

Estimating the Age Using Demirjian's 7 and 8 Teeth Technique and Indian Formula within Hadoti Population

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Abstract

Introduction: For the sciences of forensic odontology and medicine, paediatric dentistry, clinical health and dentistry, archeology; estimating the age is crucially important. The stages of teeth development gives a non-invasive and effective methodology to estimate the age of a person. The Nolla and Demirjian's are the most widely used methods for estimating age, latter being the, most trusted.

Aim and Objective: To evaluate the reliability of age estimation of Nolla and Demirjian's 7 teeth method and also to evaluate the validity of Indian formula in Hadoti population.

Materials and methods: The study sample comprised of 212 individuals between the ages of 6 - 18 years. The patients chronological age was noted by their birth certificate. First the analysis of orthopantomograph was done to evaluate the radiographic age of the sample using both Demirjian's methods and applying the specific formula. The chronological age then was compared with that of radiographic age. The results were obtained by using SPSS v16 software.

Results: The estimation of dental age using Demirjian's 7 teeth and 8 teeth method resulted in overestimation while the Indian specific formula was significantly related to chronological age.

Conclusion: Age estimating procedure using Indian specific formula diminishes the chances of errors in precisely estimating dental age. However more studies should be carried out in different regions in India to ascertain applicability of Indian specific formula.

Keywords: Age Prediction; Demirjian's Method; Dental Maturity; Nolla

Introduction

An efficient maturity indicator, dental age has significant relevance in forensic dentistry, pediatric endocrinology, archaeology and clinical dentistry. It is an essential tool for evaluating a child's growth status, assessing the age and their maturity. Tooth calcification stages are most suitable for age estimation in children as it is a progressive way that can be followed by taking radiographs and all teeth are evaluated at every examination noninvasively and directly. Majority body tissues are affected by endocrinopathies, environmental insults, exogenic factors such as malnutrition or disease and are less reliable indicators of maturity as compared to teeth [1-3].

Demirjian A. Goldstein H., *et al.* (1973) method is the most used method because of its simplicity and reliability. The developmental stages of teeth are classified into 8 stages of calcification that represents initiation of calcification to the apex closure for seven left mandibular

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teeth and a gender maturity score was assigned to each tooth. The overall maturity score can be converted into dental age using tables and centile charts. However, this method is limited for people above 16 years as exclusion of third molars are done in the scoring criteria [4]. To overcome this Chaillet's and Demirjian's added the 3rd molar for assessment of age in Belgian children and derived gender specific regression formulas for age assessment which includes two additional stages for easier calculation. Since tooth dimensions are variable in different races his revised method was tested by Acharya on south Indian population sample which showed noticeable differences and he formulated an India specific formula to accurately predict the age in Indian samples [5,6].

However there is great diversity in India as well and as no studies have tested Demirjian's original formula, its modification and Indian - specific formulas on Hadoti population of Rajasthan (India), this study was conducted with an objective to evaluate the applicability and accuracy of these method of age estimation on this selected population.

Materials and Methods

This is a cross-sectional study conducted in 212 subjects. Panoramic radiographs of 104 females and 108 males of Hadoti ethnic origin were taken who visited the Oral and Maxillofacial Radiology Department between the age group of 6 - 18 years for radiologic examination with no prior orthodontic therapy. Children with systemic diseases affecting development of teeth, hypodontia, low quality radiographs were excluded from the study. Patients consent and guardians consent in cases of minors was duly taken and the subjects were made to understand the study. All the radiographs were assessed by one investigator in a darkened room with radiographic illuminator to ensure contrast enhancement of images. To prevent investigator bias, 20% of research radiographs were randomly selected and re- examined after 3 months.

