

# A Comparative Study Of Age Estimation Methods In Forensic Odontology

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## Abstract

**Aim:** The purpose of the research was to assess the Demirjian method's applicability and compare it to Indian methods for estimating dental age in participants enrolled in an Indian dentistry school.

**Materials and Methods:** The research comprised 250 participants, 130 boys, and 120 females, aged 7 to 18 years, who had orthopantomography. The subject's chronological age was reported using their birthdate. Utilizing Demirjian's and Indian formulae, dental age was calculated. The collected data was all placed into a spreadsheet and put through statistical analysis.

**Results:** The research sample's mean chronological age was  $12.39 \pm 3.32$  years, whereas the mean ages determined using Demirjian's approach and the regression formula customized for India were  $11.56 \pm 3.17$  years and  $14.20 \pm 3.24$  years, respectively. Demirjian's technique in this research underestimated dental age in men by 0.84 years and in females by 0.83 years (P 0.05). Males' dental ages were overestimated by 1.72 years and females' dental ages by 1.91 years using Indian-specific regression formulae (P < 0.05).

**Conclusion:** The published regression methods for Demirjian and India are not appropriate for the current research group. Therefore, cubic regression formulae for boys and females in the Indian population were created.

**Keywords:** Forensic science, panoramic radiography, regression analysis, tooth mineralization, tooth, Age estimation.

## INTRODUCTION:

A person's or an object's age is the amount of time they have been alive. The length of time that has passed since a person's birth or since an item was created is referred to as the subject's or thing's chronological age. When a person's true age cannot be determined, their age at death might be estimated based on the biological maturity of their body.

If a birth certificate is unavailable, age estimate in children, adolescents, and young people is crucial to determining issues like criminal responsibility, employability (child labor), adoption, illegal immigration, reaching majority status, eligibility for marriage, etc. [1-3]. Morphologic, radiologic, biochemical, and histological approaches may be used to estimate dental age [4,5]. The radiological approach has an advantage over others since it is a useful, easy-to-use, affordable, nondestructive procedure that can be used for both live and deceased people. The factors used in age assessment techniques typically include dental development stages, tooth eruption, open tooth apices, and pulp-to-tooth ratio.

With varying degrees of effectiveness, many writers have tried Demirjian's approach on their respective demographic groupings. Results, however, were less precise when population samples of various ethnic backgrounds were compared to Demirjian's criteria. On the basis of the scoring of seven mandibular teeth on the left side in accordance with an eight-tier tooth development staging scheme, Demirjian et al. developed a radiological age estimate approach [6]. An age conversion chart was used to compute the dental age from the overall maturity score, which was obtained by adding together the scores from each tooth. However, Chaillet and Demirjian made a variation that included the third molar to address the drawbacks of only analyzing a small age range of the population [7].

In single research in the Indian population, the accuracy of Acharya's regression formulae tailored to the Indian population and Demirjian's 8-teeth approach for age estimation was tested. In this context, it is important to assess how well Demirjian's approach to age estimate applies to the current population in India and to compare it to Indian formulae.

## METHODOLOGY:

On 106 archived digital orthopantomograms, mostly preoperative orthodontic radiographs and pedodontic therapy from individuals aged 7 to 18, a retrospective cross-sectional analysis was carried out.

The patients had come to our facility between 2010 and 2015. The patients, or their parents if the patients were minors, were asked for their informed permission for the research. On a typical pro forma, personal information and succinct clinical results were documented.

The following inclusion criteria were used for the selection:

1. A written age record
2. Radiographic images of acceptable quality
3. The left or right mandibular side must have the entire set of teeth.

These criteria were used to exclude people:

1. Birth defects or developmental problems
2. Any tooth misalignment or crowding that can obstruct accurate radiographic viewing.

Each person had an OPG taken utilizing orthopantomography equipment (Orthoralix) with PSP sensors (Digora) under the manufacturer's suggested standard exposure parameters. RadiAntDicom viewing software with magnification and measurement tools was used to see the final pictures, which were produced using companion software in the Digital Imaging and Communications in Medicine (DICOM) format.

The patient's chronological age at the time of the radiograph was determined using a formula in Microsoft Excel to compute the difference between the documented date of birth and the date on which the OPG was taken. For both men and women, dental ages were determined using Demirjian's and Indian formulae. program for statistical analysis (SPSS version 16.01, SPSS,inc, Chicago, 1989-2007). The threshold for significance was fixed at 0.05 ( $P < 0.05$ ). A subset of 30 panoramic radiographs was randomly selected to be examined by the same observer over the course of two weeks in order to gauge the repeatability of our findings.

## RESULTS:

200 children between the ages of 7 and 18 who went to a dental clinic for different Pedodontic and Orthodontic procedures were the subject of digital radiography research. There were 48 percent ( $n = 120$ ) girls and 52 percent ( $n = 130$ ) men among them. The age and gender distribution of the study sample are shown in Table 1.

**Table 1:** Demographic details of the study

Chronological age	Male	Female	Total
6.01-8.00	7	167	24
8.01-10.00	25	16	41
10.01-12.00	33	27	60
12.01-14.00	18	24	42
14.01-16.00	25	17	42
16.01-18.00	12	8	20
18.01-18.99	9	12	21
Total	130	120	250

Males' mean chronological ages according to Demirjian's technique and the Indian-specific regression model (Table 2). With the exception of the 14–16 year age group, significant disparities between mean chronological age and Demirjian's age were found, showing a better application of Demirjian's technique of age estimate in this age range. Except for the 10–14 and 18–18.99-year age groups, where there were similarly substantial disparities between chronological age and dental age determined using Indian methods, these age categories are where this approach is most useful.

