H35 The Development of Forensic Anthropological Standards in Western Australia

Daniel Franklin, PhD, University of West Australia, Centre for Forensic Science, MBDP M420, 35 Stirling Highway, Crawley, Western Australia 6009, AUSTRALIA; Ambika Flavel, MSc, Algis Kuliukas, MSc, Robin Hart, PhD, The University of Western Australia, Centre for Forensic Science, Crawley, WA 6009, AUSTRALIA; and Murray K. Marks, PhD, University of Tennessee, Department of Pathology, 1924 Alcoa Highway, Box 108, Knoxville, TN 37920*

The goal of this presentation is to increase awareness of the need to develop population-specific standards for identifying unknown human skeletal remains in Western Australia and calls attention to the importance of a statistically-valid foundation for those standards.

This presentation will impact the forensic science community by demonstrating that, in the absence of demographically-sound skeletal collections, medical scans and measurements on living individuals offer an appropriate and reliable source of contemporary population-specific data from which skeletal standards for the estimation of age, sex, and stature can be developed. The presentation will highlight the importance of quantifying not only the degree of error associated with forensic standards, but also the accuracy and precision of the raw data (measurements) from which they are derived.

In Western Australia, there is an absence of population-specific standards for the estimation of sex, age and stature from skeletal remains and the living. Therefore, we apply skeletal standards from non-Australian populations. These skeletal standards are an inaccurate representation of our modern regional society both geographically and often temporally. In a global era of terrorism, crime, and natural disasters, the need for precise Western Australian standards, and novel approaches to identify unknown remains, are greatly overdue. To this end, our purpose is to fortify the capabilities of forensic scientists in Western Australia through the development and implementation of a 'Human Identification Package' (HIP): a software tool designed to provide statistically quantified estimations of standard biological features commonly utilized in the creation of an osteobiography e.g., sex, age, and stature. And, as they become available, additional modules capable of complementary analyzes will be incorporated (e.g. identifying human versus non-human remains).

In the age of *Daubert* and other relevant decisions, the statistical quantification of error and uncertainty in forensic science is vital. As the acquisition of morphometric data from clinical computed tomographic (CT) scans is still a relatively novel approach, our first level of analyzes are designed to validate raw data to formulate forensic standards. The two primary goals in our validation study include: (1) assessing precision in acquiring bone CT measurements, e.g. extent to which repeated measures provide the same value; and, (2) evaluating the accuracy of bone CT measurements, or the extent to which measurements depart from their true value.

Six dry human skulls from the Centre for Forensic Science (CFS) teaching collection were subjected to clinical multislice computed tomographs (MSCT) at Royal Perth Hospital using a *Philips Brilliance 64 Scanner*® with 0.9 millimeter slice thickness. Following 3D volume rendering, 90 bilateral landmarks were designed and acquired using *OsiriX*® (v.3.9); a total of 33 linear measurements were then calculated using *Morph Db* (an in-house developed database application). The same linear measurements were also acquired from the six dry skulls using traditional anthropometric instruments (sliding and spreading calipers – *GPM*®). Each CT scan and its corresponding dry skull were digitized and/or measured a total of six times, with a minimum of one day between re-measurement. The significance of difference between CT and dry bone ('true value') measurements are quantified using ANOVA; intra-observer error (precision) is assessed using standard anthropological statistics (e.g., TEM; rTEM; R).

No significant differences between the CT data and dry bone measurements were found. Intra-observer error was within accepted standards (rTEM $< 5\%$; low TEM and high R values) for all measurements indicating high measurement repeatability for both data acquisition methods. The most "imprecise" measurements were expectedly those with Type III landmarks – points that have at least one deficient coordinate, e.g., mastoid height. Those landmarks are more accurately located by feeling for the tip of a rounded bump or bottom of a concavity, which is not possible in CT data. Irrespective, we demonstrate that the raw data underlying our forensic standards are valid and can be reliably acquired in CT and dry skulls.

Osteobiography, Multislice CT, Measurement Error