H72 Serial Bone Histology: Interand Intra-Bone Age Estimation

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After attending this presentation, attendees will better appreciate bone micro-morphology, attendant visualization, and quantification methods used to histologically discern differences throughout the human cortical long bone shaft.

This presentation will impact the forensic community and/or humanity by identifying the degree of differentiation of microstructures used for histological aging throughout the shafts of the long bones, in order to determine the validity/accuracy of aging fragmentary remains using microstructures.

Few publications are available on the histological (microscopic) differentiation throughout human or non-human mammalian long bone cortices. That is, are osteon population dynamics specific to proximal, midshaft of distal segments? This study utilizes Kerley's (1965) four quantification categories (non-Haversian canal, osteon, and old osteon fragment number, and percent circumferential lamellae) to estimate age as well as to quantify the differential structure counts from human femur, tibia and fibula based upon section location. Each long bone was evaluated metrically following the Chicago Standards. From each midshaft onecentimeter increments were marked moving proximally and distally, which resulted in twenty-five to forty segments per bone. Three thin sections were cut from each one-centimeter segment using a high-concentration diamond blade mounted on a Buehler Isomet 1000 saw. This technique employed a modification of the methods individually created by Stout and Ubelaker.

The Kerley quantification categories were used to enumerate the same microstructures in the humerus, radius, and ulna to identify structural change from the proximal to distal ends. Age estimation via the Kerley method is not made on the pectoral girdle elements, because the method was not intended for these bones. All sections were subjected to quantification identical to Kerley's quadrant (anterior, posterior, medial, and lateral) using a Leica DMRX light microscope at 5x, 10x and 20x power magnification. Morphometric analysis of the Kerley's quantification categories was conducted using Image-Pro Express software on the Dell Optiplex GX270.

Quantification of the aforementioned microstructures indicates there are statistically significant differences throughout the shaft, which will create significantly different age estimations depending upon section location. Paired T tests were conducted on the above categories to discern the mean intra and inter bone differences. ANOVA used the variables of osteon population, old osteon fragment number, and non-Haversian canal populations against the variables of within and between bones. Age assessments using the Kerley method based on the femur, tibia, and fibula revealed that estimates made on segments away from midshaft were significantly different to the .05 level.

These findings generate two related conclusions. First, metabolically, histological bone maintenance/remodeling varies greatly throughout the shaft. Second, it is imperative that the fragment location is correctly identified and that midshaft is used for this method, because, as this research explains, moving away from midshaft when using this method can lead to significantly different age estimations. These results are particularly pertinent to fragmentary remains, suggesting that quantification on fragmentary remains can provide incorrect age estimates. Furthermore, this research underscores the fact that age estimates of fragmentary human remains must account for significant difference of microstructure populations throughout the shaft as well as within one thin section.

Skeletal Biology, Bone Microstructure, Histological Aging

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