

SKELETAL AND DENTAL ABNORMALITIES AT A PREHISTORIC CENTRAL CALIFORNIA SITE

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ABSTRACT

This presentation provides a survey of the skeletal and oral paleopathology found in a prehistoric population from archaeological site ALA-42, located in present-day Pleasanton. These conditions were produced by both pathological and activity-induced processes. A small sample of conditions, including individuals affected by acute fracture, bacterial and fungal infection, and dental grooving, are represented at this site. Causative factors and behavioral implications are explored.

INTRODUCTION

In many prehistoric research efforts, human osteology has been used only to infer basic demographic information such as age, sex, and stature, while other areas of potential investigation have been ignored. A recent trend in physical anthropology, and more specifically in human osteological studies, has been the analysis of skeletal remains as a means of interpreting activity during the individual's life. Interpretational models have been designed and improved through the use of living populations (e.g., Krogman and Iscan 1986; Iscan and Kennedy 1989). Osteological studies

can be used to document the relative health of a population, what types of diseases they suffered from, and behavioral activity that may be associated with the disease process, among many other research questions (Iscan and Kennedy 1989; Ubelaker 1989).

This paper will present a selection of pathological conditions observed in human skeletal remains recovered from archaeological site ALA-42, located in present-day Pleasanton, Alameda County (Figure 1). The causes of these conditions and related behavioral factors will be discussed.

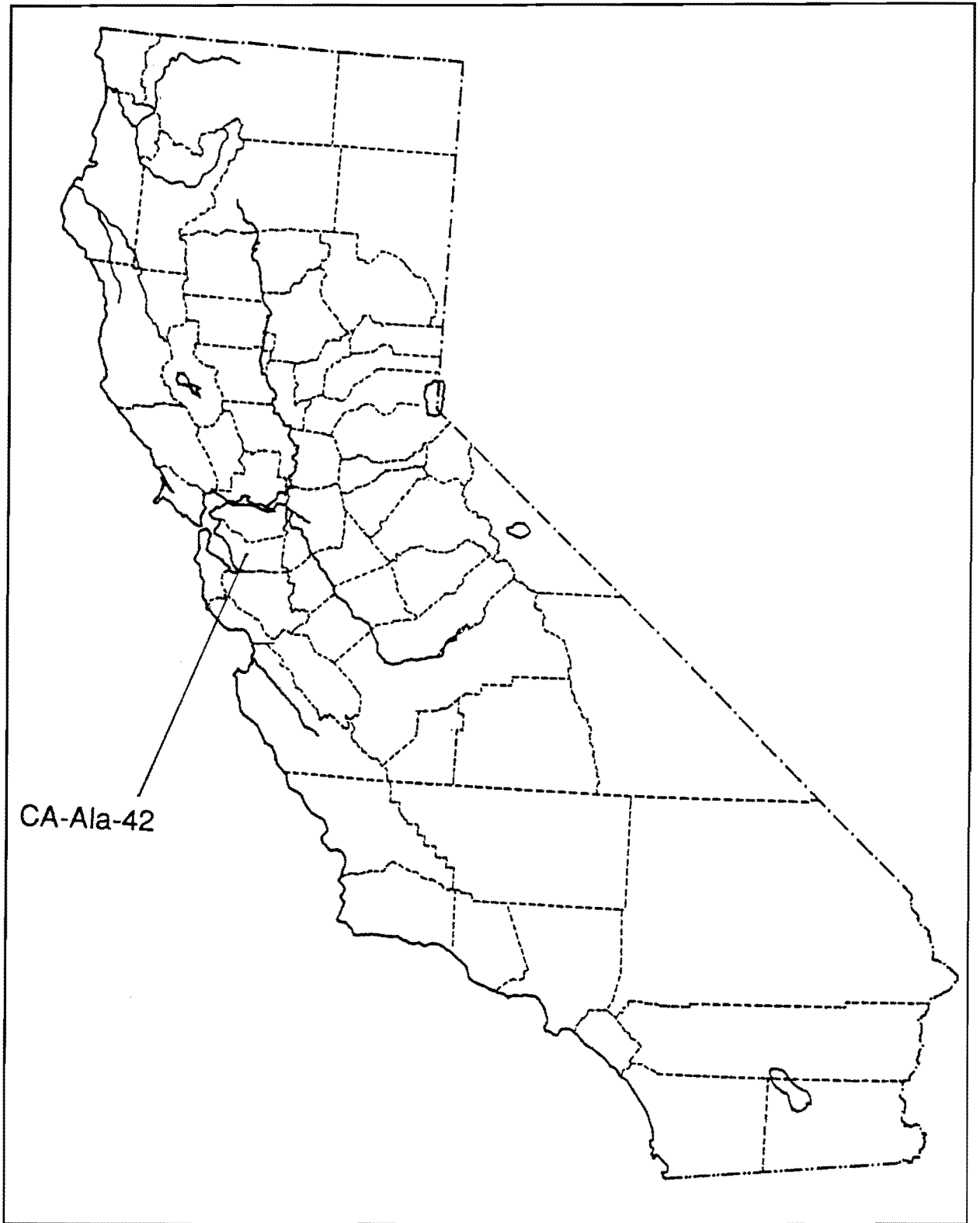


Figure 1. General location map.

MATERIALS AND METHODS

ALA-42 was excavated in the summer of 1991 as part of an emergency disinterment effort undertaken by Basin Research Associates, Inc., and the Alameda County Flood Control District, Zone 7, during modifications to the Arroyo Mocho flood channel in Pleasanton, California. Mr. Phil Galvan and Mr. Andrew Galvan made this material available to the authors for study. A minimum number of 45 individuals were recovered and identified, based upon dental and skeletal remains. Age, sex, stature, and skeletal and dental measurements were recorded using traditional osteological methods (e.g., Bass 1987; Ubelaker 1989). The material was inspected visually for any pathological conditions.

