Forensic Anthropology, Paleopathology, and the Creation of Osteobiographies

By Bronwynn Lloyd

Summary

This paper discusses the field of osteology and its origination. Osteology, the study of human bones, along with other investigative modes used for define trauma and time of death are important in the fields of archeology as well. The author highlights the fact that the study of human remains in archaeological contexts allows archaeologists to better identify significant factors present on the remains that could aid in their understanding of a site or culture.

Introduction

In forensic anthropology it is important for scientists to be able to distinguish between trauma that occurs prior to death, at death, and after death. It is even more important in forensic investigations with legal objectives that antemortem, perimortem, and postmortem trauma be identified correctly so a proper analysis of the crime scene can be given. However, this distinction must also be applied to the analysis of past human remains when found in archaeological contexts. Studies of human remains in archaeological contexts are allowing archaeologists to better identify significant factors present on the remains that could aid in their understanding of a site or culture. In these situations, specialists in the field of osteology, osteologists, are called on to analyze the remains in order to help archaeologists.

Osteology, the study of human bones, may give insight into individuals and communities lives and how they died based of characteristics identified on the remains. Like forensic investigators, they attempt to identify the sex, age at death, ethnicity, and stature of the individual. Also in their analysis, they identify any antemortem and perimortem traumas that may be present on the bones and distinguish it from any post-mortem damage that may have been done naturally or during the excavation process. One characteristic osteologists analyse are lesions on the bone caused by pathogens from either infectious or environmental sources. With ancient cultures and their diseases, the study is called paleopathology. In this analysis, insight into social status, occupation, and daily activities are interpreted through lesions present on the bones caused by environmental disease and occupational stressor. In ancient peoples, this interpretation is done through the study of ancient diseases present on the recovered bones through archaeological techniques. Assessment of pathological conditions on skeletal elements can allow archaeologists to
give an interpretation on lifestyle of individuals and what happened in their lives.

Environmental Diseases

Environmental pathological conditions are divided into lytic, proliferative, and deformative lesions. These lesions appear as bone loss, deposits of extra bone, and deformities. With environmental diseases, the most common are lytic and deformative lesions. Environmental factors that produce these lesions result from malnutrition and vitamin deficiency leading to diseases such as anemia, scurvy, and rickets. Malnutrition affects the bone through degenerative factors causing the bone to bend, weaken, or become porous.

Anemia is a lytic bone disease causing abnormal loss of bone due to a lack of iron in the body’s system. Iron deficiency causes red blood cells to become deformed so they have to be expelled from the body. With anemia, the production of new red blood cells is accelerated causing the skull to expand (Byers, 2008) and the ends of the long bones to flare (Swales, personal communication, August 4, 2007). The primary result of iron-deficiency anemia is the development of porotic hyperostosis and cribra orbitalia (Stuart-Macadam, 1989).

These diseases are characterized by porosity on the bones of the cranial vault and around the orbits. Studies of skeletons with these lesions have shown that the diseases are most common among persons from lower social classes and individuals of black ancestry (Byers, 2008). Researchers have also found that “in some cases, the presence of cribra orbitalia and porotic hyperostosis lesions hints at individuals who have been or were exposed to additional stressing agents” (Mitchell, 2003, 176).

All three of these characteristics are supported by a study done by Tanya Peckmann in 2003 that looked at the connection between the smallpox epidemic of 1866 and porotic hyperostosis and cribra orbitalia. The populations studied were colored laborers in the northern frontiers of South Africa who lived on the outskirts of the towns. These people were poor, living on the margins of society and could not afford many luxuries. These communities were also agrarian based with their primary diet being cereal grains and vegetable. As a result of their living situation, the majority of the population studied did have iron-deficiency anemia. However, since people do not usually die from anemia, the high mortality rate of individuals dating to the period of the recorded smallpox epidemic supports the connection of high rates of malnutrition resulting in iron-deficiency anemia and high rates of deadly infectious diseases (Peckmann, 2003).

Since the primary cause of porotic hyperostosis is iron-deficiency anemia, it is not surprising the archaeologists can associate this disease with agrarian societies whose diets focus around cereal grains and certain milks (Peckmann, 2003). Archaeological support for this connection can be seen in the absence of porotic hyperostosis on skeletons prior to 10,000 years ago before the adoption of agriculture and sedentary societies (Peckmann, 2003). As a result, archaeologists can determine individuals connected with agrarian and/or poor communities where access to meat high in iron is limited.

Coincidentally, iron-deficiency anemia is also connected with other deficient diseases such as vitamin C-deficiency scurvy (Clark et al, 1992). Since vitamin C helps to metabolize iron individuals exhibiting traits of anemia, especially in poorer communities, will also show signs of scurvy (Peckmann, 2003). However, it is difficult to discern between these two conditions as they manifest similarly on skeletal material (Swales, personal communication, August 4, 2007). Archaeologists can use the presence of scurvy on a skeleton along with other discernable traits to connect the individual to certain locations, oc-
ocupations, and social circumstances. Depending on the region, this can indicate poorer communities where a limit of fresh produce may have reserved it for persons of higher status. Often scurvy is found in populations living in cooler climates or where there is limited access to produce (Brickley, 2000). The most common association with scurvy is with sailors who would develop it on long voyages and often die.

