H13 Morphological, Metric, and Morphometric Variation in the Midface

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After attending this presentation, attendees will understand 1) Collecting data to answer current question can be used to answer other questions in the future 2) discriminant function analysis (DFA) is a powerful tool for estimating ancestry from skeletal remains, and 3) DFA using interlandmark distances (ILDs) can distinguish between Whites, Blacks, and American Indians very well.

This presentation will impact the forensic community and/or humanity by demonstrating the need to be more thoughtful when collecting and analyzing data.

Often, the forensic anthropologist trying to identify remains is faced with providing discrete answers: Male or Female, Black or White, or especially in possible NAGPRA cases, American Indian or White, and if Indian, which tribe. Data collection and analysis is often centered on answering specific questions, and morphological observations are more valuable when they can be quantified and analyzed in a statistical framework. Unfortunately, applicability of a method can be constrained by a limited approach.

Gill (1984) and Gill *et al.* (1988) proposed a metric method for determining American Indian vs. European ancestry. The authors calculated three ratios and "eyeballed" where the best sectioning points between groups would be in each; an unknown was classified into the group that was on the same side of the sectioning point in at least two of the ratios. Their method correctly classified 88% of large samples of Indians and Whites. However, Gill et al. (1988) also noted that the measurements of Blacks and Indians were similar enough that Blacks would classify as Indians using the method.

To test the Gill method, a three-dimensional digitizer was used to collect midfacial cranial landmark data from approximately 300 American Indians, Blacks, and Whites at the National Museum of Natural History, Smithsonian Institution. Twenty landmark coordinates were recorded on each cranium, primarily Type I landmarks, those located at the intersection of sutures, as well as the Gill landmarks. One of the challenges of the Gill method is locating alpha. The Gill definition involves drawing a line from zygoorbitale to nasale inferius and eyeballing the deepest part of the concave contour. For this analysis, the digitizer pointer was traced from zygoorbitale to nasale inferius and the alpha point on each side was calculated directly as the point of maximum departure from the straight line from zygoorbitale to nasale inferius. Other challenging landmarks are the 'deepest point on the nasal bridge," the points used to calculate subtenses, which are also apparently eyeballed. The digitizer pointer was traced from nasion inferiorly along the midline and the smallest distance to each paired alpha, maxillofrontale, and zygoorbitale determined the subtense points. Statistics were performed using SAS and SYSTAT. Reported classification accuracies are cross-validated.

Results were somewhat in agreement with Gill *et al.* (1988) with some important differences. While 103 of 117 (88%) American Indians and 88 out of 95 (93%) Blacks classified as non-White, only 59 of 95 (62%) Whites classified correctly. A sample of 20 Eskimos was classified 100% correctly. An analysis of the Gill measurements revealed that there are sex differences in the alpha index ($p < .001$) and the zygoorbital index ($p < .05$). In looking at measurement and index distributions, it was also clear that certain measurements (even when standardized by sex) showed greater differences between American Indians and Whites than the indices in which they were used. Further, DFA uses different weights according to the contribution of each variable to separating groups and their correlations to the other variables. In the Gill method, each index receives equal weight. Analyzing the three Gill indices in DFA, 79% of the Indians and 74% of the Whites were correctly classified, but the alpha index did not significantly contribute to the discriminant function. Analyzing the six Gill measurements used to calculate the indices classified the American Indians and Whites 90% correctly, and the alpha cord was especially valuable. A three-way DFA of American Indians, Blacks, and Whites classified 72% correctly.

The advantages of more extensive data collection became apparent when the interlandmark distances from 20 landmarks were calculated. In the two-way DFA, American Indians and Whites were correctly classified 95% of the time using up to 25 ILDs including alpha landmarks, and 92% without the alpha landmarks. In a three-way DFA, American Indians, Blacks, and Whites were classified 85% correctly using 19 interlandmark distances, including alpha landmarks, and 82% correctly without them.

Gill *et al.* (1988) discovered important measurements that differ between American Indians and Whites and outlined specific measurements for discriminating between them. However, greater differences were found through collecting better-defined landmarks, and employing multivariate methods such as DFA. DFA also provides posterior probabilities and other statistics so one can know how strongly an individual classifies into a particular group. Also, a more comprehensive data collection routine captured more differences, some clearly less perceptible, between groups. As a result, the original problem of misclassification of Blacks as American Indians was greatly reduced.

Cranial Landmarks, Interlandmark Distances, Discriminant Function Analysis

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