Numerous shell beads and ornaments were recovered in direct association with the burials. Stylistic typologies of these shell artifacts are considered to be temporally diagnostic for central California sites (Moratto 1984). The dates range from the Middle/Late Period Transition to the early Phase I of the Late Period. Chronologically, these periods range from AD 700 to AD 900 for the Middle/Late Period Transition, and AD 900 to AD 1100 for the early Phase I of the Late Period. Thus, the burials may be placed within a date range of AD 900 \pm 200 years (Bard n.d.).

ORAL PATHOLOGY

The oral pathologies observed include the usual range of tooth wear, dental caries, and abscess observed in other prehistoric populations from the greater San Francisco Bay area (Fong et al. 1988, 1989; James et al. 1988, 1990). The tooth wear is primarily caused by the addition of grit to the diet (Molnar 1972), introduced through the use of groundstone bowl mortars and pestles that are common to archaeological sites in California (Moratto 1984). The grit acts as an abrasive agent on the chewing surfaces of the teeth, removing enamel and exposing underlying portions of the teeth. These softer portions of the teeth are

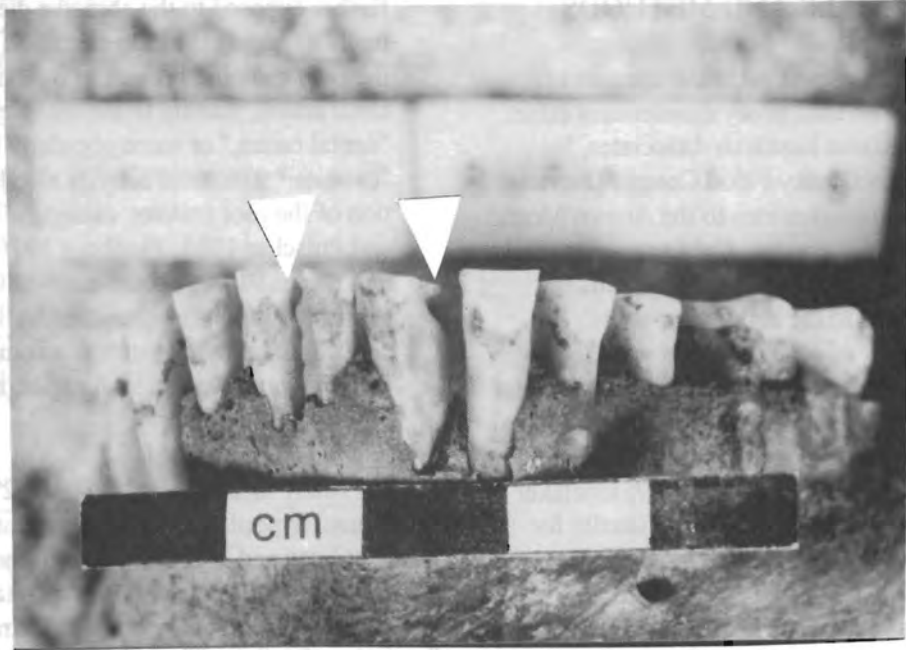
further exposed to the abrasive dietary grit, eventually exposing the pulp chamber. Once exposed, the pulp chamber is open to infection through bacterial action, leading to the disease process called "dental caries," or more popularly known as "cavities." Bacterial activity also leads to infection of the root sockets, causing abscess (Ortner and Putschar 1985; Pindborg 1970). One individual, Burial 91-30, a female aged 50-60 years, was nearly edentulous (without teeth), losing practically all of her teeth through a combination of extreme tooth wear, dental caries, and abscess.

Enamel Hypoplasia

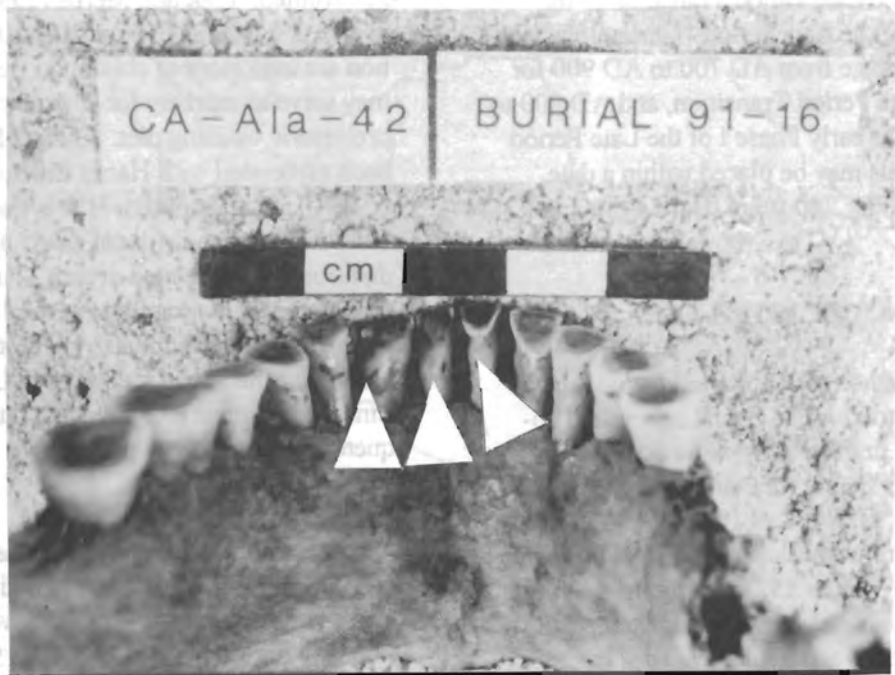
Many individuals (N=19, 42.2%) displayed enamel hypoplasia, a condition that creates distinct lines and enamel defects in the crown of a tooth. Enamel hypoplasia is a metabolic disorder, created when some event, such as nutritional stress (famine, nutrient deficiency) or infection, causes a disruption in the normal growth activity of a tooth (Goodman and Rose 1991). They occur in the developing tooth bud well before the tooth has erupted. Fink and Merbs (1991) have suggested that enamel hypoplasia in the adult dentition are indicators of childhood weaning stress and may serve as markers for deficiencies in the prehistoric weaning diet. Enamel hypoplasia has been associated with Harris Lines of the long bones. Like hypoplasia, Harris Lines are believed to be caused by nutritional stress, metabolic disturbances, or related events. These lines were observed in radiographs of several long bones from different individuals. If all of the recovered individuals had been radiographed, then Harris Lines would most likely reach a rather high frequency in this skeletal population.

