H8 Sexual Dimorphism in the Subadult Mandible: Quantification Using Geometric Morphometrics

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The goal of this presentation is to outline how geometric morphometric methods can be applied to problems in forensic anthropology. It will illustrate how these methods can further knowledge about morphological differences in the subadult skeleton with increased sensitivity and objectivity compared to standard analytical methods.

This presentation will impact the forensic community and/or humanity by providing data, based on a quantitative, rather than subjective analysis of a reference skeletal sample, allowing a degree of sex determination in the subadult mandible. Further, geometric morphometric techniques have special relevance in forensic anthropology because they are a practical alternative to biomolecular methods, which are often unavailable due to either economic and/or biological constraints, and are unable to be readily applied in the field.

The determination of sex from human skeletal material is of fundamental importance for any forensic investigator. The most favored methods are selected in the hope of providing a high degree of accuracy, but also for suitability of assessment of material that is often damaged or fragmentary. Though these methods are suitable when the recovered material is adult, when applied to the subadult skeleton, the accuracy of sex determination falls markedly. Thus, the inability to reliably assign sex in the subadult age range is a significant problem facing even the most experienced forensic anthropologist.

There have been numerous attempts to differentiate males from females on the basis of the immature skeleton. Loth and Henneberg (2001) claimed that shape differences in the mandible can predict sex with an accuracy of 81%. Subsequent research, however, using different population samples did not achieve such high classification accuracy. Though sexual dimorphism exists in the subadult mandible, two key issues require further clarification: 1) whether this bone can discriminate immature individuals; 2) whether such differences, if they exist, characterize the sample population examined, rather than reflecting universal morphological differences. To investigate these issues, techniques derived from the growing discipline of geometric morphometrics are applied. Geometric morphometric methods utilize landmark data to visualize and quantify shape changes, allowing detailed assessment of differences among specimens.

The authors report here on new morphometric data examining sexual dimorphism in the subadult human mandible. The material was sourced primarily from dissection hall subjects of European and indigenous southern African origin, consequently the sex and a statement of age are known for each individual. Thirty eight bilateral three-dimensional landmarks were designed and acquired using a Microscribe G2X portable digitizer. Measurement error in landmark acquisition was assessed by digitizing six different specimens on six different occasions; the test demonstrated that errors of precision are small with respect to sample variability. The shape analysis software morphologika (www.york.ac.uk/res/fme) was used to analyze the three-dimensional coordinates of the landmarks. A principal components analysis (PCA) explored the relationships between samples of male and female mandibles. The shape differences were then visualized and explored using three-dimensional wireframe and rendered models, and further interpreted using thin plate splines.

This presentation will illustrate and reinforce the concept that population specific differences in sexual dimorphism must be considered in order to achieve optimal sex discrimination. This presentation will benefit the forensic community by providing data, based on a quantitative, rather than subjective analysis of a reference skeletal sample, allowing a degree of sex determination in the subadult mandible.

Sex Determination, Subadult, Mandible

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