Another nutritional deficiency often seen in young children, but can continue in adults, is rickets. In adults this disease is called osteomalacia. This degenerative disease is caused by a lack of Vitamin D in the body resulting in the bowing of weight-bearing limbs particularly the legs (Byers, 2008). The disease is often associated with industrial areas, crowded populations, conservative dress, and became very prevalent in the 17th and 18th centuries (Roberts and Manchester, 1995). As an easy source of vitamin D is exposure to the sun, rickets is not generally associated with rural populations and villages. Coincidentally the disease appears to have begun increasing in the medieval period (Stuart-Macadam, 1989). Archaeologists can usually tie individuals with rickets and osteomalacia back to industrial communities and Northern European countries where exposure to sun was limited either by social ideals or by environmental conditions.

**Occupational Stress Markers**

Many occupations and activities can leave imprints on the bone in the form of occupational stress markers. These osteological factors give good information as to the lifestyle of a community and its individuals. The lesions on the bone are the result of occupations and activities involving heavy strenuous labor or continual usage of certain muscles. Occupational stress markers include lipping and osteophyte deposits, degenerative markers such as osteochondritis dissecans and osteoarthritis, stress fractures, and musculoskeletal stress markers.

Osteophytosis appears as small spurs or ridges of bone called lipping, on an area that is normally smooth (Byers, 2008, p. 375). Often these occur on articular surfaces such as vertebrae and joints. The areas of the shoulder, elbow, and knee are common areas for ridges to develop from heavy lifting or long periods of kneeling. Many of these stress markers are more common in third-world countries but can occur in industrial nations (Byers, 2008) allowing archaeologists to interpret a regional or economical association for the individuals.

Osteochondritis dissecans and Eburnation, osteoarthritis, results from cartilage between the joints being worn away. The wearing of osteochondritis dissecans forms indentations on the bone. Eburnation results in the polishing of the bone because of the bone surfaces rubbing against each other (Swales, personal conversation, August 4, 2007). Both stress markers result from over use of the joints affected and can indicate a life of hard continuous work.

Stress fractures are another common result of repeated and strenuous activities. These fractures often result from the lifting or carrying of heavy loads. Unless resulting in a serious break of one of the long bones or cranium, most stress fractures appear in the vertebral column with the separation of the neural arch from the body of the lumbar vertebrae and compression fractures in the vertebral bodies particularly the thoracic vertebrae (Byers, 2008).

Musculoskeletal stress markers are perhaps one of the most common occupational stress markers. Simply put these are modifications to areas where soft tissue attaches to the bone. The areas often appear enlarged and rugged because of the increased strength needed from the manifestation of muscular hypertrophy. These specific bony changes are produced during normal, habitual use of muscles and ligaments at their attachment sites and can reflect strength or weight training, running, or climbing (Stern & Lane, 1998).
Osteobiographies

The following case studies show how the identification of various occupational stress markers on skeletons help to interpret the activities and occupations down by individuals of certain communities. Some cases incorporate historical documents to use as references as to the occupations or activities that would have been done by these people. In these cases the paleopathology can help to support or contradict what was expressed in these documents. Other cases had no documentation to refer to and so offer interpretations supported by the data alone or in conjunction with ethnographic observations of surviving populations. The results of these studies were osteobiographies for the communities under investigation and their individuals.

Fort Edmonton and the Fur Trade

Exhumation of skeletons found at Fort Edmonton in Alberta Canada revealed signs of degenerative stress markers and musculoskeletal stress markers in both upper and lower limbs. The three male skeletons showed hypertrophy of the bone at the muscle and ligament attachment sites of the humerus, ulna, femur, and tibia. These along with accessory facets where the sacrum articulates with the ilium and kneeling facets on the metatarsals are consistent with the heavy lifting and transport of pelts documented in the Canadian fur trade (Lovell & Dublenko, 1998).

Evidence of arthritis was found in the lower limbs of the male skeletons in the form of lipping and pitting. One male showed signs that confirmed osteocondritis dissecans on the femora while another exhibited osteoarthritis on the head of the first metatarsal. The researchers concluded from these stress marks the first individual transported pelts primarily by dogsled and the second individual by canoe.

The only female recovered exhibited musculoskeletal stress markers on her upper limbs and muscle attachments of the hands. These markers were consistent with the domestic activities of milking, soap making, and butter churning documented in the fort’s records. The female also shows some osteoarthritis and lipping in the form of Schmorl’s nodes indicating weight-bearing or plant harvesting, also activities documented at the effort (Lovell & Dublenko, 1998).

