



Physical Anthropology Section – 2007

H33 Geometric Morphometrics of the Scapula: An Assessment of Ancestry

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After attending this presentation, attendees will understand the classificatory power of the scapula using geometric morphometric methods. An analysis of landmark data will be presented to assess the differences in the scapular shape of modern American white and black males. It will provide an alternative to traditional methods of ancestry determination that require the cranium or rely on simple linear measurements of the postcranial skeleton.

This presentation will impact the forensic community and/or humanity by demonstrating the classificatory power of the scapula and encouraging anthropologists to investigate the geometric morphometrics of other postcranial elements and their use in the determination of ancestry.

The determination of ancestry is an integral component of the biological profile generated by forensic anthropologists for unknown skeletal remains. The postcranium is regularly under-utilized for ancestry determination; this is due in part to the classification rate attributable to the cranium and mandible. Anthropologists have noted general differences in body form between populations, leading to the use of the postcranial skeleton for differentiating between populations using traditional linear measurements. However, the scapula is rarely used during ancestry determination and traditional linear measurements are generally limited to the maximum width and height of the scapula. The current study builds on Snow (2004) and utilizes geometric morphometrics to explore the shape differences in modern American White and Black males as reflected in the morphology of the scapula.

To determine whether differences in shape exist between modern American White and Black males, 14 landmarks were taken on 76 individuals from the William M. Bass Donated Skeletal Collection curated at the Department of Anthropology, University of Tennessee, Knoxville, TN. Coordinate data were collected from the scapulae using a Microscribe 3DX digitizer (Immersion Corporation, 2002). A Generalized Procrustes Analysis (GPA) was performed using Morphologika (O'Higgins and Jones, 2006). A GPA analyzes landmark data by stretching and appropriately fitting the data through a transformation, rotation, and translation process (Rohlf, 1996). Morphologika outputs the principal components and residuals employed in subsequent analyses in SYSTAT. A thin-plate spline analysis of the group means demonstrated several differences in shape between Black and White males. In particular, Black males exhibited an increased concavity of the subscapular fossa, and a more superior and medially positioned glenoid fossa. Furthermore, the Black male sample demonstrates a substantial anterior projection of the coracoid process. To determine how well these differences in morphology discriminate ancestry groups, a discriminant function analysis (DFA) was performed on the first ten PC scores. Using only 10 PC scores reduces the dimensionality and avoids over-fitting of the data, while still accounting for most of the shape variation. The DFA produced significant results (Wilk's $\lambda = 0.3580$, $F = 11.2978$, $dF = 10,63$, $p < 0.0001$), suggesting the scapula is an excellent element for ancestry determination. In fact, cross-validated (jackknifed) classification accuracies were 88% using only 10 PCs and accounting for nearly 100% of the variation.

This research demonstrates the classificatory power of the scapula and should encourage anthropologists to investigate the geometric morphometrics of other postcranial elements and their use in the determination of ancestry.

Ancestry, Geometric Morphometrics, Discriminant Function Analysis