

Unfolding The Link: Age Estimation through Comparison of Demirijian and Moore's Method

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Abstract

Introduction: Development of teeth is a useful measure of maturity, as it represents a series of recognizable events that occur in the same sequence from an initial event to constant endpoint. Age estimation from teeth is generally considered reliable, as they are naturally preserved long even after disintegration of bones and tissues. **Aims and objectives:** The aim of present study was to determine dental age from panoramic radiographs using Demirijian's method and Moore's method in kadapa population. It was also to compare two methods for calculation of dental age and evaluate which technique is better. **Materials and Methods:** The study was conducted in the department of Oral Medicine and Radiology at Govt dental college and hospital, kadapa. Total of 75 subjects of age group from 7 years to 14 years were included. For every individual included in the study, a panoramic radiograph was taken with standard parameters and adequate protective measures and was analysed for developmental stages of teeth accordingly to the criteria given by Demirijian and Moore's method. **Results:** A statistically significant difference was observed in all age groups except 12, 14 years in Demirijian's method and except 10, 12 years in Moore's method. Demirijian's method over estimated the age with a mean difference of -2.10 and Moore's method underestimated the age with a mean difference of 0.92. Pearson's correlation revealed more positive correlation between chronological and dental age using Demirijian's method which was 0.644 compared to Moore's method which was 0.593 showing greater accuracy of Demirijian's method compared to Moore's method. **Conclusion:** Age estimation can be done by Demirijian and Moore's method with the former showing greater accuracy than the latter. The Demirijian's method tends to overestimate the age and Moore's method underestimated the age. However further research should be aimed at with a larger sample for better accuracy of both the methods.

Keywords: Age estimation, Forensic odontology, Demirijian's method, Moore's method, panoramic radiographs.

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INTRODUCTION

Forensic Odontology is a new science that has emerged as separate speciality [1]. Age estimation is an important aspect of forensic science [1]. Dental age is considered to be a reliable indicator of chronological age and has been widely used in dentistry for age estimation. As teeth are the most indestructible part of body, they are used most reliably in age estimation.

Various radiographic methods, depending on tooth calcification have been reported. Among them the most widely accepted dental maturity method was described by Demirijian *et al.*, in 1973, which is based on developmental stages of seven left permanent mandibular teeth. Moore's method is one of the methods for assessing age which utilizes mineralization of teeth for age assessment [1].

Demirijian's method presents 8 stages of maturation of all seven left permanent mandibular teeth from A to H. It is one of the most frequently used methods to estimate chronological age due to its simplicity, ease of standardization, ability to reproduce [3]. Moores *et al.*, proposed assignation of maturation stages for crown and root, which can vary accordingly whether the tooth is single or multicrooked [4].

Tooth development is considered to be a useful measure of maturity, as it represents a series of events that occur in same sequence from an initial event to a constant end point⁷. Considering that tooth mineralization is less affected by environmental and hormonal variations than states of bone mineralization,

dental development is a more reliable indicator of chronological age than bone development [3].

The aim of present study is to determine dental age from a panoramic radiograph using Demirijian's method and Moore's method and to evaluate inter relationship between chronological age and dental age according to both the methods and also to evaluate which technique is better.

MATERIALS AND METHODS

The study was conducted in the Department of Oral Medicine and Radiology at Govt. Dental College and Hospital (Kadapa, A.P). Ethical clearance for the study was obtained from the ethical committee. A total of 75 subjects between the age group of 7-14 years were included in the study.

For clinical examination of patient, a dental chair with adequate illumination and for radiographic examination, a panoramic machine (Vatek, Pax-400c with Kvp 110/230 v weight 200kg) were used. Each patient and their parents/guardian were informed about the entire procedure and informed consent was obtained from each patient before starting the procedure.

The criteria used for selection of subjects were:

Inclusion Criteria

The inclusion criteria were a complete Set of left mandibular permanent teeth, patients with normal growth and normal development, no history of either surgical or medical conditions and radiographs of good diagnostic quality.

Exclusion Criteria

The exclusion criteria were faulty radiographs, congenital anomalies such as cleft lip, cleft palate, dental abnormalities like rotations, crowding, hypodontia, missing teeth, supernumerary teeth, history of trauma to face, patients with systemic diseases.

For each and every individual included in the study, a panoramic radiograph with standard parameters and adequate protective measures was taken and was analysed for the stages of development of teeth according to criteria given by both Demirijian's method and Moore's method.

Demirijian's method: Seven teeth present on left side of mandible were assessed. 8 stages of development (A to H) starting from calcification of tip of cusp to apex closure were determined for each tooth (Figure 1 & 2). Then, the developmental stage of each tooth was converted into a score using table given by Demirijian separately for boys and girls. All the scores of 7 teeth were added and a total maturity score was calculated, then it was converted to dental age by referring to table given by Demirijian [5].

