1939). Females also had their own athletic competitions, the most popular of which was a game called shinney, a kind of stick ball (Lowie, 1954). Many of these games and other athletic activities were reported to have been quite violent forms of exercise (Nasatir, 1952) and could have produced injuries in the younger or less skilled individuals.

Besides participation in athletics, daily work and accidents that occurred during the performance of these tasks could have also produced some of the accidental injuries observed at Larson. Domestic tasks were sex-specific. Arikara females did most of the planting and cultivation work as well as the cleaning and processing of skins and

other household chores (Denig, 1961; Holder, 1970; Lowie, 1954). Males did the hunting, fishing, and trading, including the training and trading of horses. Males also participated in village defense-related activities (Denig, 1961; Holder, 1970).

Trading was an important activity in which the Arikara played a major role during the late eighteenth and nineteenth centuries. One of the main commodities that was the object of this trade was the horse. Although the Arikara are reported to have been involved in the trade of many horses, they apparently kept only a few for their personal use (Denig, 1961; Ewers, 1968). Most Arikara men during the nineteenth century were regarded as excellent horsemen (Nasatir, 1952), and the horse was used in sport as well as for hunting and warfare (Denig, 1961; Ewers, 1968). There is no information concerning whether women rode horses.

Since the horse was a relatively recent acquisition in the Plains during the time of the Larson occupations (Holder, 1970), it seems logical to assume that not every man was equally skilled in riding. It follows, then, that some of the men got hurt as the result of riding accidents. This would especially be true in young boys who were just learning how to ride.

It is not possible, however, to distinguish riding-related injuries from other kinds of accidents, since many kinds of accidents can produce similar sorts of injuries. Also, men who were injured in this way would no doubt retain traces of such trauma long after the injury occurred, especially if the injury was severe.

The Arikara, as with most Plains Indians, were reported (Stone, 1962; Vogel, 1970) to have been adept in the treatment of traumatic injuries. Such treatment included splinting of fractures and sprains, massage and heat application to areas of injury, removal of projectiles, treatment of wounds, and the reduction of dislocations. This treatment was so skillful that in some cases Europeans went to Indian medicine men for the treatment of many kinds of trauma (Stone, 1962; Vogel, 1970). If indeed the medicine men at Larson were adept in the treatment of traumatic injuries, then it follows that only severe cases or those that did not heal properly would be visible in the archaeological samples.

Discussion

From the previously presented ethnohistoric information it can be observed that the Arikara were engaged in a number of pursuits that were conducive to accidents and the resulting injuries that would be produced.

Fractures, for the most part, appear to have resulted from accidents such as falls encountered as a result of participation in horseback riding, sports, domestic activities, and related occurrences. While it is impossible to determine the age of occurrence of most of the accidental fractures observed in the Larson cemetery, most probably occurred in young adults and adolescents. These individuals are the ones who would probably be less skillful in sports and horseback riding than older adults. There are no reports among ethnohistoric reporters of specific kinds of accidents that might have occurred, but it is likely that they did occur.

Many of the other kinds of accidental trauma reported in the Larson samples could also have been the result of mishaps from the kinds of activities pursued by the Arikara.

Violence-related trauma can in most cases be related to warfare. This is especially the case with scalping and many of the unhealed skull fractures and projectile point injuries recorded. The Arikara were known participants in intertribal raids and warfare, and the massacre of the terminal village residents supports this (Owsley, Berryman, and Bass, 1977). Some of the trauma that was the result of blows, such as localized periostitis, could also be attributed to warfare, since much of the Indian warfare reported in the Plains (Denig, 1961; Ewers, 1968; Nasatir, 1950; Lowie, 1959) involved close quarter contact. It is difficult to sort out trauma produced by blows and other similar forces into warfare or accidental causes any more clearly, since both kinds of activities could produce similar kinds of injuries.

Scalping is an interesting form of trauma since it is obviously the result of warfare, and the victim does not have to be dead to be scalped. All but one of the cemetery scalping victims apparently were scalped after death. One female survivor appears to have suffered an infection in the scalped area. This is interesting in that she was buried in the cemetery. As previously reported (Gilmore, 1933), warriors who survived scalping became self-imposed exiles from their village, and upon death were not buried in the village cemetery. Clearly, this was not the case with this female, and it may be that female scalping survivors were treated differently. The exile of male

survivors might help to explain why only one case of a scalping survivor was observed in the Larson cemetery.

Comparison with Data from Other Sites

In order to assess the importance of trauma in the lives of the Larson residents during the years of the site's occupation it is useful to compare the findings of the trauma analysis from Larson with that from other Arikara sites.

Skeletal material from two other Arikara sites in South Dakota have been subjected to pathological examination by different researchers (Palkovich, 1978; Shermis, 1969). These sites and the findings of each researcher regarding trauma will be discussed and related to the data from the present study.

The Mobridge site (39WW1) is currently thought to contain the largest skeletal sample from the Northern Plains (Jantz, 1980). Dating the site has been difficult due to the presence of at least three features comprising the cemetery area and several occupation areas (Jantz, 1980; Palkovich, 1978). Jantz (1980) has suggested that the majority of the Feature 1 burials are prehistoric. Feature 2 is probably protohistoric with about 20 percent of the burials yielding European artifacts. A date span of around 1650-1750 (Jantz, 1980; Palkovich, 1978) has been suggested with the majority of burials probably dating to around 1650-1700 (Jantz, 1980).

