ISSN: 2581-5989
PubMed - National Library of Medicine - ID: 101738774

International Journal of Dental Science and Innovative Research (IJDSIR)

IJDSIR : Dental Publication Service

Available Online at:www.ijdsir.com

Volume – 8, Issue – 3, June – 2025, Page No. : 112 - 117

Assessment of Dental Age Using Demirjian's Method in Children Aged 5–18 Years in Chhattisgarh: A Panoramic Radiographic Study

[1]Dr Meenakshi Sood, Final Year MDS, RCDSR, Bhilai

[2]Dr S Fatima Khan, Professor & HOD, Department of OMDR, RCDSR, Bhilai

[3]Dr. Deeplaxmi Dewangan, Professor, Department of OMDR, RCDSR, Bhilai

[4]Dr. Aastha Shrivastav, Senior lecturer, Department of OMDR, RCDSR, Bhilai

[5]Dr. Monalisha Das, Final Year MDS, RCDSR, Bhilai

[6]Dr. Tirno Datta, Final Year MDS, RCDSR, Bhilai

Corresponding Author: Dr Meenakshi Sood, Final Year MDS, RCDSR, Bhilai

Citation of this Article: Dr Meenakshi Sood, Dr S Fatima Khan, Dr. Deeplaxmi Dewangan, Dr. Aastha Shrivastav, Dr. Monalisha Das, Dr. Tirno Datta, "Assessment of Dental Age Using Demirjian's Method in Children Aged 5–18 Years in Chhattisgarh: A Panoramic Radiographic Study", IJDSIR- June – 2025, Volume – 8, Issue – 3, P. No. 112 – 117.

Type of Publication: Original Research Article

Conflicts of Interest: Nil

Abstract

Background: Dental age estimation is an essential tool in pediatric dentistry, forensic odontology, and legal proceedings. Demirjian's method, although widely accepted, exhibits varying accuracy across populations. This study aimed to evaluate its applicability in children from Chhattisgarh, India.

Aim: To assess the dental age of children aged 5–18 years in Chhattisgarh using Demirjian's method and compare it with chronological age to determine its accuracy and applicability.

Methods: This retrospective cross-sectional study was conducted on 300 panoramic radiographs collected from children aged 5–18 years at a dental college in Bhilai, Chhattisgarh. Dental age was estimated using Demirjian's 8-stage method on seven left mandibular teeth. Estimated dental age (EDA) was compared with chronological age (CA) using paired t-tests and regression analysis. Cohen's kappa was applied for intra- and inter-examiner reliability.

Results: Demirjian's method significantly overestimated dental age compared to chronological age in both Genders (mean overestimation: 0.58 years). The correlation between DA and CA was strong ($r = 0.83$, $p < 0.001$). The highest accuracy was noted in the 9–14 years group. Reliability tests showed excellent agreement ($\kappa > 0.8$).

Conclusion: Although Demirjian's method is reproducible, it consistently overestimates dental age in Chhattisgarh children. Region-specific standards or

correction factors are recommended for improved forensic accuracy.

Keywords: Demirjian's method, dental age estimation, panoramic radiography, forensic odontology, Chhattisgarh population.

Introduction

Age estimation is vital in multiple disciplines including forensic medicine, orthodontics, and legal systems. Dental maturity, due to its genetic control and resistance to environmental factors, serves as a reliable indicator of biological age in children and adolescents. Demirjian et al. developed an 8-stage method in 1973 based on French-Canadian data, which remains one of the most cited techniques worldwide.

Despite its global use, the method has shown significant population-based variations. Studies from India have documented systematic overestimation of age, indicating a need for regional calibration. No such data exist for the central Indian state of Chhattisgarh, which prompted this study.

Materials and Methods

Study Design and Population

This retrospective cross-sectional study included 300 panoramic radiographs of children aged 5–18 years collected at Rungta College of Dental Sciences and Research, Bhilai. Ethical approval was obtained from the Institutional Ethics Committee.

Inclusion Criteria

- Age between 5 and 18 years
- High-quality digital panoramic radiographs
- Known date of birth and date of radiograph
- Absence of congenital anomalies, orthodontic treatment, or tooth extraction

Exclusion Criteria

- Poor quality or incomplete radiographs
- Dental or skeletal abnormalities
- Systemic conditions affecting development

Dental Age Estimation

The Demirjian method was applied by scoring the calcification stages (A–H) of seven left mandibular permanent teeth. The cumulative maturity score was converted to dental age using sex-specific tables.

Statistical Analysis

Data were analyzed using SPSS v20. Paired t-tests compared EDA with CA. Pearson's correlation and linear regression evaluated association strength. Cohen's kappa tested inter- and intra-examiner reliability.

Results

Demographics

The sample included 157 males and 143 females, evenly distributed across the 5–18-year age range.

