

Shekhar Grover¹,
Tanu Anand²

¹Department of Public Health Dentistry,
²Department of Community Medicine, Maulana Azad Medical College, New Delhi

Correspondence to:
Dr. Shekhar Grover,
Department of Public Health Dentistry, Maulana Azad Institute of Dental Sciences, B.S. Zafar Marg, New Delhi-110002.

E-mail Id: shekhargrover84@gmail.com

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Dental Age Estimation of 6-15 Year Old Indian Children Using Demirjian Method

Abstract

Objective: Assessment of tooth development to estimate the age of living subjects is required in various disciplines including pediatric dentistry, orthodontics, and forensic dentistry. The most widely used method is the one given by Demirjian et al. in 1973. This method has been tested only a few times in North Indian children, thus the need for present study.

Methodology: Seven left mandibular teeth were assessed from 215 orthopantomograms (OPGs) belonging to healthy children aged 6–15 years randomly selected and were staged according to Demirjian method. Univariate quantitative analysis was performed.

Results: A general over-estimation of 0.61 years was observed (0.66 years – males and 0.56 years – females) ($p < 0.05$). The gender differences were not statistically significant ($p > 0.05$). Also, younger age groups had a higher amount of overestimation.

Conclusion: The present results support the need for refinement of the population-specific standards in Demirjian method, for its further application.

Keywords: Age estimation, Chronological age, Dental age, Demirjian method.

Introduction

Dental age determination is required in various clinical and scientific disciplines.^{1,2} In certain communities, the chronological age of living people bears significant importance regarding social benefits, employment and marriage.³ Assessment of tooth development to estimate the age of living subjects has a long history.⁴ Individuals may not have accurate information about their date of birth, or they may choose to suppress such information. In such circumstances, age determination technique, i.e., estimation of chronological age, may be required.⁵ The main criteria for forensic age determination in the relevant age group based on odontological examination are tooth eruption and tooth mineralization, both developmental biological features.

For evaluation of tooth mineralization, various stages classifications have been put forward.⁶⁻⁸ The most widely used method for comparison between different populations was first described in 1973 by Demirjian et al.⁶

The use of Demirjian's scale has demonstrated differences between several worldwide groups,⁹⁻¹¹ as well as between geographical areas or cities within the same country.^{12,13} This method has been tested scarcely in North Indian children, so little is known about its applicability in the region.¹⁴ For this reason, the aim of this study was to evaluate the applicability of Demirjian's method for dental age estimation in North Indian children.

Methodology

A cross-sectional study was carried out by estimating the development of teeth in the mandibular left permanent teeth (central incisor to second molar) in panoramic radiographs of children aged 6–15 years (with North Indian descent and having parents

of same ethnicity). The study involved 215 radiographs. The radiographs were estimated by tracing them by a pencil (by a single examiner) on a translucent paper against a light source and were assessed using Demirjian method and compared with the chronological age of the child.

Children showing congenital developmental abnormalities, physically/mentally challenged children, children having systemic diseases or having a gross malocclusion were not included in the study. For any subject with an absent left permanent mandibular tooth, the equivalent tooth on the subject’s right was used. Tooth formation is divided into eight stages and criteria for these stages are given for each tooth separately. Each stage of the seven teeth is given score. The sum of scores for seven teeth is referred to as a table giving the dental age.

A pilot study on 10 random radiographs was performed initially, giving the final sample size as 190. A random sampling method was performed to select the

panoramic radiographs available in the Department of Pedodontics and Department of Orthodontics in a North Indian dental institution.

The data was analyzed using SPSS software (SPSS v17). Chronological age and estimated dental age were analyzed demographically and using univariate quantitative analysis. The level of significance was set to be at 0.05 (*p <0.05).

Results

The subjects were divided into 10 age groups of 1 year each, from 6 years to 15 years (Fig. 1). Demirjian method produced a significant mean over-estimation of 0.61 years in study sample (0.66 years in males and 0.56 years in females) (Table 1). Pearson’s Correlation Analysis signified a gradual decrease in overestimation (dental age minus chronological age) as the age advances in both genders (Figs. 2 and 3). Table 2 shows the gender comparison of overestimation by Demirjian method; no significant difference was seen.

