H48 Pelvic Sexual Dimorphism in a Western Australian Population: Integration of Geometric and Traditional Morphometric Approaches

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After attending this presentation, attendees will have an understanding of the utility of geometric and traditional morphometric approaches for the quantification of sexual dimorphism in the adult pelvis and how both approaches offer different (albeit complimentary) insights.

This presentation will impact the forensic science community by demonstrating the value of medical scans as alternate sources of contemporary population-specific skeletal data. The presentation also demonstrates that in the Western Australian population, it is possible to estimate sex with a high degree of expected accuracy using traditional pelvic measurements.

In the analysis of unidentified skeletal remains, it is crucial to formulate an accurate biological profile. The correct assignation of sex to skeletal remains not only contributes to establishing personal identity, but also provides an essential criterion for ensuring that the appropriate sex-specific age, ancestry, and stature standards are subsequently applied. It is widely accepted that the most accurate biological profile is achieved through the application of contemporary population-specific standards. The forensic anthropological community in Western Australia (WA) is currently working toward developing a suite of population-specific standards. Furthermore, in the absence of reference skeletal material (of a contemporary population and in appropriate numbers) a morphometric approach involving the analysis of Multi-Slice Computed Tomography (MSCT) scans has been adopted. This presentation demonstrates the sexual dimorphism of the pelvis in a contemporary WA population. This is achieved using both a 3D shape and traditional linear measurement approach. The study is part of ongoing research in population-specific standards from MSCT scans of living individuals.

The sample comprises pelvic MSCT scans with a mean slice thickness of 1.2 millimeters from 50 male and 50 female adults with a mean age of 46.94 years (range 22 – 63) for males and 45.76 years (range 21 – 62) for females. Following 3D volume rendering, the 3D coordinates of 41 landmarks were acquired using OsiriX® (v.4.1.1). A total of 30 linear measurements, suitable for a complete and/or a fragmented bone, were calculated using Morph Db (an in-house developed database application). Measurements were analyzed using basic descriptive statistics and discriminant function analyses; statistical analyses are performed using IBM® SPSS® Statistics 20.0. Shape analysis software morphologika (v.2.5) analyzed the 3D coordinates of the landmarks. Principal Components (PCA) and multivariate regression analyses were used to explore relationships between the male and female samples. Shape differences were visualized and interpreted using 3D wireframe and rendered models. Significance of sexual dimorphism in pelvic shape was quantified using permutation tests for mean differences, whereby the true difference between means (Procrustes distance) is compared with the distribution of differences between means obtained by randomly permuting group membership 1,000 times.

Multivariate regression (PCs 1-5; 53.5% total variance) and permutation tests indicate significant pelvic sexual dimorphism in the WA population; males (relative to females) demonstrate an acute sub-pubic angle, narrow and short pelvic inlet/outlet, long and narrow ilium, and an anteriorly curved sacrum. A total of 24/30 linear interlandmark measurements are sexually dimorphic and sex differences explain 3.7% – 68% of sample variance. Cross-validated sex classification accuracy (stepwise and direct DFA of linear measurements) for the complete pelvis is 96%; measurements for a complete os coxa yielded accuracy rates above 90%. Other dimorphic regions in the pelvis, which may be useful for assessing fragmentary remains, include (but are not limited to) the ischium (ischial length: 88% accuracy) and the acetabulum (length and width: 84% accuracy). Only those discriminant functions with an accuracy ≥80% with a sex bias of ≤5% are deemed suitable for forensic application.

This preliminary study represents the initial forensic research into pelvic sexual dimorphism in a WA population. It was clearly established that this bone can be used to classify sex with a high degree of expected accuracy, irrespective of whether a complete or fragmented bone is examined. Future research will concentrate on expanding the pelvic database and further testing the derived standards using hold-out samples and resampling statistics, thereby improving the statistical robustness of the formulated standards and demonstrating their ability to meet the *Daubert* admissibility requirements.

Sex Estimation, Pelvis, MSCT

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