

## Dental age assessment in 8–16-year-old girls in a tertiary care hospital in Cochin – A comparative study

Anaswara Mahima Sathish, ArunMamachan Xavier\*, R. Balagopal Varma, Parvathy Kumaran, Medhini M. Menon

### ABSTRACT

**Introduction:** Age determination plays a great role in forensic medicine, pediatric endocrinology, and pedodontic treatment planning. It helps in the management of different types of malocclusion in relation to maxillofacial growth. The aim of the study was to determine the dental developmental stages in female population and to test the applicability of Demirjian's and Nolla's criteria for maturity scoring in dental age assessment. **Materials and Methods:** Orthopantomographs of 200 females of 8–16 years were taken and the dental age was calculated using the Demirjian's and Nolla's dental age estimation method. Chronological age was also recorded and correlated to the dental ages obtained. **Results:** A strong correlation was found between chronological and dental ages ( $P < 0.005$ ). The intraclass correlation coefficient between the two methods showed excellent agreement between the two ( $P < 0.005$ ). **Conclusion:** A positive high degree correlation noticed between chronological age, dental age, and both age estimation methods may thus be applicable to the female population in Cochin.

**KEY WORDS:** Demirjian, Dental age, Female population, Nolla

### INTRODUCTION

Age is one of the essential factors, which plays an important role in every aspect of life.<sup>[1]</sup> The anticipated developmental sequence that human dentition follows to reach complete dental development can be utilized in age determination.<sup>[2]</sup> The relationship among the chronological and dental age is important in diagnosis and treatment. Variations of dental and known chronological age indicate changes in the standard growth pattern.<sup>[3]</sup> The assessment of age is useful in forensic odontology and in treatments plans of orthodontic and pedodontic patients. It has been pointed out by various investigators that the development of the dentition has a close correlation to some other measures of growth. Klein and Cody suggested that the eruption of the teeth may differ greatly in the time of appearance in the mouth of different children, the majority of the children exhibit some pattern in the sequence of eruption.<sup>[4]</sup>

Dental and bone age have been assessed to determine to what extent they are correlated for diagnostic purposes. Considering that states of dental mineralization are much less affected by environmental and hormonal variations than states of bone mineralization, dental development provides more reliable indications of chronological age than bone development.<sup>[5]</sup>

Various methods have been proposed to calculate chronological age through dental maturity and mineralization. The aim of the present work was to determine the dental developmental stages in female population and to test the applicability of Demirjian's and Nolla's criteria for maturity scoring in dental age assessment.

### MATERIALS AND METHODS

A total of 200 female children of 8–16 years were selected in this study who visited the outpatient department of pediatric dentistry of this institute having no history of any known systemic diseases. The children selected were healthy, without any growth disorders and with all the mandibular permanent teeth either erupted or unerupted.

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Department of Pedodontics and Preventive Dentistry, Amrita School of Dentistry, Kochi, Kerala, India

\*Corresponding author: Dr. ArunMamachan Xavier, Reader, Department of Pedodontics and Preventive Dentistry, Amrita School of Dentistry, Kochi, Kerala, India. E-mail: [arunmamachan@yahoo.co.in](mailto:arunmamachan@yahoo.co.in)

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Children free from any developmental endocrine or nutritional disorders and any past prolonged illness were included in the study. Radiographs that were unclear or that showed hypodontia, gross pathology and previous orthodontic treatment were excluded from the study. All radiographic assessment of tooth formation was done by a single examiner. The ethics committee approval was obtained before the study and informed consent was obtained from all patients/guardians to include the orthopantomographs in this database and their subsequent use for research purposes.

### Calculation Of Age Estimation

#### Demirjian's method

Tooth formation is divided into eight stages and criteria for the stages are given for each tooth separately. As per this method, the development of the seven permanent left mandibular teeth was determined. Each stage of the seven teeth was given a score according to a statistical model, which has also been used for the assessment of skeletal maturity. The sum of the score for the seven teeth was then transferred to a dental age<sup>[6]</sup> using the reference value.

