Degenerative Joint Disease of the Long Bones in Dickson Mounds

Debra L. Martin, MA,* George J. Armelagos, PhD,* and Jack R. King, BA*

Osteoarthritis is among the oldest and most commonly known diseases afflicting humans. However, the paleopathological diagnosis is complicated, for neither the causes nor an exact definition of various osseous manifestations of arthritic responses are clearly known for archaeological skeletal specimens. The problem of measuring such an elusive but commonly encountered pathology is compounded by many factors but remains inviting to anthropological researchers nonetheless.

The purpose of this research was to devise a reasonably accurate method for quantifying degenerative joint disease in a prehistoric American Indian population. Specifically, we wanted to show the frequency, age of onset, patterning, and impact at a populational level. We also wanted to determine whether there were any correlations of the frequency of osteoarthritis with other conditions such as infectious lesions of the bone. In this way, a more complete picture of the ongoing processes influencing biocultural adaptation of prehistoric populations is possible.

Methods

Degenerative joint disease is defined by changes in the articular surface areas of joint systems. Following the exposure of subchondral bone, the articular surface regions involved become pitted, with marginal lipping and erosion; eventually eburnation may take place.

In this analysis, all degrees of osteoarthritic changes are considered, from no involvement to severe manifestations of the condition. The criteria for establishing these stages follow the observable changes on osseous material as described in both Aegerter and Kirkpatrick and Steinbock. The grading system attempts to differentiate between no involvement and slight, moderate, or severe involvement.

Results

The skeletal samples used are from the Dickson Mound, a prehistoric population from Illinois. This population offers a unique opportunity to study the ongoing impact and process of osteoarthritic responses as it represents a homogeneous group spanning 250 years. While there are three cultural traditions at Dickson Mound, we have combined the Late Woodland and Transitional groups because of small sample size. The Late Woodland-Transitional group (A.D. 1050-1200) and the Middle Mississippian (1200-1300) are distinguished by major differences in subsistence patterns. The Late Woodland-Transitional groups subsisted primarily by hunting and gathering, with some maize horticulture practiced later in the period. The Middle Mississippian group, in contrast, relied mainly on a maize diet and was a more dense and sedentary population. For this study, we selected approximately 60 individuals and centered our analysis on the joints of the long bones, the acetabulum of the pelvis, and the glenoid of the scapula.

The overall patterns of the two groups (Figure 1) show that degenerative joint disease begins to appear in the 30-35 age group and increases dramatically through the following two age classes until age 45-50. At this point, all individuals from both groups exhibit some degree of arthritic involvement of the joints. In the Late Woodland-Transitional group, 75.5% showed evidence of osteoarthritis, while 69.5% of the Middle Mississippian were afflicted. The difference in frequency is not statistically significant.

The samples were then combined to assess overall frequency (Figure 2). In individuals without osteoarthritis the frequency is greater until age 35-40, after which point the trend reverses. The frequency of individuals with osteoarthritis increases until it reaches 100% at age 45-50.

The severity of osteoarthritis was also analyzed (Table I). There was no apparent difference in the percentage of graded severity between groups. Most arthritic responses were of the grade 1 type, or slight involvement.
Degenerative joint diseases rarely are confined to a single joint complex. The weight-bearing joints, such as the hips and knees, and those joints exposed to chronic trauma, such as the shoulder and elbow, are most frequently affected. The patterning of the pelvic and scapular joints is seen to follow relatively similar paths, with that of the pelvis leveling off somewhat between 40 and 50, while the scapula continues to rise. In the combined sample, both joints are affected in 100% of the individuals by age 55. Unlike the scapula and pelvis, the elbow and knee complexes exhibit a more dramatic increase from age 35 and reach 100% by age 50.

While both groups overall show predominantly similar trends, the distal radius appears to be the least consistent (Figure 3). The two groups exhibit a significant difference in the age of onset and general impact. In the Middle Mississippian, osteoarthritic response is much more dramatic and severe. This suggests an increase in trauma and/or wear and tear of the wrist complex. It seems likely that the dependence on maize and the increase in degenerative joint disease of the distal radius are correlated. Since maize agriculture requires tools for cultivation and preparation, the use of such implements may be linked with the frequency of distal radius degeneration. Although this is by no means conclusive evidence, such findings help interpret the archaeological record and complete the overall picture of the health of the population.

An additional avenue of inquiry which may prove fruitful is the correlation between infectious lesions and degenerative joint disease. A preliminary study showed that those individuals with multiple joint involvements statistically show a higher percentage of infectious lesions such as periostitis and osteomyelitis. Both infectious lesions and degenerative joint disease are a function of age, and the more severe arthritic involvements consistently show more severe infectious reactions. Further investigation could explain more
fully this interplay and also show how cultural practices and activities affect it.

Conclusions
This analysis of osteoarthritis shows the usefulness of employing a populational approach. Individual descriptions of degenerative joint disease must be integrated with information gathered from the entire skeleton, not just isolated specimens. The information obtained from this study suggests that even though degenerative joint disease is a function of age and genetic heritage, its particular osseous manifestation seems also to be influenced by cultural and ecological variables.

Through the coordinated use of numerous methods, such as the analysis of infection, osteoarthritis, osteophytosis, dental hypoplasia, trace element analysis, and nutritional deficiencies, we can attain a much clearer view of the relationship between pathological processes and the activities affecting them. This study, although preliminary, will be combined with various other analytic techniques to achieve a more complete picture of the processes influencing mortality and morbidity in the Dickson Mound population.
Evidence of degenerative joint disease in Dickson Mound specimen. Both surfaces show osteophytic lipping peripheral to the articular surfaces, as well as eburnation.

Evidence of degenerative joint disease in Dickson Mound specimen. Besides evidence of osteophytic lipping peripheral to the articular surfaces, the humerus has additional compacting of cortical bone on the articular facet.

References