Original Article

Radiographic Evaluation of Third Molar Development in 5- to 25 Year Olds in Tehran, Iran

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Abstract

Objective: Radiographic evaluation of the third molar tooth to determine its position and degree of development is an important part in diagnosis and treatment planning, as well as in forensic dentistry procedures. The objective was to investigate the developmental stages of third molars in relation to chronologic age, gender and location (maxillary/mandibular) in an Iranian population.

Materials and Methods: The data were collected in departments of pediatric dentistry and orthodontics, Tehran Faculty of Dentistry and four private offices. Three calibrated observers visited the centers to examine panoramic radiographs and corresponded patients documents in each age cohort in the range of 5- to-25-years old. Data were analyzed by Generalized Estimating Equation (GEE) in the linear mode and exchangeable correlation structure. The significance level was defined as 0.05.

Results: The mean age of emerging third molars' follicle was 9.29±1.65 years. Early calcification was seen at the mean age of 10.28±1.66 years. The GEE model controlling for age, gender and tooth location (maxillary/mandibular) revealed that besides age (β=0.43, p<0.001), the tooth location had association with the developmental stage (β=0.11, p<0.001) so that maxillary teeth were prior in calcification stages, but no relationship between gender and developmental stages was seen (β=0.03, p=0.69).

Conclusion: Maxillary teeth were ahead of mandibular teeth in calcification stages with no gender difference. The present study may provide a reference for oral surgeons, pediatric dentists and orthodontists practicing in Iran and may have implications for the neighboring countries especially those with Caucasian populations.

Key Words: Third Molar Tooth; Developmental Stage; Iranian Population

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INTRODUCTION

Radiographic examination of the third molar tooth, determining its position and degree of completion, is an important part of diagnosis and treatment planning procedures in oral surgery, pedodontics and orthodontics [1].
This examination helps in making decisions about saving or removing the third molars and

arranging the most suitable time for the extraction if necessary. Such a decision may be of crucial importance in cases of extraction of hopeless first molars in need of replacement with the third molar.

Furthermore, as the third molar grows, its roots become longer; therefore, the tooth becomes more difficult to remove and complications become more likely.

Thus, the American Association of Oral and Maxillofacial Surgeons (AAOMS) recommends that when indicated, third molars should be removed by the time the patient is a young adult to prevent post operative problems and to ensure optimal healing, for it is expected that about 85% of these teeth will eventually need removing [2]. Some studies recommend prophylactic removal of third molars

to prevent crooked dentition [3-5]. Regardless of the reason for extraction, taking advantage of radiography to check the evolving stage of the wisdom teeth and its position is strictly recommended.

Evaluation of the development of the third molar by radiography is also useful in forensic dentistry when the chronological age may be determined by the calcification stages of the third molars.

Previous studies on calcification stages of third molars in various parts of the world have had different results regarding chronological age [1, 6-14].

This variation indicates the relevancy of third molar development with some factors such as gender, ethnicity and geographic location of the individuals [8-12, 14-19].

Table 1. The Number of Panoramics in 5- to 25-Year-Olds by Gender in Tehran, Iran

Age in years	Female	Male	Total
5.00	13 (42%)	18 (58%)	31
6.00	27 (47%)	31 (53%)	58
7.00	20 (44%)	25 (56%)	45
8.00	36 (64%)	20 (36%)	56
9.00	38 (61%)	24 (39%)	62
10.00	54 (55%)	44 (45%)	98
11.00	34 (52%)	31 (48%)	65
12.00	32 (57%)	24 (43%)	56
13.00	26 (49%)	27 (51%)	53
14.00	31 (66%)	16 (34%)	47
15.00	29 (62%)	18 (38%)	47
16.00	34 (59%)	24 (41%)	58
17.00	42 (79%)	11 (21%)	53
18.00	36 (75%)	12 (25%)	48
19.00	33 (75%)	11 (25%)	44
20.00	33 (73%)	12 (27%)	45
21.00	34 (72%)	13 (28%)	47
22.00	37 (77%)	11 (23%)	48
23.00	36 (75%)	12 (25%)	48
24.00	36 (78%)	10 (22%)	46
25.00	39 (80%)	10 (20%)	49
Total	700 (63%)	404 (37%)	1104

*The stage that was added to this classification

As third molar development takes a long period of time, it may be used as a measure for estimation of chronological age in a wide age range [8].

