

A33 The Growth and Development of Secondary Sex Characteristics in the Human Skull

Michala K. Stock, University of Florida, 2033 Mowry Road, Rm G-17, Gainesville, FL 32610*

After attending this presentation, attendees will better understand the growth and development of sexual dimorphism in the human skull, including which sexually dimorphic craniofacial traits reach adult expression before skeletal maturity, and the implication that these traits may be useful for sex estimation from adolescent skeletal remains.

This presentation will impact the forensic science community by addressing the common assumption that sex cannot (and should not) be assessed from immature remains and by suggesting avenues for further research to improve sex estimation methods in adolescent populations.

Although high accuracy rates have been achieved for sex estimation from adult skeletal remains, estimating sex in subadults remains a vexing issue facing forensic anthropologists. Many previous studies have focused on measuring sexually dimorphic skeletal features that are commonly used to estimate sex in adults, such as pelvic morphology and cranial traits, and have applied these methods to juvenile humans. As these are sexually dimorphic features whose expression is either absent or incomplete until adolescence, these methods have enjoyed mixed success when applied to immature skeletal remains; however, the growth and development of these sexually dimorphic secondary sex characteristics have not been systematically studied. The timing of their sexually dimorphic expression therefore remains unknown, and practitioners frequently and perhaps erroneously assume that these traits are not fully developed until adulthood. To assess the value of these traits for diagnosing sex among subadults, their expression must be measured during the adolescent period when growth and development of the secondary sex characteristics occurs.

This study was performed on a longitudinal sample of lateral radiographs from the Denver Growth Study, which includes males and females of European ancestry ($n=5$ males; $n=5$ females; $n=96$ total scans). To assess the growth of secondary sex characteristics in the human skull, four linear distances were measured that approximate the areas commonly scored in non-metric sex assessment: the nuchal crest, mastoid process, glabella, and mental eminence. These four measurements were taken of each individual at multiple ages; the youngest age cohort is defined as prior to the eruption of the second permanent molars, which is correspondingly before the onset of sex-based differential growth of cranial secondary sex characteristics. Measurements were taken on every subsequent scan for each individual until the measurement in question reached full adult expression (i.e., maximum size). Skeletal maturity was defined as the age of alveolar eruption of the maxillary third molar, with all earlier radiographs being characterized as immature. The age of skeletal maturity was then compared to the age of adult expression for each measurement. One-tailed, paired Wilcoxon rank-sum tests were performed to compare the pooled-sex sample's age at full expression of each trait to the age at skeletal maturity. The age of adult expression of the mental eminence was significantly younger than the sample's age of skeletal maturity ($p<0.001$), while the age at adult expression of the nuchal crest was significantly older than the age of skeletal maturity ($p=0.02$). The mastoid process and glabella ages at adult attainment did not differ significantly from the sample's age of skeletal maturity ($p=0.27$; $p=0.34$, respectively).

The results indicate that the mental eminence matures in size relatively early in adolescence and suggest that this feature is suitable for further analysis and the development of sex estimation criteria in adolescent skeletal

remains — effectively pushing back the age at which sex can be assessed from crania. These results also support the use of the mastoid process and glabellar regions for sex estimation at (and after) M³ eruption, but indicate that caution should be exercised when scoring the nuchal crest in young adults, as this trait does not reach full expression until after skeletal maturity. None of the traits included in this study are routinely employed for sex estimation in subadults. Yet their utility in this context can be assessed through the use of a longitudinal database of radiographs that began 85 years ago at the Denver Growth Study. The novel insights into adolescent growth and development of sexually dimorphic traits provided by this study demonstrate how even evolving forensic methods rely upon past research efforts.

Sex Estimation, Growth and Development, Adolescence