H85 New Scapular Measurements for Determining Sex

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The goal of this presentation is to inform attendees about the performance in sex estimation of eight new linear measurements on the human scapula. This research illustrates new scapular measurements that effectively discriminate between male and female scapulae.

This presentation will impact the forensic community by presenting new linear measurements which correctly estimate sex from the human scapula using discriminant analysis.

It has long been noted by physical anthropologists that the human scapula shows a large amount of variation (Dwight, 1887) yet typical osteological examination includes only two measurements of this bone (maximum height and scapular breadth). Not surprisingly, these measurements do not effectively capture scapular variation and generally fail to accurately estimate sex or ancestry. Uhl et al. (2007) noted that a discriminant function analysis using these two measurements yielded only 58% correct classification for ancestry between two groups for 499 individuals in the Forensic Databank. Further, maximum height has shown only about a 30% classification rate when discriminating between males and females (Dabbs, 2009). Previously, Bainbridge and Tarazaga (1956) noted shape differences in several areas of the scapula, including the acromion process, scapular spine, suprascapular notch, superior angle, and vertebral and axillary borders. However, they treated these features as non-metric rather than metric variables, thus making quantification and application difficult.

Recently, geometric morphometrics has allowed for the quantification and visualization of scapular variation for ancestry determination (Uhl et al., 2007). Unfortunately, to be of practical use to most forensic anthropologists, variation must be captured by linear measurements. Therefore the goal of this research is to develop new linear measurements to estimate sex based on areas that were previously shown to have the most shape variation (Uhl et al., 2007)

Eight linear measurements were taken (medial muscle attachment- lateral muscle attachment, maximum height of glenoid, A-P size of the glenoid, superior glenoid border-superior scapular angle, lateral acromial angle-inferior acromial angle, medial acromial angle-inferior acromial angle, lateral acromial angle-medial acromial angle, coracoid root- coracoid tip) on a sample of 51 individuals from the Hamann-Todd Collection, housed at the Cleveland Museum of Natural History.

These eight measurements were subjected to stepwise discriminant function analysis (DFA) with $p(F) = 0.05$ to enter and $p(F) = 0.10$ to remove. The DFA was significant (Wilk's $\lambda = 0.298$, $p<0.001$) and three measurements (A-P size of the glenoid, superior glenoid border-superior scapular angle, and lateral acromial angle-inferior acromial angle) were found to correctly classify 94.6% of cases, with a correct classification rate of 89.6% when cross-validated with a leave-one-out procedure.

This study indicates that much more information can be gleaned from the scapula with the inclusion of a few additional linear measurements. These measurements may be especially useful in cases of incomplete sets of remains which do not include a pelvis or cranium. Some potential drawbacks of these scapular measurements include broken scapular angles, as they can be somewhat fragile, and the presence of *os acromiale*, which would preclude the use of the acromial measurement. In the future, linear measurements may also prove useful for discriminating between different ancestry groups.

Sex Determination, Discriminant Function Analysis, Scapula

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