Agenesis of Third Molars among Turkish Children between the Ages of 12 and 18 Years: A Retrospective Radiographic Study

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***Purpose**: The aim of this study was to investigate the agenesis of third molars (M3) in children with permanent dentition in a limited population in the province of Izmir, Turkey. **Study design:** The panoramic radiographs of 773 patients (457 females, 316 males) were evaluated retrospectively at the Dental Hospital of Ministry of Health in İzmir, Turkey. The patients' ages ranged from 12–18 years. The agenesis of M3 teeth was investigated according to maxilla and mandible and right and left distribution. **Results:** In 593 of the patients (76.7%), all of the M3 teeth were present in the mouth; while in the other 180 (23.3%) patients, agenesis of a varying number of M3 teeth was identified. In 31 patients (4.0%), total M3 tooth agenesis was observed. A statistically significant relationship was not found between gender and M3 teeth (p=0.091). A statistically significant relationship was found between congenital M3 tooth agenesis and the maxilla (14.3%) and mandible (9.6%) (p<0.001). However, a statistically significant difference was not found between the right–left area of the jaw (p=0.100). **Conclusion**: As a result, while all M3 teeth were present in 76.71% of the population studied in the province of Izmir, agenesis of one or more than one M3 tooth was found in the other 23.29% of the patients studied.*

***Key words:** Agenesis, third molar, frequency, orthopantomography.*

INTRODUCTION

Researchers have stated that as the jaw has become smaller over time, it does not need some teeth due to changes in the human diet over time, such as the switching to soft foods; as a result of this, these teeth remain buried or do not occur at all.[1,2] The state of being remained buried or a deficiency are seen more in regards to the third molars (M3).[2]

The case of the agenesis of third molars involves dentists and at the same time is very important in anthropology. Human tooth development holds a very important place in the evolutionary process. It has been reported in studies conducted in the prehistoric era that the M3 teeth were very important for the survival of humans, and these teeth could find a place more easily in these humans due to the arc length in jaws being longer compared to today, which helped with the nutrition of these earlier humans.[2-5] It is said that a similar downsizing occurred in the length and width of the maxillary and mandibular arch over time in the mesiodistal and buccolingual direction of teeth.[5] Today, it is difficult to find a place in the maxillary and mandibular arches for M3 teeth, and they often remain buried. In addition to this, many anomalies in shape and size and the agenesis of one or many more M3 molars are found.[3,5]

A missing tooth is a common dental anomaly seen in primary and permanent teeth. Numerous studies have been made on this issue. Which tooth is most affected, sex, disease, and racial differences have all been investigated, and usually, the studies have been done

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by excluding data on M3 teeth.[3,4,6,7] However, it is known that there are social differences in the development of M3 teeth, and many new studies are currently being made carried out in this regard.[5,7-10]

Third molar teeth formation, calcification, position, and riding condition show social changes.[11] In the study by Daito et *al* ,[12] in which panoramic radiographs of the M3 teeth of 9111 children between the ages of 7 and 16 years were evaluated, they stated that calcification began in the maxilla and mandible as early as 7 years old, while the mean age for the initiation of calcification was 9 years, and the age for completion of the crowns for these teeth was 11 years in the maxilla and 12 years in the mandible.

Therefore, the age limit has been reported as between 7.5 and 11.8 years old.[13,14] Uzamıs *et al* [9] examined radiographs of the M3 teeth of Turkish children at aged between 6 and 13 years in their study, and they specified that the age for maxillary third molar crypt formation was 8 years, while mandibular third molars could be seen radiographically as early as 7 years. John et al.[5] stated that M3 teeth can be radiographically seen between the ages of 7 and 12 years in spite of ethnic differences, and they accepted the age of 10 years old as the lower limit in their study. For this reason, studies on M3 tooth agenesis are usually performed in children after the age of 12. These teeth are the teeth that last the longest, and can be expected to be seen at the average age of 17–25 years old.[13]

The M3 molars are the teeth in which congenital deficiency is the most prevalent. Despite the number of individuals with one or more teeth missing varying from society to society, it has been reported that this varies between 1.9% and 40%.[5,15-25,26*]

