

## **Paleopathology in Coastal San Diego, California**

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This presentation will focus on the La Jolla skeletal collection. This collection is made up of 92 individuals, and is housed at the San Diego Museum of Man in California. This is an intriguing collection for various reasons. For instance, some of the skeletons were radiocarbon dated to approximately 5000 years B.P. This is relatively old for skeletal remains found in the United States. Furthermore, the La Jollans were a coastal population. This leads to interesting implications as to the peopling of the New World when we see that there were populations living along the west coast so long ago. Finally, utilizing paleopathological evidence in the bones and teeth, it is possible to get an idea of the nutrition and lifestyle of this prehistoric coastal population.

According to Phil Walker (2006), one of the speakers here today, we are becoming a predominantly coastal population. Coastal environments are ecologically diverse and tend to be beautiful, temperate, and hospitable. However, despite the amenities offered for coastal lifestyles, Walker points out that there are health challenges associated with coastal adaptation. The fact that marine resources are protein-rich yet carbohydrate-poor is a dietary problem and results in stress as the population attempts to obtain an adequate energy supply. In addition, exploitation of marine resources is technologically intensive. Marine resources tend to be seasonally superabundant and spatially concentrated. This can lead to potential storage problems, territoriality, and interpersonal violence. Furthermore, long stretches of flat beaches and rugged cliffs define coastal environments and as such, show the immensity of coastal topographic diversity. According to Chuck Merbs (1983), another speaker here today, such environments place heavy demands on the musculo-skeletal system and result in distinctive patterns of traumatic injuries and osteoarthritis. As a result, living in coastal regions seems to result in poorer health consequences.

The La Jolla culture preceded the Kumeyaay in the area of San Diego County and Baja, Mexico. The La Jollans occupied the coastal area of San Diego County from La Jolla Shores northward to Batiquitos Lagoon (25 miles north of San Diego in Carlsbad) – an area covering 12 miles or more. The La Jollans occupied this region from approximately 7500 BP up to 2000 years ago.

There are various pathological conditions that are prevalent within the La Jolla skeletal population. These conditions reveal evidence about the population's lifestyle. For instance, the high frequency of dental disease reflects the population's dependence on plant and vegetable foods which are abrasive and harsh on teeth, as well as the use of mortars, manos, and metates. In addition, the presence of pathological conditions such as osteoarthritis, squatting facets, and large hand muscle markings give clues as to the repetitive activities of the La Jollans; specifically, they were bending down repeatedly to collect shellfish and plant foods.

In conclusion, through the use of the La Jolla skeletal collection, it is easy to see how the analysis of skeletal material contributes to the knowledge of past populations. Through studying the archaeological context and association with additional artifacts, we can gain insight into the overall health and lifestyle of the individuals. It has been the intention here to prove how valuable archaeological and paleopathological evidence is to the reconstruction of past lifestyles. The interaction between biology and behavior underscores the dynamic nature of skeletal and dental tissues, and the influences of the environment on human biological variation.

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## Evidence for Infectious Disease in the Ancient American Southwest

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The evidence for infectious disease in the American Southwest prior to the arrival of Europeans depends primarily upon pathological changes observed in ancient Native American skeletons. The evidence for three conditions, Tuberculosis, Treponematosiis, and Coccidioidomycosis, will be examined in this presentation.

Thanks primarily to work done on mummies in South America by researchers at the Medical College of Virginia, there is no longer any question that Tuberculosis, caused by *Mycobacterium tuberculosis*, was present in the Americas before European contact. Current questions deal instead with its distribution in the Americas through space and time, and the identification of various strains of the mycobacterium to determine the evolutionary history of the pathogen itself. The condition is passed from human to human, but may also be transmitted through the consumption of contaminated animal products, such as bovine milk. The role of animal vectors in the New World, if any, is not understood. Although the details are not clear, what does seem clear from the osteological record is that Tuberculosis of some form was present in the Southwest at least five hundred years prior to European contact.