Palkovich (1978), in the course of her investigations into the mortality profile of the Mobridge inhabitants, conducted an examination of trauma in her samples. Her samples consisted of MO1, probably the

earlier of the features, from which she observed 167 individuals, and MO2, with 242 observed skeletons. Each of the samples was analyzed separately and trauma found was listed in the following categories: healed fractures and collapsed vertebrae, dislocations, projectile points embedded in bone, and localized periostitis. Palkovich (1978) also examined the skeletons for other pathological conditions not related to the present investigation. The numbers of injuries in each category observed in the Mobridge sample compared to those seen at Larson and Leavenworth are presented in Table 22.

Palkovich (1978) arrived at two conclusions about trauma on the basis of her research. First, all of the trauma observed at Mobridge occurred in adults. Second, none of the injuries seen probably had a direct result on the death of the individual affected.

Shermis (1969) conducted a study of the pathology found in the skeletal material from the Leavenworth site (39C09). This site, dated circa 1803-1830, is known from historical sources, so its dating is secure (Jantz, 1977). Shermis (1969) examined approximately 261 skeletons from the cemetery during the course of his research.

The trauma noted by Shermis falls into three categories: fractures, projectile injuries, and ossified exostoses. Fractures account for the majority of the trauma observed in the Leavenworth collection (Table 22). Fractures, according to Shermis (1969), afflicted 4.6 percent of the Leavenworth population, with the median age for the highest incidence in the 31-40 age range. Shermis concluded that the majority of the trauma seen in the Leavenworth sample was due to the participation of the Arikara in "hazardous" pursuits.

TABLE 22

COMPARISON OF LARSON TRAUMA WITH THAT FROM MOBRIDGE AND LEAVENWORTH

Injury	Mobridge[1]				Larson[2]				Leavenworth[3]	
	M01 (1650-1700)		M02 (1700-1750)		Cem (1750-1785)		Vill (1785)		Leav (1800-1832)	
	I	%	I	%	I	%	I	%	I	%
Fractures	1	1.0	5	2.1	124	20.1	31	44.1	16	6.1
Projectile Points[4]	1	1.0	1	0.41	6	1.0	0	0	2	1.1
Local. Periostitis	2	1.2	14	6.1	23	4.1	2	3.1	0	0
Dislocations	0	0	1	0.41	9	1.4	1	1.4	0	0
Heterotopic Bone[5]	0	0	0	0	36	6.1	9	13.1	5	2.1
	4		21		198		43		41	

[1]Mobridge: M01 - N = 167; M02 - N = 242.

[2]Larson: Cem - N = 628; Vill - N = 71.

[3]Leavenworth: N = 261 [estimate minus number of skeletons observed not reported by Shermis (1969)].

[4]Projectile point injuries at Leavenworth include a metal tip arrow and bullet (Shermis, 1969).

[5]Heterotopic bone not recorded by Palkovich (1978).

$$\% = \frac{\text{\# of injuries reported for each category}}{\text{\# of individuals observed}}$$

I = # of injuries in each category reported for each site.

Sources: Mobridge data from Palkovich (1978) and Jantz (1980). Leavenworth data from Shermis (1968).

Since different classifications of trauma were used in each of the comparative studies mentioned, the data in Table 22 are compared among the various sites in categories each of the studies had in common. Several interesting patterns can be noted in Table 22. First, it appears that the incidence of fractures increased through time up until circa 1790, after which they decrease again in frequency. Part of the reason for this decrease may be due to an increase in the skill with which these injuries were being treated. It has been reported (Stone, 1962; Vogel, 1970), that by the time of regular European contact many of the Plains tribes had become very skillful in the treatment of traumatic injuries, including fractures. Well-splinted fractures can heal so completely that they may not be visible archaeologically, especially in young, hardy individuals (Turek, 1977).

The sharp decrease in fractures after 1790 can also be related to the increasing skill of the Arikara in the training and riding of horses. Nineteenth century Arikara were reported to have been excellent horsemen (Nasatir, 1952), so it is likely that fewer riding mishaps occurred at that time, which coincides with the occupation of the Leavenworth site. Low fracture rates at Mobridge may also be related to this since that site for the most part predates the arrival of the horse in sizable numbers in the Plains (Holder, 1970).

The decrease in fractures may also be related to a possible change in behavior, especially in terms of leisure pursuits. A decrease in fractures due to accidents could also point to the need of the

nineteenth century Arikara to concentrate on activities related to preparation for village defense (Catlin, 1913).

Projectile point injuries remained low in all the samples, and again, this may be testament to the skill of Arikara medicine men in the removal and treatment of projectile point injuries (Stone, 1962; Vogel, 1970). Heterotopic bone formations were not observed by Palkovich (1978) while Shermis reports five cases that are believed of traumatic origin at Leavenworth. The highest incidence of this injury category is in the Larson village sample.

Conclusions

From the results of the trauma analysis conducted as a part of this research, the following conclusions concerning the residents of the Larson site can be drawn.

