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Original Article *Özgün Araştırma*

RADIOGRAPHIC EVALUATION OF THE DEVELOPMENT OF THIRD MOLARS IN CHILDREN AGED 5-15 IN TURKEY

Türk Toplumunda 5-15 Yaş Grubu Çocuklarında Üçüncü Molar Dişlerin Gelişimlerinin Radyografik Olarak Değerlendirilmesi

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ABSTRACT

Objective: In this study, it was aimed to determine the age of the onset of crown calcification of third molars in children aged 5-15 years in Turkey, and to evaluate the development status of third molars by age.

Material and Methods: Panoramic radiographs of the first 1024 patients between the ages of 5 and 15 years were evaluated. The development (calcification) of third molars was classified according to the Demirjian method.

Results: When the onset age of the stages for maxillary and mandibular third molars were compared, no statistically significant difference was found (p≥0.05). In addition, although no statistically significant difference was found between genders regarding the age of calcification onset of third molars, it was observed that teeth #28 and #48 developed in boys approximately one year before girls (p≥0.05). When the onset age of the stages for maxillary and mandibular third molars were compared, no statistically significant difference was found (p≥0.05). Concerning stage 5, in which the furcation zone of third molars begins to calcify, although not statistically significant, all the maxillary and mandibular third molars were seen earlier in girls than boys.

Conclusion: It was found that the maxillary third molars on the right side developed earlier than mandibular third molars.

***Keywords**: Third molar, panoramic radiographic, child*

ÖZ

Amaç: Bu çalışmada, Türkiye'deki 5-15 yaşları arasındaki çocuklarda üçüncü büyük azı dişlerinin kron kalsifikasyonunun başlama yaşının belirlenmesi ve bu dişlerin gelişim durumlarının yaşa göre değerlendirilmesi amaçlanmıştır.

Gereç ve Yöntemler: Çalışmamızda, 5-15 yaş aralığındaki ilk 1024 hastanın panoramik radyografileri değerlendirilmiştir. Üçüncü molar dişlerinin gelişimi Demirjian metoduna göre sınıflandırılmıştır.

Bulgular: Maksiller ve mandibular üçüncü molarların gelişim evrelerinin başlangıç yaşları karşılaştırıldığında istatistiksel olarak anlamlı bir fark bulunamamıştır (p≥0.05). Ayrıca üçüncü büyük azı dişleri, kalsifikasyon başlangıç yaşı açısından değerlendirildiğinde cinsiyetler arasında istatistiksel olarak anlamlı bir fark bulunmamasına rağmen 28 ve 48 numaralı dişlerin erkeklerde kızlardan yaklaşık bir yıl önce geliştiği görülmüştür (p≥0.05). Maksiller ve mandibular üçüncü molar dişlerin gelişim evrelerinin başlangıç yaşları karşılaştırıldığında istatistiksel olarak anlamlı bir fark bulunmamıştır (p≥0.05). Üçüncü moların furkasyon kalsifikasyon derecesinin gösteren stage 5 evresi, maksiller ve mandibular molar dişlerde kızlarda erkeklerden daha erken yaşlarda görülmüştür.

Sonuç: Sağ taraftaki maksiller üçüncü molarların mandibular üçüncü molarlara göre daha erken geliştiği görülmüştür.

***Anahtar Kelimeler**: Üçüncü molar, panoramik radyografi, çocuk*

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INTRODUCTION

Forensic age estimation is made biological features in order to predict a person's chronological age or to identify a cadaver whose identity is not known for legal purpose (1). Many skeletal indicators are used for age estimation, such as the development of wrist bones and cervical vertebrae, the fusion of the cranial sutures, changes in secondary sex characteristics, or the level of dental development via panoramic radiographs (2). The development of wrist bones is completed at the age of about 18, but the development of the third molars continues until early twenties (2). Therefore, it is advantageous that the evaluation of third molars for the purpose of age estimation allows for a wider age range.