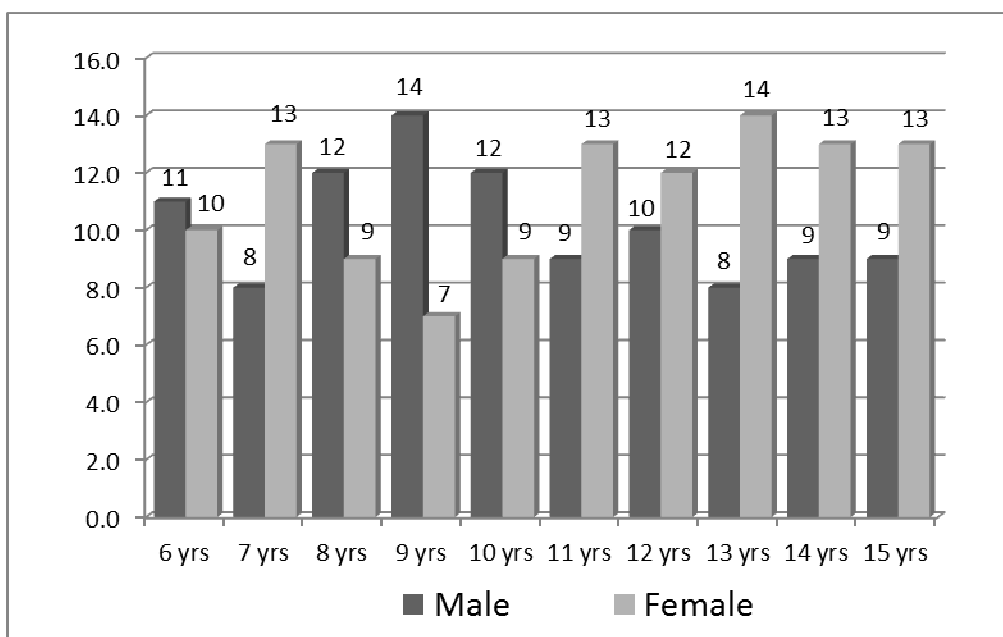


Figure 1. Distribution of Study Samples according to Age Categories

Table 1. Chronological Age and the Dental Age by Demirjian’s method (*p <0.05)

Group	Chronological Age		Dental Age		Mean Diff.	SD Diff.	p-Value
	Mean	SD	Mean	SD			
Males	10.27	2.80	10.93	2.68	0.66	0.38	0.02*
Females	10.81	2.94	11.37	2.90	0.56	0.36	0.04*
Overall	10.56	2.88	11.16	2.80	0.61	0.37	0.03*

Table 2. Gender Comparison of Overestimation by Demirjian Method (*p <0.05)

Chronological Age Minus Dental Age	Gender	n	Mean	SD	t-value	p-Value
	Males	102	0.66	0.38		
Females	113	0.56	0.36			

