A81 Examining the Effect of Region Of Interest (ROI) Size on the Ability to Accurately Estimate Age at Death From Osteon Population Density (OPD)

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After attending this presentation, attendees will understand the current issues concerning histological age estimation and the effect that ROI size has on the relationship between OPD and age-at-death estimation.

This presentation will impact the forensic science community by demonstrating that the amount of bone sampled/analyzed in histological age assessment can have a profound impact on the ability to accurately estimate age at death. This will inform future histological research, resulting in higher quality forensic research and practice.

As a complement to macroscopic aging methods, or when necessary macroscopic elements are damaged/absent, age can be estimated through histological examination of remodeling events in cortical bone. To date, the femoral midshaft has been the most commonly employed site for histological studies; however, a consensus is lacking on how much bone to analyze when quantifying remodeling, as existing methods employ ROIs that differ in size, number, and location.

Recently, histological research at the femoral midshaft has proliferated due to the revival of the Ericksen femur collection as an active resource. The current study is a meta-analysis of three recent studies that provide a unique opportunity to assess the effect of ROI size on the relationship between OPD and age. All three studies analyzed here (the Ingvoldstad, Crowder/Dominguez, and Gocha methods) primarily utilized the Ericksen collection, examined the anterior region of the femur, and quantified remodeling according to the same standard histological definitions.[1-3]

The Ingvoldstad method examined 200 individuals (97 males, 103 females), aged 30-97 years (average=71 years), all from the Ericksen collection; a fixed ROI size of 3.00mm^2 was used to quantify remodeling at eight anatomical and biomechanical locations around the femoral cortex, though only anterior data are analyzed here. The Crowder/Dominguez method examined 320 individuals (170 males, 150 females), aged 15-97 (average=66 years), 87% of whom were from the Ericksen collection. This method used a topographic sampling strategy, separating a 5mm-wide section of the anterior femur into ten columns and reading every other frame using a Merz reticule; this resulted in an average ROI size of 18.30mm^2, with an average of 9.52mm^2 of bone analyzed. The Gocha method examined only 30 individuals (15 male, 15 female), aged 21-97 years (average=59 years), 83% of whom were from the Ericksen collection. This method examined remodeling over the entirety of the femoral midshaft, though only anterior octant and quadrant data are analyzed here; average octant ROI size was 41.82mm^2, average quadrant ROI size was 89.93mm^2.

Statistical analyses were performed in SPSS 23. Kolmogorov-Smirnov tests demonstrated OPD values for all methods to be normally distributed (all p-values >0.070). The relationship between OPD and age was assessed through Pearson's correlation coefficients, as well as the adjusted R^2 value of linear regression predictive models; all of these statistical measures were statistically significant (all p-values <0.043). The person who collected the majority of the data for the Crowder/Dominguez method also performed inter-observer error measures for the Ingvoldstad and Gocha studies, neither of which demonstrated significant differences between observers.

The correlation coefficient for the Ingvoldstad method was R=0.143, and the adjusted R^2=0.016, indicating OPD explained only 1.6% of the variation in age at death. The correlation coefficient for the Crowder/Dominguez method was R=0.681, and the adjusted R^2=0.462, indicating OPD explained 46.2% of the variation in age-at-death. The correlation coefficient for the Gocha Octant method was R=0.907, and the adjusted R^2=0.817, indicating OPD explained 81.7% of the variation in in age at death. For the Gocha Quadrant method, the correlation coefficient was R=0.918 and the adjusted R^2=0.838, indicating OPD explained 83.8% of the variation in age at death.

Results indicate that ROI size has a significant effect on the ability to predict age at death from histological remodeling. Examination of small, isolated ROIs is not recommended, as such an approach is more susceptible to random variation in variable distribution and can negatively affect interpretation. Instead, future studies should examine larger ROIs to maximize histological remodeling's ability to predict age at death.

Reference(s):

1. Ingvoldstad M.E. Femoral midshaft histomorphometric patterning: Improving microscopic age-at-death estimates from adult human skeletal remains. *Proceedings of the American Academy of Forensic Sciences*, 66th Annual Scientific Meeting, Seattle, WA. 2014.
2. Crowder C.M., Dominguez V.M. A new method for histological age estimation of the femur. *Proceedings of the American Academy of Forensic Sciences*, 64th Annual Scientific Meeting, Atlanta, GA. 2012.
3. Gocha T.P., Stout S.D., Agnew A.M. Examining the accuracy of age estimates from new histological sampling strategies at the femoral midshaft. *Proceedings of the American Academy of Forensic Sciences*, 68th Annual Scientific Meeting, Las Vegas, NV. 2016.

Age Estimation, Skeletal Histology, Forensic Anthropology