H59 Maintaining Custody: A Virtual Method of Creating Accurate Reproductions of Skeletal Remains for Facial Approximation

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After attending this presentation, attendees will gain insight into new computerized methodologies that will assist local law enforcement and forensic facial approximation specialists by providing the results of a unique three-dimensional pilot study conducted by a team of researchers.

This presentation will impact the forensic community by serving to increase scientific knowledge of new technologies and methods available to the forensic community for human cranial identification. It will also attempt to advance the state of facial approximation methods which are commonly utilized by law enforcement to identify unknown individuals.

Facial approximation is a common analysis requested by local and national law enforcement agencies for human identification. Evidentiary chain of custody concerns by law enforcement have led agencies to search for technological alternative methods that can allow the agency to maintain custody of critical evidence while getting cutting edge forensic analyses. Three-dimensional imaging technologies allow researchers to go beyond traditional anthropological methods to now create virtual computed models of anatomical structures.[1] The goal of this project was to provide accurate skull models to forensic identification specialists and Medical Examiner's Offices for forensic facial approximation without taking custody of the skeletal material itself.

In this pilot study, unidentified skulls were taken by several Medical Examiner's Offices in the state of Florida to local radiology centers where the skulls were scanned on a 64-slice high resolution computed tomography (CT) scanner at a slice thickness of 0.5mm. The CT data was then given to the researchers to compute anatomically accurate virtual models of the skulls. It should be noted that the researchers never took custody of the remains and in many cases never had physical contact with the remains at any time. The volumetric data from the scans were taken into the visualization software package *Mimics*© version 12 (Materialise). A FloodFill method of seeding the image was done to model the bone pixels in the data set. This 3-D volumetric pixel grouping was then filtered of artifact holes and closed to create one unsegmented structure. The data set was then rendered into a 3-D Model and exported as a Stereolithographic file (STL). After a biological profile was created from the virtual skull data by a forensic anthropologist,[1] the STL models were exported for rapid prototyping. Accurate full size prototypes of the skulls were then produced from the computed virtual skull model using a 3-D ZPrinter 310 (© ZCorp) printer which was then submitted to the forensic facial clay modeling specialist.[2]

The clay modeling specialist and anthropologist worked with the researchers on highlighting key facial regions used in facial reconstruction that are critical in approximating the soft tissue features. From their input, focus was turned to regions such as the vomer for the estimation of the nose shape and length and suture lines for the estimation of age. Due to the lack of objective criteria for analyzing the facial approximations themselves other than superimposition, the researchers are currently focusing on developing methodologies to interpolate the soft tissue relationships from the surface voxels on the computed representation of the skulls.

This project demonstrates the potential for high-end forensic analysis to be conducted remotely without assuming custody of the evidence. This also allows local law enforcement agencies to have access to experts beyond their geographic location. While there is a wide range of variation between commonly used facial identification methods,[2] the benefit of this study is that there is an open discussion of the strengths and weaknesses at each stage of the analysis which will in turn increase the understanding and scope of forensic facial approximation from 3-D data.

References:

1 Decker SJ, Hilbelink DR, Hoegstrom EJ. Virtual skull anatomy: three-dimensional computer modeling and measurement of human cranial anatomy. Proceedings for the 60th Annual AAFS Meeting, Washington, DC 18-23 Feb. 2008; (14)312.

2 Decker, SJ, Hilbelink DR, et al. Who is this person? A Comparison Study of Current 3-Dimensional Facial Approximation Methods. Proceedings for the 60th Annual AAFS Meeting, Washington, DC 18-23 Feb. 2008; (14)338.

3-D Modeling, Evidence, Human Identification

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