#### Nolla's method

Seven teeth present on the left side of the mandible were taken into consideration. In this method, dental development is divided into 10 stages through each of which every tooth passed. The stages were determined for all the teeth. Each stage also has a numerical score. The scores are totaled to give a combined "sum of stages" score, that is, then divided by the number of teeth taken into consideration to give the dental age.<sup>[3]</sup>

#### Chronological age

The chronological age was determined from the date of birth as per patient records entered as years and months.

All the relevant data were entered, tabulated, and statistically analyzed to draw conclusions.

#### Statistical Analysis

Statistical analysis was done using IBM SPSS version 20.0 (SPSS Inc., Chicago, USA). For all the continuous variables, the results were either given in mean  $\pm$  SD and for categorical variables as percentage. Pearson's correlation was applied to obtain the correlation among chronological age and dental age. The Student's paired *t*-test was applied to compare the mean age difference of chronological age and dental age.  $P < 0.005$  was considered statistically significant.

## RESULTS

In our study, of 200 females, 63 showed dental age underestimation and 84 showed overestimation by a

few months and a year, of which the highest was by 2 years. 53 females showed exact correlation with estimated age when calculated using Demirjian's method.

In the Nolla's age estimation method, of 200 females, 78 showed underestimation and 63 showed overestimation of dental ages. However, 59 showed an exact correlation with estimated age when calculated.

Chronological age shows a positive high degree correlation between the Demirjian's age ( $r = 0.843$ ) and dental age ( $r = 0.736$ ) and both the relationship shows statistically significant ( $P < 0.001$ ) [Table 1].

The mean chronological age was  $11.02 \pm 2.24$  and the mean Demirjian's age was  $11.24 \pm 2.43$ . The mean comparison between chronological age with Demirjian's age showed non-significance ( $P = 0.189$ ) [Graph 1].

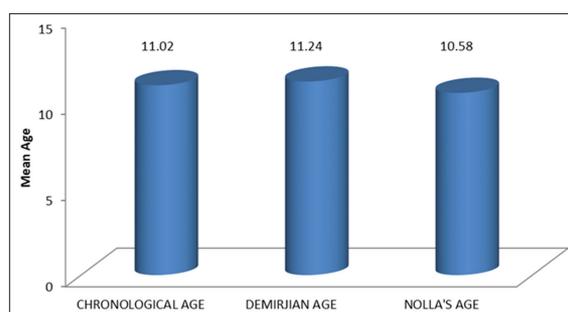
The mean chronological age was  $11.02 \pm 2.24$  and the mean Nolla's age was  $10.58 \pm 2.65$ . The mean comparison between chronological age with Nolla's age also showed non-significance ( $P = 0.070$ ) [Graph 1].

The intraclass correlation coefficient between the two methods showed excellent agreement between the two. Statistical analysis showed that there was no significant difference between chronological age and the ages obtained by Demirjian's method and Nolla's method ( $P > 0.05$ ).

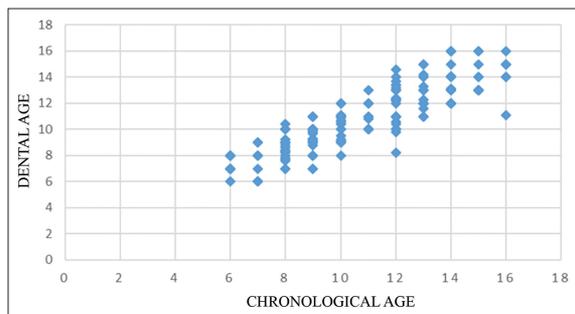
After plotting the scattered diagram of both the dental age estimation methods [Graphs 2 and 3] with chronological age, Demirjian's and Nolla's age estimation method did not show a specific pattern in variation or discrepancy in determining the age. It