First, the data collected as a result of this investigation suggest that the occurrence of accident-related deaths is quite low in both of the Larson samples, as is also the case at Mobridge (Palkovich, 1978) and Leavenworth (Shermis, 1969). War-related injuries and resulting deaths are evident in low frequencies in the Larson cemetery. Warfare appears to have been the major cause of death in the village sample (Owsley, Berryman, and Bass, 1977; Owsley and Bass, 1979). The data in Table 22 further support this. It can be noted that the highest incidence of fractures among the sites being compared occurs in the Larson village sample. Also, the amount of heterotopic bone injuries is also much higher here than elsewhere. Both of these categories in the village sample, at least, represent occurrences of violent, blow-type injuries to the head and extremities. The high

incidence of scalping here also supports the warfare idea. Apparently, from the data at hand, the residents of the Larson village were the victims of much more violent types of non-accidental trauma than in either the cemetery or at the other sites. Reasons for this could include more active participation in warfare, the commingled and incomplete nature of the sample, or both.

The large number of accident-related injuries in the Larson cemetery sample indicated active participation by both sexes and most age groups in athletic pursuits as well as domestic activities. This has been substantiated by ethnohistoric reporters (Abel, 1939; Beauregard, 1912; Brackenridge, 1904; Catlin, 1913; Holder, 1970; Larpenteur, 1962).

Finally, it can be seen that pathology studies such as the present investigation of trauma can yield useful data on the behavior patterns of skeletal populations. This can be especially useful in the absence of ethnographic records for some samples.

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APPENDIXES

APPENDIX A

List of Symbols

Sex 1 = Male
2 = Female
3 = Indeterminate

Age 1 = F-1 year
2 = 1-4
3 = 5-9
4 = 10-14
5 = 15-19
6 = 20-24
7 = 25-29
8 = 30-34
9 = 35-39
10 = 40+

Trauma Categories

1 = Fracture
2 = Scalping, cut marks
3 = Projectile point
4 = Localized periostitis
5 = Dislocations
6 = Sprain, avulsion
7 = Heterotopic bone
8 = Unknown trauma

Parts of the Skeleton

V = Vault
M = Mandible
Cerv. = p #
p = pathology (trauma category)
# = number of vertebrae affected
Thor. = P #
Lumb. = P #
S = Sacrum
Co = Coccyx
St = Sternum
LSc = Left scapula
RSc = Right scapula
LCl = Left clavicle
RCl = Right clavicle
LRib = P #
P = trauma category
# = number of ribs affected
RRib = P #
LHu = Left humerus
RHu = Right humerus

LRa = Left radius
RRa = Right radius
LUl = Left ulna
RUL = Right ulna
LHd = Left hand
RHd = Right hand
LPl = Left innominate
RPl = Right innominate
LFm = Left femur
RFm = Right femur
LTi = Left tibia
RTi = Right tibia
LFi = Left fibula
RFi = Right fibula
LPt = Left patella
RPt = Right patella
LFt = Left foot
RFt = Right foot

TABLE A.1

INVENTORY OF CEMETERY INDIVIDUALS WITH TRAUMATIC INJURIES

Feat.	Burial	Sex	Age	V	F	M	Cerv. ♀	Cerv. ♂	Thor. ♀	Thor. ♂	Lumb. ♀	Lumb. ♂	S	Co	St	LSc	RSc	LCl	RCl	LR1b ♀	LR1b ♂	RR1b ♀	RR1b ♂	LHu	RHu	LRa	RRa	LUl	RUl	LHd	RHd	LPl	RPl	LFm	RFm	LTi	RTi	LFi	RFi	LPt	RPt	LFt	RPt
101	7	2	6																					8	8										8								
	10B	3	3																						4	1																		
	10C	2	6																							1														6				
	12B	2	8			5																					1		1														
	20B	3	2																			1	1																				
	26A	3	1																	1	1															7							
	27C	1	10														7																			4	4						
	29C	1	10	1																																			4				
	33B	2	8						1	3					1				1	1	4	1	4																			8	
	33E	1	8																			1	1			1	1																
	34A	3	2																	1	3																						
	35C	3	1														8																										
	36	3	1																	1	1													7									
	40B	1	8		1																																						
	9B	2	9																1			1	1																				
201	3A	2	10													8								3																			
	3E	1	10	1																								8	8													
	4C	1	10			5										5								5																			
	6A	1	9	1																					1													1					
	6B	2	8	2	1																																7		7				
	7B	1	9																															1								
	8A	1	8																	1	2																						
	11A	3	1																																								
	12D	1	10		1																							1				1										
	12H	2	6																																							1	
	14D	2	5						1	2																1		1											7				
	19D	2	6																1																8					8			
	22B	1	10																	1	1																						
	26B	2	10		1				1	1																																
	33	2	10																							7																
	33C	1	9															8						8																			
	34B	2	8														5		4						5											4	4	4	4				
	35C	2	5		1												1																				4	4				
	36	2	10																																				7				

TABLE A.1 (continued)