In studies conducted in different societies, the rate for individuals with one or more M3 teeth missing was reported by Bolaños [11] as 38% among the Spanish, while it was 22.5% among the Czechs by Rozkovcová *et al*,[16] 32.3% among Japanese by Endo *et al*,[17] 27.2% among Jordanians by Hattab *et al*,[22] 28.5% among Singaporean children by Mok *et al* ,[23] 17.3% in the Turkish by **Çelikoğlu** *et al*,[24] 15.7% in the north Indian population by Kaur *et al* , [25] 1.9% among African men by Chagula,[26] 27.4% among Koreans by Chung *et al*,[27] and 22.7% among Australians by Lynham *et al*.[28]

In addition to the rate of one or more missing M3 teeth differing among societies, the rate of four missing M3 teeth also varies between 1.4% and 5.5% [16,20,23 25].

There are numerous studies in which no relationship was found between gender and M3 tooth agenesis.[11,17,19-24] However, others found more missing teeth in males than females [16,25.29]

Although some researchers[5,23,30] claim that missing M3 teeth are more common in the maxilla than in the mandible, some suggest that there is no difference. [21,29]

Kajii T *et al* [30] reported that missing M3 teeth in Japanese society was higher in the maxilla (17%) compared to in the mandible (11.4%), and the difference was statistically significant. However, many researchers have stated that there is no difference between the right and left regions of the jaws with regard to missing M3 teeth. [5,7,16,21,23,29,30]

Many researchers in their studies have reported that a single missing M3 tooth is seen at the highest rate, followed by two, three, and four teeth.[18-22] Shinn,[19] Endo *et al* ,[17] and Mok *et al* ,[23] reported that the most frequent incidence of M3 agenesis was in two teeth, followed by one, four, and three teeth. Moreover, Barka *et al* [20] reported that the incidence of missing M3 teeth was higher for a single tooth and then for two, four, and three teeth.

This study was conducted to detect missing M3 teeth of 12–18-year-old patients who were admitted to Izmir Education and Dental Hospital of the Ministry of Health, where most dental patients are examined in the province of Izmir, by evaluating their panoramic radiographs and also comparing the results on M3 tooth agenesis with those in other countries.

MATERIALS AND METHOD

The study involved patients between the ages of 12 and 18 years who had applied to Izmir Education and Dental Hospital of the Ministry of Health between January 01, 2013, and December 31, 2013, and who underwent panoramic radiography. Patients for the study of panoramic radiography were not taken. Data were obtained by evaluating the patient files retrospectively. Patients with any congenital and/or systemic diseases were excluded. Radiographic data of 3092 regions, including each half jaw (maxilla–mandible, right–left), of 773 patients were evaluated, and the cases in which one, two, three, and all M3 teeth were missing were detected. In addition, M3 tooth agenesis was investigated according to jaw and gender. Approval was obtained from the Dokuz Eylul University Noninvasive ethics committee (protocol number: 1402-GO and decision number: 2014/09-10) in order to conduct the study.

Statistical Analysis

The Statistical Package for Social Science (SPSS) 20.0 software program (SPSS Inc., Chicago, IL, USA) was used for the evaluation of the study data. The percentage distribution, mean (±) standard deviation, and McNemar and kappa tests were used for the descriptive statistics. The chi-square test was applied in the comparison of variables of groups indicated by number, and $p<0.05$ was considered significant.

RESULTS

In the study, 773 patients in the age range of 12–18 (15.92 ± 1.73) years and the panoramic radiographs of 3092 teeth were examined; 457 of the patients (59.1%) were females and 316 (40.9%) were males. In the panoramic radiography, 593 (76.7%) patients had all M3 teeth present in the mouth, while the other 180 (23.3%) patients had congenital agenesis in one or more teeth. The number of teeth that M3 agenesis was seen in, in order of prevalence, was one (9.1%), two (8.0%), four (4.0%), and three (2.2%).

When M3 missing teeth was analyzed by gender, despite congenital agenesis being seen more in males than females, the difference was not significant (p=0.091). However, when all four missing M3 teeth were analyzed, congenital agenesis was seen more in males (6.0%) than in females (2.6%), and the difference was identified as statistically significant (p<0.001) (Table 1).

