H31 Three-Dimensional Computer Modeling and Anthropological Assessment of the National Library of Medicine's Visible Human Male

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The goal of this presentation is to demonstrate the ability to establish a biological profile used by forensic anthropologists in human identification from three-dimensional (3-D) image data. Using previously validated methodologies,[1] it will also compare the computed models of the cranial and post-cranial skeleton to those printed by a 3-D rapid prototyping machine.

This presentation will impact the forensic community by increasing scientific knowledge of new methods available for use in training and the identification of human remains.

Using three-dimensional (3D) imaging technology, researchers have been able to create virtual computed models of anatomical structures for a wide range of educational and research activities. The purpose of this study was to demonstrate the potential for establishing an accurate biological profile of a human skeleton solely from reconstructed 3-D data of the National Library of Medicine's *Visible Human Project*®.[2]

This study began by utilizing the Visible Human Male's (VHM) anatomic serial sections to isolate the skeletal tissue from each slice. Every anatomical structure in the digital image set was assigned a unique color and isolated using Adobe *Photoshop CS3*©. These image files (.tiff) were then imported into the software package, Mimics© version 12 (Materialise) for reconstruction and 3-D visualization.

After the complete skeleton of the VHM was reconstructed, 78 anthropometric cranial and post-cranial measurements were selected from an index of standard anatomical landmarks based on their effectiveness in establishing a biological profile in skeletal analysis.[3] Additionally, non-metric traits commonly used in the assessment of age, sex and ancestry were also examined to complete the biological profile. Once the anthropological data was collected, the biological profile was then compared to the known values of the subject documented by Spitzer, et al.[2]

The 3-D virtual models of the skeleton were exported as stereolithographic (STL) files and a select series of bones were printed using a Zcorp 3-D ZPrinter© 310 Plus rapid prototype machine. The prototype bones were then measured with traditional caliper methods using the same indices as the virtual skeleton and compared to the previous results.

In this study, the biological profile generated from the virtual skeleton was consistent with the known information about the Visible Human Male. Statistical analysis of the data comprising the samples (virtual and prototype), confirmed the accuracy of the computer modeling and measurement technologies. Additionally, this study found the prototype bones to be valuable reproductions, even taking into consideration artifacts from the printing process.

This study demonstrates that 3-D datasets of different kinds (digital images and serial sectioning) can be useful tools in the study of human anatomy for clinical, educational, and forensic purposes. Data sets that are public domain such as the National Library of Medicine's *Visible Human Project*® have proven to expand the accessibility of anatomical specimens beyond actual contact. The data resulting from the *Visible Human Project*® has allowed for the possibility of creating reliable virtual models for teaching purposes as well as models for testing fundamental anthropological methods, like establishing a biological profile, through the use of 3-D volumetric data reconstruction.

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 Spitzer V, Ackerman MJ, Scherzinger AL, Witlock D. The Visible Human Male: A Technical Report. *Journal of the American Medical Informatics Association*, 1996; 3:118-130.

3 Buikstra JE, Ubelaker DH (eds.) (1994) *Standards for Data Collection from Human Skeletal Remains.* Arkansas Archaeological Survey Research Series No. 44.

3-D Imaging, Computer Modeling, Human Anatomy

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