Fea. #	Bur. #	Sex	Age	V	F	M	Cerv. ♀	Cerv. ♂	Thor. ♀	Thor. ♂	Lumb. ♀	Lumb. ♂	S	Co	St	LSc	RSc	LCl	RCl	LRib ♀	LRib ♂	RRib ♀	RRib ♂	LHu	RHu	LRA	RRa	LUl	RUl	LHd	RHd	LPl	RPl	LFm	RFm	LTi	RTi	LFi	RFi	LPt	RPt	LFt	RFt
201	38D	2	10		1																																							
	54A	1	6																																									
	55I	1	6		1				3	1																																	1	
	56D	2	8																	1	1	1	1																					
	56E	1	9	1																																								
	59	2	10																			1	1																7					
	63B	1	6	1					1	2																											7			7		1			
	63C	1	10															1																		7							1	
	64A	2	10																																			7	7					
	64B	1	8																																	7	7						
	66	1	7																1																				1				
	68A	1	9		1																							8	8							8	8	8					
	69B	1	9						1	1	1	2															7																
	71B	1	6																																									
	71E	1	9																			1	2																7					
	75A	1	8						1	12															1													8						
	79	2	10																																									
	81	3	1																	1	1																		7					
	83	1	7				1	2																															6					
	84C	2	10																													8	4					8	7			1		
	85	1	9		1	5																							1														
	93D	2	6																								1																	
	94	1	9																	1	2	1	1																7					
	97G	1	9																																					8					
	101B	2	10																																	8	8							
	110B	3	1																																									
	113B	1	9																																									
	114B	2	6																																									
	117	2	8																																					7					
	120B	2	5	2,1																																						1			
	122B	2	6																																										
	123B	1	8	1																															7									
	124C	2	10																												8													
	124F	2	9																	1	1																							

TABLE A.1 (continued)

Fea. #	Bur. #	Sex	Age	V	F	M	Cerv.		Thor.		Lumb.		S	Co	St	LSc	RSc	LCl	RCl	LRib		RRib		LHu	RHu	LRa	RRa	LUl	RUl	LHd	RHd	LPl	RPl	LFm	RFm	LTi	RTi	LFi	RFi	LPt	RPt	LFt	RFt
							♀	♂	♀	♂	♀	♂								♀	♂	♀	♂																						
201	124G	1	8																										8														
	127B	1	9														1																											
	129A	1	8		8	8														1	1	1	1													7		7						
	129B	2	10		1																																							
	133A	2	7						3	1																																		
	142	2	6		1																																							
	145D	1	8		1																																7							
	147B	3	3																	1																								
	148D	2	10	1																							1																
	148E	1	8	1																																							
	148F	1	10																																								
	148G	1	10																																								
	148H	1	10	1																																							
	13A	2	10		1																																							
	26C	2	10		1																																							
	43A	2	10		1																																							
	69C	1	10						1	5																													6			7			
	84E	1	8		1																																							
	84G	1	8		1																																					7			
301	10	1	10	1																																							
	11	1	9																																					7			
	3D	1	7																8																								
	3P	2	9	1																																							
	3G	2	10	1																																							
	3H	1	8																										8														
	4	3	1														1											1															
	12C	1	8				1	2									1																											
	12F	2	9																																								
	16	2	10																																								1
	17	1	10						1	1	1	1																1															
	21	1	6			5																																					
	22	2	8				1	1																																			
	27D	1	8										8	1					8						1														6						
	29B	2	10								1	1	1	1																														

TABLE A.1 (continued)

Fea. #	Bur. #	Sex	Age	V	F	M	Cerv. ♀	Cerv. ♂	Thor. ♀	Thor. ♂	Lumb. ♀	Lumb. ♂	S	Co	St	LSc	RSc	LCl	RCl	LR1b ♀	LR1b ♂	RR1b ♀	RR1b ♂	LHu	RHu	LRa	RRa	LUl	RUl	LHd	RHd	LPl	RPl	LFm	RFm	LTi	RTi	LFi	RFi		RPt	LFt	RFt
301	29C	1	5		1											3																								1				
	33A	2	5																				1																						
	36B	2	6																	1	1																		6					
	38A	1	8														8	8																		6								
	39A	1	5																																		8	8	8					
	42	1	9	1																																								
	43	2	8																																			4	6					
	46B	1	9		1																																							
	46C	1	9				1	2																																				
	49A	2	9														8																											
	50B	2	10																																									
	50G	1	6						3	1																																		
	50H	1	6	2,1																																								
	52	3	6	1																																								
	53	3	2	2,1																																		7	7					
	54A	1	8	1																														1					8				
	54D	1	7																															8									
	60B	2	9		5																																	8		8				
	60C	1	8														7																						6					8
	62B	1	8	2,1												3																												
	73	2	8																																			4		7				
	77B	2	6														1																					8		7,6				

TABLE A.2

INVENTORY OF VILLAGE INDIVIDUALS WITH TRAUMATIC INJURIES

Lodge #	Bur. #	Sex	Age	V	F	M	Cerv. ♀	Cerv. ♂	Thor. ♀	Thor. ♂	Lumb. ♀	Lumb. ♂	S	Co	ST	LSc	RSc	LCl	RCl	LRibs ♀	LRibs ♂	RRibs ♀	RRibs ♂	LHu	RHu	LRa	RRa	LUl	RUl	LHd	RHd	LPl	RPl	LFm	RFm	LTi	RTi	LFi	RFi	LPt	RPt	LFt	PFt
Fea 104	1A	2	8	1,2	1																															8		7						
104	1E	1	6			5																																						
104	2A	2	5	1																																								
104	2B	1	10	2																																								
	2B			1																																								
104	2C	2	6	2																																								
104	2D	3	5	2																																								
	2D			1																																								
104	3B	1	7	2	1																																							
104	3C	2	10	1																																								
	3C			2																																								
104	4A	1	9	1																																								
104	4B	1	5	2																																								
104	4C	1	7	2																																8								
104	6A	3	7																																		7							
104	11A	3	7																																									
104	12	2	10		1														8	1	2		1																					
104	13A	1	8				1	1			2	1																																	
104	15	2	7	1																																								
Lodge 23	2	1	5																																8	7	7		7						
23	4	1	7				2	1																																				
Lodge 1	3	1	8	1	1																																							
1	4	2	4	1																																								
	4			2																																								
1	5A	3	3	1																																								
	5A			2																																								
Lodge 21	2A	1	5	1,2																																									
21	6B	1	4																									2		2														
21	7	2	7	2							8	2																										7							
21	11A	2	6	2																																								
21	11C	3	8																																									
21	12A	1	8																																6			4	4						
21	17A	1	6	2																																								
21	53	1	8	2																																								

