

Dental Age Estimation by Demirjian's And Nolla's Method: A Comparative Study among Mangalorean Population

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Abstract

Objective: The aim of the present study was to radiographically evaluate the dental age by using Demirjian's and Nolla's methods and to compare the efficacy between two different methods in a study population.

Materials and Method: The present study was conducted using 30 panoramic images obtained from archives in the Department of Oral Medicine and Radiology, Yenepoya Dental College and Hospital, Mangalore. The dental age estimation was done using the Demirjian's and Nolla's methods. Seven left mandibular permanent teeth were taken into consideration for Demirjian's method and in Nolla's method both maxillary and mandibular teeth were included, excluding third molars based on staging

system given by Nolla and the dental age obtained by both methods was compared with the chronological age.

Result: Analysis showed that the Demirjian's method had some degree of overestimation although very negligible which was statistically insignificant. However Nolla's method underestimated the age and the difference was found to be statistically significant.

Conclusion: The study showed that age estimation method by Demirjian's was found to be a more accurate method in Mangalore population.

Keywords: Dental Age Estimation; Demirjian's Method, Nolla's Method, Panoramic Radiograph.

Introduction

Forensic odontology has developed as a separate speciality ¹ and age estimation using dental radiography has become an important aspect of forensic dental science. The age estimation is very important for

forensic, legal, and clinical work. Teeth are highly mineralized structures and shows lesser variability than other developmental features and also in relation to the chronological age² therefore dental tissues are a better aid in estimating the age.

Dental age assessment (DAA) is important for paediatric dentists and orthodontists in planning and timing treatment, and selecting the appropriate orthodontic appliance³. It is essential to start treatment in the optimal growth stage (pubertal growth spurt) in order to achieve ideal correction of skeletal discrepancies, use extra oral tractions and functional appliances, and correctly schedule orthognathic surgery³.

Chronological age is the actual age of the individual and Dental age assessment is the most reliable methods for estimation of chronological age. Radiographs also play an important role in the human age determination² Dental age estimation on panoramic X-rays is very useful for pediatric dentists and orthodontists in choosing a treatment plan, without the need for any additional radiographic investigation⁴.

Many authors have developed scoring methods in order to assess dental age using dental calcification stages of permanent teeth, including Demirjian, Nolla, Goldstein, and Van der Linden. The Demirjian's method is one of the most widely used options, and was first applied in a French Canadian population in 1973. Nolla in 1960 also developed one of the methods most widely used to identify the dental development of individual teeth (based on the so-called Nolla's stages). Thus the present study aims to determine the age of the children by using Demirjian's and Nolla's method and also to check for the accuracy between the two methods in Mangalorean population.

Materials and Methods

The present study was conducted in the Department of Oral Medicine and Radiology, Yenepoya Dental College and Hospital, Yenepoya (deemed to be) University, Mangalore. After obtaining Ethical clearance from institutional ethical committee, the panoramic radiographs were selected from the archives of the Oral medicine and Radiology department. The sample size was 30 patients equally divided among male & female genders and each orthopantomogram (digital) was taken by Planmeca machine, under standard protocols using the Agfa NX software.

The study included patients aged between 5-16 years, with full complement set of teeth for that age group while as faulty images, children below the age of 5 and above the age of 16, and with developmental anomalies and pathologies were excluded from the study.

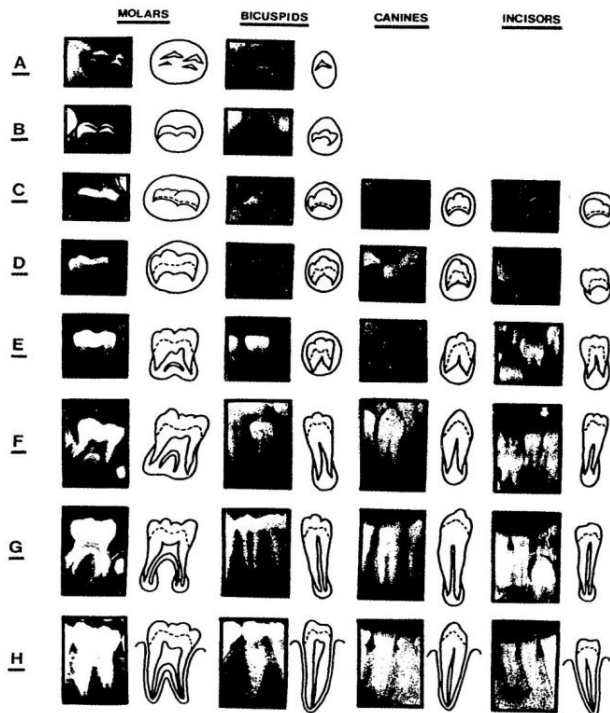
The chronological age of each individual was calculated by subtracting the birth date from the date on which patients were exposed to take radiographs.

