H38 Craniofacial Regional Variation in the United States: A Geometric Morphometric Study

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After attending this presentation, attendees will understand how environmental adaptation has impacted cranial variation in the United States within the last hundred years.

This presentation will impact the forensic science community by providing insight into craniometric variation as it applies to issues of cranial plasticity, migration, and genetic affinity. In addition, through the use of modern quantitative methods, this study will present a broader understanding of genetic versus environmental influences on cranial variation.

The main purpose of this study is to explore the effect of different environments within the United States on cranial variation. Two modern human samples were used in this analysis: 36 individuals from the donated New Mexico Unidentified and 31 individuals from the C.A. Pound Human Identification Laboratory (CAPHIL) at the University of Florida. The CAPHIL individuals represent populations residing along the eastern coast of the United States, while the New Mexico Unidentified represents populations in the west coast. Only European-American individuals were used in this analysis to establish a genetic baseline for cranial variation. Three-dimensional coordinate data for 21 landmarks were collected for individuals from these collections and a software program was used to run all multivariate statistical analyses. In order to reach a consensus least-square fit and acquire new shape coordinates for the entire dataset, Procrustes' superimposition was used to translate, scale, and rotate the landmark data. Principal Components Analysis (PCA) was performed to explore patterns of variation among the data in muliti-dimensional space, allowing the variables to be reduced to a few dimensions that represent the majority of cranial variation. The PCA identified seven principal components that represent 81% of the total variation. Typically, in closely related samples, the number of principal components representing total variation would be reduced; however, the larger number of principal components for this analysis is expected if environment can affect cranial shape.

To identify the landmarks responsible for the variation, Canonical Variate Analysis (CVA) was employed. The CVA produced two significant canonical variates with the first representing 91% of the variation, which included landmarks in the posterior and base portions of the crania (e.g., opisthion and asterion). In addition, Multivariate Analysis of Variance (MANOVA) was used to measure the statistical significance of the variance between groups. The MANOVA found significant variation in both centroid size (p-value=*0.049)* and shape (p-value=*0.001*) for the three groups. This suggests significant regional variation. Discriminant function analysis was also performed to discern the approximate level of separation by measuring the degree to which individuals could be correctly allocated to their location. A correct classification rate of 74% was found from the cross-validation and suggests these individuals are easily classified due to variation in cranial shape. Lastly, Mahalanobis D^2 was calculated to measure the distance between populations. The Mahalanobis D^2 was found to be 1.969 between the east and west coast groups. The two east coast groups were found to have a distance of 0.826. The distances found suggest a larger degree of East-West separation in European-Americans.

The differences seen in this study may affect ancestry assessment in different parts of the country and warrant further study. However, most of the variation was observed in the cranial vault and base suggesting facial landmarks are less easily influenced by the environment.

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