Dental Grooves

Anterior grooves and abrasions were observed on six adult individuals, comprised of four females and two males. These grooves and abrasions are best illustrated on Burial 91-16, a female aged 30-40 years (Figure 2). Her mandibular incisors and canines display these dental lesions on the interproximal surfaces at the cemento-enamel junction and root, creating a polished surface. The grooves have a broad or V-shaped cross-section,



A. Burial 91-16, anterior grooves (labial view)



B. Burial 91-16, anterior grooves (lingual view)

Figure 2

dissimilar to the interproximal grooves caused by probes. Other individuals have grooves worn into the occlusal surfaces. These anterior grooves may be caused by fiber processing, where the teeth are used as a gripping implement; or by fibers pulled through the teeth, both on occlusal surfaces and through interproximal spaces. Used in this manner, the dentition functions as a tool, for example during basket-making, net-making, and sinew processing. Larsen (1985) and Schulz (1977) recorded grooving of the occlusal surfaces of the anterior dentition in prehistoric Great Basin and California populations, which they attributed to task activities (see also Milner and Larsen 1991). A similar event can be observed here at ALA-42, except that the grooves and abrasions are made on the interproximal surfaces of the tooth in addition to the occlusal surfaces.

Interproximal grooves were observed on Burial 91-10, a male aged 35-40 years (Figure 3). These grooves were located on both the left and right maxillary molars, in association with interproximal dental caries and abscess. The grooves are well-developed with polished surfaces and tubular cross-sections. They were most likely caused by the insertion of thin wooden probes, analogous to toothpicks. These wooden probes were probably used in order to gain some relief from the pain induced by the associated caries and abscess. Previous research into prehistoric California Indians with this type of tooth groove show that all examples have been associated with some form of oral pathology, such as caries or abscess (Fong 1991a, Schulz 1989).

Maxillary Sinusitis

Maxillary sinusitis is an infection of the sinus areas in the maxillae. Typical symptoms of sinusitis include cough, purulent nasal discharge, headache, facial pain, nausea, vomiting, fever, and bad breath (Muntz and Lusk 1992; Friday et al. 1990). Bacteria, viruses, and fungi have all been noted as causing sinusitis, with bacteria the leading cause. In the clinical literature, sinusitis is often associated with, or caused by, upper respiratory infections, allergic rhinitis, asthma, immunodeficiency disorders, and/or cystic fibrosis

(Friday et al. 1990), with upper respiratory infection being the most frequent cause. One study (Friday et al. 1990) cited two-thirds of their sinusitis patients hosting the bacterial organisms *Streptococcus pneumoniae*, *Haemophilus influenzae*, and *Branhamella catarrhalis*.

A severe case of chronic sinusitis was noted in the ALA-42 population: Burial 91-1, a male aged 35-40 years old. From the RP⁴ to RM³ sockets, the alveolus has been completely eroded by a massive lytic lesion (Figures 5A-B). The inferior wall of the right maxillary sinus is completely resorbed. The internal sinus walls exhibit prominent reactive bone. A large cloaca is present on the medial wall of the maxillary sinus, communicating through the inferior meatus into the nasal aperture. The anterior surface of the right maxilla displays reactive periosteal bone, indicating that the exterior portion of the bone was affected by periostitis, most likely a result of the sinusitis. The root apices of RP³ and RC¹ are completely exposed by the eroded bone. Several of the molars from the maxillary right side were recovered; their presence indicates that the teeth and gums were still in place at the time of death.

The huge lesion was most likely caused initially by a root socket abscess, which allowed bacteria to enter the maxillary sinus and infect the surrounding tissues. The severe infection led to dramatic bone and soft tissue damage. This individual was eventually unable to chew food on the right side, and the swelling from the infection would lead to varying amounts of pain. The infection of the maxilla was so extreme that hematogenous dissemination of the infectious agents could have occurred, possibly leading to the death of the individual (Ortner and Putschar 1985:442).

On the mandible, the right posterior dentition contains heavy deposits of calculus ("plaque") (Figure 4). The entire occlusal (chewing) surface of RM₂ is covered with calculus, while thick calculus covers the lingual, buccal, and most of the occlusal surfaces of the right mandibular molars. Calculus is caused by food particles