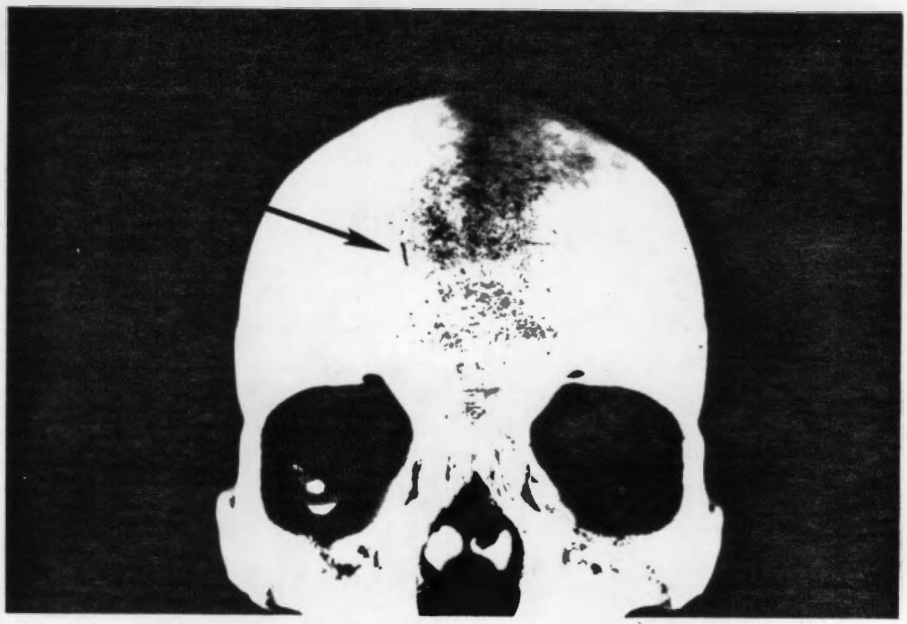
TABLE A.2 (continued)

Lodge #	Bur. #	Sex	Age	V	F	M	Cerv. P	Cerv. J	Thor. P	Thor. J	Lumb. P	Lumb. J	S	Co	ST	LSc	RSc	LCl	RCl	LRibs P	LRibs J	RRibs P	RRibs J	LHu	RHu	LRa	RRa	LUl	RUl	LHd	RHd	LPl	RPl	LFm	RFm	LTi	RTi	LFi	RFi	LPt	RPt	LFt	RFt
21	16S	1	8	1																																								
	16B			1																																								
	16B			1																																								
	16B			1																																								
21	21A	1	8	2															6																										
21	21B	1	8	2																																									
21	8C	1	8																																7										
21	23A	1	9																								6																		
21	23B	2	10																														8												
21	27	1	7						1	2	1	2																																	
21	30	1	8															1																											
21	32B	2	7								1	1																																	
21	33	1	7																	1	1	1	1										7												
21	34	1	5																																				6		6					
21	35E	3	5															1																											
21	43A	1	5																																			8							
21	45A	1	7																																			7							
21	46A	1	6																																			7							
21	31A	3	7																																									1
21	20A	3	7											1																														

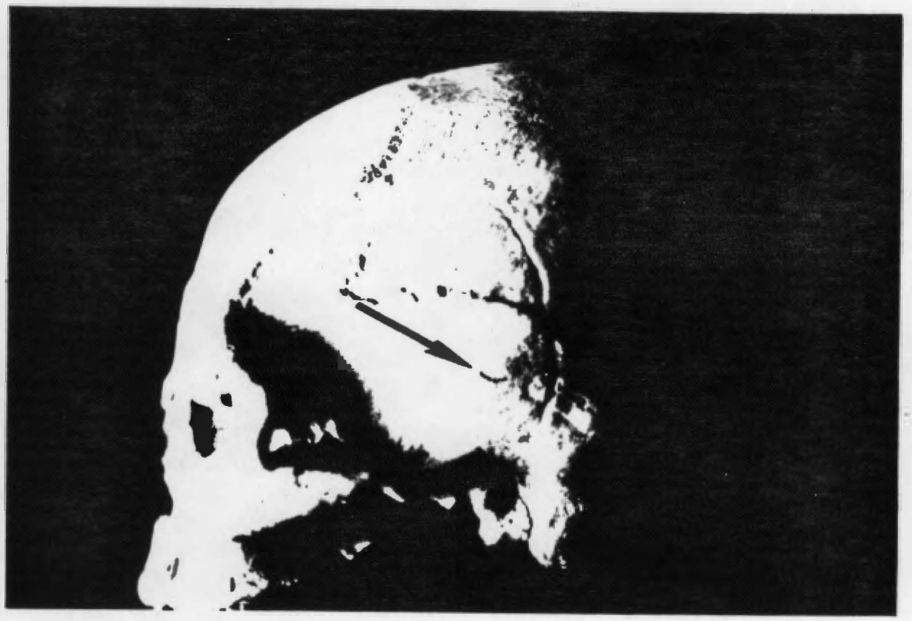
APPENDIX B

Figure 1. Healed fracture of the left cheekbone. Larson Cemetery (Feature 201 B68A, Male 35-39).