Table 1: Distrubition of M3 teeth agenesis by gender according to the number of missing teeth

Gender n (%)	1 tooth	2 teeth	3 teeth	4 teeth	Total
Males	30 (9.5)	28 (8.9)	9 (2.8)	19 (6.0)[a]	86 (27.2)[b]
Females	40 (8.8)	34(7.4)	8 (1.8)	12 (2.6)	94 (20.6)
Total	70 (9.1)	62 (8.0)	17 (2.2)	31 (4.0)	180 (23.3)

p<0.001[a], p=0.091[b]

The most common M3 tooth agenesis was observed in the upper-right tooth (15.1%), followed by the upper-left (13.5%), lower-right (10.2%), and lower-left teeth (8.9%). With regard to the relationship between gender and these teeth, it was found that agenesis of the upper-right and upper-left M3 teeth was more common in males than in females, and the difference was statistically significant ($p<0.007$, $p<0.001$, respectively). However, no statistically significant difference was found between gender and agenesis of the lower-right and lower-left M3 teeth ($p<0.478$, $p<0.105$, respectively) (Table 2).

The state of missing M3 teeth was examined according to the maxilla and mandible, and agenesis was higher in the maxilla compared to in the mandible; the difference was statistically significant ($p<0.001$) (Table 3). The total number of missing teeth in the maxilla and mandible were found to be 221 (14.3%) and 148 (8.6%), respectively.

The total number of missing M3 teeth was found to be 196 (12.7%) in the lower-upper-right side of the jaws, while it was 173 (11.2%) in the lower-upper-left side. In spite of the higher number of missing M3 teeth on the right side, the difference was not statistically significant ($p=0.100$).

Table 2: Distribution of M3 tooth agenesis according to teeth, gender, and age.

Age	Gender	n (%)	M3 teeth agenesis n (%)				Total number of M3 teeth agenesis
			18	28	38	48	
12	Male	28	7	8	3	3	**21**
	Female	26	9	8	7	7	**31**
	Total	**54 (6.9)**	**16 (2.1)**	**16 (2.1)**	**10 (1.3)**	**10 (1.3)**	**52 (14.1)**
13	Male	30	10	10	6	5	**31**
	Female	17	7	6	2	2	**17**
	Total	**47 (6.1)**	**17 (2.2)**	**16 (2.1)**	**8 (1.0)**	**7 (0.9)**	**48 (13.0)**
14	Male	20	9	7	2	2	**20**
	Female	16	5	5	4	3	**17**
	Total	**36 (4.7)**	**14 (1.8)**	**12 (1.5)**	**6(0.8)**	**5 (0.6)**	**37 (10.0)**
15	Male	50	10	9	2	9	**30**
	Female	67	8	3	4	4	**19**
	Total	**117 (15.1)**	**17 (2.2)**	**12 (1.5)**	**6(0.8)**	**13(1.7)**	**49(13.3)**
16	Male	63	8	9	8	7	**32**
	Female	117	9	7	6	8	**30**
	Total	**180 (23.3)**	**17 (2.2)**	**16 (2.1)**	**14 (1.8)**	**15 (1.9)**	**62 (16.8)**
17	Male	69	10	9	6	7	**32**
	Female	121	13	8	12	12	**45**
	Total	**190 (24.6)**	**23 (3.0)**	**17 (2.2)**	**18 (2.3)**	**19 (2.5)**	**77 (20.9)**
18	Male	56	7	6	4	6	**23**
	Female	93	5	9	3	4	**21**
	Total	**149 (19.3)**	**12(1.6)**	**15 (2.0)**	**7 (0.9)**	**10 (1.3)**	**44 (11.9)**
12-18	Male	316 (40.9)	61 (19.3)[a]	58 (18.4)[b]	31(9.8)[c]	39(12.3)[d]	189 (51.2)
	Female	457 (59.1)	56 (12.3)	46 (10.1)	38 (8.3)	40 (8.8)	180 (48.8)
	Total	**773**	**117(15.1)**	**104(13.5)**	**69(8.9)**	**79(10.2)**	**369**

$p<0.007$[a], $p<0.001$[b], $p<0.478$[c], $p<0.105$[d]

Table 3: The rates of M3 tooth agenesis in the maxilla–mandible and on the right–left sides of the jaws.