In recent years, permanent first molars with poor prognosis requiring long-term and complicated treatment are presented in the clinic due to severe hypo-mineralization, hypoplasia, or large carious lesions frequently observed in permanent first molars. In some cases, it is an important responsibility for pediatric dentists to make a long-term prognosis assessment of such teeth, whose root development has not been completed yet, and to make a decision about their extraction or preservation. In such cases, the extraction of permanent first molars performed at the appropriate time either provides spontaneous closure or greatly facilitates orthodontic treatment afterwards (3).

One of the important criteria to be considered when deciding for the extraction of first molar is the presence of third molar (3). The extraction of the first permanent molar should not be finalized without checking for the existence of third molar germs (4). For this reason, in about the age of 8-10, which is the right age for spontaneous closure, it is important to be able to detect the presence of third molars.

The age at which the presence of third molars is determined, which is used in the prediction of the forensic age of individuals or during dental treatment, calcification onset age, and the age of each developmental period are determined vary in different populations (1). In the literature, there are few studies on the age of onset and end of crown calcification of third molars in the Turkish population. Therefore, in our study, it was aimed to determine the age of onset and end of crown calcification of third molars in girls and boys. It is considered that these data will guide treatments involving third molars.

MATERIALS AND METHODS

In this study, panoramic radiographs of the first 1024 patients between the ages of 5 and 15 years presented to the pediatric dentistry clinic between 2015 and 2016 were evaluated. Patients without chronic, systemic, and genetic diseases, without malnutrition, and growth and developmental disorders, and who did not undergo a surgical operation involving the third molar region were included in the study. Patients were excluded in the presence of a pathological condition involving third molars and in cases where the radiographic image quality was not acceptable. Approval was obtained from the Clinical Research Ethics Committee (Kırıkkale University Clinical Research Ethics Committee, date: 03.01.2017, issue number: 01/18.). This study was performed in line with the principles of the Declaration of Helsinki.

The development (calcification) of the third molars was classified according to the Demirjian method (5). Demirjian method consists of 8 levels. The first four levels (A-D), the process from the start of calcification in the cusps to the completion of crown formation; and the last four levels (E-H) cover the processes from the formation of bifurcation to root formation and apical closure (Table 1) (Fig. 1) (5).

A researcher (K.N.T.) evaluated the panoramic radiographs to classify the development status of the third molars according to the age of onset and their crown age, and the teeth were scored according to the Demirjian method. Prior to the study, the third molars in

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50 randomly selected panoramic radiographs were scored and Kappa values were determined by an experienced researcher (A.A.O.) independent of the first researcher. To evaluate intra-observer reliability, 10% of the panoramic radiographs were reexamined after 8 weeks.

Table 1: Classification of the Demirjian Method

Demirjian Method (1973)	
Level A	Single occlusal tubercle peak calcification, in which different calcification areas do not merge.
Level B	Combination of mineralized tubercle peaks and identifiable occlusal surface contour.
Level C	Enamel formation on the occlusal surface is completed, and dentin formation begins. Although the pulp chamber curvature is seen, the pulp horn is not seen.
Level D	Crown formation is completed up to the enamel-cement combination, and root formation starts to form. The pulp horn begins to differentiate, but the pulp chamber walls remain curved in the same way.
Level E	Root length is shorter than crown length. The pulp chamber walls are in the form of a straight line and the pulp horn transforms further. Calcification starts in the furcation of the molars.
Level F	Pulp chamber walls are seen as an isosceles triangle. Root length is equal to or more than crown length. The bifurcations of the molars develop to form the roots.
Level G	Root canal walls are parallel, but the apical tip is partially open. In molars, only the distal root is evaluated.
Level H	The root apex is completely closed (distal root of the molar). The periodontal membrane surrounding the apex and the root are of equal width.

