

Tooth Developments: An Accuracy of Age Estimation of Radiographic Methods

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Abstract: Tooth formation is widely used to assess maturity and predict age. Within clinical dentistry this formation aids in diagnosis and treatment planning. Chronological age, as recorded by registration of birth date, is referred to throughout an individual's life. This information is relevant in medical and dental practice for evaluating developmental progress, for educational purposes and in legal matters, particularly in the application of criminal law. The panoramic radiographs of 75 healthy children (40 boys and 35 girls) aged between 5-14 years were selected. Demirjian, Nolla, Haavikko, Williams and Cameriere methods were applied for estimation of age. The result of our study have shown that Williams method is more accurate followed by Haavikko, Cameriere, Nolla and lastly Demirjian method.

Key words: Age determination • teeth • accuracy • panoramic radiograph

INTRODUCTION

It is accepted generally that somatic development is related to chronological age and, as a result, measurements of somatic maturity, for example bone age, menarche and height, have been used to estimate chronological age in the absence of accurate age data [1]. Tooth development shows less variability than other developmental features and also low variability in relation to chronological age [2]. Various odontological methods have also been carried out to estimate age, assessing eruption phases within acceptable error limits. Basically, these method define the stages of mineralization of teeth observed in radiographs and code them according to scores. The most common method for age estimation was published in 1973 by Demirjian, Goldstein and Tanner and subsequently modified by other authors [3-5].

Previous research on accuracy of dental age estimation methods is complicated by different sample sizes, age structures, grouping and statistical analysis making comparisons difficult. The majority of studies have looked at a single method, other use several methods, some investigate living children [6-8], some report on skeletal remains [9]. The aim of this study was to determine the accuracy of five methods of age estimation using developing teeth from panoramic radiographs.

MATERIALS AND METHODS

Sample: The sample was 75 healthy children (40 boys and 35 girls) aged between 5-14 years. Panoramic radiographs that were unclear or that showed hypodontia, gross pathology and previous orthodontic treatment were excluded. The chronological age for each subject was calculated by subtracting the data of the radiograph from the date of birth.

Study design: The design of this study was a retrospective cross sectional study of radiographs. There were good quality panoramic radiographs taken in the course of diagnosis and treatment.

Dental age methods: The panoramic radiographs were assessed to determine the development stages of teeth according to Demirjian [1, 4], Nolla [10], Haavikko [11], Willems [12] and Cameriere [13] methods.

Finding of accuracy: Dental age for each method was compared with chronological age for each subject. The chronological age was subtracted from the dental age and positive result indicates an overestimation and negative figure an underestimation. The significance of the difference between chronological and dental age was tested using student's t-test (SPSS version 7.0).

Table 1: Mean accuracy (in years) for each method for children aged 5-14 years

Methods	Sex	N	Mean	S.E.	S.D.
Cameriere	M	40	0.20	+0.05	+0.31
	F	35	0.18	+0.04	+0.20
Demirjian	M	40	0.18	+0.07	+0.44
	F	35	0.15	+0.09	+0.45
Haavikko	M	40	0.13	+0.04	+0.25
	F	35	0.12	+0.03	+0.15
Nolla	M	40	0.29	+0.07	+0.44
	F	35	0.27	+0.08	+0.40
Willem	M	40	0.25	+0.03	+0.18
	F	25	0.24	+0.04	+0.20

RESULTS

The method of Willems was the most accurate, followed by Haavikko, Cameriere, Nolla and lastly Demirjian. The Willems method was found to overestimate age with a mean accuracy of 0.25 year for boys and 0.24 year for girls. The difference between chronological age and estimated dental age for both boys and girls was significant from zero (Table 1, $p < 0.01$). Accuracy using Willems method was better for boys. Haavikko method yielded a mean estimation of 0.04 years for boys or 0.03 years for girls; accuracy between boys and girls was significantly different ($p < 0.01$). The Cameriere method yielded a mean estimation of 0.05 for boys or 0.04 years for girls; accuracy between boys and girls was significantly different ($p < 0.01$). Nolla method yielded mean estimation of 0.07 for boys and 0.08 for girls, also significantly different from chronological age ($p < 0.01$). Demirjian method was least accurate method.

DISCUSSION AND CONCLUSIONS

The study of morphological parameters of teeth on dental x-ray of children is more reliable than most other methods for age estimation and is most commonly used to determine age in living humans. A common finding is that Demirjian overestimated age [14], although an underestimation has also been reported [15]. In this study the adapted scoring of Willems was more accurate method followed by Haavikko. The mean accuracy for Nolla's maturity scale showed a consistent overestimation, although previous study found that real age in girls was similar to dental age, younger boys were dentally advanced [16]. Caro and Contreres found Nolla to be accurate than other methods they tested [17]. While Williams methods was more accurate as compared to

other methods. Using Haavikko to predict age gives an overestimation of age dissimilar to previous finding [18].

No study have been published till date on accuracy of Cameriere method, this method found to more accurate as compared to Demirjian and Nolla. The difference between the chronological age and calculated age due to tooth formation stages are not equally spaced during growth and are not of equal duration. To date, exact dental formation times between crown and root fractions is meager. Finally, the most accurate method was Williams followed by Haavikko, Cameriere, Nolla and lastly Demirjian.

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