The objective of the present study was to investigate calcification stages of third molars regarding chronological age, gender and their location (maxillary/mandibular) in an Iranian population.

MATERIALS AND METHODS

The data were collected in departments of pediatric dentistry and orthodontics, Faculty of Dentistry, Tehran University of Medical Sciences and four private pediatric and orthodontics dental offices located in Tehran in 2009. Three senior dental students (observers) were first educated and calibrated by an experienced pediatric dentist (AJ).

Table 2. Schematic Figures for Developmental Stages of the Third Molar (Modified from Demirjian et al.)

	Stage O*	Follicle with no calcification.
	Stage A	Calcification of single occlusal points without fusion of different calcification.
	Stage B	Fusion of mineralization points, the contour of the occlusal surface is recognizable.
	Stage C	Calcification of the crown is complete, beginning of dentin deposits.
	Stage D	Crown formation is complete up to cement enamel junction.
	Stage E	Root length shorter than crown height.
	Stage F	Root length longer than crown height.
	Stage G	Root formation finished, Apical foramen still open.
	Stage H	Apical foramen is closed.

They examined 15 panoromics twice. The disagreement of their diagnosis (inter and intra) were further discussed and later they evaluated another 15 panoromics twice to measure their intra- and inter-examiner reliability (minimum kappa=0.8). Then, they visited the centers to examine the panoramic radiographs and corresponded patients' documents in the age-range of 5- to 25-years old. All radiographs were examined by two observers, separately and in case of diagnosis disagreement, the diagnosis in accordance with the third one's opinion determined the true stage. Radiographs of low-quality, with evident radiographic lesions and those corresponding to patients with systemic disorders as recorded in the patients' documents were excluded.

This resulted in the examination of between 31 and 98 radiographies for each age (in years). Eventually, 1104 radiographs were included in the study (Table 1).

Demographic data, including age and gender, were recorded according to the patient's document. A negatoscope served for examination of radiographs to assess all the four third molars in an individual according to Demirjian method [20] (Table 2).

Furthermore, one code was added for "follicle with no calcification" which is out of the Demirjian classification. The cases of "no follicle" and the "extracted third molars" were excluded from statistic analysis. Among the present teeth, there was no evidence of third molar's follicle at the age of 5. Moreover, at the age of 25, after excluding "no follicle"s and "extracted tooth"s, all of the samples were at the final stage (root completion). Therefore, these two age groups (5 and 25 years) were also excluded at final data analysis. The final number of included teeth was 2920. The tooth Location (maxillary/mandibular) was also considered as an independent variable.

Table 3. Mean Age (SD) for the Developmental Stages of the Third Molars (n=2920) in 6- to 24-Year-Olds by Gender and Tooth Location (Maxillary/Mandibular) in Tehran, Iran

Stages	Maxilla				Mandible			
	Female		Male		Female		Male	
	mean	SD	mean	SD	mean	SD	mean	SD
0[*]	9.3	1.7	9.1	1.7	9.4	1.7	9.3	1.6
1	10.3	1.8	10.8	2.4	10.1	1.4	10.3	1.4
2	10.6	1.6	11.0	2.3	11.2	2.1	11.2	2.2
3	12.0	2.3	12.0	1.8	12.3	2.4	12.2	1.9
4	13.7	2.4	13.4	2.1	13.8	2.3	13.4	2.5
5	15.5	1.8	15.1	1.4	15.7	1.7	15.1	1.4
6	17.2	1.6	16.7	1.5	17.4	1.7	16.8	1.5
7	18.8	2.2	18.7	2.6	19.0	2.1	18.6	2.6
8	22.3	2.1	21.6	2.8	22.4	2.1	21.8	2.6

The stages of A to H in Demirjan classification were scored from "1" to "8" and "0"was used for the newly added code of "follicles with no calcification". Data were analyzed by Generalized Estimating Equation (GEE), in linear mode and exchangeable correlation structure to take into account the clustering of the wisdom teeth inside the individual's mouth. Data analysis was carried out in two steps. In univariate analysis, the mean ages were compared separately between the genders and the location of the teeth and Beta and corresponding P-values were calculated.

