

# Age estimation and its adaptation of the Turkish children using modified demirjian's method

## Abstract

**Background:** Age estimation is important in the fields of dentistry and Demirjian's method is used generally. Many different methods have been used to date and none of them meet the standards as Demirjian's method since 1973. However, this method may not be valid in some populations. The aim of this study is to evaluate the modified Demirjian's method on Turkish children and young adults.

**Methods:** The scoring table of Demirjian has been modified to Turkish children - young adults and new dental maturity score were obtained. In addition, the effect of gender on the crown and root formation were assessed using the Mann-Whitney-u test and the table was created with divided into ages. The dental maturity of 848 healthy children and young adults (445 females 403 males) aged between 10 and 19years were studied with dental panoramic tomograms. Two raters evaluated the right third mandibular molar according to development stages of Modified Demirjian's.

**Results:** The crown and root formation were statistically significant in the 17.0-17.9 age group between females and males ( $P=006$ ). Descriptive analysis showed that F stage is the shortest period. Modified Demirjian method is adapted to the Turkish population.

**Conclusion:** It is demonstrated that age estimation in Turkish children and young adults will be performed easier with Modified Demirjian method adapted to the Turkish population.

**Keywords:** age estimation, modified demirjian method, turkish population, panoramic radiographs, third molar, tooth formation

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## Introduction

Children and young adults with the same chronological age may show differences according to the developmental stages of different biological systems.<sup>1</sup> The development of each individual can be affected by genetic, racial, nutritional, climate, hormonal and environmental factors.<sup>2</sup> There are various methods for establishing age based on dental tissues, including the following: morphological (dental attrition rate, tooth color changing), metrical (Carbon14 analysis, histological analysis), radio morphological (Demirjian's methods), and radiometric (Cameriere's methods, Mornstaad's methods).<sup>3,4</sup> These methods are frequently applied in the fields of pediatric dentistry orthodontics and forensic science.<sup>5-8</sup>

Currently, the Demirjian method is the most frequently applied radiological method.<sup>8</sup> The advantage of the Demirjian's method includes the objective criteria describing stages of tooth development, which have been illustrated with line diagrams and radiographs very clearly.<sup>9</sup> However, it has been shown that different patterns of dental maturation exist in different populations.<sup>1</sup> Demirjian's dental age estimation method was done in a different nation successfully but French Canadian studies showing that French Canadian standards were not applicable for age estimation in a different population.<sup>5,10-12</sup> Although several types of researches have performed with Demirjian method on Turkish population as yet no study has tested this modified Demirjian's method.<sup>4,13-15</sup>

The aim of this study is to adapt the modified Demirjian's method on Turkish children and to research the effect of age and gender on tooth development.

## Materials and methods

Panoramic radiographs of 1182 healthy children aged between 10 and 19years who presented to Ordu University Faculty of Dentistry Department of Oral Maxillofacial Surgery between March 2010 and January 2015 was randomly selected. Of 334 panoramic radiographs with low-resolution quality were excluded from the study. There were totally 848(445 females and 403 males) panoramic radiographs using in the study as children and young adults. The study was explained to the patients and they voluntarily signed a written informed consent. The study design was approved by the Ordu University Ethics Committee.

Exclusion criteria were missing the third molar, the atypical anatomy of third molar, orthodontic treatment, dentoalveolar trauma, any radiographic errors, pathological diseases, craniofacial anomalies or syndromes such as Down syndrome, unilateral hypodontia and the presence of incomplete records or poor quality OPG. Only healthy individuals were included in the study.

The panoramic radiographs were obtained using a Kodak 8000C Digital Panoramic and Cephalometric Extra oral Imaging System (Kodak Dental Systems, Rochester, NY, USA) and images stored in a digital database.

In order to achieve higher accuracy in defining the stages of development towards apexification, the Demirjian method was modified and two stages were added, F1 and G1, making ten stages of the crown and root formation (Figure 1).<sup>16</sup>

The rating was carried out by two examiners (oral medicine and

research assistant of maxillofacial surgery), date of birth of each study subject was hidden from both the examiners and was blinded from each other. Inter and intra observer's error was calculated and there were no significant differences found. Intra observer's paired Student's t-test t value=0.30, p value=1 and inter observer consistency was rated at 96%, inter observer paired Student's t-test: t value=0.15, p value=1.48 with statistical power of 83.

tooth development, A, 10,03 B, 11,16 C, 12,41 D, 13,52 E, 15,21 F, 16,16 F1, 16,50 G, 17,25 G1, 17,82 H, 17,50 at males and A, 10,09 B, 10,62 C, 12,51 D, 14,49 E, 15,85 F, 16,60 F1, 16,35 G, 17,48 G1, 17,94 H, 18,12 at females (Table 2). In Turkish children and young adults, the mean ages at A, C, D, E, F1, G, G1 developmental stage were lower for males than for females and B and F were lower for females than males (Figures 1–3).

