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Age Esstimation using Dermijian's Method in a North Gujrat Population

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Keywords
Age estimation, Chronological age (CA), Dental age (DA), Demirjian's method.

Abstract
Aim & Objectives: To evaluate Demirjian's method's accuracy in calculating DA for the North Gujarat group of children and to Generate an appropriate age-predictive equation for the research group.
Material & Methods: In this cross-sectional retrospective study, 90 Orthopantograms (OPGs) from healthy children between the ages of 11 and 16 were selected from the medical records of Narsinhbhai Patel Dental College & Hospital (NPDCH) and evaluated to estimate dental ages.
Results: Distribution of study participants were based on age and gender, majority (31.1%) are from the age group of 16 years. Among the genders, the majority of female participants (58.3%) are from age groups 12 and 13 years, whereas the majority of male participants (64.3%) are from age groups 16 years. A formula for estimating dental age was created using logistic regression.
Conclusion: Current study showed a link between the chronological and dental ages of both sexes, with a statistically significant difference ($p<0.05$). Thus, it can be concluded that Demirjian's method can be applied to this population. Though studies with a larger sample size need to be conducted for better accuracy in this particular population.

1. Introduction

Tooth development is a valuable growth indicator owing to consistency, low coefficient of variation, and preservation of the environment.[1] For estimating a child's dental age (DA), imaging or eruption records is frequently utilised to analyze various stages of dental

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development.[2,3] The physical appearance of the tooth in a short period of time impacts how long the tooth remains in the mouth. It may differ depending on certain factors (such as space limitation) and elements like nutritious food and qualities that make radiographic procedures more accurate than clinical techniques for recording.[4]

Radiographs can be used to estimate tooth development using a variety of techniques.[5-7] Most of these methods compare radiographic tooth development stages to pattern charts made by large populations in certain geographic areas.[7]

The most widely used procedures are based on Demirjian's method, which was first reported in 1973 using a sample of Canadian &French children. According to Demirjian's, his technique is depended on eight developmental stages, beginning with crowns & roots, concluding with the apical closure of seven permanent molars in the mandibular jaw. A certain number of points are assigned at each level, with use of provided tables, dental maturity scores (DMS) can be converted to DA. The score for evaluating dental maturity was then calculated based on the percentage of the initial questionnaire. The level of maturity can be determined by examining participants reported chronological age (CA) & dental age (DA) before & after dental treatment.[4]

Many researchers have used this method for children in different parts of the world, and the significant difference among the groups used & population is defined as the difference between the actual population or long-term trends. Many authors usage this difference to explain the requirement for a population-specificDMS.[8–11]

Demirjian's method's applicability to races & ethnic groups has been considered by several authors, and there have been many debates concerning it.[1,2,12–16]

2. Methodology

A cross-sectional retrospective study was conducted on 90 Orthopantograms (OPGs) from healthy children among the ages of 11 and 16 were selected from the medical records of Narsinhbhai Patel Dental College & Hospital patients. The OPGs were used again in this investigation after being previously collected for diagnostic purposes. This study was done to assess Demirjian's method's accuracy in calculating DA for the North Gujarat group of children and to generate an appropriate age-predictive equation for the research group.

Inclusion criteria:

- Participants' CAs ranged in age from 10 to 16;
- Date of birth (DOB) & Date of the radiograph (DOR) were both accessible;
- Contact information for the child's parents was listed so that a data of the child's medical history could be retrieved.

Exclusion criteria:

- Severe malocclusion;
- Poor-quality OPGs
- Localised oral disease; a history of orthodontic treatment (current or past).
- Systemic illnesses or genetic ailments that affects the bone & dental development.

Study groups

OPGs were separated into 2 main groups, Group A (males) and Group B (females), based on biological sex. The major groups were further separated into six age levels (seven subgroups) at yearly intervals, with a minimum of five participants in each age level.

Data collection

OPG and personal data, such as DOB and DOR, regarding the CA of each individual were collected from the records that were already in existence. Each OPG was scanned using a grayscale 300 dpi KODAK 8000C Digital Panoramic & Cephalometric System, and the resulting images were saved as a 2440*1280-pixel JPEG image. The participants' CAs were listed as years with two decimal places after subtracting their DOBs from their DORs.[22]

Scoring of the radiographs

- One of the authors, who was unaware of each individual's CA and sex, independently and randomly assessed each OPG (using computer-produced random numbers).
- The digital OPG was observed on a display with Microsoft Office Picture Manager 2010. OPG

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Journal of Coastal Life Medicine

was magnified up to two times to identify dental development stages, when it was required.[22]

- Demirjian's approach was used to determine the DA, with exclusion of the third molar, all teeth in the mandibular left jaw were examined.[23] The DA was recorded by tables Demirjian's et al. provided.[4] The tooth on the other side was observed where a tooth on left side was lost, absence, missing or difficult to assessed.