In the multivariable stage, a final GEE model evaluated the association between chronological age and developmental stages controlling for the effects of tooth location (maxillary/mandibular) or gender. The significance level was defined as 0.05.

Ethical consideration
The study was approved by the Ethics Committee of the Faculty of Dentistry, Tehran University of Medical Sciences. The subjects were entered into the database with a numerical code only.

RESULTS

Sixty-three percent of the radiographs belonged to females. The details of the mean age (SD) for the developmental stages of the third molars (n=2920) in 6- to 24-year-olds by gender and tooth location (maxillary/mandibular) is shown in Table 3. Thirty-nine of the radiographs were at the O stage, initiation of follicle without any calcification, with the mean age of 9.29±1.65 years. Early calcification which is the first stage of the developmental level according to Demirjian

Table 4. Mean Age and Age Distribution in Percentiles by Modified Demirjian Classification for Third Molars (n=2920) in 6- to 24-Year-Olds in Tehran, Iran

Stages	Mean	SD	Percentile				
			05	25	Median	75	95
0*	9.29	1.65	6.00	8.00	9.00	10.00	12.00
1	10.28	1.66	8.00	9.00	10.00	11.00	13.00
2	11.02	2.06	8.00	10.00	11.00	12.00	15.00
3	12.10	2.12	9.00	10.00	12.00	13.00	16.00
4	13.62	2.30	9.00	12.00	14.00	15.00	17.00
5	15.49	1.67	13.00	14.00	15.00	17.00	18.00
6	17.10	1.58	15.00	16.00	17.00	18.00	20.00
7	18.82	2.28	16.00	17.00	19.00	21.00	23.00
8	22.19	2.30	18.00	21.00	23.00	24.00	25.00

*The stage that was added to Demirjian classification for "follicle with no calcification
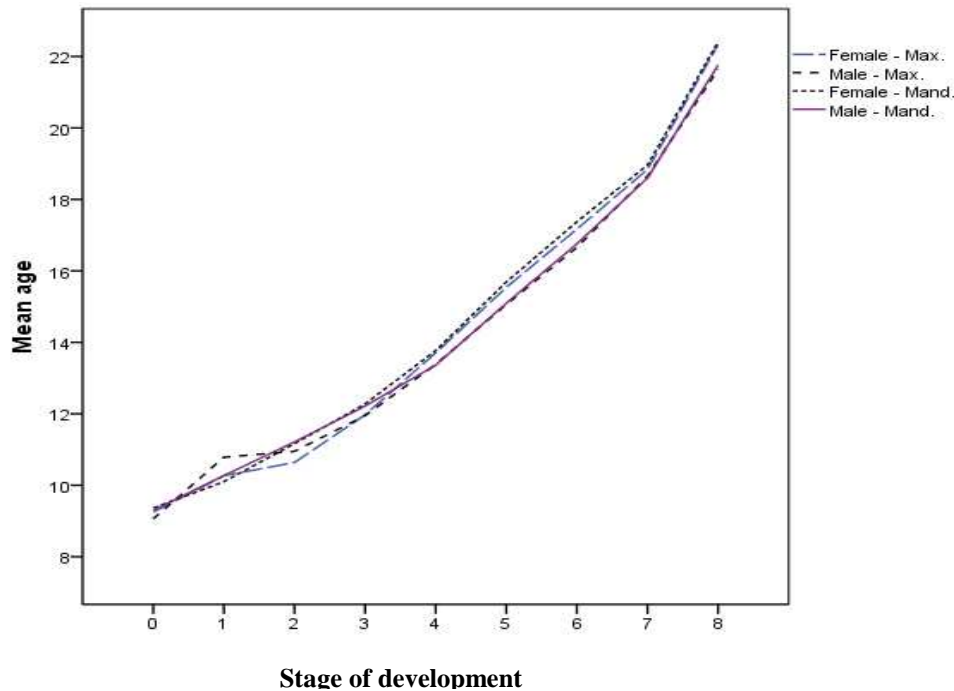
Graph 1. Developmental stages of the third molars (n=2920) by gender, age and tooth location (maxillary/mandibular) in 6- to 24-year-olds in Tehran, Iran