	female	male	
<b>a</b>	10.09±1.5	10.03±1.3	Cusp tips are rounded but the base is not yet defined.
<b>b</b>	10.62±1.5	11.16±1.4	Mineralized cusps are visible with enamel crown morphology is well defined.
<b>c</b>	12.51±1.7	12.41±1.6	The crown is almost fully formed, the pulp chamber is almost obliterated, cusps are well sculpted.
<b>d</b>	14.49±2.0	13.52±2.2	Crown formation is complete in both directions and junction. The pulp chamber has a compressed form.
<b>e</b>	15.85±1.5	15.21±1.5	Formation of the lines indicate differentiation for height. Root length is less than the crown length.
<b>f</b>	16.60±1.2	16.16±1.2	Root length is still less than crown length. Root flare formed shaped endings.
<b>f1</b>	16.35±1.9	16.50±1.9	Root length is almost equal crown length. The root still have a funnel shaped ending.
<b>g</b>	17.48±0.8	17.25±0.8	Root with expanded, but open enamel space.
<b>g1</b>	17.94±0.9	17.82±0.9	Root with an parallel for space are now relatively closed. The PDL space is displaced ending in a T-line.
<b>h</b>	18.12±1.4	17.50±1.4	Apical radiol. becomes an complete closed, and the PDL form a uniform width around the root.
	<b>age</b>		

**Figure 1** Schematic drawings and definitions of the ten stages of crown and root formation used to score third molar development and modified demirjian method was adapted to the Turkish population.

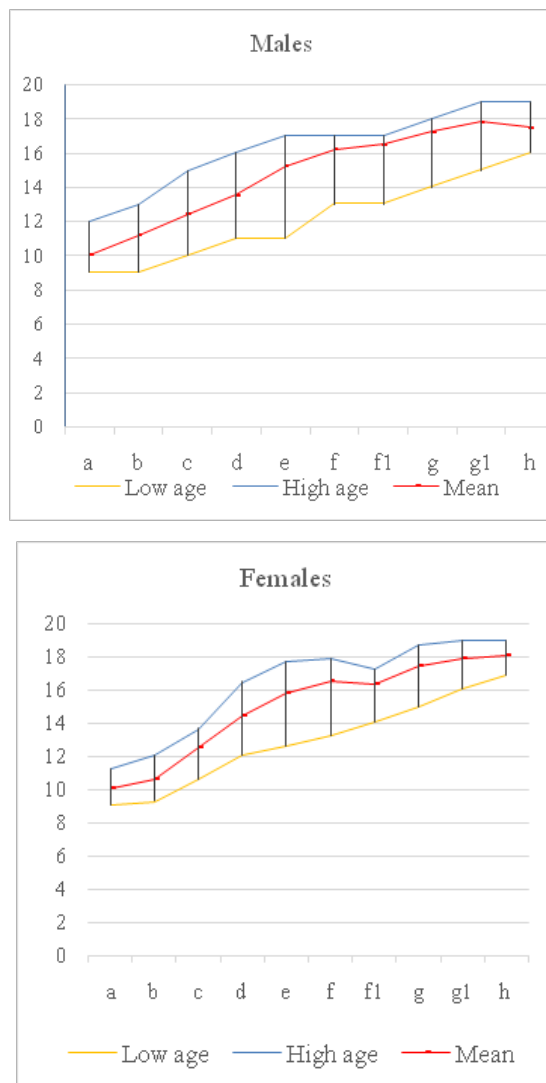
Scores of right mandibular wisdom teeth were summed to get the dental maturity score. The chronological age (CA) of each child was calculated by subtracting the date of birth from the date the radiograph was taken. "0". Whenever there was a disparity in the same tooth rated by two or more observers, the earliest formation stage was chosen.

Data were analyzed using the Statistical Package for the Social Sciences (SPSS), Version 20.00 (IBM, Corp, Chicago, Illinois, USA). Mann-Whitney Test was used to test the association between gender and crown-root formation of the third molar for the presentation of patients used in the study.

**Results**

Out of total study sample (848), 48% (n=403) were males and 52% (n=445) females of Turkish patients, with an age range from 10 to 19years. The male and female ratio is almost equal and the data was divided into separate genders (Table 1). The crown and root formation were statistically significant in the 17.0-17.9 age group between females and males (P<0.005). No statistically significant difference was found in other age groups (P<0.005) (Table 1).