212 digital panoramic radiographs were evaluated and analyzed to determine dental age using 3 different methods:

- Demirjian's system depends on eight different stages of tooth development starting from calcification of the tooth cuspal tip to apex closure. Its weight scored was assigned to each of the 7 left mandibular teeth (are designated from A to H). On a scale range from 0 to 100, the points marked of these 7 teeth are summed up and depicts the score of tooth maturation.
- The third molar is added for Demirjian's modified method to obtain the specific weighed score to calculate the dental maturity and predictable curves. The teeth were staged from 0-9 in Demirjian's 8 teeth methods and according to the stage of calculation the total maturity score (which was then substituted in the regression formula given by Chaillet and Demirjian's 2001) was calculated.
- These scores were used in Acharya's Indian specific formula which was derived using Demirjian's 8 teeth method which are as follow: Males: $\text{Age} = 27.4351 - (0.0097 \times S^2) + (0.000089 \times S^3)$ Females: $\text{Age} = 23.7288 - (0.0088 \times S^2) + (0.000085 \times S^3)$.

Chronological age was calculated as the difference between date of birth on birth certificate and the date on which the panoramic radiograph was taken for each subject.

Statistical analysis

The age obtained by all the three methods that is Demirjian's 7 teeth, Modified Demirjian's 8 teeth and the Indian specific formula the chronological age was compared and individually calculated. Microsoft Excel was used to tabulate all the data and comparative evaluation was done with SPSS v16 software. An unpaired t-test was done. Cohen's kappa coefficient was used to measure the intra-observer reproducibility.

Result

Mean age of all participant is estimated to be of 10.3 years. Mean male age is 11.5 years and mean female age is 10.9 years (Table 1).

Subject	Total	Age (in years)	
		Range	Mean
Males	108	6 - 18	11.5
Females	92		10.9

Table 1: The Mean age of subjects.

z-test gave a p and r value of 0.045 (mildly significant) and 0.76 (moderately significant) respectively. This showed comparison between chronological age and Demirjian’s 7 teeth method. A comparison of Demirjian’s 8 teeth method and chronological age done using z-test gave a p and r value of 0.043 (mildly signification) and 0.49 (mildly significant) respectively. A comparison of chronological age was done with the Indian specific formula by Acharya AB., *et al.* gave a p and r value of 0.02 (highly significant) and 0.86 (highly significant) respectively (Table 2).

Comparison	p	r
Chronological age vs age using 7 teeth	< 0.045 (Mildly Significant)	0.76 (Moderately significant)
Chronological age vs age using 8 teeth	< 0.043 (Mildly Significant)	0.49 (Mildly Significant)
Chronological age vs age using Indian specific formula	< 0.02 (Highly Significant)	0.86 (Highly significant)

Table 2: Statistical comparison of 212 subjects.

z-test was and co-efficient of correlation was applied to obtain the results.

p: Probability Value using z-test.

r: Co-efficient of Correlation.

The same comparison was performed separately for males. The p and r value of 0.032 (mildly signification) and 0.81 (highly significant) respectively was obtained. P and r value for comparison between chronological age and Demirjian’s 8 teeth method showed value of 0.021 (moderately signification) and 0.75 (moderately significant) respectively and that between chronological age and Indian specific formula gave a p and r value of 0.018 (highly significant) and 0.92 (highly significant) respectively (Table 3).

Comparison	p	r
Chronological age vs age using 7 teeth	< 0.032 (Mildly Significant)	0.81 (Highly Significant)
Chronological age vs age using 8 teeth	< 0.021 (Moderately Significant)	0.75 (Moderately Significant)
Chronological age vs age using Indian specific formula	< 0.018 (Highly Significant)	0.92 (Highly significant)

Table 3: Statistical comparison of 108 males.

z-test was and co-efficient of correlation was applied to obtain the results.

p: Probability Value using z-test.

r: Co-efficient of correlation.

Also the comparison was carried out for the females as well. The comparison of chronological age and Demirjian’s 7 teeth method gave a p and r value of 0.041 (mildly signification) and 0.68 (moderately significant) respectively. Similarly between chronological age and

Demirjian’s 8 teeth method, the p and r value obtained was of 0.034 (mildly significant) and 0.70 (moderately significant) respectively and p and r value of 0.021 (highly significant) and 0.87 (highly significant) respectively for comparison between chronological age and Indian specific formula (Table 4).

