H77 Age Related Histomorphometric Changes in Fetal Long Bones

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The goal of this study is to investigate the age-related changes in histo- morphometry among the six long bones of the fetal skeleton. Histological studies have become increasingly important in distinguishing fragmentary human remains from non-human remains,[1,2] as well as estimating age at death in forensic cases.[3,4] However, little work has been done with subadult material due to its distinct growth patterns and unique microscopic compo- sition.

This study will impact the forensic community by providing a prelim- inary investigation into the potential of utilizing histomorphometry in the estimation of age at death of fetal remains. Microscopic methods may prove invaluable to the task of aging fragmentary remains that lack the character- istic features necessary for conventional methods.

Seven stillborn cadavers of known gestational age and sex were donated to the Mineralized Tissue Histology Laboratory of the University of Tennessee by the Medical Examiners Office of the University of Tennessee Regional Medical Center. Because an autopsy was performed on these still- births, either upon the mother's request or as routine protocol in a criminal investigation, permission was granted for histological sampling before incin- eration. The sample consisted of fetuses ranging in age from 17 to 35 weeks gestation with no two fetuses having the same gestational age. The six long bones of each fetus were embedded in epoxy resin, and thin sections were cut from the midshafts using a high-concentration Buehler Isomet low speed diamond blade saw. All sections were analyzed with a Leica DMRX light microscope at 16x, 50x, 100x, and 200x power magnification. Histomor- phometric analysis was conducted using a Dell Optiplex GX270 and Image- Pro Express software. For each slide, a maximum of 111 measurements were taken: maximum sagittal medullary diameter (anterior-posterior), maximum transverse medullary diameter (medial-lateral), medullary area, maximum cortical thickness (taken at each quadrant), minimum cortical thickness (taken at each quadrant), and a maximum of 25 separate trabecular diameters per quadrant.

In order to account for potential growth retardation in these stillborn cadavers, the gestational age of each fetus was estimated via long bone length[5] and compared with actual age to quantify its developmental progress. The presence of distinct differences between actual gestational age and estimated developmental age in six of the seven fetal cadavers highlights the efficacy of analysis in terms of the latter. Considering that in the forensic setting, the actual age of a fetal specimen is unknown and that fetal death is often associated with growth retardation, all statistical analysis in this study was conducted employing developmental age as a factor.

Due to the small sample size utilized for this study and the lack of repli- cation in gestational age among these seven fetuses, the results of histomor- phometric analysis should be interpreted as extremely preliminary in nature. Future research will benefit from the utilization of a much larger sample size containing multiple fetal specimens sampled from each gestational week. Only then can the full extent of variation in fetal histomorphometry be accounted for and generalizations concerning age-related changes extrapo- lated to the entire fetal population as a whole.

The results of Pearson's rho correlation analysis reveal a statistically significant correlation between sagittal medullary diameter and fetal age for the femur, tibia, and fibula. Transverse medullary diameter was significantly correlated with age in the humerus, tibia, fibula, and radius. Regarding medullary area, the femur, tibia, and fibula were the only bones that possessed a correlation with age. Statistically significant correlations between both maximum and minimum cortical thickness and age were found for all six long bones. Among the six long bones, the humerus and tibia have the strongest correlations between cortical thickness and age, as roughly 65% and 56%, respectively, of the variation in the bone's cortical thickness is explained by its positive linear relationship with age.

The results of an ANCOVA employing age as a covariate indicate that age is a significant linear predictor of trabecular thickness in all long bones except the radius. The only long bone to possess an interaction effect between age and quadrant was the humerus; therefore, only in this bone does the rate of linear change in trabecular thickness with age differ by quadrant location.

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Subadult, Histomorphometry, Age Estimation