

Presence of third molars in orthodontic patients from northern Greece

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Objective: The purpose of the present study was to investigate the frequency of presence of third molar teeth and their distribution in each jaw and each side, according to sex, in a group of orthodontic patients with permanent dentition from northern Greece.

Methods: The sample included panoramic radiographs from 220 patients with permanent dentition (mean age 13.62 ± 1.81). The χ^2 test was used to assess the relationships between the variables, and the Fisher's exact test was used in cases where the expected frequencies in each cell were <5 .

Results: The frequency of third molar presence was 79.1%, and 20.9% was the frequency of third molar agenesis. Intersexual differences in the number of third molars was not statistically significant. There was a correlation between the distribution of third molars on the right and the left side (Fisher's exact test = 100.788; $P = 0$). The two sides showed the same tendency toward the presence or absence of third molars. A correlation was also found between the distribution of maxillary and mandibular third molars (Fisher's exact test = 24.372; $P = 0$). In each jaw, the presence or absence of third molars was highly related to the number of third molars found in the other jaw.

Conclusion: The present results showed that in this orthodontic group of northern Greek patients, presence accounted for 79.1% and agenesis for 20.9%. No significant difference was found between the frequencies of third molar presence on the left and right sides in either the maxilla or mandible.

Keywords: third molars, presence, orthodontic population, Greeks

Third molars (M3s) can be present or absent in the oral cavity. Their presence is characterized by the considerable variability in eruption timing, the level of eruption, and their angular positions. In addition, as they are the last teeth to develop, they are most frequently impacted. Many complications, such as caries and distal root resorption of the adjacent second molar teeth or late crowding of the anterior teeth, have been attributed to the presence of M3s, which may compromise the results of orthodontic treatment.

The development stage of the M3s has been explored by several authors in different populations. According to Massler et al¹ M3 calcification starts at 7–10 years of age, calcification of the crown is completed at 12–16 years of age, and eruption begins at 17–21 years of age. Garn et al² reported that the age limit for M3 genesis is 13 years, while Richardson³ suggested that M3 genesis may occur up to the age of 16 years old. In Japanese and Israeli populations,^{4,5} it is reported that calcification of M3s begins at approximately 8 years and that the average age for completion of the M3 crowns is

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12 years, while in Spanish children the onset of mandibular M3 formation was observed at very variable ages, ranging from 5.86 to 14.66 years.⁶

To date, the causes of agenesis of one or more M3s are essentially unknown. Several mechanisms have been suggested, such as physical disruption of the dental lamina and the absence of an epithelial signal to the ectomesenchyme,⁷ the failure of a tooth bud to reach a critical size,⁸ or more proximately, to receive the signaling to continue development.⁹ Space limitation and crowding are also involved in the agenesis of M3s¹⁰ as well as racial variations in facial growth, jaw size, and tooth size.¹¹

The aim of this descriptive study was to investigate the presence of M3s in a group of orthodontic patients with permanent dentition from northern Greece. The presence of M3s in each jaw, according to sex, and their relationships were also investigated. It was considered worthwhile to explore the status of M3s in this population and to compare the obtained data with the results of previous studies conducted on American, European, and Asian patients.

Methods

In the present study, we examined the initial panoramic radiographs of orthodontic patients consecutively selected from the archives of the Postgraduate Clinic of the Department of Orthodontics, of the Aristotle University of Thessaloniki, Greece. The radiographs were part of the standard diagnostic records and were taken with the same equipment (Orthopantomograph 10E; Palomex Instrumentarium Corp, Hyryla, Finland).

A total of 618 clinical records were initially examined (274 males and 344 females). These patients had been referred to our clinic from May 25, 1995 to September 14, 2009, and they had either finished or were still receiving orthodontic treatment. All subjects were treated by postgraduate students of the department under the supervision of faculty members.

Inclusion criteria were complete records, ie, medical and dental history, treatment plan, study casts, as well as panoramic and lateral cephalometric radiographs taken before and after treatment. Exclusion criteria were patients with congenital anomalies and syndromes, patients who abandoned the treatment plan or discontinued, and the poor quality of panoramic radiographs.

