MANDIBULAR THIRD MOLAR DEVELOPMENT STAGING TO CHRONOLOGIC AGE AND SEX IN NORTH INDIAN CHILDREN AND YOUNG ADULTS

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ABSTRACT

Age estimation is not only important for clinical but also for medico-legal purposes. The present study is an attempt to estimate the chronologic age based on the stages of third molar development following the eight stages (A–H) method of Demirjian *et al*[8] and to compare third-molar development by sex and age. We examined 250 orthopantomograms of young north Indian subjects of known chronologic age (range, 7-26 years). Statistical analysis was performed using the Mann-Whitney U-test and the Wilcoxon test between sex and age. Regression analysis was performed to obtain BR regression formulae for dental age calculation with the chronologic age. Statistically significant differences in mandibular third-molar development between males and females were revealed regarding the calcification stages D and G. The results further indicated that third-molar formation was attained earlier in females than in males. Statistical analysis showed a strong correlation between age and third-molar development for both the sexes.

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Keywords: forensic odontology; mandibular third molar; chronological age; JB regression equation; North Indian; age estimation

INTRODUCTION

Teeth represent useful material for age estimation. In childhood, the observation of the dentition status results in highly accurate age assessment. However, this accuracy decreases simultaneously with the completion of a person's dental development.[1] The development of each individual can be affected by genetic, nutritional, climatic, hormonal and environmental factors.[2,3] It has been reported that dental mineralization is less affected by external factors when compared to bone mineralization.[4] In addition to its clinical importance, the radiographic diagnosis may have possible medico-legal implications, because it is one of the parameters proposed to determine the age of undocumented youths.[5,6] Numerous studies have been developed to estimate dental age.[3,7-9] Although this variability may mostly relate to population differences, other factors, such as sex, age, and degree of dental maturation of the individual in different samples, may also play a major role. In the past, several studies have been undertaken in different populations to explore the usefulness of the developing dentitions as a reliable age indicator.[10-31] These studies show that dental development varies slightly between different populations, making population-specific studies necessary. Recently, for different ethnic groups, numerous reports have been published on the evaluation of third molar development, and further studies were warranted for Indian populations.[11-27]

We hypothesize that North Indian children may have a different rhythm of third molar maturation than that of children in the countries from which the standards were derived. Hence, it was considered worthwhile to determine third molar developmental stages in a sample of young Indian people to assess chronologic age estimates based on developmental stages,

to compare third molar development by sex and age, and to compare these data with the results of other studies.

MATERIALS AND METHODS

We examined 250 orthopantomograms of the middle class patients (124 males and 126 females between 7 to 26 years of age) taken from the Bhagwan Dental Clinic, Jind, Haryana, India and Jain Diagnostic Centre, New Delhi, India. The criteria for inclusion in the sample were the availability in their clinical records of an orthopantomography of adequate quality, and no history of medical or surgical disease that could affect the presence and development of permanent teeth. At the time of radiographic examination, the chronological age of each child was calculated on the basis of the reported date of birth. Examination and classification covered the development phase of the third right mandibular molar and, when not present, the contralateral molar was considered. Tooth calcification was rated according to the method described by Demirjian *et al,*[8] assigned to the third-molar tooth. Descriptive statistics were obtained by calculating the means, standard deviations, and range of the chronologic ages for the eight stages of dental development. Statistical analyses were performed using the Mann-Whitney U-test and Wilcoxon test between sex and age. Regression analysis was performed to obtain regression formulae for dental age calculation with chronologic age as the independent variable and third molar developmental stages as dependent variables. Data were tabulated and submitted for statistical analysis using SPSS version 11.0 and Student 't' test was performed. To test the reproducibility of the assessments of dental development stage, two investigators reevaluated randomly selected panoramic radiographs from 10% of the same male and female subjects 8 weeks after the first evaluation. Inter- and intra-observer agreements were determined using the Wilcoxon matched-pairs signed-rank test.