Evidence for the presence of spirochete infections of the group known as Treponematosiis in the Southwest prior to European contact is also present in the skeletal record. The specific condition involved is probably Syphilis, caused by *Treponema pallidum*, and its transmission likely occurred across the placenta as well as through adult sexual contact. The pattern of pathology associated with congenital transmission is seen in historic Native American skeletons as well as prehistoric, suggesting a continuity of the disease pattern across the Old World-New World contact boundary.

Unlike the two previous conditions, which are widespread in both the Old World and the New World, the third condition to be considered, Coccidioidomycosis, caused by the fungus *Coccidioides immitis*, is limited to the New World. Associated with dry climates and primarily, but not exclusively, low elevations, the condition is currently a problem in the American Southwest and parts of South America. Unlike the two previous conditions, which can be passed from human to human, the normal transmission of Coccidioidomycosis is from the environment to the human host, not from human to human. "Epidemics" are generally associated with environmental disturbances such as severe wind storms and earthquakes. Since Coccidioidomycosis affects the skeleton in a manner similar to that of Tuberculosis, careful study is required to distinguish between the two conditions.

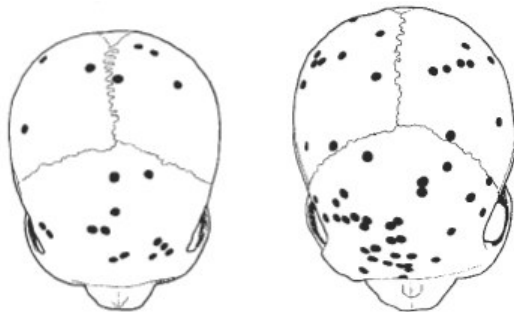
This presentation will examine examples of these three conditions as observed in the skeletal record of the ancient American Southwest and speculate on the direction of future research.

## Paleopathology of the Santa Barbara Channel Area

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Paleopathological evidence indicates that many of the pathogens that afflict modern people were present in prehistoric California. Bone lesions of the kind we now associate with streptococcal or staphylococcal infections were fairly common in some California Indian populations. There is also evidence that gastrointestinal infections transmitted by drinking contaminated water were prevalent in some areas. Tuberculosis, coccidioidomycosis and treponematosi s are three additional infectious diseases reported as possibly present in prehistoric California. Archaeological evidence shows that the prevalence of infectious diseases increased significantly during the prehistoric period. This decline in health was no doubt a result of the health problems people encountered when they began to aggregate in large villages. As the number and intensity of interactions among people grew, so did the opportunities for the maintenance and spread of infectious disease.

In the Santa Barbara Channel area, these changes in infectious disease were accompanied by a decrease in body size and an increase in the frequency of traumatic injuries. Paleopathological studies indicate people who lived in this area during periods of environmental instability suffered more infectious disease and nutritional stress than people who lived under more favorable conditions.



*Figure 1: Distribution of cranial injuries in female (left) and Male (right) crania from the Santa Barbara Channel area.*

### Traumatic Injuries

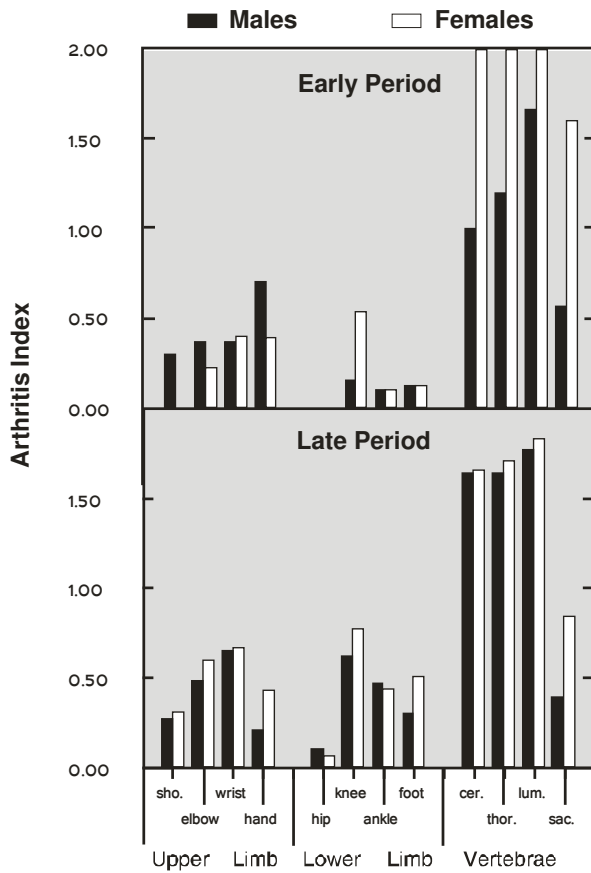
Crania from the Northern Channel Islands off the Santa Barbara coast show a high frequency of well-healed depressed fractures in the outer table of the cranial vault (18.56% n = 598). Such

