H65 Subadult Ancestry Determinations Using Geometric Morphometrics

Shanna E. Williams, PhD, University of Florida, Department of Anatomy, PO Box 100235, Gainesville, FL 32610-0235; and Ann H. Ross, PhD, North Carolina State University, Sociology and Anthropology, Campus Box 8107, Raleigh, NC 27695-8107*

The goal of this presentation is to explore the applicability of geometric morphometric techniques in subadult biological profiling.

This presentation will impact the forensic science community by highlighting the importance of understanding biological variation in the determination of ancestry in unidentified subadult remains.

Along with sex, age, and stature, ancestry determination is an essential component of the forensic toolkit. Several established metric and non-metric techniques exist which utilize the cranial and post-cranial skeleton to identify ancestry. However, all of these methods are limited to adult skeletal material, as ancestral differences, like sex differences, are believed to be indistinct in youth until stimulated by the differential growth of adolescence. As such, anthropological protocol tends to reserve judgment in regards to the ancestry of subadult material. However, the work of Strand Viðarsdóttir and colleagues (2002) found that, regardless of sex, population-specific facial morphology manifests at birth and is further modified during ontogeny. Buck and Strand Viðarsdóttir (2004) go on to suggest that geometric morphometrics (GM) is capable of identifying ancestry in subadult mandibles. The traditional metric analyses employed in ancestry determination apply discriminant functions to defined linear distances. Unfortunately, comparative datasets derived from these analyses cannot be applied to subadult material, as these datasets do not reflect the widespread allometric changes occurring during the growth period. Geometric morphometrics, on the other hand, is capable of partitioning biological size from shape, thereby circumventing this obstacle. Ross and Williams (2009) used GM to explore cranial size and shape differences in a single population of subadults and adults and found no significant differences between older subadults (mid-teens) and adults (≥18 years), suggesting that subadults reach their final form earlier than expected.

In order to further elucidate the potential of GM in identifying subadult ancestry, the present study explores how successful GM methods are at correctly classifying ancestry in modern Portuguese subadults both as a group and individually. The sample used for group analysis of craniometric affinity includes Portuguese adults (n=53) and subadults (11 to 16 years-old; n=10) from the Luís Lopes Collection in Lisbon, Portugal; native adult African slaves who died in Cuba (n=15) from the Morton Collection at the University of Pennsylvania; modern adult Cubans (n=21) from a cemetery collection housed at the Museo de Montane, Havana; and, modern adult African-Americans from the Terry Collection at the Smithsonian Institution (n=48). Nineteen three- dimensional type 1 and type 2 anatomical landmarks were collected. The landmark data were transformed by generalized Procrustes analysis (GPA) which optimally translates, scales, and rotates the points into a common coordinate system. In order to reduce dimensionality, a principal component analysis (PCA) was performed on the covariance matrix of the aligned coordinates. Group similarity was evaluated via pairwise tests with Bonferroni correction (α/n). The pairwise results found Portuguese subadults to be significantly different (Pr >F= 0.001) from all of the other populations except Portuguese adults (Pr >F= 0.189). Additionally, ancestry assessment was performed on each subadult via *3D-ID* (Slice and Ross 2009: www.3d-id.org), a software program which utilizes 3D cranial landmark data to classify an unknown specimen into a probable sex and ethnic affiliation. Although the software program does not yet include Portuguese among its 11 diverse reference populations, all 10 subadults were classified as European or European-American (average posterior probability: 0.741; average typicality=0.4621) and only one individual's sex was misclassified.

Although exploratory in nature, these results indicate that GM is capable of correctly capturing ancestry in subadult crania. This suggests ancestral differences are morphologically entrenched earlier in craniofacial development than conventionally believed. Moreover, GM allows comparative datasets of adult measurements to be directly applied to individuals who have not yet completed skeletal growth. Incorporating such information into standard forensic practice may allow for a more informative assessment of ancestry in unidentified human remains of all ages than is currently possible.

Subadult, Ancestry, Geometric Morphometrics

 ** Presenting Author*