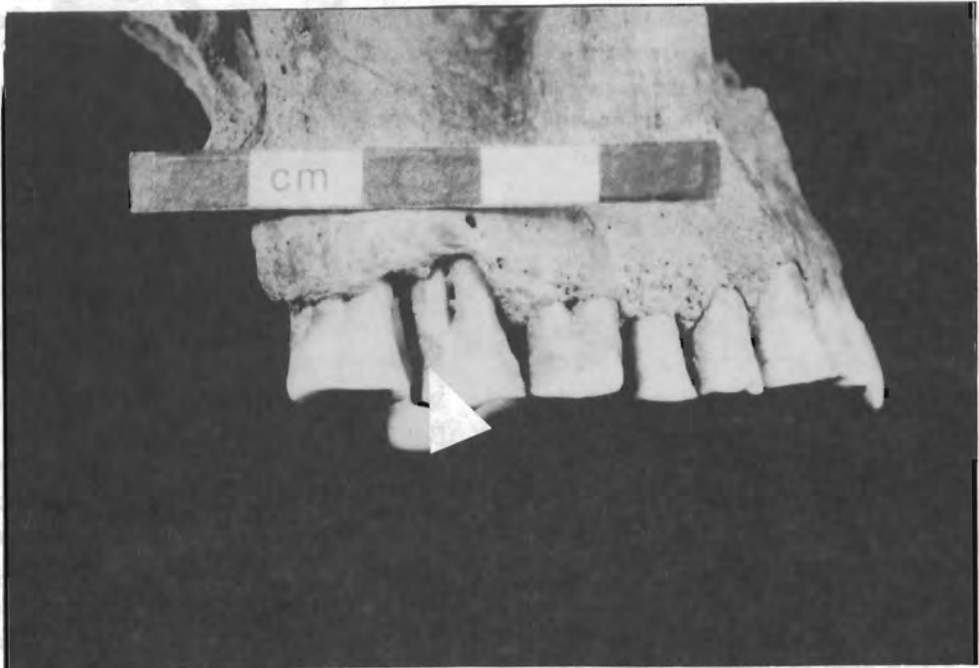


Figure 3. Burial 91-10, interproximal groove on RM².

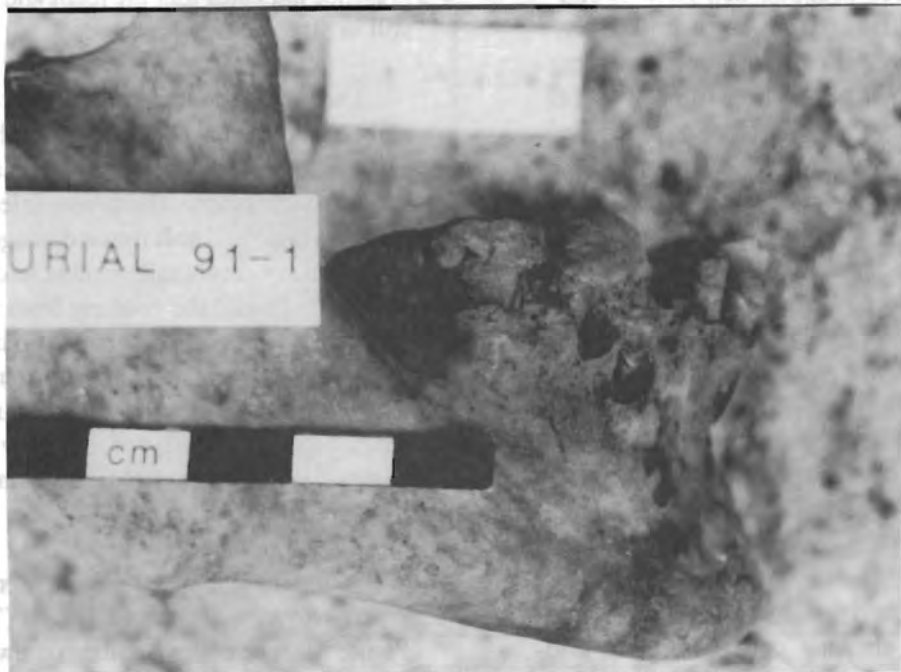
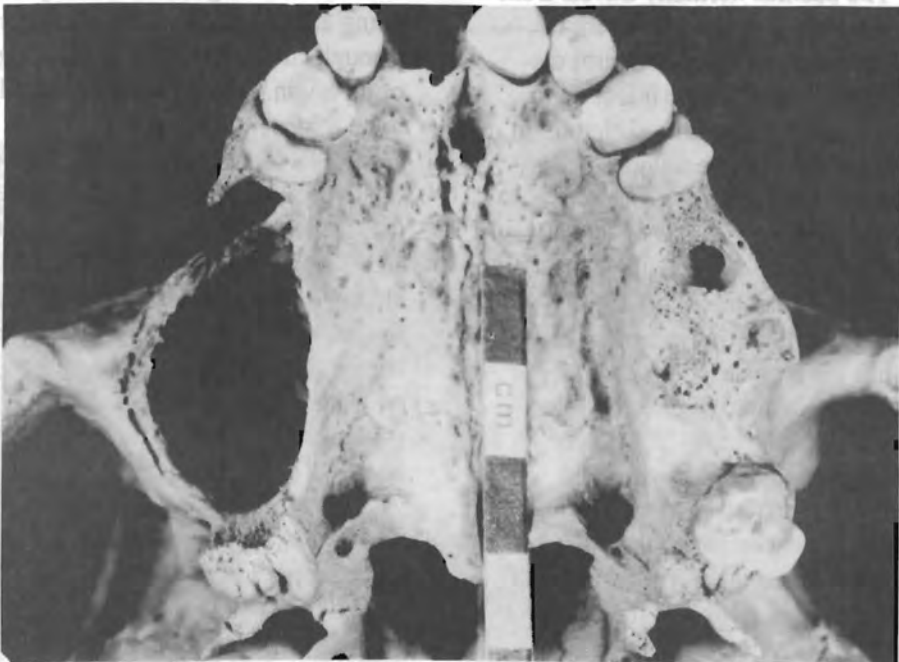


Figure 4. Burial 91-1, heavy calculus deposits on mandibular molars.



A. Burial 91-1, chronic maxillary sinusitis (lateral view).



B. Burial 91-1, chronic maxillary sinusitis (inferior view).

Figure 5

adhering to the teeth, eventually calcifying into a hard tissue (Scott and Turner 1988). The acorns that made up a large part of the aboriginal diet in California (Kroeber 1925; Levy 1978) produced a substantial amount of calculus. The process could have been accelerated in this individual through the possible use of quids, perhaps as a form of pain relief for the abscess affecting the right maxilla. If the quids had a heavy lime concentration, then the lime leads to proliferative calcification of plaque or food residue. The use of quids as pain-relief items would be an example of medical care for the sick.