Moore's method: Dental development was studied in 14 stages of mineralization for developing single and multirooted teeth (Figure-3). These stages were identified and certain age was assigned to each tooth according to smith's table [6]. After this, these age scores were averaged so as to obtain dental age.

Chronological age was determined from the date of birth and recorded as years. All the relevant data were entered in proforma prepared and was then tabulated and statistically analysed.

Satistical analysis was done using SPSS (statistical package for social sciences) version 20. The values were then subjected to paired t test and pearson's correlation was calculated.

RESULTS

A total of 75 subjects in the age group of 7-10 years were included in the study. The overall mean age of the subjects was 9.73 ± 1.69 . The overall mean age of males was 10.18 ± 1.75 and of females was 9.23 ± 1.49 years. Figure 4 shows distribution of subjects based on gender of which 53% were males and 47% were females.

When Demirijian's method for both males and females was applied, it showed mean chronological age was 9.73 ± 1.69 and mean estimated age was 11.84 ± 2.2 and for Moore's method the mean chronological age was 9.73 ± 1.69 and mean estimated dental age was 8.81 ± 1.52 . Paired t test analysis for whole sample revealed statistically significant difference between means of chronological age and estimated age using Demirijian's and Moore's method. Mean difference for Demirijian's method was -2.10 which showed over estimation and for Moore's method was 0.92 which showed under estimation (Table-1).

Table-2 shows, Using Demirijian's method, a significant difference was observed in all age groups except 12, 14 years. The maximum mean difference between chronological age and dental age was 3.05 ± 1.15 years for 10 years age group which was underestimated. Table-3 shows, Using Moore's method, a significant difference between chronological age and estimated age was observed in all age groups except 10 and 12 age groups. The maximum mean difference between chronological age and dental age was 3.86 ± 0.34 years for 14 years age group which was underestimated.

On combined comparison of mean differences of estimated age from chronological age using Demirijian and Moore's method, there was no significant difference between two methods. Pearson's correlation revealed strong positive association between dental age and chronological age in Demirijian's method (0.644) compared to Moore's method (0.593).

Graph-1 represents the correlation of chronological age and estimated dental age among male and female children which shows more correlation among females for both the methods. Graph-2

represents Scatter plot between Demirjian and Moore's method which shows Demirjian's method overestimated the age and Moore's method underestimated the age.

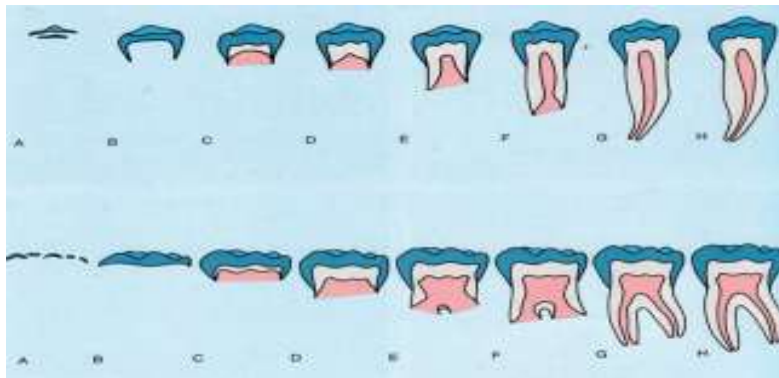


Figure-1:



Figure-2:

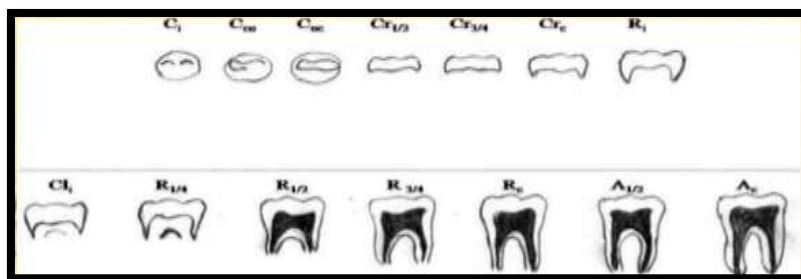


Figure-3:

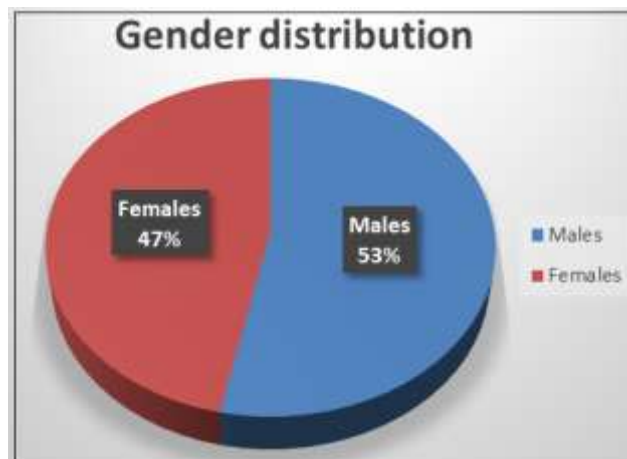


Figure-4:

