

# Relationship between Chronological Age and Developmental Stages of the Mandibular Third Molar in 12 to 20 Years Old Orthodontic Patients in Shiraz

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**Background and Aim:** Age estimation may be needed to plan treatment procedures in pedodontic, and orthodontics. Third molar is the last and most variable tooth to develop and may be used for age estimation in adulthood. The purpose of this study was to investigate relationship between chronological age and developmental stages of the mandibular third molar in a population of south Iran.

**Method:** The Demirjian's classification system was used to evaluate the developmental status of the mandibular third molars on the 500 panoramic radiographs of orthodontic patients. The age range of patients was 12 to 20 years. Mean and Standard deviations of Chronological age for each developmental stages were calculated. One-way ANOVA and post-hoc Tuckey HSD test were used to compare the mean age and developmental stages of molar teeth. The age differences in the developmental stages between the genders was assessed. Correlation between calcification stages of the third molars and age was determined.

**Results:** Crown calcification was completed at the mean age of 13.8 years, and root formation without apex closure was observed at the mean age of 17.5 years. At a mean age of 18.4 years apex closure was occurred. Males were advanced in the most of stages of calcification. A strong correlation between developmental stages of the lower third molars and chronological age was found in both genders.

**Conclusion:** The present investigation could provide reference data for third molar development in our population. Developmental stages of mandibular third molars showed a strong correlation with age. The lower third molars developed earlier in males than females.

**Key words:** Chronologic Age, Third Molar Tooth, Developmental Stage, Iranian Population

Received 10 February 2014; accepted 4 March 2014; Published 7 June 2014

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## Introduction

Age estimation has an important role in treating many developmental and endocrine disorders (1,2). Determining the age of an individual may also be important in medico-legal statuses (3,4).

In dentistry, age estimation may be needed to plan treatment procedures in pedodontic, and orthodontics or decision making regarding orthognathic surgery.

Tooth development have been used as an acceptable parameter to estimate chronologic age (3- 7)

Demirjian's classification has been accepted and used widely as one of the most accurate methods for evaluating dental development. This classification is based on morphological changes rather than tooth measurements and includes eight stages of calcification (from A to H). Crown formation begins from stage A and completes at stage D. Stages E to H represent formation of root from beginning until apical closure (8-11).

Development of teeth completes until early adulthood except for third molars. Third molar is the last and most variable tooth to develop and may be used for age estimation in teenagers. (6-7,12). Unlike other teeth, it does not form completely until puberty (13). Radiographic evaluation of the third molar is important in estimating the age of individuals and treatment planning (14, 15).

Due to long calcification period of third molars, it's developmental stages can be used for chronological age estimation in a wide range of age (12).

Thevissen et al. stated that estimation of individual age, particularly in young adults, needs to be accomplished on an appropriate population (16). Many studies has found that developmental stages of third molar is significantly variable in different populations and it is a population specific process (16-21). That's why establishing population-specific standards for third molar development has been recommended (16). Hence, detected variations confirms the relevancy of wisdom tooth development with ethnicity gender and geographic location.

The purpose of this study was to investigate relationship between chronological age and developmental stages of the mandibular third molar in a population of south Iran.

## Material & Methods

In this cross sectional study, 500 digital radiographs were chosen randomly among panoramic x- rays of patients from a private orthodontic office and orthodontic Department of Dental School, Shiraz University of Medical Sciences. Age range of patients was between 12 and 20 years (mean 16.7 years) (Table 1). The chronologic age of patients was determined on the basis of difference between the date of birth and the date of the x-ray. All panoramic radiographs were taken with a Proline XC (Planmeca Co., Helsinki, Finland) machine. Panoramic x-rays were excluded in cases of no follicles, unclear image or extracted third molars and any pathologic lesion related to the third molars.

The Demirjian's classification system was used to evaluate the developmental status of the mandibular third molars on the panoramic radiographs. Results of a previous study on an Iranian population revealed that among the four third molars, developmental stages of the lower left third molar led to the most accurate and reliable estimation of age (22). Hence we used the left mandibular third molar for this investigation. The assessments were carried out by an expert oral and maxillofacial radiologist in a room with dimmed light, blind to the age of the patients. The stage of development was registered for patients in each age group . Mean and Standard deviations of Chronological age for each developmental stages of third molars was calculated. Comparison of mean Chronological age for developmental stages of third molars between males and females was performed. Correlation between developmental stages of the lower third molars and chronological age in the population was determined. Intra observer reliability was checked by re-evaluating 15 radiographs two weeks after the first evaluation by using Cronbach's alpha test.

