H74   Error and Uncertainty of Adult Age Estimation of the Pubic Symphysis in an Australian Sub-Population Using Computed Tomography

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After attending this presentation, attendees will gain awareness of: (1) the error and uncertainty associated with the application of the Suchey-Brooks (S-B) method of age estimation of the pubic symphysis to a contemporary Australian population; (2) the implications of sexual dimorphism and bilateral asymmetry of the pubic symphysis through preliminary geometric morphometric assessment; and, (3) the value of Three-Dimensional (3D) autopsy data acquisition for creating forensic anthropological standards.

This presentation will impact the forensic science community by demonstrating that, in the absence of demographically sound skeletal collections, postmortem autopsy data provides an exciting platform for the construction of large contemporary "virtual osteological libraries" for which forensic anthropological research can be conducted on Australian individuals. More specifically, this study assesses the applicability and accuracy of the S-B method to a contemporary adult population in Queensland, Australia, and, using a geometric morphometric approach, provides an insight to the age-related degeneration of the pubic symphysis.

Despite the prominent use of the S-B (1990) method of age estimation in forensic anthropological practice, it is subject to intrinsic limitations, with reports of differential inter-population error rates between geographical locations.[1-4] Australian forensic anthropology is constrained by a paucity of population specific standards due to a lack of repositories of documented skeletons. Consequently, in Australian casework proceedings, standards constructed from predominately American reference samples are applied to establish a biological profile. In the global era of terrorism and natural disasters, more specific population standards are required to improve the efficiency of medicolegal death investigation in Queensland.

The sample comprises Multi-Slice Computed Tomography (MSCT) scans of the pubic symphysis (slice thickness: 0.5mm, overlap: 0.1mm) on 195 individuals of Caucasian ethnicity aged 15 – 70 years. Volume rendering reconstruction of the symphyseal surface was conducted in Amira® (v.4.1) and quantitative analyses in Rapidform® XOS. The sample was divided into ten-year age subsets (e.g., 15 – 24) with a final subset of 65 – 70 years. Error with respect to the method's assigned means were analyzed on the basis of bias (directionality of error), inaccuracy (magnitude of error), and percentage correct classification of left and right symphyseal surfaces. Morphometric variables including surface area, circumference, maximum height and width of the symphyseal surface, and micro-architectural assessment of cortical and trabecular bone composition were quantified using novel automated engineering software capabilities.

The results of this study demonstrated correct age classification utilizing the mean and standard deviations of each phase of the S-B method of 80.02% and 86.18% in Australian males and females, respectively. Application of the S-B method resulted in positive biases and mean inaccuracies of 7.24 (±6.56) years for individuals less than 55 years of age, compared to negative biases and mean inaccuracies of 5.89 (±3.90) years for individuals greater than 55 years of age. Statistically significant differences between chronological and S-B mean age were demonstrated in 83.33% and 50% of the six age subsets in males and females, respectively. Asymmetry of the pubic symphysis was a frequent phenomenon with 53.33% of the Queensland population exhibiting statistically significant (χ^2-p<0.01) differential phase classification of left and right surfaces of the same individual. Directionality was found in bilateral asymmetry, with the right symphyseal faces being slightly older on average and providing more accurate estimates using the S-B method.[5] Morphometric analysis verified these findings, with the left surface exhibiting significantly greater circumference and surface area than the right (p<0.05). Morphometric analysis demonstrated an increase in maximum height and width of the surface with age, with most significant changes (p<0.05) occurring between the 25 – 34 and 55 – 64 year age subsets. These differences may be attributed to hormonal components linked to menopause in females and a reduction in testosterone in males. Micro-architectural analysis demonstrated degradation of cortical composition with age, with differential bone resorption between the medial, ventral, and dorsal surfaces of the pubic symphysis.

This study recommends that the S-B method be applied with caution in medicolegal death investigations of unknown skeletal remains in Queensland. Age estimation will always be accompanied by error; therefore, this study demonstrates the potential for quantitative morphometric modeling of age-related changes of the pubic symphysis as a tool for methodological refinement, providing a rigorous and robust assessment to remove the subjectivity associated with current pelvic aging methods.

References:
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