Figure 2. Skull vault wound due to blow from an axe or similar weapon. Larson Cemetery (Feature 201 B120B, Female 15-19).



A. Front view



B. Side view

Figure 3. Skull with cut marks probably due to scalping. Larson Village (Area 104, No. 936, Smithsonian Institution, Female 40+).

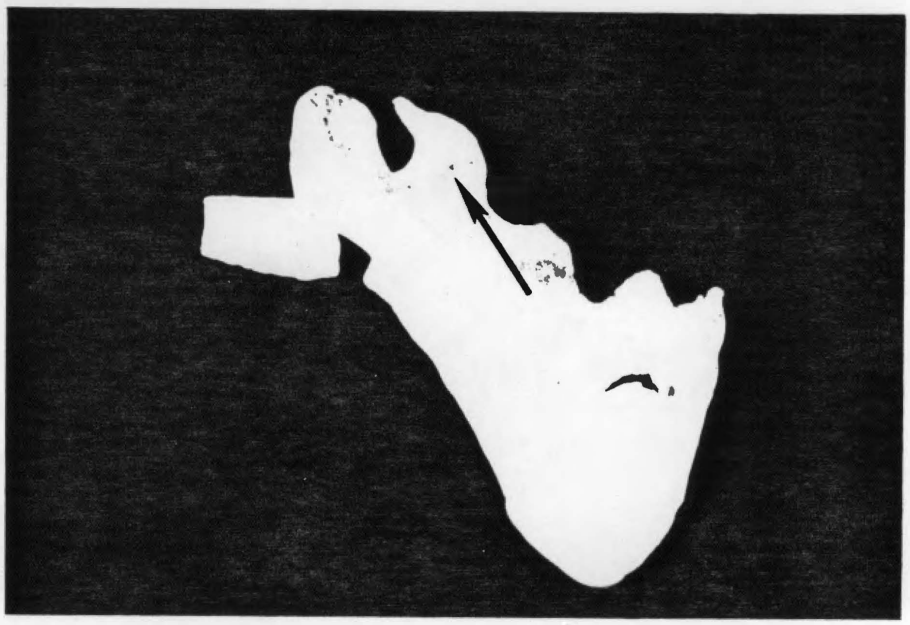


Figure 4. Scapula with projectile point tip embedded in acromian. Larson Cemetery (Feature 301 B29C, Male 15-19).

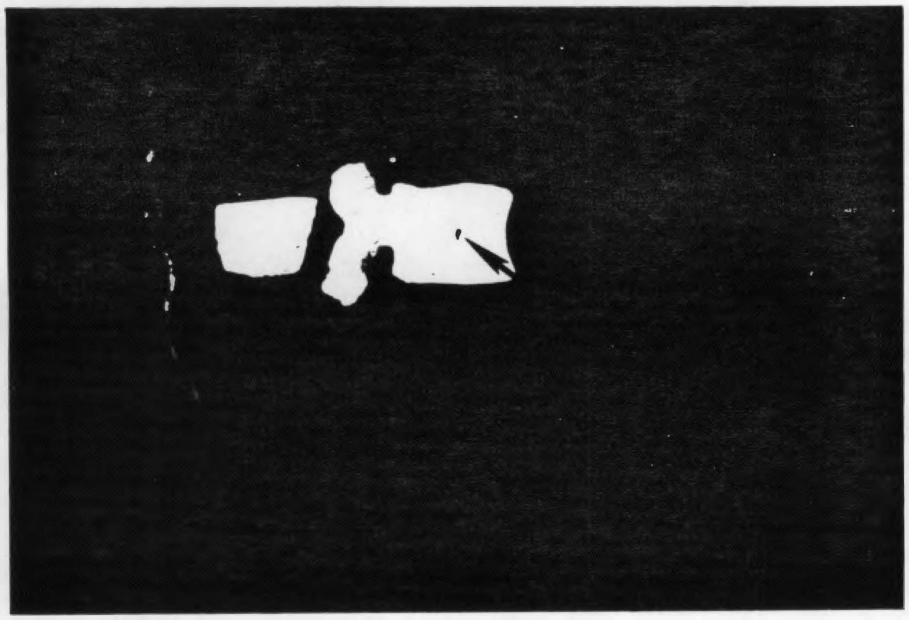


Figure 5. Lumbar vertebra with projectile point tip embedded in body. Larson Cemetery (Feature 201 B55l, Male 20-24).

