## H46 Sex and Ancestry Estimation Using the Olecranon Fossa

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After attending this presentation, attendees will learn methods for quantifying shape measures in the olecranon fossa through GIS and elliptical Fourier analysis and their application to sex estimation.

This presentation will impact the forensic science community by testing the Rogers method on the distal humerus and also offering a method to quantify complex shapes.

Forensic anthropologists generally work with either partially or fully skeletonized human remains. Their task is to generate a biological profile consisting of age, sex, stature, and ancestry for law enforcement to aid in a positive identification. Due to the *Daubert* standards for the admissibility of expert opinion, the measures of the biological profile should ideally have a quantifiable basis and associated levels of confidence (*Daubert v. Merrell Dow Pharmaceuticals, Inc* 1993). Therefore, forensic anthropologists are constantly looking for new techniques and also ways to improve previous methods (i.e., ways to quantify non-metric methods) to aid in their investigation.

The distal end of the humerus is often found through recovery efforts due to its durability in withstanding environmental factors. Through this durability, the distal humerus is frequently used in sex estimation. The morphology of the humerus has been previously studied by Rogers (1999, 2006, 2009) as a means to estimate sex in adults and adolescents. Using four criteria (trochlear constriction, trochlear symmetry, angle of medial epicondyle and olecranon fossa shape and depth), Rogers has reported sex estimation accuracy rates as high as 92%. The most significant of the aforementioned traits was determined to be the shape and depth of the olecranon fossa; however, her study is based on visual observations with no quantifiable measurements. For example, the male olecranon fossa form is described as a "shallow triangle," while the form of the female olecranon fossa is described as a "deep oval" and Rogers concluded that, "shape is more important than depth" (Rogers 1999). Beyond these simple descriptions, there are no guidelines on how this trait is to be examined and evaluated. Her method results in subjective characteristics by offering only qualitative data, especially regarding shape.

This study was conducted to evaluate the Rogers method in regard to olecranon fossa depth and shape for sex estimation. A sample of 140 (35 black males, 35 black females, 35 white males, 35 white females) left humeri were digitized from the Hamann-Todd Osteological Collection curated at the Cleveland Museum of Natural History, Cleveland, OH. The coordinate data for each humerus was uploaded into ArcGIS (ESRI 2008) and ArcMap was used to define the olecranon fossa outline, or rim, and to calculate the output variables maximum and mean slope, maximum curvature, and surface volume. Outlines were also analyzed using Elliptical Fourier Analysis (EFA) through the program Shape 1.3 (Iwata and Ukai 2002) where principle components of shape were calculated and visualized. The programs TPSdig (Rohlf 2010) and GMTP (Taravati 2009) were used to calculate centroid size from the outlines. In all, 13 variables representing size, shape, and depth of the olecranon fossa were obtained and used for sex and ancestry estimation.

FORDISC 3.0 (Jantz and Ousley 2005) was then used to perform discriminant function analysis from the 13 variables. Forward Wilks stepwise selection was used to select the appropriate variables for each analysis and all percent correct classifications were cross validated. A four-way sex and ancestry estimation for all groups classified 48.3% correctly and a two-way sex estimation of the individuals classified 82.5% correctly. Two-way sex and ancestry specific ranged from 58.3% to 82.5% correct classification.

The Elliptical Fourier results show that shape of the olecranon fossa rim had no correlation with either sex. Both sexes showed similar ranges of shape variation, only being separated by size. Between ancestral groups there were significant differences in shape through slope, curvature and the principle components generated through the EFA. This study presents an objective means to record the olecranon fossa form and demonstrates that sex and ancestry can be determined through the olecranon fossa alone while also meeting the *Daubert* standards for court admissibility.

**Sex Estimation, Humerus, GIS**

 ** Presenting Author*