Dental age estimation using the Demirjian's method

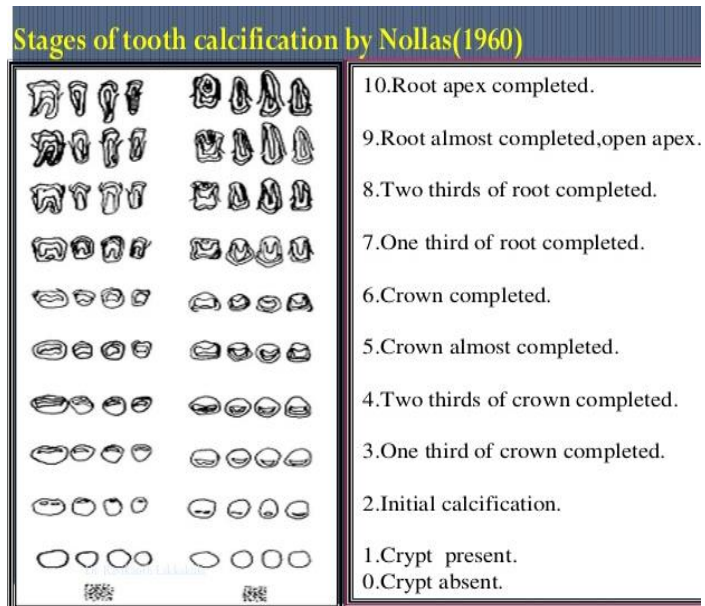
The dental age estimation was done using the Demirjian's radiographic method of age estimation². The teeth assessed were seven left mandibular permanent teeth in following order: 2nd molar, 1st molar, 2nd bicuspid, 1st bicuspid, canine, lateral incisor, central incisor. All teeth are rated on a scale A to H². (Fig 1)

Each tooth was given a score depending on its stage and the scores on all teeth were added together to give a total maturity score which can be converted directly into a dental age using an appropriate table of standards. Girls and boys were given different system of scores.

Fig. 1: Stages of development of permanent dentition



The statistical analysis was carried out using the students unpaired-t-test for the present study.



Results and Observation

Table 1: Statistics

	Chronological Age	Age By Demerjans	Age By Nollas Method
N	30	30	30
Mean	12.658	12.713	11.806
Median	13.005	12.800	11.700
Std. Deviation	1.962	1.891	2.0450
Range	8.10	7.400	7.00
Minimum	8.70	8.300	8.00
Maximum	16.80	15.700	15.00

Table 2: Combined Correlations Between Demirjian's And Nolla's Method

Dental age estimation using the Nolla's method

The dental age estimation was done using the Nolla's radiographic method of age estimation. Nolla had divided the stages of dental development into ten stages through which every tooth passed.(Fig 2) These stages were determined for all the teeth. Each stage also had a numerical score.

a) If the tooth shows stage between any two stages a score of 0.5 is added.

b) When the radiograph shows a reading that was slightly greater than the illustrated grade the value 0.2 is added.

c) When the development were slightly less than the grade indicated the value of 0.7 is added.

After every tooth is assigned a reading, a total was made of maxillary and mandibular teeth excluding third molars and compared to Nolla's age norms given separately for girls and boys.

		Age By Demerjians	Age By Nollas Method
Chronological Age	R	.894	.850
	P	.000	.000
	N	30	30
Age By Demerjians	R		.932
	P		.000
	N		30

Table 3: Correlations between Demirjian’s and Nolla’s method in males and females

Gender		Age By Demerjians	Age By Nollas Method	
Male	Chronological Age	R	.884	
		N	15	
		P	.000	
	Age By Demerjians	R		.958
		N		15
		P		.000
Female	Chronological Age	R	.898	
		N	15	
		P	.000	
	Age By Demerjians	R		.900
		N		15
		P		.000

Table 4 - Comparison of chronological age with Demirjian’s method and Nolla’s method

	Paired Differences		P
	Mean	Std. Deviation	
Chronological Age - Age By Demerjians	-.055	.890	.737

Chronological Age - Age By Nollas Method	.852	1.099	.000
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Table 5: Comparing chronological age with Demirjian’s method and Nolla’s method in males and females

Gender	Paired Differences	P	
		Mean	Std. Deviation
Male	Chronological Age - Age By Demerjians	-.097	.928
	Chronological Age - Age By Nollas Method	.449	.979
Female	Chronological Age - Age By Demerjians	-.013	.881
	Chronological Age - Age By Nollas Method	1.254	1.094

