H79 Determination of Sex From Juvenile Crania by Means of Discriminant Function Analysis: A First Study

Richard A. Gonzalez, PhD, Department of Anthropology, Saint Lawrence University, 23 Romoda Drive, Canton, NY 13617*

After attending this presentation, attendees will understand how sex- specific growth and developmental patterns in the human craniofacial skeleton can be used to develop sex determination standards by means of discriminant function analyses for the identification of juvenile skeletal remains.

This presentation will impact the forensic community by demonstrating that it is possible to develop accurate methods for sex determination in unidentified juvenile remains.

This study examines variation of craniofacial dimensions and morphology in juvenile humans. The major outcome of this investigation is the identification of sex specific developmental patterns in the craniofacial skeleton. In doing so, the study creates a set of standard values that facilitate the accurate determination of sex and a reduction in subjective error in the development of biological profiles of unidentified juvenile remains.

Craniofacial growth variation between the sexes provides the basis for identifying sexual dimorphism in juveniles because the craniofacial skeleton reaches maturity early in life (Ackermann and Krovitz, 2002; Guihard-Costa and Ramirez-Rozzi, 2004; Smith, 1991). Growth of the craniofacial skeleton slows down from about 2.5 years of age with many of the adult features already established by the time the first permanent molar erupts (Ackermann and Krovitz, 2002; Guihard-Costa and Ramirez-Rozzi, 2004; Smith, 1991). Given the early establishment of craniofacial form, it should be expected that sex-specific features be present during craniofacial development. Thus, the craniofacial skeleton provides the best sources for sex identification in the juvenile skeleton.

To identify sexually dimorphic differences in the growth of the juvenile craniofacial complex, the study analyzed lateral cephalometric radiographs housed at the University of Michigan School of Dentistry (Riolo et al., 1974). These cephalometric radiographs represent an average local school popu- lation from the Ann Arbor, Michigan area (Dibbets, 1995). Five-hundred and ninety-eight 11x14 lateral cephalometric radiographs with a range of 5-16 years of age were randomly selected. The sample was organized according to age group with males and females equally distributed. Each radiograph was traced on 11x17 hyprint vellum using a .05mm mechanical pencil. Eight craniometric points were identified and marked film-by-film. From these points, 20 measurements in millimeters and 17 angular dimensions were recorded from each subject using a Mitutoyo Mycal E-Z 300mm sliding.

For data input and analysis, this investigation relied on The Statistical Package for the Social Sciences (SPSS) version 14.0. All data were organized according to the eruption standards of the maxillary permanent dentition. Before data analysis, a calibration scale converted raw data to natural size, since the radiographs utilized for the study have a magnification factor of 12.9%. The data were calibrated using the formula provided by Dibbets, (1995) and Dibbets and Nolte (2002).

Calculation of descriptive statistics for all variables by age cohort and sex provided initial comparative information. Multivariate statistical proce- dures aided in the identification of possible sex differences in craniofacial growth. The multivariate statistical analyses consisted of a general linear model procedure (GLM MANOVA), which tested the main effects of inter- actions between the independent and independent variables, a canonical discriminant function analysis, which facilitated the identification of cranio- facial growth trends, and a backward stepwise canonical discriminant function analysis, which created a series of predictive models for sex iden- tification for each age group category. Statistical significance was observed on the Wilks' Lambda and F statistic at the .05 level.

The results of this investigation suggest that craniofacial sexual dimor- phism results from variation in the rate and timing of growth, which leads to allometric differences between the sexes. Growth varies between age group and has independent control over the face and neurocranium. A combination of neurocranial and facial measures provide the best classification models for sex. The 15-16 age group yielded the greatest accuracy with 90% sex identification. In the younger age groups, sex identification was high for the age groups 7-8 (82%), 9-10 (83%), and 13-14 (83%). The 5-6 age group (71%) and in the 11-12 age group (77%) had lowest percentage for sex iden- tification. The reliability of sex identification depends on stage of devel- opment and developmental trends. Therefore, the results of this study suggest that measures from the entire craniofacial skeleton must be used to derive accurate predictive models for sex identification.

Sex Determination, Craniofacial Growth, Skeletal Profiling

 ** Presenting Author*