Original Article

RADIOGRAPHIC EVALUATION OF DEVELOPMENTAL STATUS OF 3RD MOLARS IN AN INDIAN POPULATION

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ABSTRACT

Introduction: Third molars show high degree of variance with respect to morphological and radiological characteristics in individuals and within each individual in different quadrants. The study evaluated the developmental status of the 3rd molars in both jaws based on Demirjian's classification. **Materials and methods:** The study included 200 orthopantomographic records of patients in the age group 10-25 who reported to the department of Orthodontics, Vydehi Institute of Dental Sciences, Bangalore. These records were evaluated by a single researcher. **Results:** There was no relation between gender and missing third molars. Statistically significant difference was found between males and females in stages C , D, E , G and H in the first quadrant, stages C,D F and H. In the 2nd quadrant and stages C, E, F and H in the third and fourth quadrants. Maximum incidence of calcification was found in stage D in all the 4 quadrants in the age group 10- 14 years, stage C was predominant in the age group of 15- 19 years in 1st, 2nd and 3rd quadrant and stage G was predominant in the 4th quadrant. In the age group 20 and above, stage H had maximum incidence in all quadrants. Root completion was seen in stage G in the age group 15- 19 in both jaws. **Conclusion:** Demirjian's classification can be used as a useful tool for estimation of age of the patient based on radiographic evidence of calcification of the 3rd molars in the maxilla and the mandible.

KEYWORDS: 3rd molar; eruption; Demirjian; mineralization; calcification

INTRODUCTION

A third molar, often called the "wisdom tooth", usually appears in the oral cavity between the ages of 17 & 25 years.[1] It is the last tooth to erupt in the oral cavity. However, the initial calcification of this tooth begins at about 7-10 years of age. Third molars show high degree of variance with respect to morphological and radiological characteristics in individuals and within each individual in different quadrants.[2] While clinical estimation of the eruption status is routinely practiced, radiographic changes in mineralization of the erupting 3rd molar is an important tool in age estimation and is less influenced by external influential factors[3,4] (Fig. 1). In 1973, Demirjian A came out with a classification of the developing 3rd molar based on the stage of mineralisation. This classification is today used frequently as a parameter for establishing the maturity levels of the 3rd molar.[5] Estimation of age with other growth indicators such as diaphysis-epiphysis fusion, hand-wrist examination, cervical vertebrae assessment, amino acid racemisation, sternoclavicular bones, changes in the pubic symphysis, fusion of cranial sutures or changes in secondary sex characteristics have been used for unreported or undocumented cases but it is usually inconclusive.[6] Etimating the age of a child in their teens in dealing with legal matters or in juvenile crimes is a big challenge.[7].Teeth are one of the commonly used tools for age estimation. The status of the 3rd molar has been an integral part of forensic odontology in establishing age.[8] In adjunct to these methods, using teeth to determine unreported cases could help us to obtain proper conclusions. This observational study was undertaken to evaluate the

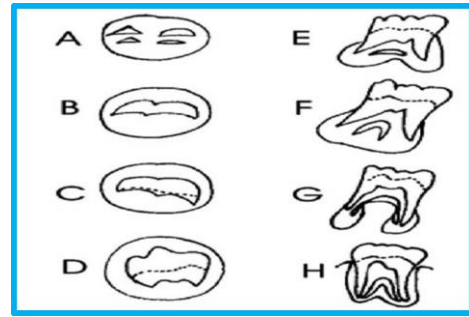Fig. 1: The initial developmental stages of the third molars

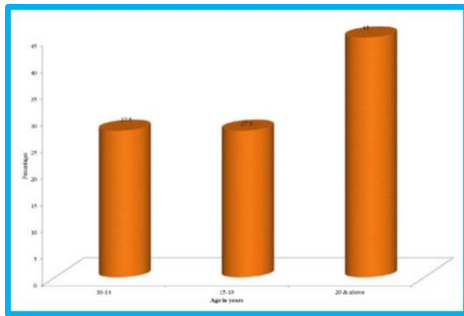Fig. 2: Stages of dental maturity (modified from Demirjian)
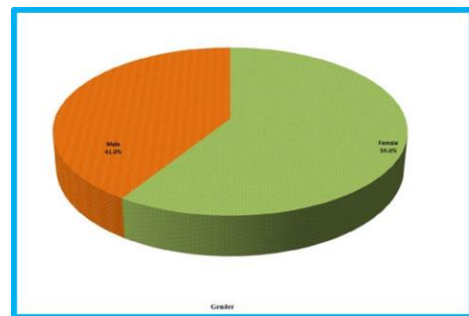

Fig. 3: Age distribution of Study design

Fig. 4: Gender distribution of Study design

developmental status of the 3rd molars in a sample size of 200 in the age group 10-25 based on radiographic records (Orthopantomographs) available in the Dept of Orthodontics in Vydehi Institute of Dental Sciences, Bangalore.

