H45   Group Classification Using Traditional Craniometrics, Angle Measurements, Geometric Morphometric Techniques, and the Potential Applications of These Methods to Fragmentary Crania

Jolen Anya Minetz, MA*, and Jiro Manabe, MA, JPAC-CIL, 310 Worchester Avenue Building 45, Hickam AFB, Honolulu, HI 96853

After attending this presentation, attendees will have a greater understanding of the utility of various craniometric methods as they pertain to differentiating populations as well as associating fragmentary crania with specific groups. The goal of this presentation is to examine the morphological variation evident in the crania of three groups and the utility of several craniometric techniques: (1) traditional craniometric measurements; (2) angles acquired for cranial landmarks; and, (3) geometric morphometric techniques to differentiate between groups and assist with the assessment of race in a biological profile.

This presentation will impact the forensic science community by contributing to the continuous evaluation of the utilization of craniometric analyses and emphasize the importance of developing diverse craniometric methods for the analysis of fragmentary crania.

The purpose of this research is to test the discriminatory ability of these analyses in the classification of three groups, and evaluate the ability for these methods to classify fragmentary crania. The reference sample consists of 198 dry male skulls representing three groups: Japanese (n=105), American White (n=42) and American Black (n=51). Cranial landmarks were collected in Cartesian coordinates using a Microscribe G2X digitizer. The three dimensional coordinates were deposited into a formatted spreadsheet that computed inter landmark distances for 24 standard cranial measurements and angles between

landmarks for as 8 angle variables. A generalized procrustes analysis was also conducted on the data in Morphologika2 to obtain principle components for using in discriminant function analyses.

A discriminant function analysis was performed using SPSS statistical software. The classification rate for the three groups using the standard measurements alone ranged from 78.6% for American White to 90.2% for American Black. The classification rate for the angles was between 80.0% for Japanese and 86.3% for American Black, and when the analysis was performed in a combined model (standard measurements and angles), each of these groups were correctly classified above 90%. The 3D data classified the three groups at a higher rate than the standard craniometric analysis but not as well as the combined method; the predicted group member ship ranged from 82.4% for the American Black group to 94.3% for the Japanese group.

The utility of the different methods was tested in the analysis of several fragmentary crania. Different models were used depending on the portion of the cranium preserved. If portions of the crania, such as the craniofacial area or cranial vault are preserved, then measurements and landmarks are generally abundant enough to be analyzed using all of the models. However, in more heavily fragmentary crania where the midsagittal plane was compromised or lateral fragmentation obscured the contralateral point of a paired craniometric point, then metric analysis was only capable with geometric morphometric analysis. Heavily fragmentary crania that exhibited these patterns tended to retain very few non metric traits that could assist with race determination. The cranial fragments were analyzed by inputting a database into FORDISC 3.0 comprised of the principle components produced by the geometric morphometric analysis of the aforementioned groups and cranial fragment and running a discriminant function analysis. The results were then compared to the mtDNA haplogroup of the cranial fragment, and in some cases to the antemortem records. Overall, the classification results were useful, but the discriminating powers of the landmarks ranged based on the location and number of obtainable landmarks. For future research it would be valuable to assess the utility of all combinations of landmarks and how the combinations relate to the underlying morphology in order to better predict the classification potential for any fragmentary crania. It would also be valuable to compute and analyze a variety of inter landmark angles in order to understand the relationship of small areas of the cranium in relation to the overall morphology and provide more minute measurements to assist with the classification of fragmentary crania.

The development and validation of these methods in the future will greatly assist with the biological profile of fragmentary remains. Since the cranium is the most important aspect of the skeleton for determining race, advancing these techniques for the purpose of evaluating cranial fragments that retain little information otherwise, could be a great help in a variety of forensic contexts where remains have been compromised and may not yield an mtDNA sequence.

Geometric Morphometrics, Cranial Angles, Craniometrics