A117 The Relationship of Palatal Suture Complexity and Fusion

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After attending this presentation, attendees will better understand how palatal suture complexity, palatal suture fusion, age, sex, and ancestry are interrelated.

This presentation will impact the forensic science community by demonstrating that sutural complexity and fusion are linked in such a way that complexity cannot be overlooked when producing an age estimate from the sutures of the hard palate.

Age estimation from the palatal sutures is based on the age-progressive synostosis of the incisive, median palatine (the Anterior Median Palatine (AMP) and Posterior Median Palantine (PMP)), and Transverse Palatine (TP) sutures. While closure of the palatal sutures is useful in categorizing unidentified skeletal remains into broad age categories, methods employing palatal sutures suffer from a lack of precision and exhibit only moderate correlations with known age-at-death. An investigation of other variables that potentially contribute to palatal suture fusion is important in order to better understand variation in suture closure and to improve current methods.

The palatal sutures are part of a complex biomechanical environment and play an important role in permitting strength and flexibility of the palate during mastication. Complex sutures, those with many interdigitations, have increased surface area along the sutural margin. These sutures thus have greater energy-absorption potential and strength in bending and are usually found where loading is predominantly compressive. Simple sutures signify a largely tensile loading environment, and they may resist fusion to a certain extent due to the continuous separation at the margins brought about by tensile forces.

Data on palatal suture fusion and complexity were collected from 762 male and female individuals of African, Asian, and European ancestry. The sample was stratified prior to data collection so that each sex, ancestry, and age group was evenly represented. The palate was photographed, and fusion, total sutural length, and suture chords were digitally measured for the TP, PMP, and AMP sutures using ImageJ and standardized landmarks; error introduced from digital measurement is believed to be negligible. Sutural complexity is the total suture length divided by the suture chord (suture length ratio; values at or close to 1 = simple suture; values increasing from 1 = greater complexity). The total amount of fusion along a given suture was measured, even if discontinuous, and this amount was divided by the total length of the suture (fusion ratio; 0 = absence of fusion; 1 = complete fusion). The relationship of sutural complexity and fusion was tested using Pearson's *r* and linear regression, and the relationships of complexity, fusion, and demographic group (e.g., age, sex, and ancestry) were tested using linear regression and Analysis of Variance (ANOVA).

Overall, the sutures of the palate in this sample are not complex (mean complexity values: TP suture = 1.53; PMP suture = 1.24; AMP suture = 1.25), and the correlation of fusion and suture complexity ratios is always negative (TP r = -0.39; PMP r = -0.37; AMP r = -0.17). The adjusted R^2 for regression of fusion on sutural complexity is 0.187, and TP and PMP suture complexity have significant effects on fusion while AMP complexity does not (TP, PMP $p < 0.001$; AMP $p = 0.292$). Sutural complexity shows little to no relationship with age (R^2 values from 0.001 to 0.006). Sutural complexity for all three sutures was significantly different between the sexes and among the ancestral groups ($p < 0.001$). Males show decreased complexity as compared to females. Asians have the most

complex sutures for the median palatine suture, while Europeans are the most complex for the transverse palatine suture.

The negative correlation of sutural complexity and fusion indicates that sutures displaying increased complexity have a tendency to exhibit less fusion, while sutures that are less complex are more likely to display fusion. Since palatal sutures in this sample are simple, this indicates a largely tensile environment in the palate, which may explain the patency of palatal sutures even into late adulthood. These results also are interesting in light of sex and ancestral differences in fusion. Males have higher fusion ratios than females, but are less complex. Asian individuals have the most complex sutures for the median palatine but also the lowest fusion ratios. Future research will focus on including complexity data in age estimation methods.

Adult Age Estimation, Palatal Sutures, Sutural Complexity