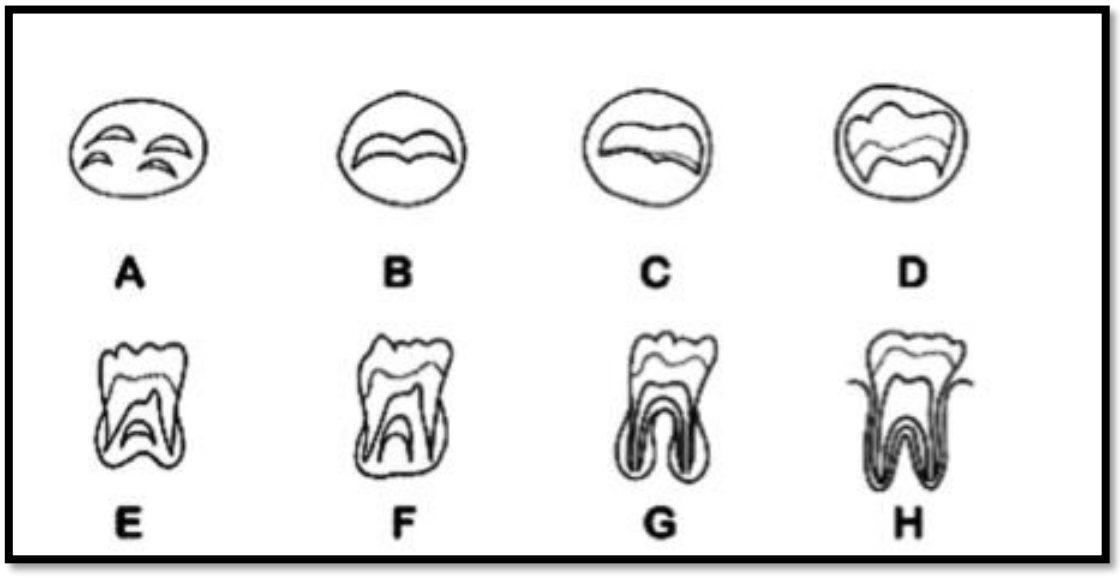

Fig. 1: Schematic representation of the developmental stages A to H as devised by Demirjian et al. (1973)

(Scoring A=1, B= 2, C=3, D=4, E=5, F=6, G=7, H=8)

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In a sample of 50 radiographs, it was found that there was no significant inter-observer or intra-observer difference ($p<0.05$). The sample size in our study was determined by examining similar studies and the G*Power software (1,6,7). Based on the power analysis using the G*Power version 3.0.10 software with a power of 95% and 5% significance level, the total sample size was found to be 983 patients (University of Kiel, Kiel, Germany).

Statistical analyses were performed using IBM SPSS Statistics for Windows, version 22 (IBM Corp., Armonk, NY, USA). Mean and standard deviations were calculated using descriptive statistics and these values are given as mean ± standard deviation in tables. Independent samples t test was used to compare the mean age of the girls and boys, and all test results were interpreted at $p<0.05$ statistical significance level.

RESULTS

In this study, 30 out of 1024 panoramic radiographs were excluded because the image quality was not clear, and the evaluation was made on 994 radiographs, of which 504 were of girls and 490 were of boys. These radiographs showed that tooth #18 in 2 patients, tooth #28 in 5 patients, tooth #38 in 12 patients, and tooth #48 in 10 patients were in buccal-occlusal position; therefore, they were excluded (Fig. 2).

