H81 Overjet or Prognathism? Morphometric Assessment of Midface Morphology Between Blacks, Whites, and Hispanics

Michael W. Kenyhercz, MS, University of Alaska Fairbanks, 403 Salcha Street, 310 Eielson Bldg, Fairbanks, AK 99775; Joseph T. Hefner, PhD, Central Identification Laboratory, 310 Worchester Avenue, Bldg 45, Joint Base Pearl Harbor Hickam, HI 96583; and Kate Spradley, PhD, Texas State University, Dept of Anthropology, 601 University Drive, San Marcos, TX 78666*

After attending this presentation, attendees will understand the utility of morphometrics to elucidate shape differences in the human palate and ultimately use this information as a resource to aid in ancestry estimation.

This presentation will impact the forensic science community by serving as a means to enhance the biological profile, specifically the estimation of ancestry, using a simple model that is easy to interpret.

In a recent paper by Hefner *et al.*, the ancestry of Black, White, and Hispanic crania were estimated through the combination of metric and non-metric observations through random forest models.[1] In their findings, Hefner et al. noticed a trend for the model to focus on maxillary, and specifically palate, variables as major discriminators.[1] This study noticed a trend for Hispanic crania to exhibit a pseudo-prognathism that was related to an orthodontic condition known as overjet, in which there is an increased projection of the teeth, labially or buccally, projecting at an angle anteriorly, thus giving the appearance of prognathism. The aim of the current study is to refine the observations of Hefner *et al.* through the use of geometric morphometric analyses of recent Black, White, and Hispanic crania and to test which classification statistics are most appropriate for morphometric data, i.e., which methods yield the most optimistic classification results.[1]

For the present study, coordinate data for 287 crania were collected. Coordinate landmarks were chosen to represent the midface adequately and included: alveolon; basion; bregma; ectomolare (left and right); prosthion; and, staurion. Data were obtained for American Whites (n=84) and American Blacks (n=82) from the Terry Collection at the Smithsonian and from the Pima County Office of the Medical Examiner in Tucson, AZ (n=121). The data were subjected to a Generalized Procrustes analysis that translated, scaled, and rotated the data. The raw coordinate data were transformed into Procrustes coordinates (size-free shape coordinates) and further refined using principal components analysis on the Procrustes coordinates to analyze the midfacial complex as an entire unit, in addition to simply x, y, or z coordinates.

Total correct classifications ranged from 65.5% to 89.3% depending on the statistical analysis used and whether Procrustes coordinates, or their derived principal component scores, were used. The single highest classification was achieved through random forest model using the Procrustes coordinates. In the random forest model using the Procrustes coordinates, Whites classified most accurately at 92.9%, followed by Hispanics at 90.1%, and lastly Blacks at 84.1%. Across the board, Blacks most commonly misclassified as Hispanic, while Hispanics generally misclassified equally as White or Black. Lastly, Whites tended to misclassify most commonly as Hispanic.

The analyses based on the Procrustes coordinates yielded higher overall classification results. It might be the case that generating principal components from Procrustes coordinates generates redundant data due to some anatomical structures being relatively stable between population groups. Ectomolare, basion, bregma, and prosthion overwhelmingly contributed to both the classification models, as well as generating the greatest loadings for each of the principal components. Principal component 3 contained 12.6% of the total shape variation and was consistently an important variable among all of the analyses. Principal component 3 demonstrated major shape changes in a reduction of palate width, with ectomolare moving anteromedially and prosthion moving distally. Additionally, staurion moved distally with the same magnitude as prosthion. Whites demonstrated the most exaggerated reduction in palate width relative to the cranium, while also demonstrating a deeper palate anterodistally. Blacks exhibited shape just the opposite of Whites with wider, shallower palates relative to the cranium, but with the addition of an exaggerated anteriorly projecting prosthion, related to the prognathism. Hispanics demonstrated an intermediate morphology with a slight reduction of palate width and depth, but with a slightly more exaggerated prosthion, likely the effects of overjet. The palate has proven to be an effective discriminator of ancestry, and with a simple model using morphometrics, fine-grained shape differences were observed.

Reference:

1. Hefner JT, Spradley MK, Anderson BE. Ancestry assessment using random forest models. J Forensic Sci, In press.

 ** Presenting Author*

Forensic Anthropology, Geometric Morphometrics, Ancestry Estimation

 ** Presenting Author*