The Golovin and the Nunivak in Alaska

Ethnoarchaeological studies of two Inuit populations revealed occupational stress markers connected with the habitual activities of the groups. Evaluation of these activities was done by observing degenerative joint diseases, accessory facets, and musculoskeletal stress markers. While the two groups, the Golovin and Nunivak populations, all exhibited the same conditions, the location of the lesions and data recovered from ethnographic observations reveal remodeling based off different activities (Steen & Lane, 1998).

The stress markers in both populations were found in the upper and lower limbs and around the cranium. Golovin peoples had larger attachment areas of the cranial facial muscles, which are used for mastication and using the teeth as tools, as a result of chewing skins for making footwear. The Nunivak population did not make footwear in this method explaining why the same attachment areas are not as rugged. Both populations had hypertrophy around the insertion site of the costoclavicular ligaments which typically results from the rotary motion associated with kayaking. In the lower limbs, Golovin people also had greater hypertrophy then Nunivak peoples. The muscle attachment sites are important for walking which Golovin peoples are documented as transversing long distances which would explain the higher development (Steen & Lane, 1998).
Pre-Historic Signs of Occupational Stress in Abu Hureyra

In Abu Hureyra, occupational stress markers revealed domestic activities around the early agricultural community were very strenuous. Skeletons showed stress with buttresses around the femur and bony growths around the knee. The metatarsals also showed bony growth and wear as a result of long periods of kneeling while grinding grains.

Skeletons from the Abu Hureyra population showed many of the same signs of heavy load-bearing discussed in the previous cultures. Stress markers in this group appear as hooks on the vertebrae and buttressing around the cervical vertebrae for support. Researchers interpret this as resulting from carrying heavy loads on the head (Molleson, 1994). Given the type of work, it would not be surprising to see hypertrophy on the bone around the nuchal area as the muscles would have strengthened and developed from the weight being carried.

The teeth of the individuals studied showed excessive wear from the course meal that was ground. Often, small bits of stone would also chip off and become mixed into the ground grain and then accidentally eaten. As a result many of the oldest individuals studied had no teeth left to analyse has they had eventually fallen out from so much use. Skeletons dating to later periods in the culture did not appear to have as much wear on their teeth indicating a less course meal being eaten. Archaeologists have determined that during their agricultural development the people of Abu Hureyra began sifting the ground substance to remove hard kernels and stones that would be in the mixture (Molleson, 1994).

Occupational Stress among Italy’s Elite Family

Even though most stress markers appear on skeletons from more labor intensive, poorer communities, privileged wealthy individuals also show revealing skeletal traits. The Medici were one of the most powerful families in Italy and ruled the country for four centuries (Fornaciari et al, 2005). However, despite all their wealth and privilege, when archaeologists exhumed the remains of Cosimo and his wife Eleonora in 2004, their skeletons appeared just as marked and deformed as any other individual with a life of habitual stress put on the body.

Cosimo’s teeth showed signs of eating hard foods such as nuts and raw vegetables (Fornaciari et al, 2005). The teeth were very worn and most likely, though it was not discussed in the article, the attachment sites for mastication muscles showed hypertrophy and were very rugged. His musculoskeletal stress markers showed years of strenuous physical activity. It is known through historic documentation that Cosimo was an avid sportsman, lifting weights, hunting, and riding horseback. The markers on his bones were consistent with these activities appearing on his femora (Fornaciari et al, 2005) and also most likely on his humerus and on his vertebrae.

Similarly, Eleonora’s life was also revealed in her bones. During her life, she gave birth to 11 children. Each birth is a traumatic experience on the body, in Eleonora’s case so many births without a period of recovery caused her pubic symphasis to become rough and irregular and the back of her pelvis to flatten. Each pregnancy also leaches calcium from the mother’s body so Eleonora’s bones were thin and weak and some of her teeth were missing (Fornaciari et al, 2005).

Conclusions

Since forensic anthropology, archaeology, and osteology are such dynamic fields, techniques of excavating human remains and identification of the characteristics are constantly being reassessed, developed, and shared to improve the analysis and interpretation of
finds. Research, like those summarized throughout this paper, are essential to further understanding of how lesions on the bone relate to various activities or circumstances. This understanding can then be used to develop further interpretations of the culture being studied.

Signs of heavy-intensive labor, childbearing, and malnutrition all show up on the bones allowing paleopathologists, osteologists, and archaeologists to create an osteobiographical assessment of an individual’s life. The osteobiographies created for individuals, like those used for this paper, often rely on historical documents or observations of present populations to help with the interpretation. From these osteobiographies information regarding dietary habits, work types, and level of strenuous work can be used to give indications as to the social conditions of the activities they were engaged in and the social status they had during their life.

Further investigations and developments may then be able to bring clarity to cultures where a lot of information is not known about them or shed light on cultures that are shrouded in myths and legends. Physical evidence recorded on the bones can help to support or argue the ideas already established about certain groups furthering the understanding about them. Information about location, socio-economic status, and occupation can lead to further information and interpretations about other aspects of these cultures that are of interests to anthropologists.

**Bibliography**


