Research or Thesis title

Molar Size and Shape in the Estimation of Modern U.S. Biological Affinity: A Comparison of Relative Cusp Location Using Geometric Morphometrics and Interlandmark Distances

Abstract – 100 - 500 words

Dental morphology has long been utilized in anthropology as a means to examine biological affinity (Irish, 1997, 1998, 2005). Dental morphological variation has traditionally been recorded in accordance with the Arizona State University Dental Anthropology System (ASUDAS) scoring procedures (Turner et al., 1991) in which morphological traits were scored either by presence or absence or by degree of expression on an ordinal scale. Odontometrics have also been ubiquitous in dental anthropology to investigate biological affinity (Lukacs 1985, Lukacs and Hemphill 1993, Hanihara and Ishida 2005). Geometric morphometric techniques offer a bridge between morphology and metric in the analysis of biological forms. Morris's (1986) work on occlusal polygons represented the first use of geometric techniques to analyze cusp location on molars to estimate biological affinity in modern human populations. Occlusal polygons utilized lengths, angles, and areas of the molar crowns by using each cusp tip as a vertex. This approach has continued to be used by Bailey (2004) and Bailey et al. (2008) to estimate biological affinity but have recently been analyzed through newer geometric morphometric analyses (Martinón-Torres et al. 2006, Bernal 2007, Gómez-Robles et al. 2007, Gómez-Robles et al. 2008).

Recently, Klales et al. (2012) and Kenyhercz et al. (2013) demonstrated the utility of molar shape, as determined through geometric morphometric analyses, in the estimation of biological affinity with total correct classifications as high as 87%. The current research proposes to use newer geometric morphometric techniques to investigate molar size and shape in relation to biological affinity in four modern U.S. population groups: black, white, Asian, and Hispanic. Shape variables will be compared to measures of gross size, i.e., centroid size and interlandmark distances to examine possible allometric relationships. Once it has been established that the shape changes observed are independent of size, the molar morphometrics can be used to examine the biohistory, divergence, and admixture found within the United States to further explore the significance of each of the four major groups, and ultimately as a means of ancestry estimation in a forensic context.

Coordinate data from mandibular and maxillary first and second molars will be collected in accordance with the methodology of Morris (1986). Only the x and y coordinates will be retained for the analyses because the differential degree of wear between specimens would introduce noise to the data. The coordinate data for each molar will be analyzed individually through MorphoJ to perform a generalized Procrustes analysis (GPA), as well as to generate principal components of shape and centroid size. Lastly, interlandmark distances will be calculated from the coordinate data using a simple Euclidean distance function. All of the size and shape variables will be subjected to different statistical treatments to examine within and between group variations to examine the biohistory of each of the modern groups as compared to parental population data, leading to the significance of each modern group.