



## Physical Anthropology Section – 2011

### H44 Ancestry Determination From Foramen Magnum

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After attending this presentation, attendees will become aware of possible cranial base changes and of the usefulness of the foramen magnum shape as a non-metric characteristic of ancestry to aid in the identification of unknown human remains.

This presentation will impact the forensic science community by presenting results that suggest possible localized change in cranial base dimensions and explore the potential for an eliminating non-metric characteristic for ancestry determination.

Ancestry estimation is a crucial part of creation of a biological profile in forensic anthropology. Improper classification of ancestry can affect other aspects of the biological profile, such as stature. Several metric and non-metric techniques are used by forensic anthropologists to determine ancestry of unidentified human remains. Some anthropologists believe the cranium to be an excellent indicator of ancestry (Rhine 1990).<sup>1</sup> Previous studies have explored the effectiveness of using the cranial base's occipital condyles for ancestry assignment of an individual. Holland (1986)<sup>2</sup> studied the Terry Collection, housed at the Smithsonian, to develop five multiple-regression equations for determining ancestry from osteological landmarks on the cranial base. The current presentation focuses on the utility of the foramen magnum region on the cranial base as a positive indicator of ancestry.

This research utilizes the same measurements as the study conducted by Holland (1986) to analyze four modern skeletal collections consisting principally of whites, blacks, and Hispanics. A total of 12 measurements were taken from 465 cranial bases from collections of modern forensic remains housed at the William M. Bass Donated Skeletal Collection at the University of Tennessee, Knoxville, the Louisiana State University Forensic Anthropology and Computer Enhancement Services (FACES) Laboratory, Pima County Office of the Medical Examiner, in Tucson, Arizona, and the Maxwell Museum of Anthropology's Osteology Laboratory at the University of New Mexico. All measurements were taken with a sliding caliper unless the osteological landmarks were missing or incomplete. These measurements included: length of the left and right occipital condyles, maximum width of the left and right occipital condyles, minimum width of the left and right occipital condyles, maximum distance between occipital condyles, minimum distance between occipital condyles, maximum interior distance between occipital condyles, foramen magnum width, foramen magnum length, and length of the basilar process. A Student's t-test indicates that variation of the foramen magnum width among blacks, whites, and Hispanics is significant ( $p < 0.05$ ). Also, when comparing results of the measurements of blacks and whites from the modern forensic collections with those from Holland (1986),<sup>2</sup> variation was significant ( $p < 0.05$ ) in two of the 12 measurements for both sex and ancestry. These results suggest that localized changes on the cranial base may have occurred. The maximum distance between occipital condyles increased in length and the maximum interior distance between occipital condyles has decreased in length.

Finally, to assess non-metric variation of the shapes of the foramen magnum, five different shape categories were defined to classify each foramen magnum: Arrowhead, Circle, Diamond, Egg, and Oval. A Pearson's chi-square test showed a significant relationship between black, white, and Hispanic ancestral groups and foramen magnum shape ( $p < 0.05$ ) based on shape analysis as defined by the researchers. To test the practicality of applying such a non-metric assessment of ancestry based upon the shape of the foramen magnum, a survey was conducted at the 62<sup>nd</sup> American Academy of Forensic Sciences Annual Meeting. That survey asked participants, ranging in experience from undergraduate students to experts, to classify a group of foramen magnums into one of the five categories. The results from the survey showed that the five foramen magnum shape categories are highly subjective and that the Diamond and Arrowhead categories should be combined. Interestingly, since none of the 37 presumed Hispanic skulls (either self-identified or defined by the Pima County Office of the Medical Examiner) possessed an Egg-shaped foramen magnum, an Egg shape has the potential to be used as an eliminating non-metric characteristic.

#### References:

1. Rhine, Stanley. "Non-Metric Skull Racial." *Skeletal Attribution of Race: Methods for Forensic Anthropology*. Albuquerque: Maxwell Museum of Anthropology Press, 1990.
2. Holland, T.D. "Race Determination of Fragmentary Crania by Analysis of the Cranial Base." *Journal of Forensic Sciences*. Vol 31, No 2. (1986): 719-725.

#### Ancestry, Foramen Magnum, Biological Profile