RESPIRATORY DISEASE

Tuberculosis

Tuberculosis is a chronic bacterial infection caused by the bacterium, *Mycobacterium tuberculosis* (Ortner and Putschar 1985). The bacteria most often enter the human body through the respiratory tract, although intestinal infection can also occur. The bacillus normally travels from host to host via moisture droplets. In severe or chronic cases, hematogenous [blood stream] dissemination of the bacilli spreads the infection to other parts of the body, including the skeleton. In bone, the tubercle bacillus can be found in areas rich with red marrow, primarily the cancellous portions of a bone (Ortner and Putschar 1985). The tubercle bacillus leaves a cavity filled with a cheese-like substance. After the death of the individual and subsequent soft-tissue decay, the remaining bone has the typical "Swiss cheese" appearance (caseation) of open cavities or holes.

Burial 91-22 is a female, 25-35 years old. She was affected by an active (open) case of tuberculosis, indicated by caseation on the left pubis, head of the left humerus, glenoid surface of the left scapula, distal right tibia, and the vertebral column; the skeletal involvement is also called "Pott's Disease." Caseation is most evident on the T12 through L5 vertebrae (Figure 6). In addition, the first thoracic vertebra (T1) has undergone complete collapse of the body. The seventh cervical (C7) and second and third thoracic verte-

brae (T2 and T3) all contain caseation on their respective bodies. This female most likely had a hunch-backed appearance due to her collapsed T1 body. The C7 inferior articular facets and T1 superior articular facets were extended anteriorly, suggesting that posture had been affected. The surrounding vertebrae had not undergone ankylosis (fusion) at the time of death as in more advanced cases of Pott's Disease (Ortner and Putschar 1985).

There has been considerable debate in paleopathology circles regarding the origin of tuberculosis (see Clark et al. 1987; Merbs 1992). Much earlier research focused on an Old World origin for tuberculosis, primarily a bovine form of mycobacterium being transferred to humans, and later transmission to the New World following Columbus' voyages. However, many reports have been made noting the presence of skeletal tuberculosis in pre-Columbian sites in the New World (Merbs 1992). Clark et al. (1987) and Kelley (1989) suggest that in the New World, tuberculosis may have originated from mycobacteria occupying aquatic environments, infecting humans through cuts, inhalation, or drinking. Regardless of its origin, tuberculosis is generally considered to be a "density-dependent" disease (Merbs 1992:19), causing problems for groups living in relatively high densities and fairly sedentary for long periods of time. The population density for ALA-42 has not conclusively been determined, although the recovered skeletal population (45) suggests that population levels were considerable. Nevertheless, tuberculosis has been diagnosed in only a single individual, and so may represent an isolated case (pending future discoveries at this site).

Coccidioidomycosis (Valley Fever)

Coccidioidomycosis, or Valley Fever, is caused by inhaling the spores *Coccidioides immitis* (Huntington 1971; Rippon 1974). This spore is a fungus, normally living in alkaline soils of hot, arid environments, including the Central Valley of California. Infection of humans most often occurs when the fungal spores are inhaled after disrupting the soil and "kicking up dust," or

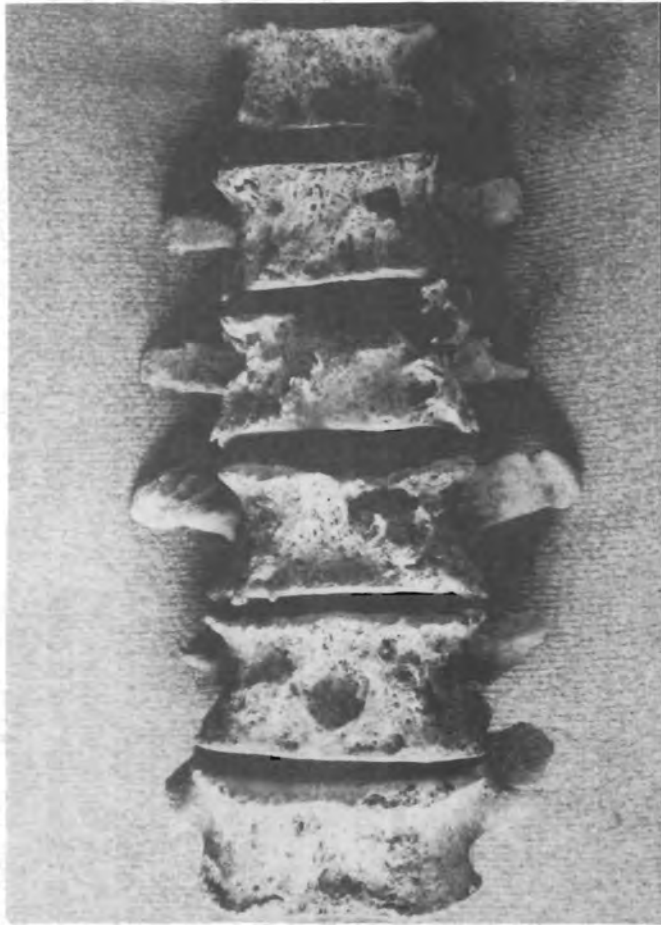


Figure 6. Burial 91-22, Tuberculosis affecting lower vertebral column (anterior view).