injuries are rare among the mainland inhabitants (7.5% n = 146). This prevalence of traumatic injuries among the islanders may be a result of intense competition over resources in a geographically circumscribed environment. The frequency of cranial injuries increases significantly between the early and late prehistoric periods on the Channel Islands. This temporal variation appears to reflect changes in patterns of violence associated with population growth and environmental instability (Walker 1989).

### Osteoarthritis

The severity of osteoarthritis Santa Barbara Channel area changed markedly with the economic shift from hunting and gathering to intensive fishing and craft specialization that occurred in this area (Walker and Hollimon 1989). The joints of 967 burials from seven archaeological sites occupied between 3500 B.C. and the time of European contact were scored for osteoarthritis. These data show that the rate at which people developed osteoarthritis increased through time. This suggests that the adaptive shift toward more intensive exploitation of the marine environment resulted in an increase in the time people spent in strenuous physical activity. The increase in osteoarthritis affected males to a greater extent than in females. One interpretation of this is that the workload of men increased with the economic importance of fishing.

An analysis of the distribution of arthritic lesions in the knees suggests that some individuals engaged in strenuous activities that involved kneeling for prolonged periods of time. Activity-related arthritic changes in this population include porosity, lipping, and eburnation of the postero-superior surface of the femoral condyles and complimentary changes in the articular surfaces of the proximal tibias. These lesions are similar to those found in European ecclesiastical populations where kneeling in prayer for long periods was a common practice. Ethnographic evidence suggests similar lesions among Native Americans from the Santa Barbara Channel area are an osseous response to habitual digging stick use, a subsistence activity that was predominantly the domain of women.



**Figure 2.** Diagrams showing sex differences in osteoarthritis in early and late period Santa Barbara Channel area populations

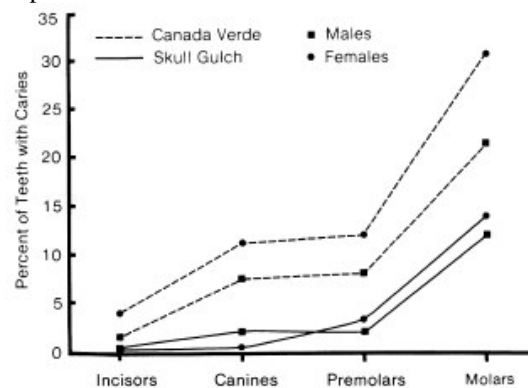


**Figure 2:** Photographs showing osteoarthritis of the distal femur in skeletal material from the Santa Barbara Channel area of southern California. Note lesions on the superior-posterior articular surface of the condyles in the photo on the left.

### Oral Health

Dental studies of Channel Island skeletal collections provide evidence of significant temporal changes in oral health. Carious lesions decrease significantly through time, as do sexual differences in caries rates. Tooth wear rates also decrease through time. These dental health changes appear to reflect shifts in diet and sexual

division of labor associated with a subsistence shift from the exploitation of roots, tubers, and other cariogenic plant foods to the intensive exploitation of fish.