- Before accumulating DPTs, the child's parents and caretaker(s) were requested to sign a signed consent form approving usage of the child's personal & radiological data.

Statistical testing

All collected data were arranged in Microsoft excel sheet. The statistical analysis of the data was achieved by using IBM SPSS Version 26 (Statistical Package for Social Sciences). While qualitative data is explained using the numbers (n) and percentage (%), quantitative data is presented using the range, mean, and standard deviation (SD). An independent sample t-test was applied to statistically evaluate the quantitative data & a scatter plot and regression line were used for association analysis. The probability (p) for each test was divided into the following categories:

- Non-significant if p value ≥ 0.05;
- significant if p value <0.05;
- Highly significant if p value <0.01; and
- Very highly significant if p value <0.001.

Inter-examiner and intra-examiner reliability were tested using Cohen's kappa test, with a p-value < 0.05 indicating significance.

Table 1: Age and gender distribution of the study participants

AGE (YEARS)	MALE		FEMALE		TOTAL	
	N	%	N	%	N	%
10	2	50.0	2	50.0	4	4.4
11	0	0.0	3	100.0	3	3.3
12	5	41.7	7	58.3	12	13.3
13	5	41.7	7	58.3	12	13.3
14	5	45.5	6	54.5	11	12.2
15	10	50.0	10	50.0	20	22.2
16	18	64.3	10	35.7	28	31.1
Grand Total	**45**	**50.0**	**45**	**50.0**	**90**	100.0

Table 2: Gender-wise comparison of mean dental and chronological age among study participants

AGE (YEAR)	GENDER	Mean CA age ± SD	Mean Dental age ± SD	Difference	f value
10	M	10.12±0.06	10.31±0.86	0.19	0.05*

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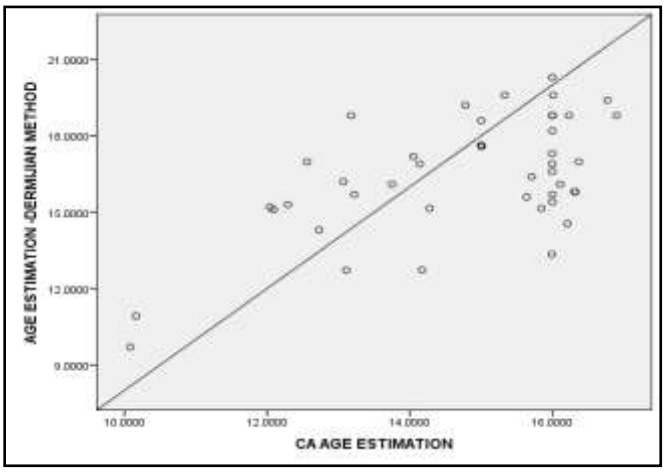
	F	10.78±0.03	12.10±1.99	1.32	0.05*
11	M	0.0	0.0	0.00	-
	F	11.73±0.26	14.92±1.28	3.19	0.05*
12	M	12.34±0.30	15.37±0.98	3.03	0.05*
	F	12.42±0.32	15.28±1.11	2.86	0.05*
13	M	13.27±0.28	15.90±2.16	2.63	0.05*
	F	13.50±0.22	16.13±1.20	2.64	0.05*
14	M	14.28±0.29	16.23±2.43	1.95	0.05*
	F	14.47±0.30	16.55±1.61	2.08	0.05*
15	M	15.35±0.41	16.91±1.82	1.55	0.05*
	F	15.22±0.31	15.93±1.46	0.71	0.05*
16	M	16.18±0.27	17.44±1.70	1.26	0.05*
	F	16.51±0.39	16.84±1.39	0.33	0.05*

*Level of significance≤0.05, * statistically significant*

Graph 1: A scatter plot-regression line for the male group that shows the variations among the assessed dental ages and the chronological ages (EDA-CA) plotted against the chronological ages (CAs)



Graph 2: A scatter plot-regression line for the female group that shows the variations among the assessed dental ages and the chronological ages (EDA-CA) plotted against the chronological ages (CAs)