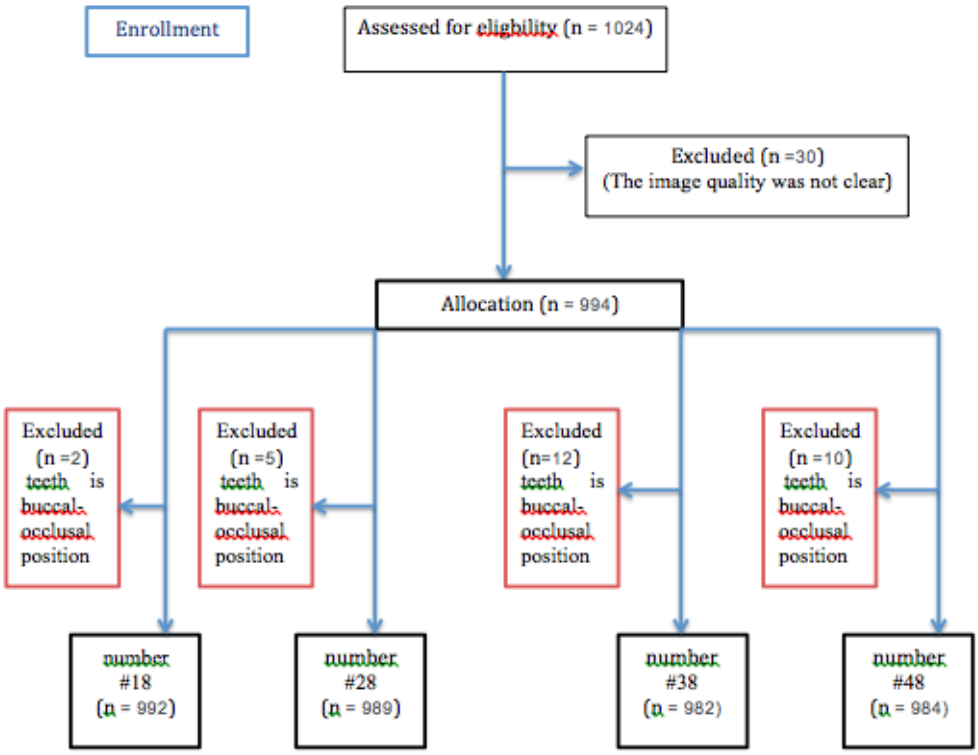

Fig. 2: Flow diagram showing the number of patients in the study.

In this study, the earliest age at which dental calcification started (stage 1) was: tooth number #18 both in girls and boys at the age of 8; in tooth #28, in girls aged 8 years and boys aged 7 years; tooth #38 both in girls and boys at the age of 7; tooth #48 in girls aged 7 years and boys aged 6 years (Table 2). In addition, although no statistically significant difference was found between genders regarding the age of calcification

onset of third molars, it was observed that teeth #28 and #48 developed in boys approximately one year before girls (p≥0.05).

It was found that the average age of the girls (12.73) was higher than the average age of the boys (12.08) for tooth #18 in 4 Stage, in which the crown formation was completed (p<0.05). The average age of the girls (12.64) with tooth #28 in stage 4 was higher than the average age of the boy (12.08) (p<0.05) (Table 3).

Table 2: Distribution of Stage 1 patients by age and sex.

Toot #	Sex	Age									
		6	7	8	9	10	11	12	13	14	15
18	Female	-	-	1	-	1	-	1	-	-	-
	Male	-	-	3	2	2	-	-	-	-	-
28	Female	-	-	4	1	1	1	-	-	-	-
	Male	-	2	3	3	1	-	-	-	-	-
38	Female	-	2	3	3	3	-	-	-	-	-
	Male	-	3	7	6	5	-	1	-	-	-
48	Female	-	3	4	7	2	1	-	-	-	-
	Male	1	2	8	8	6	-	1	1	-	-

Table 3: Comparison of maxillary third molars by age and gender.

