H53 Improving Histomorphometric Age Estimation: An Application of Osteon Population Density on Kerley's Original Sample Data

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After attending this presentation, attendees will understand the benefit of the OPD variable in histological age estimation.

This presentation will impact the forensic community by demonstrating that Osteon Population Density (OPD) can simplify previously reported age estimation techniques by reducing observer error and eliminating the need to subjectively determine an age interval when multiple regression models produce overlapping prediction intervals from a single specimen.

In 1965 Kerley developed age regression formulas from 126 undecalcified cross-sections taken from the midshaft of the femur, tibia, and fibula.[1] These samples were of known age, sex, and clinical history. Kerley's statistical models were based on four predicting variables including intact osteons, osteon fragments, non-Haversian canals, and percentage of circumferential lamellar bone. The variables were observed using four circular fields within the outer third of the cortex adjacent to the periosteal surface of the bone at 100x magnification. The individual variables (osteons, fragments, and non-Haversian canals) were counted within each field, including those partly obscured by periphery of the field, and then totaled across all four fields to create a composite value. The percentage of circumferential lamellar bone was averaged for all four fields. These raw counts were then used to develop four different regression models for estimating age from a single cross section of bone. Kerley and Ubelaker[2] revised the original Kerley paper warning investigators that the variance in field diameters of different microscopes would contribute to "apparent errors" and "unreasonable [age] estimates." Kerley and Ubelaker[2] realized that using a smaller field size than Kerley's original field size would underestimate age since the sum of recorded structures would be less than that recorded when the regression models were created. During this revision, it became apparent that the original microscopes were not available for inspection. A survey of available microscopes suggested that the field diameter used by Kerley[1] was most likely 1.62 mm at 100x magnification, rather than the previously reported 1.25 mm diameter. A 1.62 mm field diameter results in an area 2.06 mm2.

Recognizing the contributions of earlier bone histology studies in age estimation, Stout and Paine[3] developed a histomorphometric variable that summed the intact and fragmentary structures over the observable cortical area. This single variable was used as a predicting variable for determining age-at-death, rather than developing multiple prediction models from each of the observed structures. Stout and Paine[3] suggested that combining the number of intact and fragmentary osteons reduced the potential for inter-observer error associated with individual differences in osteon interpretation. Later, Crowder evaluated the effectiveness of OPD and determined that it significantly reduces inter-observer error as had been suggested in the literature.[4]

Kerley's original data from 126 specimens were used to calculate OPD by adding the raw composite values for intact and fragmentary osteons and dividing by the sum of the four 2.06 mm2 field areas (8.24 mm2) as determined by Kerley and Ubelaker.[2] A statistical regression analysis was performed by plotting age-at-death against OPD using SPSS 15. Four separate regression models were created, one for each skeletal element tested and one that combined the data of all three skeletal elements. All models correlate well with age, with the femur analysis providing the strongest positive linear relationship between OPD and age-at-death (R2=0.912), followed by the combined analysis for femur, tibia, and fibula (R2=0.894), tibia (R2=0.889) and fibula (R2=0.888). The results of this study indicate that the OPD variable correlates better with age than the raw counts, and the new models alleviate the need to generate a subjective age interval due to overlapping prediction intervals of the constituent variables. Suggestions for future research in histomorphometric age determination are also discussed. **References:**

1 Kerley ER. The microscopic determination of age in human bone. Am J Phys Anthropol 1965; 23: 149-63.

2 Kerley ER, Ubelaker DH. Revisions in the microscopic method of estimating age at death in human cortical bone. Am J Phys Anthropol 1978; 49: 545.

3 Stout SD, Paine RR. Brief communication: histological age estimation using rib and clavicle. Am J Phys Anthropol 1992; 87:111-5.

4 Crowder C. Evaluating the use of quantitative bone histology to estimate adult age at death. Doctoral Dissertation, University of Toronto, Ontario 2005.

Histomorphology, Osteon Population Density, Age Estimation

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