M3 Teeth	Maxillary (18-28)		Mandibular (38-48)		Right side (18-48)		Left side (28-38)	
n (%)	**Present**	**Absent**	**Present**	**Absent**	**Present**	**Absent**	**Present**	**Absent**
Male	513 (33.2)	119 (7.7)	562 (36.4)	69 (4.0)	531 (34.3)	102 (6.6)	662 (42.4)	87 (5.6)
Female	812 (52.5)	102 (6.6)	836 (54.0)	79 (4.6)	819 ((52.9)	94 (6.1)	716 (45.8)	96 (6.2)
Total	1325 (85.7)	221 (14.3)[a]	1398 (90.4)	148 (8.6)	1350 (87.3)	196 (12.7)[b]	1378(88.2)	173 (11.8)

[a] McNemar–Bowker Test, $t=19.028$, $p<0.001$.

[b]McNemar–Bowker Test $t=6.244$, $p=0.100$.

DISCUSSION

The most common agenesis among congenital teeth agenesis is M3 tooth agenesis and may occur due to a syndrome or without any reason.[5] The changes in eating habits within human evolutionary development may have caused changes in the structures of the jaw and teeth.[24] It has been reported in many studies that dietary habits and the work of the muscles of mastication affect craniofacial development.[5,17,31] It was reported in the study conducted by Katsaros [32] that masticatory muscle function provided transverse growth of the jaw and the width of the dental arch by directly affecting the skull.

Researchers have stated that the germs of M3 teeth start on average at 7 years of age and that calcification starts at 9 years. However, calcification has been observed between the ages of 7.5 and 11.8 on average due to social differences.[11-14] It was determined in a study conducted by Orhan *et al* [33] in Turkish children that M3 tooth germination of the maxilla and mandible occurs as early as 7 years of age. Similarly, many researchers reported that the calcification of M3 teeth begins as early as 7 years in the maxilla and mandible, while the mean age of calcification is 9 years, and the mean age for the completion of crowns is 11 years in the maxilla and 12 years in the mandible.[9,12,13,14] Baba-Kawano *et al* [34] specified that the germs of M3 teeth formed radiographically between the ages of 7 and 12 years, despite ethnic differences.

In line with these data, children between the ages of 12–18 were included in our study, and if the radiolucent areas of the maxilla–mandible and right–left M3 teeth were not visible, it was decided that those teeth were not present.

Many researchers have reported that the incidence of missing teeth varies between 1.9% and 40%, also stating that there are social differences in the incidence of M3 agenesis.[5,15,25,26] It has been reported that ethnic background and eating habits may play a role in these differences in the incidence of M3 tooth loss between communities.[5,16,18] M3 tooth loss ratios were found to be 32.3%, 22.5%, and 20.9% in Japanese,[17] Czechoslovakian,[16] and Greek populations,[20] respectively. John [5] reported in their study conducted on M3 missing teeth in three different ethnic groups that missing teeth were seen more in Chinese people (32%) compared to in Indians (21.4%) and Malaysians (25.5%). This is connected to Chinese people typically consuming food in small pieces, because they eat with sticks traditionally. It has been reported that the social differences were based on Indian and Malaysian cultures, in which the foods consumed are more fibrous and unprocessed and in which they are eaten mostly with the hands. Hence, this may have affected the development of the jaws. In the study conducted by Kazancı *et al* [35] in eastern Turkey, the rate of M3 agenesis was 23.8%. We found the incidence of M3 agenesis to be 23.3% in our study conducted in western Turkey, and these data are similar to the data of Kazancı *et al*. [35]

Although there are studies [that] indicating that there is no relationship between M3 tooth agenesis and gender,[11,17,19-24] there are also studies that indicate that there is a relationship. [5,12,16,25,29,36] John *et al*,[5] Daito *et al*,[12] and Harris *et al* [36] reported that M3 tooth agenesis was more common in females than in males. In the studies conducted by Rozkovcová *et al*,[16] Kaur *et al*,[25] and Liu *et al*,[29] M3 tooth agenesis was determined more in males than in females. In our findings, despite M3 tooth agenesis being higher in total in males than in females, no statistically significant difference was found, but a statistically significant difference was found in the agenesis of four M3 teeth.

