A106 Estimating Age in Juvenile Crania Using Cranial Vault Thickness (CVT)

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After attending this presentation, attendees will better understand a novel technique of aging juvenile skeletal remains using CVT.

This presentation will impact the forensic science community by offering an alternative technique for aging unknown juvenile skeletal remains.

Age estimation, a component of the biological profile, contributes significantly to the creation of a postmortem profile of an unknown set of human remains, which can aid forensic professionals in linking remains to a missing person's profile. The goal of this study is twofold: (1) to introduce a new juvenile age estimation technique using CVT; and, (2) to compare CVT age estimation in an unknown individual with dental development, a more reliable technique.

Data for this study comes from Computed Tomography (CT) scans (n=74, 37 males and 37 females) of living children in Paris and Bordeaux, France. These scans come from individuals aged newborn to 16 years old and from different ethnic backgrounds. CVT was measured at five craniometric points (nasion, glabella, bregma, lambda, and opisthocranion) that have previously shown correlations between CVT and age, using the Half Maximum Height (HMH) function of the Treatment and Increased Vision for Medical Imaging (TIVMI) software.[1,2] HMH values provide an optimized interface between the tissues (air, soft tissue, bone, etc.) with high accuracy, based on the Hounsfield units of the CT scan. Multivariate Adaptive Regression Splines (MARS) models, using LOcal regrESSion (LOESS) regression, were created to illustrate the relationship between cubed root of known age and CVT in the open-source statistical software, R. A Prediction Interval (PI) was created for each point from each of the models.[3]

Results from this study indicate that CVT data vary in their predictive ability for age by location. CVT data for nasion and glabella do not conform to normality tests, which was further reinforced by visual examination of the Quantile-Quantile (QQ) plots. Models at bregma, lambda, and opisthocranion were normal and indicated that the models fit the data. PIs at bregma varied by 0.4mm, a difference that cannot be reliably used as an age indicator. PI values for lambda range from 0mm to 3mm in thickness and values for opisthocranion range from 0mm to <4mm.

The PIs were then used to assess age in an unknown juvenile cranium, from the Mississippi State Medical Examiner's Office in Jackson, MS. CVT was measured by manually calculating HMH values on a radiograph in ImageJ. These values were compared to PIs created from the models, and low, high, and mean values were produced at the 95% and 85% PI.

At the 95% PIs, predicted values for both lambda (2.214 years to 17.704 years with a mean age of 7.469) and opisthocranion (0.848 years to 22.778 years with a mean age of 6.762) are very large. The mean values remained the same at the 85% PIs, but the ranges narrowed to 3.2175 years to 14.4074 years for lambda and 1.715 years to 17.254 years for opisthocranion. Age estimation using transition analysis of dental development produce an age range of 3.811 years to 7.839 years with a mean age of 5.509 years old.[4]

Comparison of the two methods indicates that the PIs for age estimation using CVT at lambda and opisthocranion are large. The PIs for opisthocranion reach into early adulthood. Results also show that aging by CVT overestimates juvenile age at both points, although the mean at lambda is more overestimated. Aging by CVT is not as accurate as aging by dental development. Aging by CVT could benefit from additional known-age samples in model and PI creation. A larger sample could possibly narrow PIs and make estimates more reliable.

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Age Estimation, Juvenile, Computed Tomography