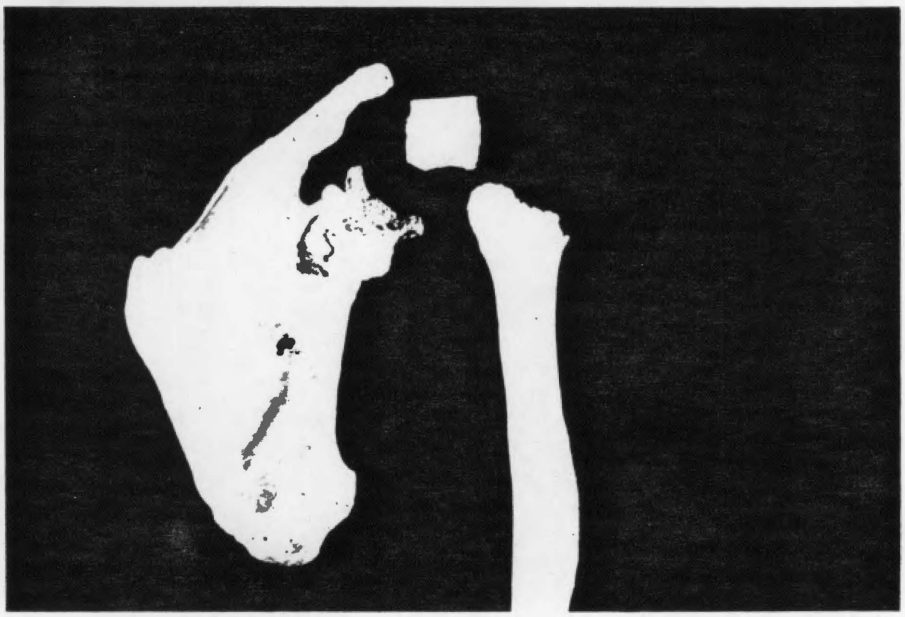


Figure 6. Traumatic dislocation of right shoulder. Larson Cemetery (Feature 201 B34B, Female 30-34).

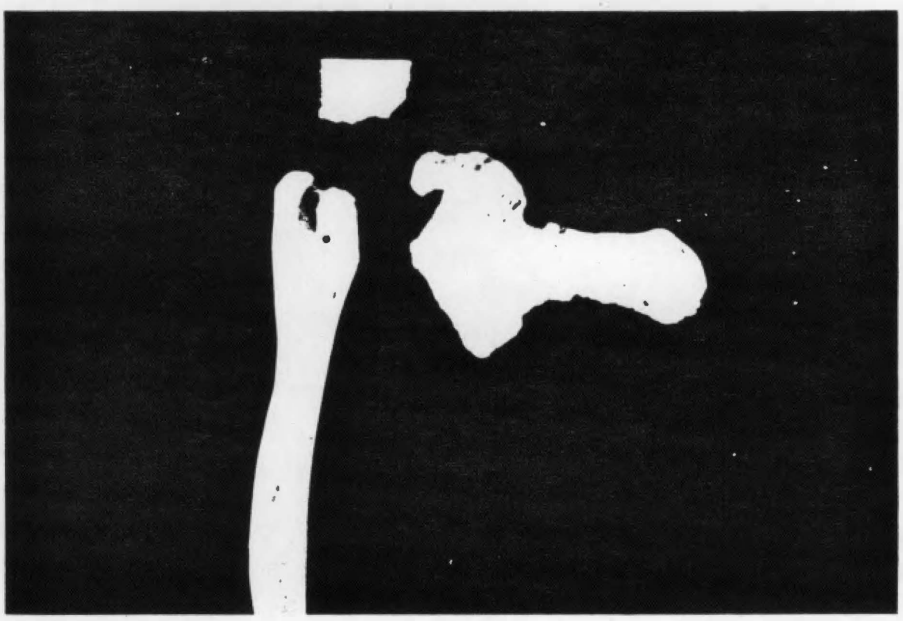


Figure 7. Traumatic dislocation of left shoulder. Larson Cemetery (Feature 101 B4C, Male 40+).

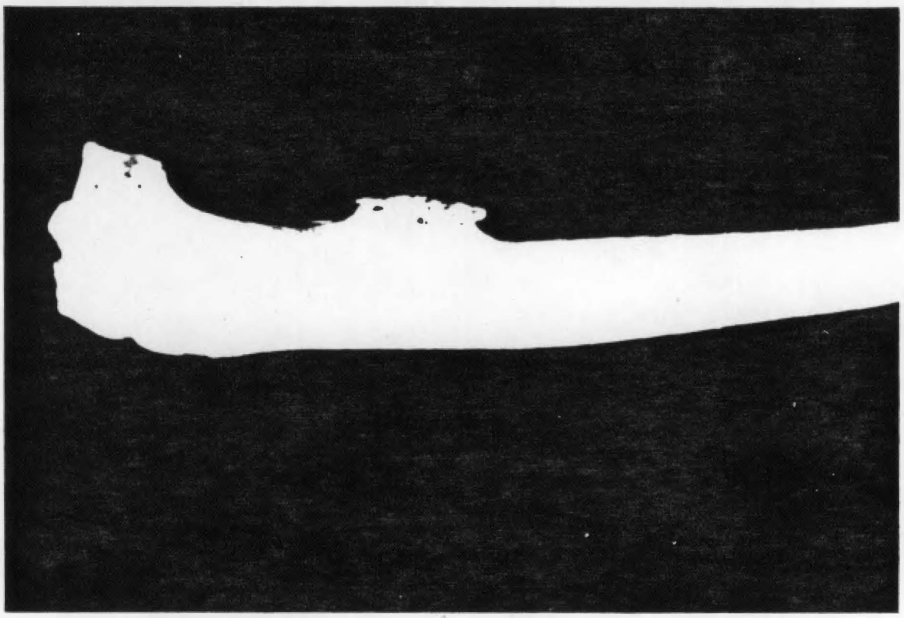


Figure 8. Heterotopic bone formation with right tibia. Larson Cemetery (Feature 101 B27C, Male 25-29).