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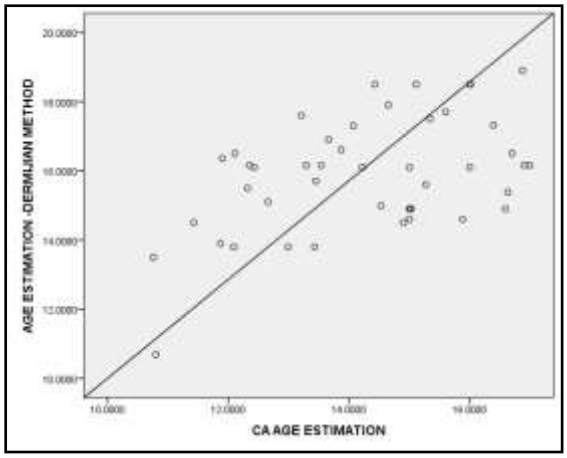

3. Result:

Out of the total 90 participants, the majority (31.1%) are from the age group of 16 years. Among the genders, the majority of female participants (58.3%) are from age groups 12 and 13 years, whereas the majority of male participants (64.3%) are from age groups 16 years. (Table 1, Graph 1). Gender wise distribution of study participants based on mean dental age & chronological age is also checked. Among all age groups, the difference between the mean dental & chronological age is of statistical significance. (P value ≤0.05) (Table 2, Graph 2)

Correlation between DMS and CA:

To investigate the association among the DMS and CA, a logistic regression analysis was done. The two measures appeared to be strongly positively correlated on the scatter plot graph, established by Spearman's correlation coefficients for males & females of 0.397 and 0.399, respectively. For both sexes, logistic regression discovered a significant association among the DMS and CA ($p < 0.001$). For males and females, the slope coefficients for the DMS were 0.035 and 0.037, respectively. The R^2 values were 0.96 and 0.97, representing that 96.1% and 97.1% of the variation in CA for males & females respectively, described by the logistic model containing only the DMS. Therefore, the suggested equation for age prediction according to data are as follows:

Equation for males:

$$CA = 1/ (1.001 + 0.96 \times 0.0344^{DMS)}$$

Equation for females:

$$CA = 1/ (1.001 + 0.97\times 0.0354^{DMS}$$

4. Discussion

In the present study, OPGs of a total of 90 participants were included, which were further divided into 7 different age groups, majority of the participants (31.1%) remained in age group of 16 years. Among the genders, the majority of female participants (58.3%) are from age groups 12 and 13 years, whereas the majority of male participants (64.3%) are from age groups 16 years.

In the present study, the gender-wise distribution of the participants based on their mean chronological & dental age discovered a statistically significant difference among all age groups with a p-value of <0.05. A similar study reported by **A. M. Moness Ali et al**[19] who noted the statistically significant difference among all the age groups in males and females. **Chandramohan et al**[20] in their study also reported a statistically significant difference, which was similar to our present study.

The logistic regression analysis used in the current study revealed a strong positive connection among dental maturity score & chronological age. 96.1% & 97.1% of the difference in the chronological age for males & females respectively, described by dental maturity score. The positive association was also noted by **T. et al.**[17] in their study, which was consistent with the current study. A very strong positive correlation among chronological age & dental age was reported by **Nelwan C. S. et al**[18] in their study, which was parallel to the current study**. Madhulika Macha et al**[21] in their study, also discovered a positive correlation.

Our findings were consistent with those of **A. M. Moness Ali et al**[19], who discovered a difference between males and females of 89.7% and 87.4%, respectively, despite their

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observation of an overestimation of 0.466 years in the male group.

In contrast to a study by **V. Jain et al**[24], which found a substantial mean underestimation of 8.4 months (0.7 years) and 7.2 months (0.6 years) for males & females respectively, the current study didn't find such underestimation. The alteration in the results of their study could be due to smaller age groups as compared to our age groups.

In the study by **Koshy and Tandon S**[25] reverse observation was noted, with an underestimate of 3.04 years for males & 2.82 years for females.

Our investigation demonstrated that, although a larger sample size is needed for more precise findings, the equation might be used to estimate dental age.

5. Conclusion:

Chronologic age only provides a general estimate of a person's level of maturity; Therefore, dental & skeletal ages have been considered as maturity-markers. The Demirjian's technique is still a useful tool for determining a child's age based on dentition.

The findings of this study showed a link among the chronological age & dental ages of both sexes, with a statistically significant difference ($p<0.05$). Thus, it can be concluded that Demirjian's method can be applied to this population. Though studies with a larger sample size need to be conducted for better accuracy in this particular population.

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