RESULTS

Inter-observer agreement was 96% while intra-observer agreement was 97%. Repeated scorings of a sub-sample of 25 radiographs indicated no significant intra- or inter-observer differences. The third molar formation process was observed in both the sexes, and the mean ages and standard deviations for the Demirjian stages are described in Table 1. Statistically significant differences ($p < 0.05$) were observed in third molar development between males and females regarding the calcification stage D and stage G. These differences indicated that third molar genesis attained the Demirjian formation stages earlier in females than in males. The linear regression coefficients were provided to assess the correlation of third molar development and chronologic age. Statistical analysis showed a strong correlation between age and third-molar development for females ($r = 0.63$) and for females ($r = 0.62$). Regression formula for whole sample and males and females separately, based on the number of third molar teeth present, were calculated. The following regression equations were derived:

Whole sample: Age = 9.34 + 1.75 stage
Males: Age = 10.34 + 1.68 stage
Females: Age = 9.12 + 1.96 stage

DISCUSSION

Age estimation for medico-legal (age at death, criminal cases *etc*) and clinical purposes represents a fundamental problem, and various methods have been established for age determination. It has been shown that dental development relates more closely to chronological age than skeletal, somatic or sexual maturity indicators.[2] Tooth formation has been more widely used than tooth eruption for assessing dental maturation, because it is a continuous and progressive process that can be followed radiographically, and most teeth can be evaluated at each examination. It has been reported that development of each individual can be affected by genetic, racial, nutritional, climatic, hormonal and environmental factors.[2,6,7] Demirjian *et al*[8] proposed a classification distinguishing four stages of crown development (stages A–D)

Table 1: *Means (in years) and standard deviations (SD) of chronological age using the methods proposed by Demirjian et al[8] for North Indian genders.*

Stages of third molar	Female	Male	Both genders	p value
A (15 F,16M)	11.51+ 5.34	11.93+ 4.93	11.76+ 6.47	NS
B (16F,15M)	11.70+ 4.62	11.51+ 4.63	11.62+ 4.24	NS
C (15F,15M)	12.61+ 6.39	13.01+ 4.77	12.85+ 4.36	NS
D (17F,16M)	13.00+ 4.33	14.79+ 5.62	13.51+ 5.44	S
E (17F,16M)	14.54+ 3.76	15.00+ 5.73	14.53+ 4.64	NS
F (16F,16M)	17.59+ 4.63	17.51+ 4.38	17.54+ 4.32	NS
G (15F,15M)	19.67+ 4.67	21.57+ 4.46	20.34+ 4.54	S
H (15F,15M)	23.34+ 4.33	23.58+ 4.45	23.54+ 5.62	NS

NS; P < 0 .05.

and four stages of root development (stages E–H). The system avoids any numeric identification of stages so as not to suggest that the different stages represent processes of the same duration. The stages observed by these authors were defined by changes of shape, independent of speculative estimations of length. Dhanjal *et al* investigated the reproducibility of different radiographic stage assessment of third molars and concluded that the method of stage assessment of third molars developed by Demirjian *et al*[28] performed best not only for intra- and inter-examiner agreement, but also for the correlation between estimated and true age. It has been reported that mandibular third molars start to calcify between the ages of 7 and 9 years in Turkish Children and adolescents.[29] Hence, in the present study the minimum age limit was selected as 7 years for third-molar crypt formation. This was possible because the crypt may be visible as early as 7 years in the mandibular arch. Because previous studies that investigated sex differences showed rather diverse results, we compared the mean ages of each stage for male and female patients with a Turkish population.

Statistically significant differences in third molar development between male and female subjects were observed as in the present study, as in Turkish a population regarding calcification stages D and G. These results are however, contrary to two recent studies.[30,31] This may be due to different genetic, geographical and environmental factors. Our results indicate that females attained Demirjian formation stages 6 to 21 months earlier than males. This observation was contrary to previous studies,[21-30] which report that the mean age at some of the development stages was lower for males than for females in different population. Third-molar development among the north Indian population examined was found to occur at an advanced age relative to other populations.[21-30] The development staging of the third molar has a linear relation to the age in both the sexes and statistical analysis shows a stronger correlation for males than for females of North Indians. Hence, the proposed regression equations can be used for age estimation from mandibular third molar teeth.

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