Stage	Tooth #18					Tooth #28				
	Female	**n**	**Male**	**n**	**p**	**Female**	**n**	**Male**	**n**	**p**
0	8.64±2.71	211	8.49± 2.86	230	.588	8.46±2.62	201	8.42±2.85	220	.896
1	10.00±2.00	3	8.86± .90	7	.228	8.86±1.22	7	8.33±1.00	9	.360
2	9.92±1.89	25	9.12±1.40	26	.089	9.95±1.76	20	9.20±1.24	40	.061
3	10.98±1.95	53	10.80±1.82	55	.618	11.08±1.78	52	11.11±1.78	38	.941
4	12.73±1.71	85	12.08±1.43	73	.011	12.64±1.83	86	12.08±1.56	88	.031
5	13.54±1.16	78	13.55±1.20	58	.948	13.55±1.34	88	13.64±1.16	53	.630
6	14.00±1.11	37	14.29±.76	34	.193	14.05±1.01	38	14.26±.75	34	.321
7	14.33±1.00	9	15.00±.00	6	.081	14.17±1.17	6	15.00±.00	6	.141
8	15.00±.00	3	.	0[a]		14.75±.50	4	.	0[a]	

Independent samples t test: p<0.05 [a] T cannot be calculated because at least one of the groups is n = 0

It was determined that the average age of the girls (8.67) in stage 0, which is the stage in which tooth buds of tooth #38 are not observed, was higher than that of the boys (8.1), and the average age of the girls (12.86) in stage 4 was higher than that of the boys (12.43) (p<0.05). There was a statistically significant difference between the average age of the girls (9.79) and the boys (9) at stage 2 for tooth #48 (p<0.05). In stage 4, which is the stage

where the crown formation of tooth #48 is completed, the average age of the girls (12.89) was higher than that of the boys (12.42) ($p<0.05$) (Table 4).

In this study, it was found that the maxillary and mandibular third molars on the right side developed earlier than mandibular third molars (Table 5).

Table 4: Comparison of mandibular third molars by age and gender

Stage	**Tooth #38**					**Tooth #48**				
	Female	**n**	**Male**	**n**	**p**	**Female**	**n**	**Male**	**n**	**p**
0	8.67±2.88	196	8.10±2.74	196	.047	8.50±2.84	187	8.27±2.89	202	.429
1	8.64±1.12	11	8.77±1.23	22	.760	8.65±1.12	17	8.93±1.47	27	.506
2	9.74±1.28	19	9.58±1.84	31	.747	9.79±.98	19	9.00±1.14	18	.030
3	10.89±1.88	66	1085±1.76	60	.893	11.10±1.77	73	10.72±1.57	67	.182
4	12.86±1.57	115	12.43±1.53	106	.042	12.89±1.61	114	12.42±1.51	105	.028
5	13.89±.90	57	14.04±.82	48	.389	13.90±.85	58	14.16±.81	44	.118
6	14.35±.85	26	14.56±.71	18	.393	14.46±.81	26	14.60±.68	20	.542
7	14.40±1.34	5	17.75±.50	4	.639	14.25±1.50	4	14.67±.58	3	.673
8	15.00[a]	1	.	0[a]		15.00[a]	1		0[a]	

Independent samples t test, $p<0.05$, [a] T cannot be calculated because at least one of the groups is n=0

Table 5: Comparison of right and left side third molars in terms of development levels and age.

Independent samples t test; $p<0.05$; [a] Standard deviation could not be calculated because n=1

Stage	**Right**						**Left**					
	Maxilla (18) n			Mandibula (48) n p			Maxilla (28) n			Mandibula (38) n p		
	Mean	SD		Mean	SS		Mean	SD		Mean	SD	
0	8.56	2.78	441	8.38	2.86	389 .359	8.44	2.74	421	8.39	2.83	394 .798
1	9.20	1.32	10	8.82	1.33	48 .414	8.56	1.09	16	8.73	1.18	33 .630
2	9.51	1.69	51	9.41	1.12	37 .755	9.45	1.47	60	9.64	1.64	50 .523
3	10.89	1.88	108	10.91	1.68	140 .931	11.09	1.77	90	10.87	1.82	126 .377
4	12.43	1.61	158	12.65	1.57	218 .185	12.36	1.72	174	12.66	1.56	221 .064
5	13.54	1.17	136	14.01	.84	102 .000	13.58	1.14	141	13.96	.87	105 .003
6	14.14	.96	71	14.52	.75	46 .025	14.15	.90	72	14.43	.79	44 .092
7	14.60	.83	15	14.43	1.13	7 .694	14.58	.90	12	14.56	1.01	9 .962
8	15.00	.00	3	15.00[a]	.	1.	14.75	.50	4	15.00[a]	.	1 .685

