G20 First Molar-to-Tooth-Length Ratios in Age Estimation

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Learning Overview: After attending this presentation, attendees will better understand a simple and easy-to-use new method for estimating age in developing dentitions and its advantages over a standard dental age estimation method. This will be presented in the form of a research study that aimed to compare the new technique to an existing standard method of dental age assessment.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by demonstrating the steps of the new, alternative procedure for age estimation and presenting its advantages over an existing standard dental age estimation method in terms of age correlation, error rate, and recording tooth development.

Permanent teeth development is crucial to assess age in living children, adolescents, and individuals who have just crossed the threshold of legal adulthood. The literature is replete with a variety of methods of age estimation in the above age group, and this study presents yet another new technique for age estimation in developing permanent teeth; the method was designed to compare its correlation to age and accuracy of age estimation (in terms of error rate) with a standard dental age estimation method.

Since the first molar is the first permanent tooth to commence development and complete calcification, the ratio of its length to that of the lengths of remaining teeth should consistently change with age (i.e., ratio of non-first molar tooth length to first molar length should—by and large—increase with age). The length of all eight teeth on the mandible's left side were measured on orthopantomograms of 311 subjects (219 females and 92 males) ages 9 to 23 years using a free-to-download open source image editor (GIMP version 2.10). The length of the first molar was used to divide the length of the remaining seven teeth separately to obtain seven ratios; these in turn were subjected to multiple regression analysis with them as independent variables and chronological age as dependent variable. In addition, Demirjian's grading system and its modifications were used to assess the same teeth on the same radiographs.[1-3] Stage- and sex-specific maturity scores assigned to the teeth were totaled and regression analysis undertaken with the total maturity score as the independent variable and chronologic age as dependent variable.[3] Multiple regression analysis for the seven ratios produced $R = 0.81$ for males (Standard Error of Estimate (SEE) ±2.1 years) and $R = 0.78$ for females (SEE ±2.1 years), whereas the linear regression analysis for Demirjian's total maturity scores resulted in $r = 0.76$ for males (SEE ±2.3 years) and $R = 0.77$ for females (SEE ±2.1 years).

The "ratios method" applied herein has a slightly higher correlation to age and is marginally more accurate than Demirjian's method in terms of the error rate. Moreover, it has additional advantages in that rotated teeth do not influence the measurement (tooth rotation may affect assessment of teeth using Demirjian's method), and it is not influenced by ambiguity of whether root development is completed or not, or any other subjective stage is reached or not, which Demirjian's method may be. In conclusion, the relative simplicity of, and the aforementioned advantages to, measuring tooth lengths and calculating ratios—coupled with their stronger age-correlation and lower Standard Error of Estimate—indicates that the new technique may be used as an alternative to Demirjian's method.

Reference(s):

1. Demirjian A., Goldstein H., Tanner J.M. A new system of dental age assessment. *Hum Biol* 1973;42:211-27.
2. Levesque G.Y., Demirjian A. The Inter-examiner Variation in Rating Dental Formation from Radiographs. *J Dent Res* 1980;59(7):1123-6.
3. Chaillet N., Demirjian A. Dental maturity in South France: A comparison between Demirjian's method and polynomial functions. *J Forensic Sci* 2004;49(5):1059-66.

First Molar Length Ratio, Demirjian's Method, Regression Analysis

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