method was seen at the mean age of 10.28±1.66 years. Complete crown formation (stage D) had happened in 13.62±2.27 years of age and stage H (finishing root formation without closure of the apex) was seen in 18.82±2.28 years of age. Finally, apex closure had happened at the mean age of 22.19±2.30 years. The age distributions in percentiles by modified Demirjian classification for third molars (n=2920) in 6- to 24-year-olds is shown in Table 4. According to our data, approximately 75% of those in stage O were under 10 and 90% had less than 12 years of age. The corresponding figures for stage D were 15 and 17, and for apex closure (stage H) were 24 and 25 years of age. In univariate analysis, the effect of gender or tooth location on third molar developmental stage was studied.

In this regard, the third molars of males were prior to females in attaining Demirjian stages as well as maxillary teeth to mandibular teeth (p<0.001, for gender, β=0.87 and for location's difference β=0.12) (Graph 1).

In the next step, a multivariable approach that was taken by a GEE model controlling for age, gender and tooth location (maxillary/mandibular) revealed that besides age (β=0.43, p<0.001), the tooth location is correlated to the developmental stage (β=0.11, p<0.001) so that maxillary teeth were prior in calcification stages, but no relation between gender and developmental stages was seen (β=0.03, p=0.69).

DISCUSSION
The present study investigated the development of third molars in a 5- to 25-year-old Iranian population. No significant differences related to gender existed in calcification stages. To be comparable with the results of other studies, Demirjian classification which is one of the most simple and widely accepted employed methods served as the calcification criteria. The evaluation of the developmental stages were performed by three educated and calibrated dentists and the intra and inter ob-

servers' reliability were perfect or substantial [21]. The data were collected from the available records and radiographs in the predetermined sampling sites leading to different numbers of radiographs in different ages. Nevertheless, as the number of radiographs were enough in all ages we did not continue the sampling to reach equal numbers of panoromics in all groups. The findings however should be interpreted cautiously because of the cross-sectional nature of the study.

In our study, all of 5-year-old subjects were in stage O and the oldest age of the individuals with crypt formation of the third molar (stage O or merging follicle stage) was 12 years which concurs with other studies reporting the earliest age for crypt formation of the third molar to be in a range of 5 to 14 years old [1, 2, 13].

The mean age of those in stage D (crown completion) was 13.62 for the present population which is comparable to what has been observed in the Turkish population (12.90), but much less than those of Japanese (18.2 for males, 18.0 for females) or German (16.3 for males, 15.5 for females) populations [8] which may explain the differences between ethnicities and the dissimilarity between observers. In the present study, no significant differences related to gender existed in the calcification stage of the third molar. While some of the previous studies have not found significant differences in calcification stages of third molars between genders [6,7,13], some others have [3,5,9-12,14].

Our findings differ from what has been shown in another study on 5.5 to 24 year-old Iranians reporting earlier third molar calcification among males.

The fact that the mentioned study has been performed in five provinces other than Tehran may show the association of third molar calcification with geographic location and ethnicity [5]. Some of the previous studies evaluating the developmental stage of the third molar by radiography have not shown any difference in the mineralization level based on the tooth location (maxillary/mandibular) [22]. Others have found that maxillary teeth development is slightly ahead of mandibular developments in Caucasians [1] which is in line with our results. Differences in developmental stages of the third molars in different populations call for more ethnic-specified reports to be performed throughout the world to get a real view of the association between chronological age of the individuals and developmental stage of the third molars. This aspect is considered of more importance in recent years as increased attention has been devoted to the development of the third molar tooth, specifically to improve forensic age estimations in the cohort of the late teenage years and early adulthood (15-25 years) [23]. In conclusion, maxillary teeth had acceleration in calcification stages rather than mandibular teeth in this study with no gender difference. The present study may provide a reference for oral surgeons, pediatric dentists and orthodontists practicing in Iran and the neighboring countries especially those with Caucasian populations. It may also meet the need for assessing the association between chronological age and third molar development in forensic medicine.

ACKNOWLEDGMENTS

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