



## Physical Anthropology Section - 2012

### H106 A Radiographic Study on the Utility of Cranial Vault Outlines for Positive Identifications

Ashley B. Maxwell, MA\*, North Carolina State University, Department of Sociology & Anthropology, 334 1911 Building, Campus Box 8107, Raleigh, NC 27695; Ann H. Ross, PhD, North Carolina State University, Department of Sociology & Anthropology, Campus Box 8107, Raleigh, NC 27695-8107; and Sam Simmons, MD, North Carolina Office of the Chief Medical Examiner, Campus Box 7580, Chapel Hill, NC 27599-7580

The goal of this presentation is to explore the applicability of radiographs in medicolegal investigations.

This presentation will impact the forensic science community by highlighting the importance of biological variation and the utilization of radiographs in unidentified remains.

The visual and statistical assessment of the utility of radiographs for positive identification was examined in accordance with the *Daubert* and the 2009 National Academy of Sciences Report, which calls for more testable and reliable scientific research. Currently, there has been a surge in research pertaining to morphological variation in the crania and post-crania for positive identification. The areas most explored include the frontal sinus, chest, and vertebrae. The availability of antemortem radiographs of particular areas of the body can be used for positive identifications in cases where other measures of identification cannot be employed. The utility of radiographs for medicolegal purposes is shown by the uniqueness of certain features of the skeleton in previous research; however, there is a need to quantify their uniqueness to appease the *Daubert* ruling and National Academy of Sciences Report. The purpose of this research is twofold: (1) to test the visual accuracy of positive identification in antemortem and postmortem radiographs of the lateral cranial vault outline among practitioners with different levels of forensic experience; and, (2) to use shape analysis (elliptic Fourier analysis) to evaluate the uniqueness of vault outlines and its applicability to positive identifications.

A sample of 90 individuals with varying levels of education participated in a visual accuracy test, which included: Ph.D. (n=34), M.D. (n=6), M.A. or M.S. (n=39), and B.A. or B.S. (n=11). Along with education, forensic case experience was also recorded, which included: none (n=13 or 14%), 1-10 cases (n=23 or 25%), <50 cases (n=25 or 27%), and >50 cases (n=31 or 34%). The visual test was comprised of left lateral radiographs taken from 14 crania (labeled A-O) representing the “antemortem” radiographs, and the “postmortem” radiographs were comprised of five randomly chosen crania from the same sample of 14 crania comprising the “antemortem” set that were radiographed a second time. Participants were asked to match the “postmortem” radiographs with the “antemortem” radiographs. Out of the 90 individuals, 38 (or 42%) correctly assigned all of the radiographs, with accuracy rates ranging from 70-93% for each of the five radiographic comparisons. Individuals with the highest level of education (PhD) and the lowest level (BA or BS) also had the most correct responses (45% correct) along with individuals with the highest forensic case experience (50% correct). Participants were also asked to list the skeletal markers that aided in their assessments and theinion hook (22%) and overall vault shape (21%) were listed as the most useful for identification.

Vault shape was compared among the 14 antemortem cranial vault outlines and the five postmortem vault outlines with geometric morphometric methods of contour shapes using the statistical program SHAPE 1.3, which performs an elliptic Fourier analysis. A principle component analysis was run on 30 harmonics to examine the variation in the morphological features of the cranial vaults. Paired t-tests were computed on the effective principle components to assess significant differences between each of the five antemortem and five postmortem radiographs and a two tailed t-test was computed between all of the antemortem and postmortem radiographs. The results indicate that there were no significant differences between any of the radiograph comparisons.

The visual comparison test and shape analysis was performed to evaluate the uniqueness of cranial vault outlines in radiographs, accuracy rates, reliability, and their utility in positive identifications. The visual accuracy test shows that the visual assessment of radiographs is not useful for positive identifications under the *Daubert* criteria due to the low accuracy rates (only one comparison had over 90% accuracy). However, education and experience did appear to affect the ability to correctly assign the radiographs. The shape analysis also indicates that vault outlines are not useful for positive identifications alone, although they could be used in conjunction with other features (such as the frontal sinus) for positive identifications.

#### **Cranial Vault Radiographs, Elliptic Fourier Analysis, Positive Identification**