Dental vs. Chronological Age

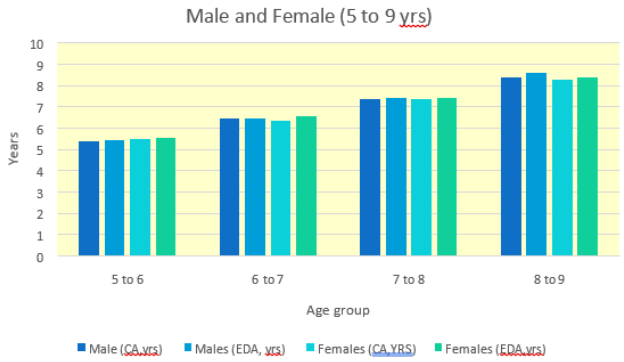
Demirjian's method significantly overestimated dental age in both sexes ($p < 0.05$). Males showed greater overestimation (mean = 0.65 years) compared to females (mean = 0.51 years).

Age Groups	Number	Percentage
5 to 7	44	14.67
7 to 9	43	14.34
9 to 11	44	14.67
11 to 13	42	14.00
13 to 15	44	14.67
15 to 17	43	14.34
17 to 18	40	13.34

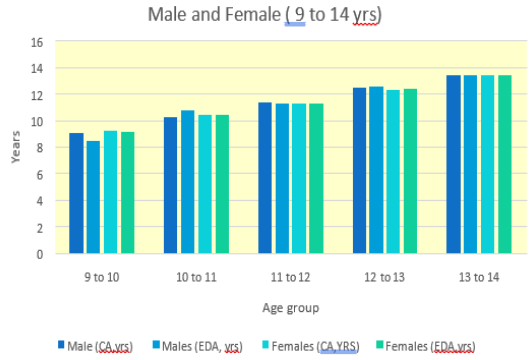
Table 1: Distribution of study participants according to age

Age groups (years)	Male n (%)	Female n (%)
5 to 7	22 (7.33)	22 (7.33)
7 to 9	22 (7.33)	21 (7.00)
9 to 11	22 (7.33)	22 (7.33)
11 to 13	21 (7.00)	21 (7.00)
13 to 15	22 (7.33)	22 (7.33)
15 to 17	21 (7.00)	22 (7.33)
17 to 18	20 (6.67)	20 (6.67)

Table 2: Distribution of study participants according to gender in each age group



Graph 1: Comparisons between the estimated dental ages (EDA) and chronological ages (CA) among the studied male and female children (5-9 years) using an independent samples t-test



Graph 2: Comparisons between the estimated dental ages (EDA) and chronological ages (CA) among the studied male and female children (9-14) years) using an independent samples t-test

Correlation Analysis

Strong positive correlation was observed between CA and DA ($r = 0.83$, $p < 0.001$), especially within the 9–14 years age group.

Reliability

Cohen's kappa coefficient indicated excellent intra- ($\kappa = 0.87$) and inter-observer ($\kappa = 0.84$) agreement.

Discussion

The present study was undertaken to evaluate the applicability of Demirjian's method for dental age estimation among children aged 5–18 years in Chhattisgarh, Central India. Our findings reveal that while the method demonstrates a strong correlation with chronological age ($r = 0.83$), it consistently overestimates age, particularly in younger age groups and more significantly in males than females. This outcome aligns with a large body of literature suggesting that Demirjian's standards, developed on French-Canadian children in 1973, may not be universally applicable without regional adjustments.

Comparison with Other Studies

Several Indian studies have previously reported similar patterns of overestimation when applying Demirjian's method. Koshy and Tandon (1998) observed an overestimation of 3.04 years in males and 2.82 years in females in a South Indian cohort, while Hegde and Sood (2002) reported a smaller overestimation of 0.14 years in boys and 0.04 years in girls among Belgaum children. These discrepancies underscore regional, ethnic, and environmental influences on dental maturation timelines within the Indian subcontinent.

International comparisons further substantiate this trend. Studies from China, Turkey, and Brazil consistently report that Demirjian's method overestimates dental age, although the magnitude of overestimation varies across populations. For instance, Jayaraman et al. (2011) found

a mean overestimation of 0.62 years in boys and 0.36 years in girls among Southern Chinese children. Similar findings were noted by Willems et al. (2001) in a Belgian cohort, prompting them to propose adjusted scoring tables tailored to their population.

Possible Explanations for Overestimation

The systematic overestimation observed in our study can be attributed to multiple factors:

1. **Ethnic and Genetic Differences:** Dental development is known to be influenced by ethnicity. Since Demirjian's sample comprised French-Canadian children, the maturity scores may not align with the dental growth patterns seen in Indian children.
2. **Environmental Influences:** Factors such as diet, climate, and socioeconomic status may indirectly impact dental development through their effects on overall health and growth.
3. **Nutritional Status:** Children from different regions may exhibit varied rates of dental maturation due to differences in nutritional intake, which can impact both skeletal and dental development, albeit to a lesser extent in teeth.
4. **Secular Trends:** There has been a global trend toward earlier maturation in children over the past few decades. These secular changes could mean that populations assessed in 1973 (Demirjian's sample) may not reflect current growth patterns even within the same region.
5. **Methodological Biases:** The method's reliance on radiographic stages of tooth calcification introduces observer bias. However, in this study, high intra- and inter-observer agreement (Cohen's kappa > 0.80) mitigates this limitation, ensuring methodological reliability.

