H100 Understanding Uncertainty in Age Estimation: Error Associated With the Mann et al. Maxillary Suture Method

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After attending this presentation, attendees will gain further understanding of the Mann et al. maxillary suture method, the types of error that are associated with adult age estimation methods, and ways to approach the estimation of uncertainty in measurement as required by the ISO and ASCLD/LAB.

This presentation will impact the forensic science community by providing error rates for the Mann et al. maxillary suture method in response to critiques raised by the National Academy of Sciences concerning the need to evaluate the reliability and accuracy of methods used in forensic science.

Age estimation using cranial sutures is not generally accepted as an accurate or reliable adult age estimation technique. Cranial suture obliteration is most commonly used to place an unknown individual into a general age group (e.g., young versus old adult) or when no other age indicators are present. While techniques utilizing cranial suture closure have come under significant attack, the perceived failure of these methods may also be due to the use of inappropriate statistics and problems with associated error intervals.

The Mann et al. maxillary suture method is based on palatine suture obliteration. There are two versions of the method: the 1987 version relies on measuring the amount of obliteration and the 1991 version is the revised visual method of assessment. Gruspier and Mullen (1991) claim that the 1987 method is inaccurate and Ginter (2005) found that the revised method is more accurate than commonly used age estimation methods such as the pubic symphysis and sternal rib ends. Given these findings, an examination of the performance of the maxillary suture method and the error associated with its use is warranted. Error can result from the method itself (e.g., improper statistical basis for age intervals or the method does not express the total range of human variation possible) and human observer error (e.g., improper assignment of individuals to phases of a method or misunderstanding of methodology).

This study was designed to examine the error associated with the 1991 visual maxillary suture age estimation method. Error was analyzed by comparing the known and estimated ages-at-death of individuals identified at the JPAC/CIL between 1972 and 31 July 2008 whose case documentation referenced the revised maxillary suture method (n=55); a sample size of n=7for the 1987 method precluded error analysis. The following calculations were employed: correct classification (percent of individuals whose known age fell within the assigned age interval), inaccuracy (average error in years), bias (directionality of the error), and Pearson's r (strength and direction of the relationship between known and estimated age-at-death). To further test error associated with application of the visual maxillary suture method, volunteers in attendance at the 2009 AAFS Annual Meeting and JPAC/CIL anthropologists (n=38) were asked to age two individuals.

The sample for the visual maxillary suture method (n=55) has a mean age-at-death of 23.9 years, an age range of 18 years (youngest individual=18, oldest individual=36), and is entirely male. There is a statistically significant difference (p=0.003, ANOVA) in mean age-at- death between this sample and the total known age-at-death sample (n=979, =27.2). The visual age estimation method has a correct classification rate of 87.3%. Only those age estimates reporting closed intervals (e.g., 25-30 and not 30+) were further analyzed (n=27). The method has an average inaccuracy of 2.3 years, a negligible tendency to over-age (bias=0.1), and a statistically significant positive relationship between estimated and known age-at-death (r=0.8, p<0.001, ANOVA). The full range of error extends from -6.5 years to 7 years. Error, as measured by bias, is normally distributed.

Approximately half (48.7%) of the participants in the interobserver error study had never used the maxillary suture method and of the 46.2% that had, only 16.7% use it on a regular basis. Participants reported a "low" level of comfort with this method. Sutures reported as obliterated for each of the two samples were consistent between observers, but age assignment based on observations of obliteration was not. For sample one, participants most frequently reported being 60% sure that their observations of obliteration were correct and 75% sure that their interpretation of the age interval was correct. For sample two, confidence in observations of obliteration and interpretation of the age interval were reported most frequently at 80%.

Results from analyses of the JPAC/CIL casefiles and applications of the method to two crania of unknown age indicate that there are significant problems in assigning age intervals based on the reference method. Given the overall low error rates associated with this method, the method would benefit from standardization in reporting age intervals. This study does not provide information concerning method performance for older adults. Future improvements to the method should include the development of 95% prediction intervals, a more clear definition of what constitutes obliteration, and testing on a larger, older, and more varied sample.

Adult Age Estimation, Maxillary Sutures, Error

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