H82 The Petrous Portion of the Human Temporal Bone Revisited: A Bayesian Analysis of its Potential Value in the Identification of Human Skeletal Remains

Jason M. Wiersema, PhD, Harris County Medical Examiner, 1885 Old Spanish Trail, Houston, TX*

The goal of this presentation is to inform the attendee of the utility of the petrous portion of the temporal bone, as seen on axial head CT, in the identification of human remains, and will discuss the results within the framework of Bayesian theory in light of recent federal court requirements regarding forensic testimony.

This presentation will impact the forensic community and/or humanity presenting a novel means for identifying fragmentary human skeletal remains with a high degree of accuracy; presenting the results of this research within the framework of Bayesian theory as a means to satisfy the most recent federal requirement for the admissibility of forensic testimony.

Recent federal court decisions, most notably including the Daubert vs. Merrell-Dow ruling (1993) require more demonstrable levels of repeatability and more substantial statistical support for forensic scientific testimony including identifications. Currently, the content of forensic testimony must: (1) be testable by the scientific method, (2) have been peer reviewed, that is, published in a peer-reviewed journal, (3) be accompanied by explicit and demonstrable reliability and error rates, and

(4) achieved general acceptance within the relevant scientific community. For this reason, research in forensic identification has undergone a transformation that has significantly influenced the development of recent novel identification methods. Considerable recent attention has been levied on the statistical basis for positive identifications made specifically by forensic anthropologists (Steadman et al. 2006). Traditional anthropological methods of identification have been short on the type of information necessary to satisfy the Daubert requirements. However, some more recent anthropological methods have been designed with these federal admissibility requirements in mind (Christensen 2003).

Wiersema (2006) presented preliminary results of an evaluation of the potential of the morphology of the petrous portion of the human temporal bone as seen on axial CT scans of the head as a means to generate identifications of fragmentary human skeletal remains. The current poster presents the final results of that study and considers them within the context of Bayesian theory in light of the recent rulings regarding the admissibility of forensic testimony.

The data used in this research were collected from axial CT images of the cranium. Two sets of images were collected for each of the 115 individuals in the sample so that Euclidean distance comparisons could be made between images of the same individual and images from different individuals. Two-dimensional coordinate data were collected from 36 landmarks on each of the CT images and the distances between each of the coordinate points were calculated to generate the data used in the statistical analyses. The author pared down this set of measurements using two different models (referred to as the biological and PCFA models). The measurement sets of both models were then compared to one another using nearest neighbor analysis, to test their relative efficiency in matching replicate images to one another. The results of both models were highly accurate. Three incorrect nearest neighbor matches resulted from the biological model and 5 from the PCFA model. The errors appear to have been the result of variation in the axial plane between the first and second scans.

The results of the nearest neighbor comparisons were then considered within the context of Bayes' Theorem by calculating likelihood ratios and posterior probabilities. The likelihood ratios and posterior probabilities were very high for both models, indicating that: 1) there is significant individual variability in the measurements of the petrous portion used in this research, and 2) this variation represents a high level of potential accuracy in the application of this method in the identification of forensic remains. This poster will illustrate these results and compare them to the results of other identification methods including DNA.

Forensic Identification, Petrous Portion of the Temporal Bone, Axial Computed Tomography

 ** Presenting Author*