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DISCUSSION

Third molars show great variability among individuals when compared to other teeth in terms of their anatomy, formation and eruption age (6). In addition, it is necessary to determine the presence of permanent third molars in the treatment procedure in which spontaneous closure is targeted after the extraction of the permanent first molar.

Third molars differ from the other teeth in terms of size, shape, and agenesis due to the environmental factors, systemic diseases, genetics, and teratogens and also the agenesis of these teeth varies among ethnicities (6,8,9). The third molar agenesis was found to be 12.7% in British population, 24.75% in Chilean population, and 41% in Korean population (10). Çelikoğlu et al. reportd the third molar agenesis in Turkish population as 22.7% (11).

Various classification systems have been developed to determine the level of tooth calcification (12-14). In 1973, Demirjian et al. created a new scoring system by evaluating left mandibular teeth from incisors to second molar (5). Since the Demirjian method is a simple and practical method and because it clearly defines the stages of tooth development and causes the least variability among observers, it was preferred also in the present study (9). Lee et al. showed that the Demirjian method yielded ±1 year error, giving 92% correct results for boys and 92.5% for girls (15). The Demirjian method is the most common method used in the assessment of tooth age (16). For these reasons, Demirjian method was used in our study.

Mihai et al. reported that the starting age of crown calcification of third molars is between 7 and 10 years but may vary between 5 and 14 years (17). Hedge et al. studied Indian children and reported the calcification onset age as 5.4 years (6). Uzamis et al. reported that mandibular third molars began to calcify between the ages of 7 and 9 in their study involving 400 panoramic radiographs of Turkish children (18). Orhan et al. obtained similar results in their study and showed that the calcification onset age of third molars was between 8 and 14 years (7). In our study, the age of calcifications onset of third molars varied between 6 and 13 years. It is thought that the reason for the difference in the age of calcification reported for Turkish populations is due to differences in genetic and environmental conditions.

Olze et al. did not find any significant difference in Japanese children when they evaluated their third molars with respect to gender, arc, and teeth's being on the right or left side (1,2,19). In our study, when the teeth's occurrence side (right/left) was evaluated in terms of gender, there was no significant difference in mandibular third molars, but calcification started in maxillary third molar #28 earlier than tooth #18 at an earlier age in both genders.

Karataş et al. reported no significant difference in the level of development of third molars between genders (1). In our study, there was also no significant relationship between the calcification onset age of third molars and gender, but calcification of teeth #18 and #28 started calcification earlier in boys than girls, and the teeth #38 and #48 started calcification earlier in girls.

Orhan et al. stated that the formation of third molars in the maxilla and mandible occurred as early as at the age of 7 in Turkish population (7). Researchers reported that third molar buds were first seen in the mandible in Turkish population, but the development levels of third molars in the maxilla and mandible were similar (7). In our study, similar to other studies, it was observed that the calcification onset of third molars in Turkish population was earlier in the mandible, and the level at which the occlusal contour was completed was at the age of 6 at the earliest in all third molars.

According to the results of our study, our hypothesis was confirmed, and it was observed that maxillary third molars developed earlier than mandibular third molars. In addition, no statistically significant difference was found between genders regarding the age of calcification

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onset of third molars. The presence of third molars, which are used in forensic age estimation and dental treatments, the age of calcification onset, and the age of the development of third molars vary among ethnicities, so these ages should be determined for each population. The data obtained in this study provide reference information regarding Turkish population.

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