Table-1:

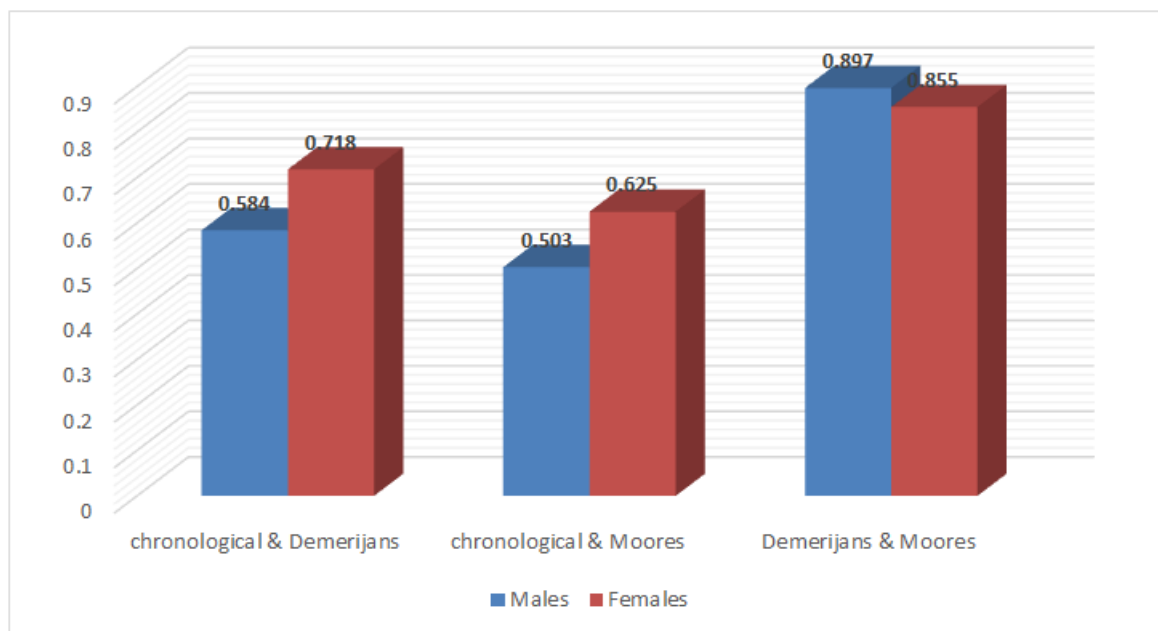
		Mean	N	Std. Deviation	Std. Error Mean	Correlation	p- Value
Pair 1	CHRONOLOGICAL AGE[YEARS]	9.73	75	1.695	.196	.644	.000
	DEMIRIJANS AGE	11.8415	75	2.26653	.26172		
Pair 2	CHRONOLOGICAL AGE[YEARS]	9.73	75	1.695	.196	593	.000
	MOORES AGE	8.8187	75	1.52818	.17646		
Pair 3	DEMIRIJANS AGE	11.8415	75	2.26653	.26172	.861	.000
	MOORES AGE	8.8187	75	1.52818	.17646		

Table-2:

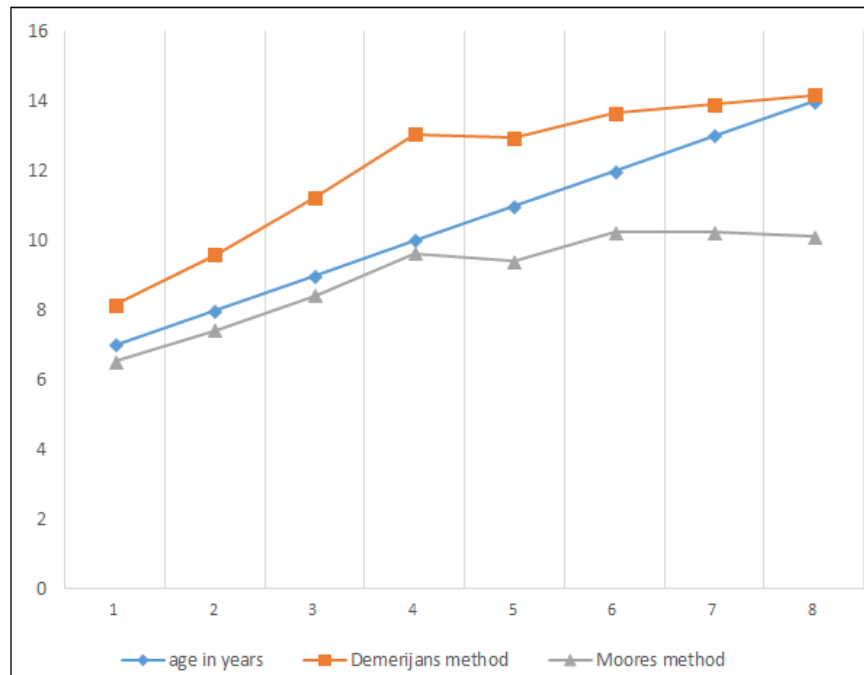
Age groups	Chronological Age		Dental Age		Mean difference	Sd	t	P value
	Mean	Sd	Mean	Sd				
7	7	0.00	8.15	1.12	-1.15	1.11	-2.52	0.05
8	8	0.00	9.58	1.03	-1.58	1.03	-3.74	0.01
9	9	0.00	11.26	2.09	-2.25	2.09	-5.6	0.001
10	10	0.00	9.63	1.44	-3.05	1.5	-9.02	0.001
11	11	0.00	12.95	1.12	-1.95	1.12	-4.6	0.004
12	12	0.00	13.65	0.78	-1.65	0.78	-3	0.205
14	14	0.00	14.16	0.56	-.16	.55	-.65	0.551

Table-3:

Age	Chronological Age		Dental Age		Mean difference	Sd	t	P value
	Mean	Sd	Mean	Sd				
7	7	0.00	6.53	0.36	0.46	0.36	3.62	0.02
8	8	0.00	7.41	0.42	0.59	0.42	3.39	0.01
9	9	0.00	8.42	1.28	0.58	1.29	2.34	0.02
10	10	0.00	9.63	1.44	0.37	1.45	1.15	0.265
11	11	0.00	9.4	1.25	1.57	1.15	3.59	0.01
12	12	0.00	10.25	0.49	1.75	.49	5	0.126
14	14	0.00	10.14	.33	3.86	.34	25.6	0.00



Graph-1:



Graph-2:

DISCUSSION

Accurate age estimation is considered to be of great importance in dental and medical practices [7]. The method of assessment of dental age by tooth mineralization is a more accurate method as tooth mineralization is a constant, ongoing process [7]. Panoramic radiographs have been used because they are easier than intraoral radiographs in the young children and also gives less amount of radiation exposure when compared to intra oral full mouth radiography [7]. Demirijian's method was originally regarded as a better method of dental age estimation [2].

The aim of an ideal age estimation method is to achieve an age that is as close as possible to chronological age. Demirijian's method is one of the simplest and most widely accepted methods to predict age and Moore's method is based on mineralization stages of teeth. The present study represents a basic investigation to compare accuracy of Demirijian and Moore's method.

Demirijian's Method

In combined population, the mean chronological age was 9.73 ± 1.69 and mean estimated age was 11.84 ± 2.26 . The present study showed significant difference between chronological age and estimated age in all age groups except 12, 14 years. The results showed Demirijian's method overestimated the ages of these groups and similar results were seen in study done earlier by Prabhakar *et al.*, in 2002, Philips VM *et al.*, in 2009, Mani et al in 2008 which showed that Demirijian's method over estimated the age [6, 8].

In the present study, Demirijian's method is more positively correlated to chronological age when

compared to that of Moore's method. These findings were in accordance with studies done earlier by Nanda *et al.*, in 2007 [7]. In our study, the correlation was found to be more in females (0.718) as compared to males (0.584). These findings were not in accordance with study done by Nanda *et al.*, in 2017 which showed, correlation was more in males (0.835) as compared to females (0.761) [7].

Moore's Method

The present study showed that Moore's method underestimated the age of these groups. Similar results were seen in study done earlier by Philips VM *et al.*, in 2009, Martinez Gutierrez VM *et al.*, in 2017 who found that Moore's method underestimated the age [8, 9].

Furthermore, when the correlation was compared for different age groups, a positive correlation was seen in younger age group i.e. 7-11 yrs as compared to older age groups, confirming low applicability of Demirijian's method to older age group. These results are in agreement with study done earlier by Nanda *et al.*, in 2017, in which they found correlation among young age groups of 9-11 yrs was more compared to older age group 12-14 yrs [7].

CONCLUSION

The Moore's method consistently underestimated and Demirijian's method overestimated the ages of study population. Of both the methods, Demirijian's method exhibited greater accuracy in dental age estimation for whole studied sample. However further research should be aimed at with a larger sample for accuracy Of Demirijian and Moore's method. It can be concluded that although various

methods of age assessment are used, the applicability can vary due to ethnic differences between populations.

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