Agenesis of the upper-right M3 tooth was found to be the most common missing tooth (15.1%), followed by agenesis of the upper-left (13.5%), lower-left (10.2%), and lower-right (8.9%) M3 teeth. With regard to its relationship with gender, it was detected that agenesis of the upper-right and left M3 teeth was more common in males than in females, and the difference was statistically significant. Likewise, although there was a difference between males and females in terms of agenesis of the lower-right and left M3 teeth, no statistically significant difference was found. In terms of the agenesis of all the right–left jaws and maxilla–mandible M3 teeth, the rate was 48.8% in females and 51.2% in males, and no statistically significant difference was found. In addition, Barka [20] and Rozkovcová [16] reported that agenesis of all the right, left, maxilla, and mandible M3 teeth was more common in females than in males, but this difference was not statistically significant.

In our study, the maximum incidence of M3 tooth agenesis was for a single tooth (9.1%), followed by for two (8.0%), four (4.0%), and three teeth (2.2%). Many researchers in their studies have stated, similar to our study, that the agenesis of three M3 teeth is seen at least.[20,37] In the study conducted by Kazancı *et al* [35] in eastern Turkey on 2579 patients, M3 tooth agenesis was found to be 9.2% in a single tooth, 8.3% in two teeth, 3.7% in four teeth, and 2.6% in three teeth, which is compatible with our study data. The data of these studies conducted in the eastern and western parts of Turkey are quite compatible with each other.

While some researchers stated that M3 tooth agenesis was mostly seen in two teeth, one tooth, four teeth, and three teeth,[17,23], Hattab [22] reported that it was mostly seen in a single tooth, two teeth, three teeth, and four teeth.

In our study, the rate of agenesis of all M3 teeth was found to be 4.0%. In many studies, the rate of four missing M3 teeth varies between 1.4% and 8.4%. [16,20,23,25] The rate of four missing M3 teeth was reported to be 5.6% in the study by Kaur *et al* [25] and 8.4% in the study by Barka. [20]

With regard to M3 tooth agenesis in the maxilla and mandible, there are some studies suggesting that there is a statistical difference[5,23,30], as well as other studies suggesting that there is no difference. [21,29] John *et al* [5] reported M3 tooth agenesis to occur at a rate of 17% in the maxilla and 11% in the mandible, while Mok *et al* [23] reported it to occur at a rate of 17% in the maxilla and 11.4% in the mandible. They also found statistical differences. Moreover, Rozkovcová [16] revealed that M3 tooth agenesis occurred at a rate of 14.3% in the maxilla and 15.0% in the mandible, and they found no statistical differences. Also, in our study, the number of missing M3 teeth was higher in the maxilla (14.3%) than in the mandible (8.6%), which was statistically significant.

Our study revealed that the rate of M3 tooth agenesis was 12.7% on the right side of the jaws and 11.2% on the left side of the jaws, and no statistically significant difference was found.

It was found in the data that we obtained that M3 agenesis was highest in the upper-right tooth (15.1%), followed by the upper-left (13.5%), lower-right (10.2%), and lower-left (8.9%) M3 teeth. John [5] reported that missing tooth was highest in upper-right teeth and lowest in the left M3 teeth.

While many researchers state that M3 tooth agenesis is more common in the maxilla than in the mandible, they could not find any difference between the left and right regions.[5, 7,16,17,20,21,23,25,29,30,35] It was determined in our study, similar to these studies, that the rate of missing M3 teeth is significantly higher in the maxilla (14.3%) than in the mandible (9.6%), but there is no statistically significant difference between the left (11.2%) and right (12.7%) regions.

As a result, the rate of congenitally missing teeth in society is highest in M3 teeth. However, due to social and ethnic differences, M3 agenesis is indicated as demonstrating significant differences between countries. Therefore, it is important that each country finds its own reliable data. The prevalence of missing M3 teeth was determined in the present study among a new generation of young people living in the province of Izmir, located in the west of Turkey. Therefore, we believe that performing similar studies on M3 agenesis in all regions of Turkey is meaningful.

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