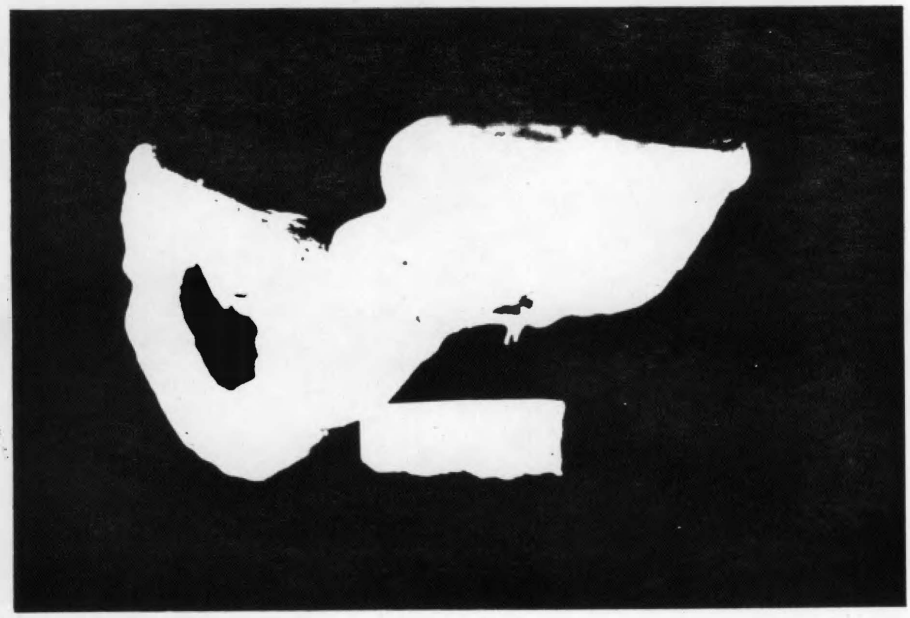


Figure 9. Ossified ligament on left innominate. (Larson Village (Lodge 21 B1405, Male 25-29).

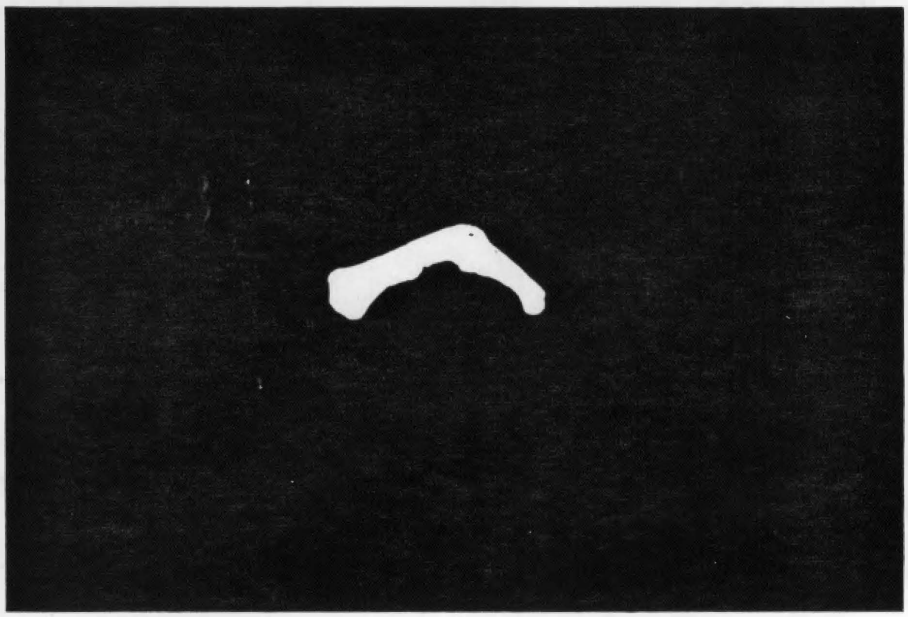


Figure 10. Fused right finger of probable traumatic origin, cause unknown. Larson Cemetery (Feature 201 B127B, Male 35-39).

Figure 11. Fused right sacrum and innominate of probable traumatic origin, cause unknown. Larson Village (Lodge 23 B2, Male 15-19).

VITA

Lynn Meredith Deitrick was born June 14, 1954, in Harrisburg, Pennsylvania. She attended elementary and junior high schools in Merrick, New York. After a family move to New Jersey in 1967, Lynn entered Freehold Regional High School and graduated in June 1972. The following fall she entered Ohio University, and after two years, transferred to The Pennsylvania State University. She was graduated from Penn State in June 1976 with a Bachelor of Arts degree in Anthropology. Lynn enrolled at The University of Tennessee, Knoxville, in January 1977, and was awarded the Master of Arts degree in August 1980.

The author is a member of the American Association of Physical Anthropologists, The Paleopathology Association, and the Medical Anthropology Society.