**Table 2:** Comparison between chronological age (CA), Demirjian's age (DA) and Indian age (IA) in males

Age	Chronological age			Demirjian age			Indian age		
	Mean	Std. deviation	Sig	Mean	Std. deviation	Sig	Mean	Std. deviation	Sig
6.01-8.00	6.88	0.34	0.00	6.23	0.23	0.01	14.78	0.78	0.00
8									
8.01-10.00	8.12	0.45	0.00	8.01	1.11	0.00	12.12	0.56	0.00
8									
10.01-12.00	10.88	0.34	0.22	19.67	0.23	0.00	10.11	0.11	0.12
10									
12.01-14.00	12.23	0.67	0.45	11.21	1.23	0.02	11.67	1.56	0.34
12									
14.01-16.00	14.34	0.23	0.00	14.78	0.67	0.16	16.56	0.87	0.00
14									
16.01-18.00	16.56	0.11	0.00	15.11	0.23	0.01	16.80	0.23	0.00
16									
18.01-18.99	18.45	0.04	0.45	15.90	0.11	0.00	17.89	0.45	0.34
18									

10									
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\*Statistically significant value  $P < 0.05$ , (CA: Chronological age; DA: Demirjian's age; IA: Indian age)

Females' mean chronological ages according to Demirjian's and India-specific regression methods, respectively (Table 3). With the exception of the 10–14-year age group, all age groups showed significant discrepancies between mean chronological age and Demirjian's age, showing a wider application of Demirjian's technique of age estimate in this age range. All age groups, with the exception of those between 18 and 18.99 years old, showed similarly substantial disparities between chronological age and dental age determined using Indian formulae, showing that this approach is more useful in these age ranges.

**Table 3:** Comparison among chronological age (CA), Demirjian's age (DA) and Indian age (IA) in females

Age	Chronological age			Demirjian age			Indian age		
	Mean	Std. deviation	Sig	Mean	Std. deviation	Sig	Mean	Std. deviation	Sig
6.01-8.00	7.11	0.51	0.01	6.78	0.51	0.00	11.11	0.51	0.00
8.01-10.00	8.23	0.51	0.00	7.67	0.56	0.01	11.34	0.51	0.00
10.01-12.00	10.65	0.56	0.02	10.11	0.55	0.09	11.56	0.56	0.04
12.01-14.00	11.56	0.55	0.00	12.23	0.59	0.16	14.11	0.55	0.00
14.01-16.00	13.56	0.59	0.00	14.11	0.40	0.00	17.34	0.59	0.00
16.01-18.00	14.67	0.40	0.01	14.90	0.59	0.00	19.01	0.40	0.00
18.01-18.99	16.40	0.51	0.00	15.78	0.40	0.00	19.34	0.51	0.41

\*Statistically significant value  $P < 0.05$ , (CA: Chronological age; DA: Demirjian's age; IA: Indian age)

Demirjian's formulae provided more precise age estimates for the research group of 7 to 18-year-olds than did Indian formulations.

## DISCUSSION:

Correlating an individual's physical, skeletal, and dental maturity may be used to estimate an individual's age [1,4]. Dental development has been thoroughly and exclusively examined, such as in Demirjian's technique of age estimate, which was initially published in 1973 [6]. Dental development follows a precise timetable of creation, mineralization, and maturity. According to their developmental stage, each of the seven mandibular teeth on the left side was given a unique score using Demirjian's original technique.

Dr. Ashith B. Acharya made one such alteration in 2010. Using 547 Indians (348 female and 199 male) between the ages of 7 and 25, he evaluated Demirjian's 8teeth approach and created regression models specifically for Indians. The degree of intra-observer agreement in the current research was described as "strong" in males and "nearly perfect" in females by the kappa statistics. The research found that the intra-observer agreement was 82.26% for men and 91.94% for women in absolute terms. In their research employing Demirjian's approach, Maia NCG et al. showed a mean intra-observer and inter-observer agreement of 86.6%.

Between age groups, there were differences in the amount of mean age underestimation. In the 18–18.99 year age group, it reached a maximum of 2.73 years for men and 3.52 years for women. Boys and girls of Belgian Caucasian population showed a greater difference in dental age between the ages of 9 and 10 years when compared to chronological age [5]. Using Demirjian's approach, Rózyo Kalinowska et al. revealed substantial differences between chronological and dental ages in boys and females 13 years old and older [8]. Al. Emran discovered a statistically significant increase in dental adolescence in boys and females between the ages of 9 and 14 [9]. Bagherpour et al. discovered that older boys and girls aged 6 to 8 had the biggest mean difference or mean error (ME) between chronological age and dental age. He claimed that the Demirjian approach is acceptable for determining a patient's dental age, particularly if they fall into the 9–13 age range [10]. In Saudi Arabian females aged 11 to 12, Al-Tuwirqi et al. discovered the biggest disparity between chronological and dental ages (1.10 0.80 years,  $P < 0.001$ ) and the lowest difference (0.33 1.19 years) [11].

However, when Demirjian's technique was applied to several global demographic groupings, other research found that age estimates varied. Although Demirjian's population-specific curves were better at predicting age, there was still a lot of diversity within each community. These findings support the development of fresh population-specific curves for each location. Because polynomial functions are so much more dependable than percentile methods (age-maturity score charts), several writers favor them [12–15]. Therefore, from a forensic perspective, oral health specialists will find polynomial functions more beneficial for age estimates.

## CONCLUSION:

It is useful to test Demirjian's calculations on population-specific samples in genuine forensic situations when panoramic radiographs are available, as well as to apply them locally within defined locations, even in enormous samples. Future development of regional databases in diverse populations would result from this.

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