H89 The Use of Geometric Morphometric Analysis for Subadult Sex Estimation Utilizing Innominates

Jennifer M. Vollner, MS, 328 Baker Hall, East Lansing, MI 48824; Nicholas V. Passalacqua, MS, 3518 Hagadorn Road, Okemos, MI 48864-4200; and Stephen D. Ousley, PhD, Mercyhurst College, Department of Applied Forensic Anthropology, 501 East 38th Street, Erie, PA 16546*

The goal of this presentation is to inform attendees about a new geometric morphometric analysis (GMA) approach to the estimation of sex of subadult skeletal remains via innominates.

The presentation will impact the forensic science community by exploring the potential of sex estimation of subadult innominates using GMAs and discriminant function analysis.

The estimation of the biological profile, particularly the estimation of sex, is notoriously difficult in subadults because of the immaturity of the skeleton. This issue affects both bioarchaeologists and forensic anthropologists working with juvenile skeletal remains. The difficulty in the estimation of sex is because the skeleton is not fully sexually developed before puberty and is therefore less sexually dimorphic. In skeletally mature adults; however, the innominate is recognized as one of the best indicators of biological sex. Due to the high reliability in sex estimation of mature adult skeletal remains, the innominate was selected as the focus of this study.

Non-metric studies of juvenile innominates have been previously conducted with a wide range of accuracy rates from slightly better than chance, to almost perfect classification. However, most relate to the morphology of the sciatic notch and do not take other morphologies into account. Further, these subadult sex estimation accuracy rates often increase as the individuals' ages increase, which may bias the results of the younger specimen estimates. Metric studies of subadults are difficult to conduct because of the age related variation in size and relatively small sample sizes available. The geometric morphometric study presented here provides a method to accommodate age related size variation thus focusing on shape. In addition, this research captures the morphologies of the innominate using 3D landmarks that have been shown to have a high accuracy of sex estimation in adults (Klales et al. 2009; Vollner 2009).

A sample of 36 left subadult innominates from the Hamann-Todd Osteological Collection, which is housed at the Cleveland Museum of Natural History, was utilized. The individuals were of known age, sex, and ancestry without any apparent pathological conditions. Age-at death of the individuals ranged from 4 to 19 years. A total of 18 landmarks were collected using a digitizer on each individual and analyzed in MorphoJ (Klingenberg 2008) to conduct a Procrustes' fit. A discriminant function analysis with a Wilks' stepwise option was then conducted to prevent overfitting and to generate classificaiton rates.

The initial discriminant function analysis after the Procrustes' fit in MorphoJ demonstrated that correct classification increased with the age of the individual. The shape differences as displayed by MorphoJ indicate that sub-adult pelvic sexual dimorphism is similar, yet more subtle, than adult pelvic sexual dimorphism. The discriminant function yielded a 75% correct cross-validated classification for the estimation of sub-adult sex using a Wilks' stepwise function. Females were classified at a higher rate of accuracy at 81.8% correct, while males classified at 64.3% correct. This high classification rate for females versus males may suggest that subadult innominates tend to illustrate more female morphologies before skeletal maturity. Further studies will be conducted using larger sample sizes to more conclusively analyze the geometric morphometric morphologies of subadult innominates.

Geometric Morphometrics, Sex Estimation, Discriminant Function Analysis

 ** Presenting Author*