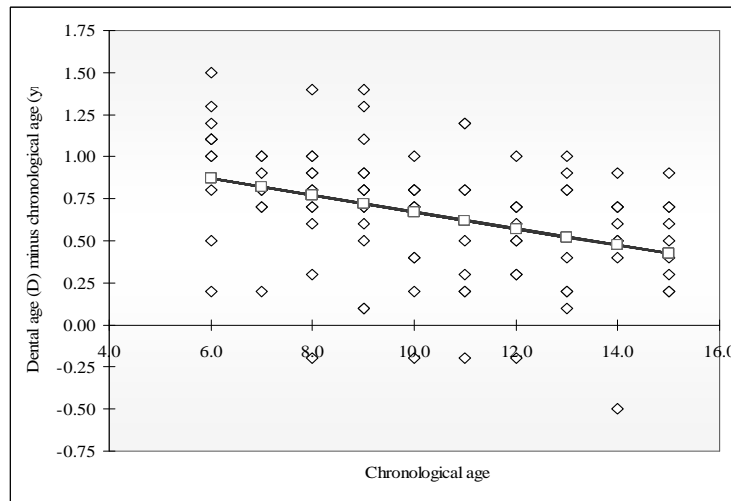


Figure 2.Scatter Diagram of Overestimation of Dental Age among Boys

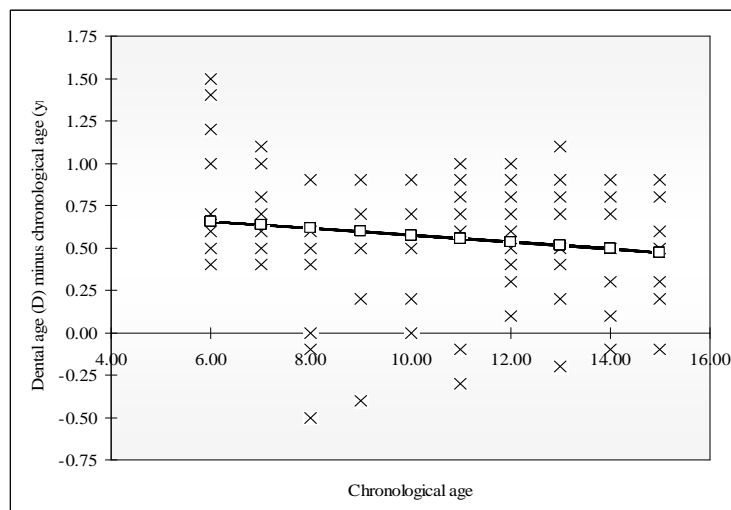


Figure 3.Scatter Diagram of Overestimation of Dental Age among Girls

Discussion

There are often seen large differences in growth and development rates among children of same chronological age.¹⁵ Teeth are one of the key systems in the body, and their degree of development is used as one of the indices of biological age. 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. OPGs are considered as the best tool for age estimation in children because intraoral radiography is difficult to obtain in children without image distortion.¹⁶ A total of 215 OPGs were investigated (aged 6–15 years) in the present study-102 males (48%) and 113 females (52%). Ethnic uniformity of the study sample was a prerequisite as development of teeth may vary among populations.¹⁷

The observed difference in estimation of age by Demirjian method is reported in numerous studies in

the past, implying its inapplicability in various populations.^{1,6,9,10,14} The findings can be inferred to the fact that the Demirjian method was framed almost 40 years ago, and there may have been a difference in the present-day comparisons due to positive secular trends.

Gender comparison did not reveal any significant difference, implying that there is no disparity in the accuracy of age estimation among boys and girls. According to the present results, we cannot judge the favorable accuracy of dental age estimation towards any gender as is with other studies.^{7,15}

When scatter plots were created between estimated age and chronological age, there were linear lines showing a strong negative correlation (Figs. 2 and 3). This implied that the younger age groups had a greater overestimation than the older age groups. This may be explained by the fact that acceleration of growth reduces as the age advances and body development becomes gradually stabilized, as the growth reaches

maturity. This finding is comparable to results of Leurs et al.¹⁹ where a significant difference was seen in the 5–10 years age groups. Some other studies predict a variable result, showing more overestimation in higher age groups²⁰ or in different age categories.^{11,18} This varying degree of overestimation indicates that dental growth is not a steady and uniform process, but is possibly associated with para-pubertal speed fluctuations.

Assessing OPGs was favorable as it is a non-invasive approach and hence readily acceptable. Also, teeth were assessed for development and not for eruption, which accounts for low variability due to local and environmental factors.

Conclusion

The Demirjian method produced a significant overestimation similar to other population studies. Gender comparisons achieved satisfactory results and younger age groups were presumed to have more irregular growth pattern as compared to their adolescent counterparts. The overall study supports the need for refinement of the population-specific standards in Demirjian method for further application in forensic sciences.

Conflict of Interest: None

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