The group selected comprised 428 patients (249 females and 179 males). Two hundred eight patients were noted with mixed dentition, and 220 with permanent dentition. In the present study, the presence of M3s was explored only in

patients with permanent dentition ($n = 220$). Third molars refer to both impacted germs and erupted teeth. Signs of crypt formation or crown calcification signified the presence of the corresponding M3 germ. We classified teeth as developmentally missing when no evidence was found in the records that they had been extracted and when no sign of crypt formation or mineralization of the tooth crown was found on the panoramic radiographs.

We examined the number of M3s present per person as well as on the right or the left side in either the maxilla or the mandible and their relationships, for both males and females. The relationship between the distribution of M3s on the right and the left side as well as between the maxilla and the mandible were also evaluated for the total group.

Collected data were subjected to statistical analysis using SPSS software (v 19.0; SPSS Inc, Chicago, IL) and the level of significance for all analyses was set to $\alpha = 5\%$. The χ^2 test was used to assess the relationships between our variables. The Fisher's exact test was used in cases where the expected frequencies in each cell were <5 . The Fisher's exact test allows the computation of the exact probability of the χ^2 statistic in such cases.¹²

To check for diagnostic reproducibility, the radiographs of 35 randomly selected patients from the initial 428 of the study were re-evaluated after an 8-week interval by the same investigator. The McNemar statistical test¹³ showed no statistically significant differences.

Results

Table 1 shows the descriptive statistics for the patients' age. The mean age of the sample was 13.62 ± 1.81 years old.

The distribution of angle malocclusions for each gender is presented in Table 2. The observed differences between females and males in angle classification were not statistically significant.

Table 3 shows the percentage of each M3 (18, 28, 38, 48) for all our patients ($n = 220$) and for each sex as well. In most cases (90.9%) the upper left M3 was present, followed by the upper right M3 (90%), lower left M3 (89.5%), and finally lower right M3 (89.1%). Higher percentages were recorded for females but based on χ^2 statistics this difference was not found to be statistically significant.

The number of M3s found per person is shown in Table 4. All four M3s were found in 174 patients (79.1%), three M3s

Table 1 Descriptive statistics for age

	N	Minimum	Maximum	Mean	Std deviation
Age	220	9.51	18.22	13.6233	1.81930

Table 2 The results for Angle I, Angle II/1, Angle II/2, Angle II, Angle III, and unclassified malocclusions for each sex, respectively

	Sex		Total	P-value
	Male	Female		
Angle I				
No	72 (32.7%)	82 (37.3%)	154 (70.0%)	0.183
Yes	24 (10.9%)	42 (19.1%)	66 (30.0%)	
Angle II/1				
No	48 (21.8%)	72 (32.7%)	120 (54.5%)	0.275
Yes	48 (21.8%)	52 (23.6%)	100 (45.5%)	
Angle II/2				
No	79 (35.9%)	109 (49.5%)	188 (85.5%)	0.254
Yes	17 (7.7%)	15 (7.7%)	32 (14.5%)	
Angle II				
No	94 (42.7%)	122 (55.5%)	216 (98.2%)	1
Yes	2 (0.9%)	2 (0.9%)	4 (1.8%)	
Angle III				
No	91 (41.4%)	113 (51.4%)	204 (92.7%)	0.433
Yes	5 (2.3%)	11 (5.0%)	16 (7.3%)	
Unclassified				
No	96 (43.6%)	122 (55.5%)	218 (99.1%)	0.506
Yes	0 (0%)	2 (0.9%)	2 (0.9%)	

were found in 19 patients (8.6%), two M3s were present in 17 patients (7.7%), one M3 was present in four patients (1.8%), and absence of all M3s was found in six patients (2.7%). Females have four M3s present more frequently than males, but again no significant difference was found in the number of M3s according to sex ($P = 0.313$).

Table 5 summarizes the figures for patients with none, one, or two M3s present in the maxilla or the mandible and on the left or the right side and the frequencies according to sex. Two maxillary M3s were found in 194 patients (88.2%), and two mandibular M3s were found in 188 patients (85.5%). The distribution of M3s was equal for both sides (183 M3s on the right side, 184 M3s on the left side).