The scoring table of Demirjian's gives the value of the Turkish children and young adults' chronological age for the ten stages of



**Figure 2** Age intervals according to stages of the patients.



**Figure 3** The right third mandibular molars were evaluated with panoramic radiographs (15years male-Stage D).

## Discussion

The Demirjian method is the most widely used method of calculating a dental age. But since the timing of teeth development varies between populations, age estimation analyses should be made in the regions showing the same characteristics.

There are some studies in the literature evaluate the applicability of Demirjian method for Turkish population between 2010 and 2015.<sup>13–15,17–19</sup> In all studies, the applicability of Demirjian method is not suitable for Turkish population (Table 3).<sup>14,15,18</sup> Therefore, in the present study, modified Demirjian method is adapted to the Turkish population, (Figures 1–3).

The modified Demirjian stages of tooth development<sup>9,16</sup> used in this study were designed for third molars. Third molar formation stages were rated because of the absence of other reliable biological markers during late adolescence. Solari et al.<sup>16</sup> analyzed the stage of third molar development using the eight-grade scheme developed by Demirjian and coworkers and described that In Hispanics, the mean ages at each developmental stage were lower for males than for females. Results of the present study agree with a previous one, the

mean ages at A, C, D, E, F1, G, G1 developmental stage were lower for males than for females and B and F were lower for females than males (Table 2). This result is confirmed by Zhai,<sup>8</sup> Gungor,<sup>13</sup> Solari,<sup>16</sup> Mincer et al.<sup>20</sup> Compared with the present study and similar results are seen in the mean ages of the third molar at given stages of tooth development. However, it is observed at all groups that crown-root formation earlier completed in the Turkish children and young adults.

In previous studies conducted in Turkish populations, it has been reported that dentition shows gender differentiation, with that in females preceding that in males.<sup>13–15,17,19,21</sup> Karadayi et al.<sup>19</sup> described that this difference was usually in only one stage and not in all teeth. In this study, similarly with Karadayi et al.<sup>19</sup> females show faster dental maturation than males in one stage (17.0-17.9) (P=006) (Table 1). With most maturational events, the tempo of maturation is faster in females.<sup>22</sup>

In the present study, F stage and F1 stage are similar age ranges (Figure 1–3). There is a proportional increase in other value ranges, where similar values are seen here suggest that F runs for a shorter time or that F and F1 are confused during the examination.

**Table 1** Distribution of samples based on age and sex

Age	10-10.9	11-11.9	12-12.9	13-13.9	14-14.9	15-15.9	16-16.9	17-17.9	18-18.9	19-19.9
Male	39	57	44	39	46	56	34	48	34	6
Female	39	37	39	37	48	49	54	81	43	18
Sgn	464	118	893	216	491	277	88	6	297	834

**Table 2** Demirjian table was adapted to the Turkish population

Stages	A	B	C	D	E	F	F1	G	G1	H
<b>Males</b>										
Mean	10,03 (37)	11,16 (57)	12,41 (75)	13,52 (66)	15,21 (68)	16,16 (32)	16,50 (6)	17,25 (16)	17,82 (11)	17,50 (20)
SD	1,384	1,437	1,628	2,214	1,589	987	548	1,291	751	761
<b>Females</b>										
Mean	10,09 (23)	10,62 (42)	12,51 (65)	14,49 (91)	15,85 (80)	16,60 (40)	16,35 (17)	17,48 (21)	17,94 (17)	18,12 (17)
SD	1,564	1,545	1,786	2,013	1,592	1,277	1,967	873	966	1,409

**Table 3** The studies related age estimation between 2010 and 2015 in Turkish population

	Participants	Year	Method	Mean difference		P value
				M	F	
Gungor et al. <sup>13</sup>	535	2016	Demirjian method	0.04-0.85	0.02-0.79	p<0.05
Altunsoy et al. <sup>14</sup>	635	2015	Demirjian method	0.10-0.76	0.28-0.87	p<0.05
Celik et al. <sup>15</sup>	932	2014	Demirjian method	1.02-1.69	1.20-1.36	p<0.05
Nur et al. <sup>18</sup>	673	2012	Demirjian method	0.86-0.54	0.86-0.54	p<0.05
Celikoglu et al. <sup>17</sup>	807	2010	Demirjian method	0.4-1.3	0.2-1.9	p<0.05

## Conclusion

Teeth are generally developed earlier in females than in males between 17.0-17.9years. In the present study, modified Demirjian method is adapted to the Turkish population. We suppose that similar studies should be published in different countries in order for the calculation of the dental age to yield more accurate results.

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## Conflict of interest

Author declares that there is no conflict of interest.

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