MATERIALS AND METHOD

The orthopantomographic records of patients in the age group 10-25 who reported to the Dept of Orthodontics, VIDS, Bangalore were evaluated. Of the 200 patient records evaluated there were 82 male and 118 female patients. The age range was 10-25 with a mean age of 17.5 years.

Inclusion criteria

1. Patients in the age group 10-25 years
2. Patients with no history of extraction of the 3rd molars
3. Good quality radiographs

Exclusion criteria

1. History of 3rd molar extraction
2. Obvious pathology related to the region
3. Distortion of the image in the radiograph.

The Demirjian classification system was used to assess the developmental stages of third molars of maxilla and mandible[5] (Fig. 2). The radiographs were studied and the scores established by a single observer to rule out bias. Stage A-D stage showed development of the crown from the cusp calcification to completed crown of the tooth and stage E-H showed the development of root from bifurcation to apical closure. The scores recorded the eight stages, A to H including 0, indicating the absence of the four wisdom teeth of each subject.

The mean age for developmental stages were calculated. The prevalence of third molars in the four quadrants was also determined in order to estimate the frequency of missing teeth. Comparisons between genders, between the upper and lower arches and between both sides were obtained. Descriptive and inferential statistical analysis was performed. Mean and standard deviations along with chi square test to find the significance of the parameters was considered. Statistical software namely SAS 9.2, SPSS 15.0, medcalc 9.0.1, Systat 12.0 and R environment ver. 2.11.1 were used for the analysis of the data.

RESULTS

Out of the 200 patient records that were studied, 55 (27.5 %) were in the age group 10-14, 55 (27.5 %) were in the age group 15-19 and 90 (45 %) were in the 20-24 age group (Fig. 3). The gender distribution was 118 (59 %) females and 82 (48 %) males (Fig. 4). All four third molars were present in 159 out of 200 subjects in this study. Both maxillary third molars were found in 87% (n= 174) patients and both mandibular third molars were found in 87.5% (n=175) patients. 3.5% (n=7) did not show the presence of third molars. There was no significant difference found

Table 1: Third molars and Demirjian classification according to age

Demirjian classification	Age in years			
1st Quadrant	10-14 (n=55)	15-19 (n=55)	20 & above (n=90)	Total (n=200)
A	0 (0%)	0 (0%)	2 (2.2%)	2 (1%)
C	11 (20%)	1 (1.8%)	0 (0%)	12 (6%)
D	29 (52.7%)	3 (5.5%)	1 (1.1%)	33 (16.5%)
E	7 (12.7%)	9 (16.4%)	1 (1.1%)	17 (8.5%)
F	0 (0%)	6 (10.9%)	1 (1.1%)	7 (3.5%)
G	0 (0%)	9 (16.4%)	8 (8.9%)	17 (8.5%)
H	0 (0%)	21 (38.2%)	65 (72.2%)	86 (43%)
O	8 (14.5%)	6 (10.9%)	12 (13.3%)	26 (13%)

$\chi^2=161.900; P<0.001**$

Table 2: Third molars and Demirjian classification according to age

Demirjian classification	Age in years			
2nd quadrant	10-14 (n=55)	15-19 (n=55)	20 & above (n=90)	Total (n=200)
A	1 (1.8%)	0 (0%)	1 (1.1%)	2 (1%)
B	0 (0%)	0 (0%)	1 (1.1%)	1 (0.5%)
C	11 (20%)	2 (3.6%)	0 (0%)	13 (6.5%)
D	25 (45.5%)	5 (9.1%)	1 (1.1%)	31 (15.5%)
E	8 (14.5%)	8 (14.5%)	1 (1.1%)	17 (8.5%)
F	3 (5.5%)	3 (5.5%)	1 (1.1%)	7 (3.5%)
G	0 (0%)	8 (14.5%)	12 (13.3%)	20 (10%)
H	0 (0%)	25 (45.5%)	63 (66.7%)	88 (44.4%)
O	7 (12.7%)	4 (7.3%)	10 (11.1%)	21 (10.5%)