Table 3 The results for third molars 18, 28, 38, and 48, respectively

	Sex		Total	P-value
	Male	Female		
Third molar (18)				
No	14 (6.4%)	8 (3.6%)	22 (10.0%)	0.068
Yes	82 (37.3%)	116 (52.7%)	198 (90.0%)	
Third molar (28)				
No	13 (5.9%)	7 (3.2%)	20 (9.1%)	0.058
Yes	83 (37.7%)	117 (53.2%)	200 (90.9%)	
Third molar (38)				
No	10 (4.5%)	13 (5.9%)	23 (10.5%)	1
Yes	86 (39.1%)	111 (50.5%)	197 (89.5%)	
Third molar (48)				
No	11 (5.0%)	13 (5.9%)	24 (10.9%)	0.831
Yes	85 (38.6%)	111 (50.5%)	196 (89.1%)	

In each gender, the distribution of two M3s was found almost equal for both sides. Two left side M3s were found in 107 females (48.6%) and 77 males (35.0%), while two right side M3s were found in 108 females (49.1%) and 75 males (34.1%). These differences were not statistically significant. Moreover, two maxillary M3s were found in 115 females (52.3%) and 79 males (35.9%), while two mandibular M3s were found in 107 females (48.6%) and 81 males (36.6%). Although the frequency of the presence of M3s in either the maxilla or the mandible was found higher in females than in males, the χ^2 statistic revealed no significance.

The distribution of M3s on the right and the left side is depicted in Table 6. Since some cells (four in number) have an expected count <5 , the Fisher's exact test was used to assess the significance of the relationship (Fisher's exact test = 100.788; $P < 0.001$). The χ^2 statistic revealed a significant relationship, indicating that there is a correlation between the frequencies of M3 existence on the left and the right side. In most patients with both M3s present on the right side, M3s are present on the left side as well (95.1%). Out of the nine patients who had both right side M3s absent, six of them had both left side M3s absent too (66.7%), and the rest of them had just one M3 present on the left side (33.3%). In 28 patients, one right side M3 was absent. In those patients we observed that more frequently one left side M3 was absent too (60.7%), followed by the presence of both M3s on the left side (35.7%).

Table 7 shows the distribution of M3s present in the maxilla and the mandible. The χ^2 statistic revealed a significant relationship (some cells – four in number – have an expected count <5 , and the Fisher's exact test was used to assess the statistical significance of the relationship [Fisher's exact test = 24.372; $P < 0.001$]), indicating that there is a correlation between the frequencies of present M3s in the upper and the lower jaw. When patients had two maxillary M3s, most of them (89.7%) had also two mandibular M3s. In cases in which both maxillary M3s were absent, more frequently patients (43.8%) had two mandibular M3s or none (37.5%). Patients with one M3 absent from the maxilla, usually have both M3s present in the mandible (70%) and less frequently (20%) one. In the rest 10% of the cases, both M3s were absent in the mandible.

Discussion

In the present study based on panoramic radiographs, we attempted to determine the prevalence of M3 presence in a sample of orthodontic patients from northern Greece. The existence of M3s was investigated in patients with permanent

Table 4 The number of third molars found per person, in both sexes

	Number of third molars					Total	P-value
	None	One	Two	Three	Four		
Sex							
Male							
Patients	3	2	9	12	70	96	0.313
% of total	1.4%	0.9%	4.1%	5.5%	31.8%	43.6%	
Female							
Patients	3	2	8	7	104	124	
% of total	1.4%	0.9%	3.6%	3.2%	47.3%	56.4%	
Total							
Patients	6	4	17	19	174	220	
% of total	2.7%	1.8%	7.7%	8.6%	79.1%	100.0%	

dentition in order to evaluate the prevalence of M3 genesis in this population. Third molar presence refers to both impacted germs and erupted teeth. Early extraction of M3s because of dental disease or other eruptive complications was not noticed in our study group. In the present study, females noted higher percentages than males with regard to the presence of each of the four M3s (18, 28, 38, 48), but the intersexual differences were not statistically significant (Table 3). Unfortunately, to our knowledge, published data to make comparisons with our results are lacking. Hence, further research on the presence of each of the four M3s would be worthwhile in order to generate population-specific data and examine further intersexual differences among other populations.