**Table 1: Correlation of chronological age and dental ages**

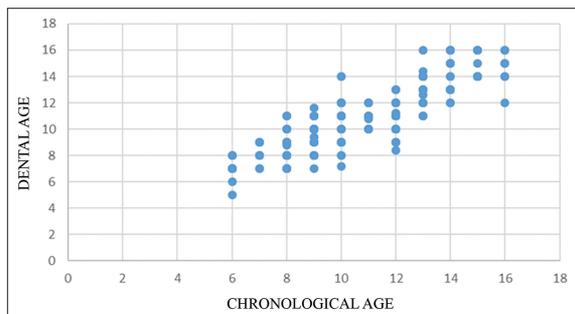
Chronological age	Pearson's correlation (r)	P value
Demirjian age	0.843	0.001*
Nolla's age	0.736	0.001*



**Graph 1: Comparison of chronological age between dental ages**



**Graph 2:** Scattered diagram of Demirjian's dental age estimation



**Graph 3:** Scattered diagram of Nolla's dental age estimation

neither confirmed that either of the method specifically overestimates nor underestimates age.

## DISCUSSION

Human growth shows considerable variation in the chronologic ages at which individual children reach similar developmental events. Chronologic age alone is not sufficient for assessing the stage of the development of a growing child. Accurate information is provided by developmental stages such as skeletal maturation, secondary sexual characters, and maturation of different tissue systems.<sup>[7]</sup> Tooth development is also a useful measure of maturity since it represents a series of recognizable changes that occur in the same sequence from an initial event to a constant end point.<sup>[3]</sup> The anticipated developmental sequence that human dentition follows to reach complete dental development can be utilized in age determination.

The present study was undertaken to test the applicability of Demirjian's method and Nolla's method in female children undergoing treatment in a tertiary care hospital. Dental age assessment was done by both the estimation methods and the interrelationship between dental age and chronological age was evaluated. Chronological age and Demirjian's dental age showed a significant positive correlation ( $P < 0.001$ ). This is in agreement and support the results of with Cheraskin and Ringdorf,<sup>[8]</sup> Malagola *et al.*,<sup>[9]</sup> Jaeger,<sup>[10]</sup> and Carvalho and Decarvalho.<sup>[11]</sup>

Evaluation of tooth maturation using the method of Demirjian and Goldstein is thought to be of great value. In this study, the mean chronological age was  $11.02 \pm 2.24$  years and the mean estimated age using Demirjian's method was  $11.24 \pm 2.43$  years ( $P > 0.05$ ). The observations of the present study are in agreement with Rai *et al.*, using Demirjian's method, where the discrepancy was reduced for all the age groups and both sexes.<sup>[12]</sup> However, Holtgrave *et al.* found a high accuracy in Nolla's method, showing no significant difference between dental age and chronological age in girls. This method had shown to overestimate age prediction in boys.<sup>[13]</sup>

According to Fantasia *et al.*, for girls, predictivity of Nolla's method was evident till late childhood, whereas the Demirjian's method was less effective and was able to predict ages from 10 to 18 years.<sup>[14]</sup>

As puberty is achieved early in females than males due to parapubertal fluctuations, gender discrimination may also produce changes along with other factors of age determination.<sup>[15]</sup> According to Sachan *et al.*, females were more advanced in dental maturation than males. Chronological age showed an inconsistent correlation with dental age.<sup>[7]</sup>

The present study enrolled only females to avoid gender variations. The results in the present study also show that there was not much statistical difference in age estimation in the 8–16-year-old female children. Although assessed methods showed applicability for age estimation for different purposes, it is necessary to adapt them to the studied populations since the populations might exhibit different ethnic characteristics and environmental factors. Although both the methods were significantly accurate at estimating age, further studies are necessary in a larger sample size to derive more appropriate conclusions.

## CONCLUSION

The present study revealed overestimation of age with the Demirjian's method and underestimation of ages with the Nolla's method, though both the methods are statistically insignificant. The study concluded that both the age estimation methods may be applicable to the female population in Ernakulam district.

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