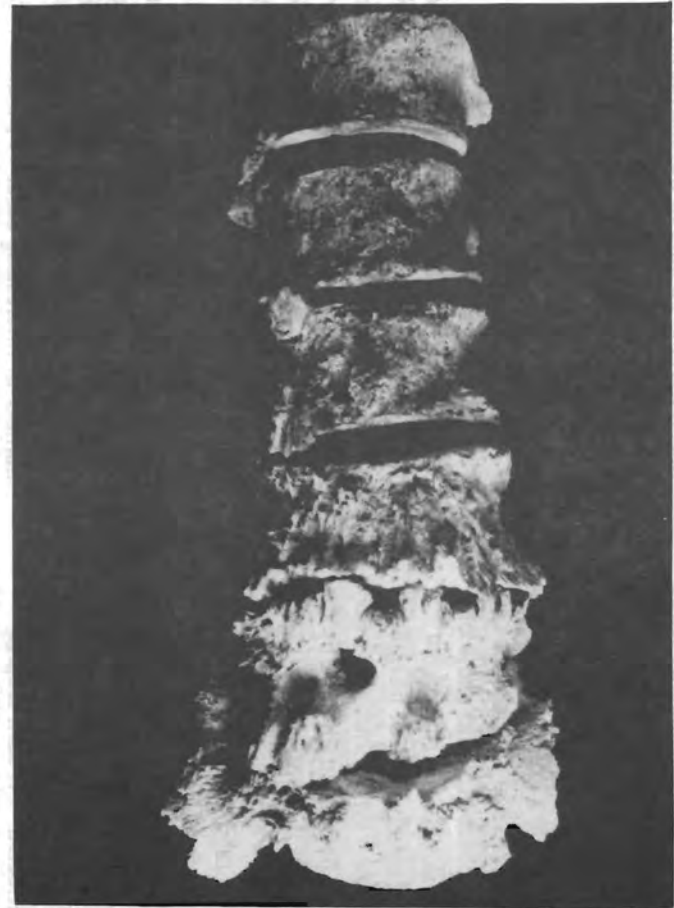


Figure 7. Burial 91-26, Coccidioidomycosis (Valley Fever) affecting lower vertebral column (anterior view).

following dust storms. Symptoms typically include chest pain, cough, fever, headache, muscle pain and stiffness, sore throat, rash, and occasionally ulcers (open sores) on the skin (Huntington 1971; Rippon 1974).

Valley Fever is primarily a pulmonary (lung) infection, although in severe cases the spores can be hematogenously distributed to other parts of the body, including the skeleton. From recent clinical studies, approximately 60% of infected individuals have little or no symptoms; many do not even know that they have been infected by the spores (Rippon 1974). Of the remaining 40%, most have symptoms often attributed to cold or flu. A very small percentage of these individuals have severe effects from the *C. immitis* infection, including skin ulcers, lung damage, and organ and skeletal involvement. The affected skeletal areas undergo an erosive process with ossification of soft tissues; the vertebrae, tibia, metatarsals, and skull are most often affected. Modern studies indicate only a small proportion of affected individuals die from Valley Fever; most people display no more than flu-like symptoms for a few weeks, then the infection clears up (Huntington 1971). No information is currently available on the prehistoric mortality rates from Valley Fever.

A probable case of coccidioidomycosis can be seen in Burial 91-26, a male, 25-35 years old. He is affected by large cavitating lesions in the lower vertebral column (Figure 7). L4 and L5 vertebrae have very large cavitating lesions to their bodies. Exuberant new bone growth is present on the anterior bodies of L1 to S2, caused by ossification of surrounding soft tissue. This individual obviously had a severe infection, as evidenced by the vertebral lesions. Skin lesions in addition to severe flu-like symptoms were no doubt present. Clearly, the immune system of this person could not handle the infection, hence the skeletal involvement. Although the exact cause of death cannot be determined, Valley Fever most likely played a part. ALA-42 does not lie within the endemic zone for coccidioidomycosis, but does lie within the range of reported modern cases (Huntington 1971; Rippon 1974). This individual may

have travelled through the endemic zone (the Central Valley), or spores may have been introduced into the vicinity of the site during dust storms. However, the prehistoric endemic zone has not been established for California.

TRAUMATIC FRACTURE

Trauma is caused by extrinsic factors often related to environmental influences or hazards, primarily accidental falls or aggressive interactions with other individuals (Merbs 1989b; Ortner and Putschar 1985). The term "fracture" refers to a break in a bone; fracture usually occurs as a result of abnormal stress applied to one or more bones by tension, compression, twisting, bending, and/or shearing forces (Ortner and Putschar 1985). When the applied force exceeds the ability of the bone to resist, a fracture occurs. The skeletal population from ALA-42 displays a number of interesting cases of traumatic fracture.

Spondylolysis

Spondylolysis is a vertebral fracture, generally in the lower lumbar region, occurring in the area of the articular facets or, less frequently, in some area of the neural arch (Merbs 1989a). This injury is normally considered to be a type of chronic stress fracture, although acute stress can also cause spondylolysis. Modern-day clinical examples of spondylolysis can be observed in weight-lifters, professional American football players, and other occupations and activities which require heavy lifting (Merbs 1989a). Waldron (1991) reports that spondylolysis is considered to be a relatively common injury affecting 3-7% of modern populations. Essentially, the chronic or acute stress exceeds the resistance of the bony area of the vertebrae so that stress and fracture results. Interestingly, the bone usually does not reunite, especially in cases caused by chronic stress; instead, a non-union occurs, where the fractured ends of the bone heal and a semi-mobile joint (pseudarthrosis) is formed. Merbs (1989a) has speculated that spondylolysis may be a form of adaptation to the upright, bipedal posture that characterizes human beings.

In this hypothesis, our upright posture creates lower back strain which is intensified by heavy lifting. Following fracture of the vertebra, a new joint is formed, providing a somewhat more mobile lumbar region, better able to cope with the recurring movements that caused the fracture.