$\chi2=129.141; P<0.001**$

Table 3: Third molars and Demirjian classification according to age

Demirjian classification	Age in years			
3rd quadrant	10-14 (n=55)	15-19 (n=55)	20 & above (n=90)	Total (n=200)
A	0 (0%)	0 (0%)	0 (0%)	0 (0%)
B	2 (3.6%)	0 (0%)	0 (0%)	2 (1%)
C	19 (34.5%)	2 (3.6%)	1 (1.1%)	22 (11%)
D	23 (41.8%)	4 (7.3%)	0 (0%)	27 (13.5%)
E	2 (3.6%)	8 (14.5%)	1 (1.1%)	11 (5.5%)
F	3 (5.5%)	12 (21.8%)	2 (2.2%)	17 (8.5%)
G	0 (0%)	14 (25.5%)	17 (18.9%)	31 (15.5%)
H	0 (0%)	15 (27.3%)	55 (61.1%)	70 (35%)
O	6 (10.9%)	0 (0%)	14 (15.6%)	20 (10%)

$\chi^2=176.78; P<0.001**$

with regards to the gender and missing third molars. The analysis of the 3rd molar status in the 4 quadrants are given in Tables 1-4. In the 10-14 age group, most subjects were seen in the stages C, D & E in the maxilla and in stages C & D in the mandible. 13.6 % of the subjects did not have an upper 3rd molar and 10 % of them had absent lower 3rd molars. In contrast, the age group 14-19 and 20-24 showed most of the cases having stages G & H in the maxilla. In the mandible, the 14-19

Table 4: Third molars and Demirjian classification according to age

Demirjian classification	Age in years			
4th quadrant	10-14 (n=55)	15-19 (n=55)	20 & above (n=90)	Total (n=200)
A	1 (1.8%)	0 (0%)	0 (0%)	1 (0.5%)
B	1 (1.8%)	0 (0%)	0 (0%)	1 (0.5%)
C	22 (40%)	1 (1.8%)	2 (2.2%)	25 (12.5%)
D	22 (40%)	2 (3.6%)	0 (0%)	24 (12%)
E	1 (1.8%)	9 (16.4%)	0 (0%)	10 (5%)
F	3 (5.5%)	9 (16.4%)	5 (5.6%)	17 (8.5%)
G	0 (0%)	17 (30.9%)	19 (21.1%)	36 (18%)
H	0 (0%)	13 (23.6%)	55 (61.1%)	68 (34%)
O	5 (9.1%)	4 (7.3%)	9 (10%)	18 (9%)

$\chi^2=182.10; P<0.001**$

Table 5: Third molars and Demirjian classification according to gender

Demirjian classification	Gender		
1st Quadrant	Female (n=118)	Male (n=82)	Total (n=200)
A	1 (0.8%)	1 (1.2%)	2 (1%)
C	10 (8.5%)	2 (2.4%)	12 (6%)
D	24 (20.3%)	9 (11%)	33 (16.5%)
E	13 (11%)	4 (4.9%)	17 (8.5%)
F	5 (4.2%)	2 (2.4%)	7 (3.5%)
G	13 (11%)	4 (4.9%)	17 (8.5%)
H	37 (31.4%)	49 (59.8%)	86 (43%)
O	15 (12.7%)	11 (13.4%)	26 (13%)

$\chi^2=19.405; P<0.001**$

Table 6: Third molars and Demirjian classification according to gender

Demirjian classification	Gender		
2nd quadrant	Female (n=118)	Male (n=82)	Total (n=200)
A	1 (0.8%)	1 (1.2%)	2 (1%)
B	0 (0%)	1 (1.2%)	1 (0.5%)
C	10 (8.5%)	3 (3.7%)	13 (6.5%)
D	24 (20.3%)	7 (8.5%)	31 (15.5%)
E	9 (7.6%)	8 (9.8%)	17 (8.5%)
F	6 (5.1%)	1 (1.2%)	7 (3.5%)
G	13 (11%)	7 (8.5%)	20 (10%)
H	41 (34.7%)	47 (57.3%)	88 (44.0%)
O	14 (11.9%)	7 (8.5%)	21 (10.5%)

$\chi^2=16.323; P<0.001**$

age group showed most cases in the F, G & H stages and the 20-24 group showed most cases in the G & H stages. In an analysis of the gender influence (Tables 5-8), an interesting finding was the predominantly larger percentage of females in each of the stages A-G as compared to males. However in stage H, there was a sudden increase in the percentage of males when compared to females. This was a universal finding in all the 4 quadrants. These tables also show the