Observations

The efficiency of Demirjian’s and Nolla’s method was calculated statistically using students unpaired t-test. The overall mean chronological age was 12.658 and the mean estimated age when Demirjian’s method was applied in both males and females was 12.713 and the mean estimated age in Nolla’s was 11.806. (Table 1)The combined correlation between Demirjian’s and Nollas method revealed that as chronological age increases the age by Demirjian’s and Nolla’s also increases and both of them have good correlation.(Table 2) However the age estimation method by Demirjian’s have a more good correlation when compared to the Nolla’s methods. The correlation between Demirjian’s and Nolla’s methods in males and females (Table 3) shows that Demirjian’s method have a good correlation in females when compared to males and in Nolla’s method it was found

that the males had a good correlation when compared to females. The comparison of Chronological age with Demirjian's and Nolla's methods (Table 4) revealed that in Demirjian's method statistically there is no significant difference ($p=0.737$) whereas in Nolla's method there is a difference ($p=0.000$). It was found that Demirjian's is a much more reliable method of age estimation as compared to Nolla's. The combined comparison of chronological age with Demirjian's and Nolla's methods in males and females (Table 5) showed that while comparing the chronological age by Demirjian's method there was no significant difference in males and females, the difference was found to be (-0.097) in males and (-0.013) in females. While comparing the chronological age by Nolla's method in males the difference was (0.449) and in females it was (1.254) and it was found that there was significant difference in females. Dental age correlates closely with chronological age in a person's development. Demirjian's method is one of the simplest and widely employed method of age estimation which clearly defines the developmental changes of teeth in 8 stages. Nolla's method has been the method of choice for so many years which defines the teeth development in 10 stages⁴.

Discussion

Age estimation is important in forensic sciences as a way to establish the identity of human remains. Of the various parts of the body used in age estimation, teeth are least affected by taphonomic process. Dental age correlates closely with chronological age in a person's development⁴. The aim of the ideal age estimation method is to arrive at a value close to the chronological age as possible. Various age estimation methods have been tested and reported in literature on different ethnic populations¹. One such widely used method is the Demirjian's method of age estimation which was developed by Demirjian A and Goldstien H in 1973, on French Canadian population.

This method not only estimates age in years but also month of an individual's age. Nolla's method is based on 10 stages of tooth development which was introduced by Nolla in 1960. In this method the staging is done based on calcifications of individual tooth which is from stage 0 to 10. Nolla has given age norms separately for boys and girls and also including third molars and excluding third molars which is one of the unique feature of this method². The present study comprised of 30 individuals that is 15 males and 15 females, in which the dental age was calculated using Demirjian's and Nollas method and compared to the chronological age. It was found that the dental age estimation by Nolla's method underestimates the chronological age by 1.099 years and although there is some degree of overestimation by the Demirjian's method it is very negligible and statistically insignificant. Hence age estimation method by Demirjian,s was found to be more accurate method in Mangalore population.

Similar results were seen in a study conducted by Sinha S et al in 2014 on North Indian population. The results of the study showed that there was no significant differences between the actual and estimated age when using the Demirjian's method whereas in Nolla's method there was significant differences between the actual age and estimated age was observed particularly in subjects aged 9 years and above. Thus it was concluded that Demirjian's method was more applicable to all age groups and for both genders with better accuracy than the Nolla's method, which had limited utility in younger age groups.

A study conducted by Gupta R et al in 2014 among adolescents of western Uttar Pradesh, aimed at comparing the efficacy of Demirjian's and Nolla's method using the Indian formulas in age estimation of adolescents (8-13 years) by Conventional tracing technique. Study was carried out on 20 orthopantomograms (OPGs) of patient and the result showed that the comparison of

Chronological age and Dental age by Demirjian's methods revealed non significant results ($p=0.057$) whereas the same comparison for Nolla's method revealed significant results ($p<0.05$). It was found that Demirjian's was more reliable method of age estimation as compared to Nolla's. Furthermore in Nolla's, underestimation of age in 100% of the subjects was noted. Thus, it was found that Demirjian's method showed insignificant difference in chronological and dental age of the patients as compared to Nolla's method⁴ The results of this study are in agreement with the present study.

The results of our study however were in discordance to the results of study conducted by M Mario et al in 2016 among the Spanish population. The objective of their study was to compare the accuracy of estimating dental age versus chronological age using the Nolla and Demirjian methods. Results of the study showed that the Demirjian method over-estimated age by 0.853 years on average with respect to the chronological age and the Nolla's method under-estimated the age by 0.213 years on average with respect to the chronological age. Nolla's method was found to be more accurate than the Demirjian method, however difference in estimation by the two methods was minimal and statistically insignificant hence, they concluded that both the methods were totally reproducible and accurate in estimating chronological age from dental age in a Spanish population⁷. The reason for discordance of our study results could be attributed to the variations in geographical factors, nutritional factors, socio-economic levels and a wide biological variability in dental developments among different individuals in different populations. In addition to that cultural and ethnic variations may also be attributed to have a role.

Conclusion

The present study was conducted to determine the dental age using Demirjian's and Nolla's method in Mangalore

population in order to compare which method was more accurate. The study concluded that there is no statistically significant difference between the estimated age and chronological age by the Demirjian's method ($p=0.737$), whereas age estimation by Nolla's method showed a statistically significant difference ($p=0.00$) between estimated age & chronological age. Thus, it can be concluded that Demirjian's method of age estimation is a better method when compared to Nolla's method in Mangalorean population. However further research can be carried out with a larger sample size to acknowledge the effectiveness of both the methods.

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