Burial 91-15 is a female with a skeletal age of 20-25 years. She is affected by bilateral spondylolysis at the fifth lumbar vertebra (L5) (Figure 8). Lysis occurs at pars interarticularis, the area between the superior and inferior articular facets. This example of spondylolysis appears to be the result of chronic stress. The articular facets show only minimal osteoarthritic changes, while the fractured ends of bone are healed with smoothing and resorption. No other indications of acute trauma are present. Clearly, this woman was engaged in some form of heavy lifting for a long period of time. Some of the larger and heavier groundstone bowl mortars which are present throughout many California archaeological sites can easily be imagined as one of the contributing factors in this woman's injury. (In fact, we suspect more than one California archaeologist has injured their own lower back lifting a bowl mortar.)

Cranial Trauma

Cranial trauma is an injury to the skull resulting most often from acute stress applied to the cranial area; injuries can range from soft tissue damage to fractures of the cranial vault. Accidental or intentional activities can create a fracture of the skull. At ALA-42, an example of cranial fracture through interpersonal violence was recovered. The injuries were most likely the cause of death. This example of interpersonal violence is not an isolated case: several sites in prehistoric California reveal evidence of violent encounters (eg., Fong 1991b; James et al. 1990; Nelson 1993; Walker 1989).

Burial 91-17 is a female, 20 years old, exhibiting severe perimortem ("at death") trauma to the cranial vault and face. These injuries were most likely caused by multiple blows with a blunt instrument. The most evident and visible blows can be seen on the left parietal, occipital, and on

the right side of the face (Figures 9-10).

The left parietal exhibits two separate depression fractures (Figures 10A-B). The anterior fracture is triangular in shape and protrudes completely through the bone. The antero-posterior diameter of the hole is ca. 22.6 mm. The medio-lateral diameter is ca. 16.3 mm. The posterior portion of the lesion has been compressed, suggesting that the blow came from behind. The inner table has been ruptured with bone at the anterior margin completely removed, exposing diploe. The posterior margin of the lesion has been levered or hinged inward, but not completely detached, supporting the hypothesis that the blow came from behind the victim.

The second depression fracture occurs posterior and slightly lateral to the first lesion. The second fracture compressed both the inner and outer tables, creating a disturbance of the endocranial surface. The antero-posterior diameter is ca. 25.7 mm, and the medio-lateral diameter is ca. 26.2 mm. The lesion is roughly semi-circular in shape. The blow did not create a hole in the cranium, but rather a pond-type fracture. The endocranial surface is depressed inwards, and no healing took place.

The occipital contains a depression fracture inferior and slightly left lateral to lambda (Figure 10B). The outer table is depressed ca. 1.75 mm. The supero-inferior diameter of the lesion is ca. 14.5 mm., while the medio-lateral diameter is ca. 5.6 mm. The blow ruptured the inner table but did not produce a hole. The endocranial surface is compressed inwards with a portion hinged but not completely detached.

The right maxillary frontal process is fractured in the horizontal plane just inferior to the frontomaxillary suture (Figure 9). The fracture line continues across the right nasal bone. Damage is also present running horizontally between the infraorbital foramen and the alveolar process, beginning medial to the zygomaxillary suture and continuing medially to the nasal aperture. Additionally, the RC¹ root apex and surrounding

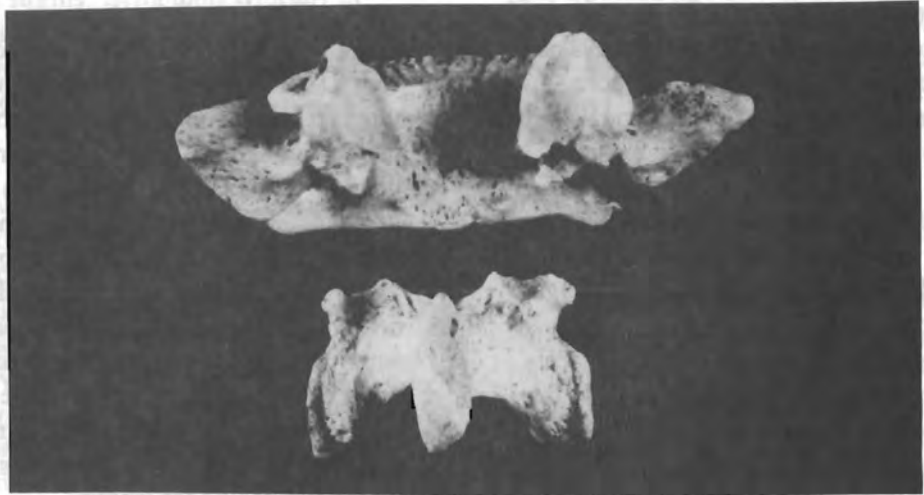


Figure 8. Burial 91-15, Spondylolysis on 5th lumbar vertebra.



Figure 9. Burial 91-17, facial fractures.



A. Burial 91-17, fractures on left parietal (exterior surface, superior view).



B. Burial 91-17, pond fracture on left parietal and fracture on occipital (posterior view).

Figure 10

alveolus protrudes anteriorly, caused by the tooth pivoting outwards at the root apex. This condition may have been caused by an additional blow to the right side of the face: the buccal portions of the maxillary molars are chipped and fractured. The pivoted canine and chipped molars could all have been damaged by the same blow.

Interestingly, the postcranial skeleton did not show any signs of trauma; apparently, the assailant(s) limited their attack to the head only. These blows most likely caused the death of this female through cranial hemorrhage and possibly compression of the brain itself (Gordon and Maloney 1978). These fractures are considered to be evidence of interpersonal violence because of the number of blows, the damage caused, and the absence of any post-cranial skeletal trauma. The recovered skeleton was nearly complete and nothing unusual was noted regarding burial position or location. None of the other individuals recovered from this site displayed indications of severe interpersonal violence. A number of questions are raised by this case: why was this woman attacked; was there more than one attacker; and was this an example of intragroup or intergroup violence? All of these questions require further research.

