



Physical Anthropology Section – 2010

H90 Secular Trends in Cranial Morphological Sexing: The Mastoid Process

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After attending this presentation, researchers will be aware of the metric changes in size of mastoid processes in American Whites from 1829-1983.

This presentation will impact the forensic science community by demonstrating how increasing the understanding in the changes a population has undergone since the inception of a particular sexing technique will strengthen the accuracy of the forensic practitioner by allowing them to adjust for skeletal changes over time.

Cranial morphology has markedly changed over the last two centuries (Godde and Dautartas 2009; Meadows Jantz and Jantz 2000)^{3,4} causing contemporary American head shape and size to vary from earlier Americans. Both cranial nonmetric (Godde and Dautartas 2009)³ and metric (Meadows Jantz and Jantz 2000)⁵ morphology changes suggest that enough differentiation has occurred to render modifying current methods of sex estimation. This paper further explores the secular trends in cranial morphological traits for cranial sex estimation, specifically by metrically modeling the mastoid process.

In 1920, Hrdlicka officially adopted cranial morphological traits as indicators of sex. He incorporated characteristics and research that he read about in French and German literature. Later, Buikstra and Ubelaker (1994)¹ included this methodology in their volume for standardization of skeletal data collection. However, both Hrdlicka (1920)⁴ and Buikstra and Ubelaker (1994)¹ did not take a forensic approach; these methods were not tested on a modern American population. Walker (2008)⁶ applied the cranial morphological sexing method on two relatively modern collections, the Terry Collection and Hamann-Todd Collection. He found that the method published in Buikstra and Ubelaker (1994)¹ could be applied by observers of various backgrounds and levels of experience with accurate results. However, as Godde and Dautartas (2009)³ pointed out, there was a significant change in morphology from individuals born in the 1850s (Hamann-Todd Collection) to those born in 1930s and on (William M. Bass Donated Collection), indicating the cranial morphology for sex estimation has changed and forensic techniques that have been developed on archaeological populations (Buikstra and Ubelaker 1994; Hrdlicka 1920)^{1,4} and tested on an almost contemporary American population (Walker 2008)⁶ are not reflective of the current trends in cranial morphology.

Godde and Dautartas (2009)³ applied categorical time series techniques and teased out the patterns of secular change in their report of secular trends in cranial morphology from the 1820s through the 1980s. In order to support their prior study with continuous data, this project mathematically modeled the mastoid process for use in well-established continuous time series methods. Howells' mastoid measurements, mastoid length and mastoid breadth, were collected along with a new measurement, mastoid width (defined in Dautartas and Godde 2008).² These three measurements were selected as they can metrically model the mastoid as a cone, and thus volume of a mastoid can be calculated. Data was collected from two skeletal collections: Hamann-Todd and William M. Bass Donated Collection (Donated Collection). At the Hamann-Todd collection, 99 white females and 81 white males were measured that had documented birth years associated with the remains. Conversely, 55 white females and 55 white males with known birth years were observed at the Donated Collection. Collectively, the birth years of the individuals from both collections span 1829-1983, allowing for investigations into skeletal changes spanning 154 years.

The best time series model applied to the data indicates that secular change has occurred over the time period represented in the sample. The results show that in the last century and a half, females have become larger, while males have become smaller. In other words, mastoid processes in both sexes of American Whites are beginning to resemble and overlap each other in size. It is important for forensic scientists to understand that mastoid size has changed, lending to more ambiguity among the sexes. Moreover, these changes also imply that techniques developed on archaeological populations need to be adjusted for application in a contemporary forensic context.

References:

- ¹ Buikstra JE, Ubelaker D. 1994. Standards for data collection from human skeletal remains : Proceedings of a seminar at the Field Museum of Natural History. Fayetteville: Arkansas Archaeological Survey, 1994.
- ² Dautartas A, Godde K. 2008. Are cranial morphological traits population specific? A reevaluation of traditional sex estimation methodology. Proceedings of the American Academy of Forensic Sciences XIV: 349-50.
- ³ Godde K, Dautartas A. 2009. Secular trends in cranial morphological sexing. Proceedings of the American Academy of Forensic Sciences XV: 311-2.
- ⁴ Hrdlicka A. 1920. *Anthropometry*. Philadelphia: The Wistar Institute of Anatomy and Biology.
- ⁵ Jantz R, and Meadows Jantz L. 2000. Secular change in craniofacial morphology. Am J of Hum Bio 12: 327-338.



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- ⁶ Walker PL. 2008. Sexing skulls using discriminant function analysis of visually assessed traits. Am J Phys Anthropol 136: 39-50.

Time Series, Mastoid Volume, Nonmetrics