H96 The Use of the Endocranial Base in the Estimation of Ancestry

Nicole D. Siegel, DVM, Mercyhurst Univ, Dept of Applied Forensic Sciences, 501 E 38th St, Erie, PA 16546*

The goal of this presentation is to inform attendees about an evaluation of selected internal (endocranial) base landmarks performed on crania from the Hamann-Todd Human Skeletal Collection, and to test the merits of inclusion of endocranial base landmarks in forensic analysis.

This presentation will impact the forensic science community by demonstrating the utility of endocranial base landmark analysis in estimation of ancestry on a large sample of known remains.

Ancestry assessment is an integral part of the analysis of human remains in forensic studies. The cranium is among the most useful parts of the skeleton for estimation of sex and ancestry. In metric analyses, ancestry assessment has traditionally relied on linear distances between landmarks on the external (ectocranial) surface of the cranium.[1-3] In particular, in forensic settings a current analytical tool is the multivariate group comparison of these interlandmark distances using the software FORDISC 3.[4]

The endocranium, in particular the endocranial base, is easily accessed after an autopsy cut routinely performed in forensic settings, and contains several consistent, easily identifiable anatomical landmarks. The endocranium is also very durable, and is often well preserved in fragmentary remains. Since similar developmental pressures affect both the internal and external surfaces of the cranium, it is likely that, like ectocranial landmarks, endocranial landmarks can be useful to discriminate different sex and ancestry groups.

Studies assessing the utility of endocranial landmarks are scarce in the literature. Cameron devised angles about the pituitary point on sagittal sections of crania from the Hamann-Todd Human Skeletal Collection to evaluate cranial flexion, which was revisited by May and Sheffer and Lieberman et al. in extant primates and modern humans.[5-7] Bruner and Ripani, in a forensic application of endocranial landmarks, evaluated the utility of 19 endocranial base points for sex estimation, finding that all detected sex differences were found to be primarily related to allometry, they did not evaluate differences in ancestry.[8]

In this study, the utility of a set of endocranial landmarks is assessed for ancestry determination using landmarks proposed by Bruner and Ripani, as well as an additional set of landmarks proposed by the author. A 3D digitizer was used to digitize landmarks on 200 crania from the Hamann-Todd Human Skeletal Collection. Both interlandmark distances and Procrustes coordinates were analyzed through discriminant function analysis using FORDISC 3 and a geometric morphometrics software. Sex differences were attributed to size, so they were detected in interlandmark distance measurements but not in Procrustes coordinates, which eliminate size differences, focusing solely on shape. When the sexes were pooled, shape differences between ancestral groups were found. Similar to traditional ectocranial landmarks, endocranial base landmarks showed significant differences between African American and European American crania, with African Americans displaying significantly longer and narrower cranial bases. Discriminant function analysis using FORDISC 3 classified ancestral groups with a cross-validated accuracy of 77.3%.

References:

1. Howells WW. Cranial variation in man. Cambridge (MA): Papers of the Peabody Museum of Archaeology and Ethnology; 1973: 166-90.
2. Walker PL. Sexing skulls using discriminant function analysis of visually assessed traits. Am J Phys Anthropol 2008;136:39-50.
3. Hefner JT. Cranial nonmetric variation and estimating ancestry. *J Forensic Sci* 2009;54(5):985-95.
4. Jantz RL, Ousley SD. FORDISC 3.0: personal computer forensic discriminant functions. Knoxville (TN): The University of Tennessee, 2005.
5. Cameron J. Craniometric studies: XXXIII. The inferior frontal triangle—a new cranial triangle. Am J Phys Anthropol 1932;17: 99-110.
6. May R, Sheffer DB. Growth changes in internal and craniofacial flexion measurements. Am J Phys Anthropol 1999;110:47-56.
7. Lieberman DE, Ross CF, Ravosa MJ. The primate cranial base: ontogeny, function, and integration. Yearb Phys Anthropol 2000;43:117-69.
8. Bruner E, Ripani M. A quantitative and descriptive approach to morphological variation of the endocranial base in modern humans. Am J Phys Anthropol 2008;137:30-40.

Endocranial, Base, Ancestry

 ** Presenting Author*