A109 Estimation of Juvenile Age at Death Using Anterior-Posterior (AP) Radiographs of the Knee

Rachel E. Smith, Marquette, MI 49855; Carolyn V. Isaac, PhD, Kalamazoo, MI 49008-8074; Jered B. Cornelison, PhD, Western Michigan University School of Medicine, Kalamazoo, MI 49008; Jane Wankmiller, PhD, Northern Michigan University, Marquette, MI 49855*

Learning Overview: After attending this presentation, attendees will be familiar with a new measurement-based method of age-at-death estimation for juvenile decedents using radiographs of the lower limb.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by providing a new metric juvenile age determination method that highlights the value of using the metaphyseal regions of long bones for age determination. This method is applicable for complete remains and remains that may be incomplete due to decomposition, trauma, or dismemberment, and offers the potential to narrow current age range estimates, particularly for young juveniles.

Except in cases of extreme malnourishment or other biological stressors, bone growth and development in juveniles generally occurs at relatively predictable rates.[1] Building upon this predictability, several reliable age determination methods exist, including but not limited to those based on dental development, epiphyseal appearance and fusion, and the diaphyseal length of many long bones. The timing of the appearance of primary and secondary ossification centers and their fusion provides forensic anthropologists with fairly narrow age ranges for juveniles; however, these methods do not take into account the individual development of the epiphyses and metaphyses and their relationships to one another. During juvenile development of long bones, given that the metaphysis is present well before the appearance of the secondary ossification center of the epiphysis, the epiphysis must undergo a rapid widening to match the width of the metaphysis before the two elements approximate each other's size and later fuse together. This observed difference in the metaphyseal and epiphyseal growth rates raises the question of predictability in the metaphysis-to-epiphysis size ratio—can this ratio be used to reliably estimate age? Cunningham et al. report that the distal femoral epiphysis approximates the width of the metaphysis by age 7 in girls and age 9 in boys, suggesting the metaphyseal region to be a useful tool in juvenile age estimation.[2]

This study explores the relationships between the development of the distal femoral and proximal tibial metaphyses and their respective epiphyses. Anterior-posterior radiographs of the lower limbs of 111 juveniles of known age (61 males, 50 females; ages 0 to 18 years) are included in this study. Measurements of the femoral and tibial metaphyses and epiphyses were documented using the Picture Archiving and Communication System (PACS) at the Western Michigan University Homer Stryker M.D. School of Medicine, Department of Pathology (WMed). Measurements of the metaphyses and epiphyses associated with the knee were used to generate ratios for each individual, which were then used to establish ratio-based age cohorts.

Results from preliminary statistical analyses suggest that the distal femur and proximal tibia metaphysis/epiphysis diameter ratios may be reliable for determining a relatively narrow age range for young juveniles. Differential development of the femur and tibia must be considered when applying this method, as their respective ratios for different age cohorts vary. This presentation will discuss inter- and intra-observer error rates associated with this method, as well as the manners in which juveniles' circumstances of life and death affect its applicability and efficacy.[3] Overall, this method is reliable and repeatable and may provide forensic anthropologists with an additional tool for juvenile age determination, which is especially applicable in situations when remains do not involve complete long bones and/or dentition.

Reference(s):

1. Scheuer, Louise, and Sue Black. *The Juvenile Skeleton*. Elsevier Ltd. 2004.
2. Cunningham, Craig, Louise Scheuer, and Sue Black. *Developmental Juvenile Osteology*. 2nd ed. Elsevier Ltd. 2016.
3. Isaac C.V. 2016. *Utilizing Paleopathology Techniques to Detect Childhood Neglect in Forensic Cases.* Poster presented April 16, 2016, at the American Association of Physical Anthropologists 85th Annual Meeting, Atlanta, GA, April 13-16, 2016. Invited poster symposium "Towards a Holistic Forensic Anthropology."

Radiography, Age-at-Death Estimation, Knee