Clinical and Forensic Implications

In forensic odontology and legal medicine, particularly in India, accurate age estimation is critical for cases involving juveniles, criminal responsibility, and eligibility for government welfare schemes. The age group of 5–18 years is especially significant due to its overlap with age-based legal thresholds (e.g., criminal responsibility at age 7, majority at age 18).

Given the overestimation tendency, uncritical application of Demirjian's method in Indian legal settings could potentially misclassify minors as adults, leading to legal and ethical issues. It is therefore imperative that population-specific calibration or alternative methods—such as Willems or Cameriere's method—be explored and validated.

Scope for Population-Specific Modifications

Our results highlight the need for developing regional maturity score tables or regression models based on data from local populations. This approach has proven successful in countries like Belgium and Saudi Arabia, where modified Demirjian scoring systems have yielded improved accuracy. Implementing such standards in Chhattisgarh would not only enhance the accuracy of forensic evaluations but also serve as a reference for clinical pediatric dentistry and orthodontics.

Limitations

While the study offers valuable insights, certain limitations must be acknowledged:

- The cross-sectional nature limits the ability to observe individual maturation patterns over time.
- The sample is restricted to a single region and may not reflect the full diversity of Chhattisgarh's population.
- Socioeconomic and nutritional data were not included, which could have provided additional context for developmental variation.

Future Directions

To build upon this work, future research should:

- Include larger, multi-regional samples within Chhattisgarh for broader applicability.
- Compare the Demirjian method with alternative techniques like Willems and Cameriere methods.
- Integrate nutritional, anthropometric, and socioeconomic parameters to understand their influence on dental development.
- Explore machine learning approaches for age estimation using AI-assisted radiographic interpretation.

Conclusion

Demirjian's method provides a reliable and reproducible approach for estimating dental age but requires adjustment when applied to Chhattisgarh children. The creation of regional dental maturity standards is strongly recommended to enhance forensic and clinical age estimations in India. Furthermore, future studies should be conducted using larger, more diverse samples across different regions to develop more representative and accurate age estimation models. These studies would also benefit from incorporating longitudinal designs and additional biological markers to refine existing methods and improve their applicability in medico-legal and clinical contexts.

Several studies underscore these conclusions. Jayaraman et al. (2013) emphasized the limitations of applying Demirjian's method universally and suggested meta-analytical evidence for population-specific models. Chaillet and Demirjian (2004) proposed international adjustments for different ethnicities. Willems et al. (2001) developed a modified scoring system for a Belgian population that improved accuracy. Similarly, Rai et al. (2010) and Gupta et al. (2017) highlighted significant regional variations in dental development in Indian children, advocating for population-specific studies to better calibrate age estimation techniques.

References

1. Demirjian A, Goldstein H, Tanner JM. A new system of dental age assessment. Hum Biol. 1973;45(2):211–27.
2. Koshy S, Tandon S. Dental age assessment: the applicability of Demirjian's method in South Indian children. Forensic Sci Int. 1998;94(1-2):73–85.
3. Hegde RJ, Sood PB. Dental age assessment: the applicability of Demirjian's method in Indian children. J Forensic Dent Sci. 2002;2(1):25–29.
4. Jayaraman J, Wong HM, King NM, Roberts GJ. The French-Canadian data set of Demirjian for dental age estimation: a systematic review and meta-analysis. J Forensic Leg Med. 2013;20(5):373–81.
5. Willems G, Van Olmen A, Spiessens B, Carels C. Dental age estimation in Belgian children: Demirjian's technique revisited. J Forensic Sci. 2001;46(4):893–5.
6. Chaillet N, Demirjian A. Dental maturity in South France: a comparison between Demirjian and Chaillet methods. J Forensic Sci. 2004;49(5):1059–66.
7. Rai B, Anand SC. Age estimation in children from dental radiograph: a review. Indian J Dent Res. 2010;21(1):1–5.
8. Gupta R, Reddy NR, Reddy BN. Assessment of dental age in 6 to 14-year-old children using Demirjian's method: a study in Southern India. J Indian Soc Pedod Prev Dent. 2017;35(2):150–154.
9. Grover S, Marya CM, Avinash J, Pruthi N. Estimation of dental age and its comparison with chronological age: accuracy of two radiographic

methods. Med Sci Law. 2012;52(1):32-35. doi:10.1258/msl.2011.011021

10. Malik P, Saha R, Agarwal A. Applicability of Demirjian's method of age assessment in a North Indian female population. Eur J Paediatr Dent. 2012;13(2):133-135.