G24 Dental Age Quicksheets (DAQS): The Use of Rapid Calculation Procedures to Determine "Uncertainty" in Dental Age Estimation (DAE)

Derek M. Draft, DDS, 3100 Wilson Avenue, SW, #3, Grandville, MI 49418; Graham J. Roberts, MDS, King's College London, Dept Orthodontics, Fl 25, Guy's Tower Wing, London Bridge, London SE1 9RT, UNITED KINGDOM; Victoria S. Lucas, PhD, King's College London Dental Institute, Dept of Orthodontics, Fl 22, Guy's Tower, London SE1 9RT, UNITED KINGDOM; Fraser McDonald, PhD, King's College London, Fl 25, Guy's Tower Wing, Great Maze Pond, London SE1 9RT, UNITED KINGDOM; and Manoharan Andiappan, MSc, King's College London Dental Institute, Dept of Population and Patient Health, Bessemer Road, London SE1 9RS, UNITED KINGDOM*

After attending this presentation, attendees will be: (1) aware of the differences in the expression and interpretation of the amount of variation associated with DAEs; (2) able to consider the differences in presenting estimate of "uncertainty;" and, (3) in a position to determine the appropriate method of expressing uncertainty.

This presentation will impact the forensic science community by educating attendees on the differences in error calculation and reporting with DAE cases and by improving the accuracy of DAEs by utilizing the correct method of obtaining the pooled standard deviation.

Introduction: DAEs are widely used in forensic human identification, age estimation of asylum seekers, and in forensic anthropology. When calculating the estimated age, the "error of the method" must also be reported. The most common method of reporting the error in DAE is the Standard Deviation (SD). The usual presentation is to indicate the Dental Age (DA) ±1SD, ±2SD, or even ±3SD. These are helpful ranges as they encompass approximately 68%, 95%, and 99%, respectively, of the data.

Historical DAE studies have utilized Tooth Development Stages (TDS), enabling the dental assessor to use the published mean values of the stages to calculate the DA by taking an average of those values. The associated error of the TDS values are also published and the dental assessor therefore averages the SD values of each TDS value used to obtain the overall SD of the DA. The error of the DA is *usually* reported as a multiple of the SD, and, by convention, this is ±2SD.[1] A more appropriate method of calculating the error associated with the DA is utilizing a pooled SD equation, which takes into account a weighted average of the SD by utilizing n-1.

The purpose of this study is to compare the range of values for the SD calculated using the pooled calculation (n-1) with the range of values using the simple average of SD (n).

Materials and Methods: Dental panoramic tomographs from a study of accuracy of age estimation at the 10-year threshold were re-used. The tooth development stages using the Demirjian description were determined and entered into the DAQS. For each subject, the DAQS calculated the age of the subject and the pooled SD n-1 and simple average SD n separately. The range of uncertainty was then expressed as a range of the SD, namely ±1SD, ±2SD, or ±3SD.

Results: It was found that there was a statistically significant difference between ranges of uncertainty calculated respectively from the pooled SD n-1 and SD n.

Discussion: The DA for a single subject is estimated by averaging the mean values for the TDS present on the subject for whom a DA is required. The variation or level of uncertainty is expressed as the SD or multiples thereof.

The data revealed the pooled SD n-1 to be greater than the averaged SD n for 92 of the 100 subjects and the reverse for 8 subjects. The average difference between SDS and SD n-1 is 0.085. This translates into a difference in the estimated DA range of 0.17 years or 2.04 months for ±1SD, 4.04 months for ±2SD, and 6.06 months for ±3SD.

Conclusion: It is clear that the use of the orthodox method of estimating the pooled SD n-1 provides a wider range for the expression of uncertainty, often referred to as the error of the method, compared to the simplistic method of simply averaging the SD.[2] The differences are small, but in the interests of sound logic and improved accuracy, the correct method of obtaining the pooled SD should be used.

Reference(s):

1. Lewis J.M., Senn D.R. Dental Age Estimation. *A Manual of Forensic Odontology.* Chapter 8. Ed. Senn D.R. and Weems R.A. 5th Edition 2013. CRC Press. Boca Raton. Florida. ISBN: 978-1-4398-5133-3.

2. Vosk E., Emery A.F. Forensic metrology. Scientific measurement and inference for lawyers, judges, and criminalists. *International Forensic Science and Investigation Series.* 2015. CRC Press. Boca Raton, Florida. ISBN 978-1-4398-2619-5. Chapter 16.

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*Presenting Author