Comparison	p	r
Chronological age vs age using 7 teeth	< 0.041 (Mildly Significant)	0.68 (Moderately significant)
Chronological age vs age using 8 teeth	< 0.034 (Mildly Significant)	0.70 (Moderately Significant)
Chronological age vs age using Indian specific formula	< 0.021 (Highly Significant)	0.87 (Highly significant)

Table 4: Statistical comparison of 108 females.
z-test was and co-efficient of correlation was applied to obtain the results.
p: Probability Value using *z*-test.
r: Co-efficient of Correlation.

Discussion

Dental age is estimated by the tooth eruption date or by the progression of calcification in teeth. Dental eruption is highly influenced by various factors including ankylosis, crowding, ectopic eruption, retained teeth and cannot be applied in children between 3 - 6 years and those above 13 years. Hence tooth calcification is more reliable criteria for determining the dental age [7]. Several methods have been proposed for dental age assessment using dental calcification involving the use of different types of radiographs. Panoramic radiographs due to their ease in accessibility and ability to visualize all teeth has been widely adopted by authors. Panoramic radiographs are preferred over intraoral radiographs as they are difficult to obtain without image distortion as it can lead to inaccuracy of findings. Thus, panoramic radiographs were used in this study to determine estimated dental age [8].

Demirjian [4] derived the initial dataset in 1973 and worked upon French-Canadian people and later updated the dataset with additional samples. The disadvantage of the Demirjian 7 teeth method was that it excluded the third molar which also has variable size, shape and congenital presence or absence of it owing to variation in its development. Hence, it could not be used in children above 16 years. In order to break this Chaillet and Demirjian (2004) modified the method and utilized third molar for dental age estimation. Also they developed new maturity scores for age estimation in Belgian population in which age upto 18 years was included. However, when both these methods were applied to study sample, it resulted in overestimation of age. This was corroborated by previous studies based on Demirjian’s 7 teeth and 8 teeth methods conducted in various populations, which also resulted in overestimation in age ranging from 0.02 to 3.04 years. This wide range could be due to ethnic differences, climate, nutrition, socioeconomic level, urbanisation, age structure of sample, sample size, statistical methods. Also genetics, nutritional status, living conditions and dietary habits are potent reasons for variations in dental and skeletal maturity among different ethnic groups [9].

295 radiographs were tested by Acharya AB of individuals aged between 7 - 16 years and compared in terms of the number of age estimates that fell outside the 95%, 97% and 99% confidence intervals. Furthermore, developed Indian specific formulas from 355 individuals and also tested the Indian and Demirjian’s cubic equations on 70 individuals aged between 9 to 18 years and concluded that Indian formulas predicted age better than Demirjian’ formulas [6].

Kumar and Gopal tested Demirjian’s 8 teeth method using India-specific formulas and concluded that in 57.9% of cases the error rate was within ± 1 year with accuracy of 1.18 years and also found that the addition of third molar increased the error rates in the older individuals [10].

In the present study it was seen that Indian specific formula (p value < 0.02) was more efficient in estimating age of an individual when compared to Demirjian's 7 teeth and 8 teeth method and the Indian specific formula given by Acharaya AB was more efficient for estimating age for both males and females with a slight predilection for males (p value for male < 0.018 and for females is < 0.018).

Conclusion

In the present study, three famous methods were used to compare and estimate the dental age of Hadoti population. It was concluded that Demirjian's 7 teeth method did not give a reliable result for males as well as females. But when Demirjian's 8 teeth was used to estimate the dental age it was concluded that this method could be used as a measure of estimating dental age more reliably in males when compared to females. Lastly the Indian specific formula was found to be the most reliable method for estimating dental age both for males and females with a very less margin of error.

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