H58 Detecting Individuals With Reduced Mobility Using Femoral Morphology

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The goal of this presentation is to demonstrate the unique morphological characteristics associated with reduced ambulatory ability and immobility. Attendees will learn how to recognize characteristics of the femur that provide information about the mobility of individuals whose skeletons they are examining and how this information may provide unique clues to help in the identification process.

This presentation will impact the forensic community by demonstrating that femur morphology can be used to determine activity levels, including reduced ambulatory ability caused by disease or injury.

Bone is an extremely plastic material that constantly modifies itself throughout life, and unique or distinguishing skeletal traits and activity markers, especially those that are likely to be recorded in medical records or observable in photographs, can provide valuable information leading to identification in medicolegal investigations. Osseous morphological features can often allude to distinguishing physical activities regularly conducted by an individual during life, especially if the activities require repetitive movement or commonly result in recognizable bony injuries. For decades physical anthropologists have been examining femur morphology to reconstruct activity patterns and intensity in past populations, and osteological changes expected with increases in particular activity are well known. Bony changes expected with decreased activity have received far less attention, but recent secular change studies demonstrate that Americans have undergone significant changes in femoral shaft morphology and strength over the past 150 years in large part due to reduced daily mobility. Likewise, numerous clinical studies have shown differences in the angle of inclination, angle of torsion, and bicondylar angle between ambulatory and nonambulatory individuals. Information gained from biomechanical, secular trend, and clinical studies can also be used by forensic anthropologists to not only recognize particular activities but also decreased ambulatory ability caused by disease or trauma. In this presentation we compare femur mid and subtrochanteric diaphyseal cross-sectional properties and three functional angles (inclination, torsion, and bicondylar) between normally ambulatory adult individuals and individuals known to have reduced mobility due to cerebral palsy.

Reduced mobility or long-term immobility results in diminished musclar stress and normal weight bearing on the lower limb bones. Depending on the age of the individual when ambulatory problems arise, normal ontogenetic changes in femoral angles often do not transpire and/or wasting of the femoral shaft cortical bone occurs. The angle of inclination (angle between the long axis of the neck and long axis of the shaft), which ranges from 120 to 135 degrees in normal ambulatory individuals, is frequently coxa valga or greater that 135 degrees in individuals with reduced mobility due to decreased muscular and weight stress on the developing hip. The angle of torsion, a measure of the rotation of the femoral head and neck relative to the diaphysis that

averages about 12 degrees in normally ambulatory adults, is commonly greater (shows antetorsion) in individuals with cerebral palsy due to differential proximal and distal muscle pull. The bicondylar or tibiofemoral angle results from differential forces on the medial and lateral condyles during normal walking causing greater growth of the medial than the lateral condyle forming the bicondylar angle during childhood. Consequently, the bicondylar angle does not form in non- ambulatory individuals. The presence of the bicondylar angle is indication of at least early childhood ambulatory ability. Finally, wasting of the cortical bone associated with reduced mobility/immobility is reflected in bone strength and mediolateral diaphyseal dimensions. Individuals with reduced ambulatory ability associated with cerebral palsy, for example, are often more than two standard deviations below the average (size standardized) in the mediolateral midshaft dimension, but do not differ significantly from normal in anteroposterior dimensions.

Bone is an extremely plastic material that constantly modifies itself throughout life. Many of the morphological features of the long bones have been used by physical anthropologists to reconstruct activity patterns and intensity in individuals and populations. Likewise, morphological features of the femur can also be used as evidence for reduced ambulatory ability or complete immobility. The unique combination of features may even provide information regarding when the ambulatory problems arose during life.

Forensic Anthropology, Mobility, Femoral Antetorsion and Coxa Valga

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