### Statistical analysis:

Data analyzed using SPSS V.17.0 (Chicago. IL. USA). Quantitative data presented by prevalence (%), mean and Standard Deviation (SD). Spearman's correlation coefficient used to verify the relationship between chronologic age and eight developmental stages of third molar teeth. One-way ANOVA and

post-hoc Tuckey HSD test were employed to compare the mean age and developmental stages of molar teeth. A paired t-test was used to analyze the age differences in the developmental stages between the genders. P-value less than 0.05 was considered as statistically significant.

## Results

The intra-observer reliability showed a high degree of consistency (0.91) between the two evaluations. In total, 500 panoramic radiographs of 299 female and 201 male patients with the age range of 12 to 20 years (mean  $16.07 \pm 2.76$ ) were entered to the study (Table 1).

**Table 1.** Distribution of subjects according to age and gender

Number of subjects			Age			
male	female	total	Min	Max	Mean	Std. Deviation
201	299	500	12.0	20.0	16.073	2.7699

Due to age range of our sample, only 1.4% of subjects were in stages O, A, B of calcification of third molars. Therefore they did not considered for the statistical analysis (Table 2).

**Table 2.** Distribution of different developmental stages of third molars

stage	Frequency	Percent
O	2	.4
A	4	.8
B	1	.2
C	30	6.0
D	174	34.8
E	52	10.4
F	50	10.0
G	54	10.8
H	133	26.6
Total	500	100.0

Mean and Standard deviations of Chronological age for developmental stages of third molars in the whole sample was calculated and is shown in table 3.

Crown calcification was completed (Stage D) at the mean age of 13.8 years, and root formation without apex closure (Stage G) was observed at the mean age of 17.5 years. At a mean age of 18.5 years apex closure (Stage H) was occurred (Table 3).

**Table 3.** Mean and Standard deviations of Chronological age for developmental stages of third molars

Stage	N	Age			
		Mean	Std.Deviation	Min	Max
C	30	12.533	.8604	12.0	14.0
D	174	13.865	1.5949	12.0	17.5
E	52	16.519	2.3388	12.0	20.0
F	50	16.960	2.0199	12.0	20.0
G	54	18.421	1.0554	16.0	20.0
H	133	18.593	1.7065	15.0	20.0
Total	493	16.125	2.7544	12.0	20.0

Comparison of mean Chronological age for developmental stages of third molars between males and females revealed that males were advanced in the most of stages of calcification. However differences were not statistically significant except for stages C and D (Table 4).

**Table 4.** Mean and Standard deviations of Chronological age for developmental stages of third molars in relation to gender

Stage	Male			Female			P-Value
	N	Mean	SD	N	Mean	SD	
C	1	12.23	0.56	1	12.93	1.03	.045*
	7		2	3		7	
D	8	13.55	1.37	8	14.18	1.73	.009*
	7		8	7		0	
E	1	16.50	1.65	3	16.56	2.56	.966
	4		5	8		2	
F	2	16.53	2.44	2	17.50	1.14	.072
	8		6	2		3	
G	1	18.45	1.21	4	18.68	1.02	.631
	1		6	3		1	
H	3	18.74	1.68	9	18.27	1.70	.161
	9		4	4		8	

\*p<0.05

Spearsman’s correlation analysis showed a strong correlation between developmental stages of the lower third molars and chronological age in our population ( $r^2 = 0.771$ ). This correlation was also strong when calculated in gender groups ( $r^2 = 0.800$  and  $0.700$  in males and females respectively) (Table 5). Distribution of developmental stages of third molars in each age group has shown in Table 6.