**Figure 2:** Diagram showing sex differences in the prevalence of dental caries in early (Canada Verde) and late prehistoric period Santa Rosa Island skeletal collections.

This shift towards more intensive marine resource use has been documented through isotopic studies. The ratios of  $^{15}\text{N}$  to  $^{14}\text{N}$  and  $^{13}\text{C}$  to  $^{12}\text{C}$  tend to be higher in marine than in terrestrial organisms. They consequently can be used to make inferences about the contribution of marine and terrestrial resources to prehistoric diets. Differences in  $^{15}\text{N}/^{14}\text{N}$  and  $^{13}\text{C}/^{12}\text{C}$  ratios of individuals from mainland sites dating from the early and late prehistoric periods show that the marine component of the diet increased substantially through time (Walker and Deniro 1986). Our isotopic studies also provide evidence of sex difference in diet with males consuming more marine resources during the early prehistoric period than females.

### Evidence of Nutritional Deficiency

Cribra orbitalia, a form of porotic hyperostosis that often has been linked to iron-deficiency anemia, is as common among the fisher-people of the Santa Barbara Channel area, whose diet was rich in iron and essential amino acids, as it is among maize-dependent agriculturalists. Northern Channel Island crania have much more cribra orbitalia than those from the California mainland. The highest incidence is on San Miguel, a small geographically isolated island with a shortage of fresh water and terrestrial resources. The Indians who lived on Santa Cruz, the largest of the northern Channel Islands with the greatest diversity of terrestrial plants and animals, have less cribra orbitalia than those who lived on Santa Rosa or San Miguel Island. This

geographical distribution appears to be explained by island-mainland and interisland differences in water contamination, exposure to fish-borne parasites, and nutritional adequacy of the diet. Recent research suggests that these lesions are difficult to explain in terms of iron deficiency and may instead reflect megaloblastic anemia associated with vitamin B<sup>12</sup> and folic acid deficiencies.

### Treponemal Disease

The earliest well-documented cases of treponemal disease in the western United States come from SBa-52, a village site on the mainland coast of the Santa Barbara Channel. The cranial lesions typical of modern venereal syphilis are uncommon among these people.

Skeletal remains from SBa-52 are especially informative because both macroscopic and microscopic evidence indicate that treponemal disease afflicted a large proportion of the population.

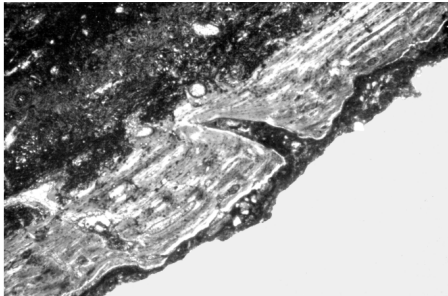


Figure 2: Histological section of a tibia from Burial 5 at SBa-52 showing features associated with treponemal disease.

In figure 2, The first dark, diagonal band in the upper portion of the slide is a thin layer of caliche deposited on the surface of the bone. The underlying band is a laminated layer of subperiosteal new bone that formed on top of the original cortical surface, which is the triangular area formed by the lower left corner of the slide. The layer of subperiosteal new bone formation has *polster* (pillow-like structures) which are delimited invaginations formerly occupied by blood vessels that reach nearly to the level of the original cortical surface. Some of the diagonal striations, or *grentstreifen*, in the layer of subperiosteal new bone contain collagen and delimit the boundary between the original cortical surface and the newly formed bone. *Polster* and *grentstreifen* are diagnostic features of treponemal disease.

The hypothesis that a new European form of treponemal disease was introduced during the early historic period is supported by cranial lesions in two crania from the Skull Gulch site (SBa-2b) on Santa Rosa Island. In striking contrast to the treponemal disease syndrome seen in the Santa Barbara Channel area throughout the prehistoric period in sites such as SBa-52, these individuals exhibit the massive cranial vault and nasopalatine involvement that is pathognomonic of modern untreated venereal syphilis. *Caries sicca* affects most of the cranial vault of one individual and another shows extensive nasopalatine destruction.

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