A15 The Utility of the Sacrum for Sex Estimation

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Learning Overview: After attending this presentation, attendees will understand the utility of the sacrum for sex estimation.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by serving as a test of current methods and providing recommendations for use or disuse of sacral morphology and metrics for skeletal sex estimation in forensic anthropology.

As part of the pelvis, the sacrum is considered one of the best skeletal indicators of sex. Morphological features of the sacrum used for sex estimation include: overall shape, number of segments, posterior visibility of the sacroiliac joint, degree of curvature, and the relative size and proportions of sacral segment one and the alae. The sacral morphology sex differences, as summarized by Klales and references within, include "the female sacrum is considered to be shorter, wider/broad, and less anteriorly curved than the male sacrum, which, in turn, creates a larger more ovoid pelvic inlet (gynecoid). The wider first sacral segment (S1) and alae breadth have consistently been the best distinguisher of females using the sacrum. In females, the alae are generally as wide or wider than the promontory; and in males, the alae are narrower than the promontory. The increased base breadth (S1 and large alae) creates an average sacral shape in females that is more similar to an equilateral triangle with three roughly even sides, while the male sacrum more closely resembles an isosceles triangle with the two sides being longer than the base. Males are also considered more likely to have greater than five sacral segments, which can also contribute to the overall longer appearance in some individuals. The male expression includes visibility of the articular surface, while it is not visible in the female expression. Lastly, the degree of curvature is also useful for sex estimation … [with] the greatest degree of anterior curvature in males occurs between the S2 and S4 segments."[1]

Most of these features appeared early in Krogman's trait list and have since been included as indicators of sex in popular forensic anthropology textbooks.[2-6] Aside from Rogers and Saunders, who ranked several of these sacral traits in the top 15 most-effective pelvic traits for sex estimation based on precision and accuracy ranks, very few studies have independently tested their utility.[7] The aim of this research was to examine sex differences in the size of S1, number of sacral segments, proportional alae size, and sacral shape (equilateral-short and wide versus isosceles- long and narrow) using qualitative and quantitative sacral data (n=1,221) from the Forensic Databank of the University of Tennessee. Measurements used included: anterior length (height), anterior superior breadth (based width), and maximum transverse diameter of base (S1).

Cross-validated (cv) discriminant function classification using S1 size was 72.8% (73.5% females, 72.4% males) based on the sectioning point of 48.75mm. The male mean was 5.47mm larger (p=<0.001); 24.6% of the sample had greater than five sacral segments and 67.4% of these were male. Cross-validated discriminant function classification of the alae proportion (%) of base breadth/width was 70.8% (74.3% females, 69.0% males), with the female average being 5.36% larger than males (p=<0.001). Neither sacral base length (49.5% combined cv accuracy) nor sacral height (54.8% combined cv accuracy) as a proxy for shape could be used to accurately predict sex. Sacral shape was further approximated by comparing the calculated side length (hypotenuse) to base breadth and calculating by what percentage the base was smaller than the sides (i.e., an isosceles versus equilateral triangle). There were significant differences (p=<0.001) between the male (base 12.02% smaller than sides) and female (base 9.52% smaller) means. However, classification accuracy was low with 37.5% for females and 72.0% for males using the sectioning point of 10.77mm.

Overall, none of the morphological traits that were assessed metrically produced high levels of classification accuracy (>75.0%) between males and females. Given that metrics of observable features (size and proportions) could not differentiate the sexes, it is advised the visual assessment of these subtly different features no longer be used to predict sex. Geometric morphometric approaches have produced higher accuracy (up to 98%) and could prove to be more useful for sex estimation from the sacrum provided there is a way to translate the research into a practical application and method.[8]

Reference(s):

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