**Table 5.** correlation between developmental stages of the lower third molars and chronological age in gender groups

	Correlation coefficient		
	Male	Female	Total
	N=201	N=261	N=500
<b>Age/Developmental stages</b>	0.800	0.700	0.771

**Table 6.** Frequency of developmental stages of third molars in different age groups

Age	Stage (N %)									
	0	A	B	C	D	E	F	G	H	Total
12	0	3	1	21	44	2	5	0	76	76
.0	.0	3.9	1.3	27.6	57.9	2.6	6.6	.0%	100.	100.
	%	%	%	%	%	%	%	0%	0%	0%
13	2	1	0	2	40	3	0	0	48	48
.0	4.2	2.1	.0	4.2	83.3	6.3	.0%	.0%	100.	100.
	%	%	%	%	%	%	0%	0%	0%	0%
14	0	0	0	7	37	8	0	0	52	52
.0	.0	.0	.0	13.5	71.2	15.4	.0%	.0%	100.	100.
	%	%	%	%	%	%	0%	0%	0%	0%
15	0	0	0	0	11	4	0	0	26	26
.0	.0	.0	.0	.0%	42.3	15.4	.0%	.0%	100.	100.
	%	%	%	0%	%	%	0%	0%	0%	0%
16	0	0	0	0	33	10	11	1	70	70
.0	.0	.0	.0	.0%	47.1	14.3	15.7	1.4	100.	100.
	%	%	%	0%	%	%	%	0%	0%	0%
17	0	0	0	0	8	6	11	7	46	46
.0	.0	.0	.0	.0%	17.4	13.0	23.9	15.2	100.	100.
	%	%	%	0%	%	%	%	0%	0%	0%
17	0	0	0	0	1	0	0	0	1	1
.5	.0	.0	.0	.0%	100.	.0%	.0%	.0%	100.	100.
	%	%	%	0%	0%	0%	0%	0%	0%	0%
18	0	0	0	0	0	7	16	18	52	52
.0	.0	.0	.0	.0%	.0%	13.5	30.8	34.6	100.	100.
	%	%	%	0%	0%	%	%	0%	0%	0%
19	0	0	0	0	0	4	3	15	53	53
.0	.0	.0	.0	.0%	.0%	7.5	5.7	28.3	100.	100.
	%	%	%	0%	0%	%	%	0%	0%	0%
20	0	0	0	0	0	8	4	13	76	76
.0	.0	.0	.0	.0%	.0%	10.5	5.3	17.1	100.	100.
	%	%	%	0%	0%	%	%	0%	0%	0%

## Discussion

In current study we investigated the developmental stages of mandibular third molars in a 12 to 20 year old individuals. Determination of stages was performed using Demirjian classification, a very simple and widely accepted method (8). While wide variation of developmental stages was observed, a clear and logical correlation between the calcification stages of mandibular third molars and age of patients was presented.

Stages 0, A and B of calcification observed only in a few radiographs. This was due to minimum age (12 years old) of our subjects. Mean age for crown completion (stage D) was 13.86 years for present population. This was very close to announced results of study conducted by Jafari et al. (13.62 years) which was performed on another Iranian population (12). It was comparable to the results has been reported in Turkish population as well (23). In Japanese, German and Korean populations much higher mean ages for this stage has been reported (18.2, 16.3 and 15.04 respectively) (19,21). Also studies on Brazilians, black and white Americans showed higher results than ours (4,13). The detected variations confirms the relevancy of wisdom teeth development with ethnicity and geographic location.

Maximum age to reach stage D was 16 years in current study, whereas it was reported to be 17 years in an Iranian study, 19 years for females and 18 for males in Australian and 19 for Korean populations (12,21,24). Ethnic differences, variations in reading and interpreting radiographs, differences in number of groups and sample size may also be responsible for such a difference.

In the present study the mean age for stages E and F and stages G and H were identical.

In our study, mean age for complete closure of apical ends of third molars (stage H) was 18.59 years. This is in line with those reported in some Iranian studies (12, 22). Some other studies resulted in a higher mean age for this stage (12,25,26). This may attributed to sample size difference, although some ethnic factor may play role. Our data showed that stage H was first observed at 15 years old. Similarity

of the most of results on populations of different parts of Iran may indicate as impact of ethnicity.

Our findings showed that males were advanced in developmental stages of third molar in comparison to females. However, significant difference was observed only in stages C and D when comparing mean chronological age for developmental stages of third molars between genders. While studies conducted on Thai, Saudi and Indian populations (18,25,26) showed significant difference, no significant difference related to gender was found in some others (12,23).

In conclusion results of current study reveal that there is strong correlation between chronological age and developmental stages of mandibular third molars. Development of these teeth were advanced in males than females in our study population.

### Acknowledgement

The authors appreciate financial support of Vice Chancellor of Research, Shiraz University of Medical Sciences in this research.

This article has been derived from graduate thesis (No. 345) by Dr. Anahita Bagheri.

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