H83 Mandibular Morphology as an Indicator of Human Subadult Age: Interlandmark and Geometric Morphometric Approaches

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The goal of this presentation is to outline how methods utilizing three-dimensional landmark coordinate data can be applied to problems in forensic anthropology. It will illustrate how these methods can be used to further knowledge about morphological differences in the subadult skeleton, with specific reference to age-related developmental remodeling of the mandible. This presentation will also show that in this specific analysis of data containing a strong allometric scaling signal, complex analytical techniques, compared to simple linear methods, do not necessarily confer a significant improvement in age prediction.

This presentation will impact the forensic community and/or humanity by providing data capable of predicting age using the subadult mandible with accuracy closely approaching that of standards based on the dentition. This technique has the potential to be a highly accurate means of age prediction in the subadult skeleton, which can be applied in situations where the mandible is fragmentary and/or the dentition is missing.

Age estimation from human skeletal remains is a well established practice in forensic anthropology and is one of the four key biological characteristics important in forensic identification. Age related changes have been documented for almost every part of the human skeleton, with the selection of an appropriate technique being inherently dependant upon skeletal preservation and the efficacy of the available standards. When developing or applying age estimation standards, due consideration must also be given to the effects of nutritional deficiencies or other environmental insults, and the degree of variability among individuals of a given age, both within and between populations[1].

Dental development and eruption is recognized as the set of developmental markers that appear to show the least variability against chronological age[1]; these markers are thus widely used in forensic investigations involving both living and deceased individuals. Alternatively, there is an example in the literature of an attempt to determine whether infants (aged birth to 2 years) can be discriminated based on mandibular measurements[2]. ANOVA statistics demonstrated that the best discrimination was obtained using ramus height, although no age prediction standards were formulated. However, this evidence does suggest that subadult mandibular morphology has a potential application in forensic age estimation, but four key issues require clarification: 1) determining the standard error of age estimation using the measurement of ramus height; 2) determining whether geometric morphometric methods provide more accurate age estimations; 3) determining whether age estimations are accurate beyond the first few years of life; 4) determining whether age estimation using mandibular morphology is sex and/or population specific.

The authors report here on new morphometric data designed to assess the potential of mandibular morphology as a developmental marker for estimating age at death in subadult human skeletal remains. A total of 79 subadult individuals (aged 1 to 17 years) were sourced from two documented skeletal collections (*The Hamann Todd Osteological Collection* and *The R.A. Dart Collection of Human Skeletons*). Sex and a statement of age are thus known for each individual. Thirty eight bilateral three-dimensional landmarks were designed and acquired using a Microscribe G2X portable digitizer. Linear regression was used to predict age using both the linear measurement of ramus height and the multivariate descriptors of mandible size and shape based on configurations of three dimensional landmarks. The accuracy of the different predictors was compared in the pooled sample and in subgroups by age (pre-pubertal individuals; < 10 years and adolescents; > 10 years) and ethnicity. The best age predictor was then used to derive a simple linear regression model to predict age of subadults; the validity of the model was tested by cross-validation using a resampling procedure. Geometric morphometric analyses were performed using *morphologika*, *TPSSmall 1.20* and *NTSYS-pc 2.2f*; statistical analyses were performed using *SPSS 11.5* and *NTSYS-pc 2.2f*.

References:

[1] Konigsberg L, Holman D. Estimation of age at death from dental emergence and implications for studies of prehistoric somatic growth. In: Hoppa RD, Fitzgerald CM, editors. Human growth in the past: studies from bones and teeth. Cambridge: Cambridge University Press, 1999;264-289. [2] Norris

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SP. Mandibular ramus height as an indicator of human infant age. *J For Sci* 2002;47:8-11.

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