Table 7: Third molars and Demirjian classification according to gender

Demirjian classification 3rd quadrant	Gender		
	Female (n=118)	Male (n=82)	Total (n=200)
A	0 (0%)	0 (0%)	0 (0%)
B	1 (0.8%)	1 (1.2%)	2 (1%)
C	20 (16.9%)	2 (2.4%)	22 (11%)
D	17 (14.4%)	10 (12.2%)	27 (13.5%)
E	9 (7.6%)	2 (2.4%)	11 (5.5%)
F	14 (11.9%)	3 (3.7%)	17 (8.5%)
G	19 (16.1%)	12 (14.6%)	31 (15.5%)
H	28 (23.7%)	42 (51.2%)	70 (35%)
O	10 (8.5%)	10 (12.2%)	20 (10%)

$\chi^2=26.968; P<0.001**$

Table 8: Third molars and Demirjian classification according to gender

Demirjian classification 4th quadrant	Gender		
	Female (n=118)	Male (n=82)	Total (n=200)
A	1 (0.8%)	0 (0%)	1 (0.5%)
B	0 (0%)	1 (1.2%)	1 (0.5%)
C	20 (16.9%)	5 (6.1%)	25 (12.5%)
D	15 (12.7%)	9 (11%)	24 (12%)
E	8 (6.8%)	2 (2.4%)	10 (5%)
F	13 (11%)	4 (4.9%)	17 (8.5%)
G	23 (19.5%)	13 (15.9%)	36 (18%)
H	28 (23.7%)	40 (48.8%)	68 (34%)
O	10 (8.5%)	8 (9.8%)	18 (9%)

$\chi^2=20.155; P<0.001**$

development of third molars in both the sexes. Statistically significant difference was found between males and females in stages C, D, E, G and H in the first quadrant, stages C, D, F and H In the 2nd quadrant and stages C, E, F and H in the third and fourth quadrants. The tables 1-4 show the development of third molars in relation to mean age of the subjects. Maximum incidence of calcification was found in stage D in all the 4 quadrants in the age group of 10-14 years. In addition, the 4th quadrant also demonstrated equal incidence in stage C as well. In the age group of 15-19 years, stage C was predominant in 1st, 2nd and 3rd quadrant and stage G was predominant in the 4th quadrant. In the age group of 20 and above, stage H was found to have maximum incidence in all the 4 quadrants. There was statistically significant difference found between males and females in stage H in 1st quadrant, stages C, D, F and H in 2nd quadrant and stages C,

E, F and H in the 3rd and 4th quadrants. As far as the crown completion of third molars as shown in Demirjian classification is concerned, stage D was seen in the age group 11-14 in both the jaws. Root completion as per the same classification was seen in stage G in the age group 15-19 in both the jaws. Apical root closure (Stage H) was seen in the age group 20 and above in both the jaws.

DISCUSSION

Age estimation plays an important role in forensic medicine. Estimation of age using tooth gives an accurate chronological age.[6] Assessing the age using 3rd molars is quite challenging because of its morphological variance.[7] Mincer et al.,[9] in their study used third molars in assessing the age and demonstrated that 3rd molars could be used for at least predicting that the individual was 18 years old. In literature there are many classifications given by Gleiser and Hunt,[10]

Kullman *et al.*,[11], Moorrees *et al.*,[12] Nolla[13] and Kohler e*t al.*[14] However, these classifications consisted of numericals, many stages and had many disadvantages. In order to avoid these short comings, the Dermijian *et al.*, classification[5] was chosen as it is simple and is the only mode of classification based on shape. Also, the study conducted by Dhanjal *et al.*,[15] proved that Dermijian classification had intra and inter examiner agreement and also was accurate in estimating the age. In our study, maxillary and mandibular third molars showed existing calcification at the age of 10 which proves that for the Indian subjects the calcification begins much earlier than age 10 which is in accordance with the study conducted by Uzameis *et al.*,[16] and Orhan *et al.*[17] Congenital absence of the third molars was found in almost 3.5% subjects in contrast to a study in Japan that showed about 7% absence of third molars.[18] In our study, development of the third molars was faster in females than in males in all the four quadrants from stage A-G but in stage H the gender reversed which is in contrast to studies by Prieto *et al.*,[19] Gunst *et al.*,[20], Solari *et al.*,[21, 22] and Kullumann *et al.*,[11] In Japanese studies, the gender differences was almost equalised before the completion of the root.[18] The data from our study showed that the stage D which indicates completion of the crown was found in the age group of 10-14yrs old and similar results were found in Japanese studies conducted by Szilvia *et al.*[18] Also, stage G which determines the root completion was found in the age group of 15-19 years in both the jaws and similar results were found in Japanese studies.[18]

CONCLUSION

Based on the results from this radiographic study, it can be safely surmised that the maturation levels of the 3rd molars can be a specific indicator of the age of the patient and can be an important adjunct in forensic odontology.

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