Pattern of Trauma in One Individual

Burial 91-30 is a female, 50-60 years old and among the oldest individuals recovered from this site. Radiographs of the radius and ulna indicate moderate demineralization, suggesting she suffered from osteoporosis. She displays a pattern of post-cranial trauma that suggests a series of injuries, possibly over some period of time. All are well-healed, indicating that she was able to cope with her injuries.

Both left and right radii are affected by Colles' fractures. This type of fracture normally occurs when an individual is falling forward and puts their arms out to break the fall; the force of the fall occasionally exceeds the limits of the bone, resulting in fracture of the radius (Merbs 1989b; Ortner and Putschar 1985). (This type of fracture is seen today often in bicycle riders, skateboarders, and

those who engage in similar activities, especially amongst adolescents and teenagers; the fracture is generally referred to as a "broken wrist".) There is posterior displacement and some lateral angulation of the radii. The distal left ulna was compressed into the distal left radius during the injury. As a result, the left wrist area was effectively fused during life with no forearm rotation possible. Osteoarthritis affects the right wrist area with slight eburnation, caused by bone rubbing against bone following degeneration of the articular cartilage (Merbs 1989b; Ortner and Putschar 1985).

The left tibia was affected by a depression fracture to the lateral condyle, caused by the condyles of the left femur being forced into the tibia. The femur itself does not display any indications of fracture, although there is osteoarthritis at the knee joint, caused by the depression fracture damaging the articular cartilage.

The entire vertebral column is affected by substantial vertebral osteophytosis and osteoarthritis; this female most likely was in the early stages of ankylosing spondylitis, the bony fusion of her vertebral column. Of note are the inferior articular facets of C1 and the superior articular facets of C2 which display substantial areas of eburnation. T8 to T12 have Schmorl's nodes, created when compressive forces caused an incomplete herniation to the intervertebral disks (Ortner and Putschar 1985). L2 to S1 display osseous lesions consistent with an anterior herniation of the intervertebral disks. L5 exhibits degenerativeolisthesis, an anterior displacement of one or more vertebral bodies in the absence of spondylolysis (Merbs 1989a; Inoue et al. 1988). There is marked flattening with osteoarthritic remodelling of the articular facets between L5 and S1.

This relatively "elderly" female suffered from a compressive force or forces (compression fracture) causing numerous complete and incomplete herniations. The acute and/or chronic stresses that affected her eventually resulted in degenerative olisthesis and the initial stages of ankylosing spondylitis. These events may also have led to the

long bone fractures, especially in the left tibia. She could have suffered all of these fractures in a single event, perhaps falling a substantial distance down a hillside. Because she suffered from osteoporosis, a fall of any type could potentially lead to numerous fractures. However, some of her fractures may have occurred prior to the onset of osteoporosis. Nevertheless, she did survive numerous injuries; her fractures were well-healed. Merbs (1989b) has suggested that some prehistoric groups may have engaged in medical treatment for fractures, with one or more persons acting as "bone-setters." Considering that this female had both wrists broken, several herniations, very painful arthritis, and a severe knee injury at various periods during her life (if not all at once), one would not be surprised if some form of medical care was available. At the very least, fellow group members almost certainly provided food and other basic care for her until she could recover from her injuries.

SUMMARY AND DISCUSSION

We have looked at a number of pathological conditions in a skeletal population from ALA-42. Out of a minimum number of individuals of 45, nearly one-third have some form of trauma (not all were discussed here). Most of the individuals have some form of oral pathology, ranging from severe dental wear to caries to abscessing. A number of individuals also showed enamel hypoplasia and Harris Lines, indications of metabolic stress on a growing individual.

The oral pathologies that were discussed can be traced to cultural factors. The severe dental wear is a direct result of the food processing techniques used by prehistoric California Indians, specifically the pestles and bowl mortars we are all familiar with. Caries (cavities), periodontal disease, and abscessing result from a diet rich in sticky carbohydrates, primarily from ground acorns so common in prehistoric California. The anterior grooves and interproximal grooves are caused by specific behavioral activities: anterior grooves caused by gripping or processing objects;

interproximal grooves caused by wooden probes.

The variety of trauma represented in this sample is interesting. We have seen evidence of interpersonal violence, spondylolysis, and one individual with a number of fractures throughout her body, including compression fractures, vertebral herniation, and Colles' fracture. Out of these examples, only one, Burial 91-17, died as a direct result from her traumatic injuries. Fractured bones can lead to a number of complications, including muscle and nerve damage, disseminated bacterial infection, fat embolism, and eventually death. The number of healed fractures in this population is impressive, suggesting again that some medical knowledge in bone setting may have been possessed by this group.

In addition, we have seen skeletal evidence for pulmonary disease: tuberculosis and Valley Fever. Since only two individuals were affected, we can assume that a major outbreak of either disease did not occur within this population. However, we must be careful in making this assumption, because both tuberculosis and Valley Fever can be fatal to the victim without skeletal involvement. In addition, some of the individuals are poorly and incompletely represented, so that key elements may be missing.

All of these factors suggest that the population from ALA-42 led a physically strenuous lifestyle. Because most of the recovered sample (40/45, 88.9%) are adults (age 20+), one can hypothesize that the population was also well-adapted to this lifestyle; only 4/45 (8.9%) were under the age of 12 (one individual was ca. 15 years old). However, one should keep in mind that the sample of individuals from ALA-42 is a non-random sample; only a portion of the site was exposed during the construction in 1991.

Our study of the paleopathology in this population has shed some light on not only the health and disease aspects of these people, but also illuminated some cultural and behavioral aspects as well. We hope that the contribution of osteological studies to the investigation of human

activity is not overlooked in the future by archaeologists and anthropologists. The potential information which can be obtained from these studies is enormous, adding to our knowledge and understanding of past lifeways and California's rich and diverse prehistory.

NOTES

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