Furthermore, we found that 79.1% of the subjects had all four M3s, while varying degrees of M3 agenesis were

Table 5 The results for the maxillary and the mandibular third molars, and the right and the left side third molars, for each sex respectively

	Sex		Total	P-value
	Male	Female		
Maxillary				
None	10 (4.5%)	6 (2.7%)	16 (7.3%)	0.054
One	7 (3.2%)	3 (1.4%)	10 (4.5%)	
Two	79 (35.9%)	115 (52.3%)	194 (88.2%)	
Mandibular				
None	6 (2.7%)	9 (4.1%)	15 (6.8%)	0.745
One	9 (4.1%)	8 (3.6%)	17 (7.7%)	
Two	81 (36.6%)	107 (48.6%)	188 (85.5%)	
Right side				
None	4 (1.8%)	5 (2.3%)	9 (4.1%)	0.154
One	17 (7.7%)	11 (5.0%)	28 (12.7%)	
Two	75 (34.1%)	108 (49.1%)	183 (83.2%)	
Left side				
None	4 (1.8%)	3 (1.4%)	7 (3.2%)	0.458
One	15 (6.8%)	14 (6.4%)	29 (13.2%)	
Two	77 (35.0%)	107 (48.6%)	184 (83.6%)	

noted in the rest (20.9% of the subjects) (Table 4). These results indicate that about three-quarters of the patients had all four M3s, which is close to the frequency of 76.2% reported by Kazanci et al¹⁴ for Turkish patients aged from 12 to 16 years. Our proportion was higher than that reported for the Jordanian¹⁵ (72.8%) and Chinese¹⁶ populations (71.5%) and closer to that seen in the Asian-Indian¹¹ (76%) and Japanese¹⁷ (77%) populations. However, our results differ from those reported for another Turkish population with ages ranging from 20 to 26 years where the presence of all four M3s accounted for 63.5%¹⁸ and from observations made on Spanish children where it was found that less than one-half of the subjects (38%) had all four M3s present.⁶ The lower

Table 6 The relationship between the right and the left side third molars, for the total sample

	Left side third molars			Total	P-value
	None	One	Two		
Right side third molars					
None					
Count	6	3	0	9	0
% within right side third molars	66.7%	33.3%	0.0%	100.0%	
% of total	2.7%	1.4%	0.0%	4.1%	
One					
Count	1	17	10	28	100.0%
% within right side third molars	3.6%	60.7%	35.7%	100.0%	
% of total	0.5%	7.7%	4.5%	12.7%	
Two					
Count	0	9	174	183	100.0%
% within right side third molars	0.0%	4.9%	95.1%	100.0%	
% of total	0.0%	4.1%	79.1%	83.2%	
Total					
Count	7	29	184	220	100.0%
% within right side third molars	3.2%	13.2%	83.6%	100.0%	
% of total	3.2%	13.2%	83.6%	100.0%	

Table 7 The relationship between the maxillary and the mandibular third molars, for the total sample

	Mandibular third molars			Total	P-value
	None	One	Two		
Maxillary third molar					
None					
Count	6	3	7	16	0
% within maxillary third molar	37.5%	18.8%	43.8%	100.0%	
% of total	2.7%	1.4%	3.2%	7.3%	
One					
Count	1	2	7	10	
% within maxillary third molar	10.0%	20.0%	70.0%	100.0%	
% of total	0.5%	0.9%	3.2%	4.5%	
Two					
Count	8	12	174	194	
% within maxillary third molar	4.1%	6.2%	89.7%	100.0%	
% of total	3.6%	5.5%	79.1%	88.2%	
Total					
Count	15	17	188	220	
% within maxillary third molar	6.8%	7.7%	85.5%	100.0%	
% of total	6.8%	7.7%	85.5%	100.0%	

proportion of M3 presence in the later study may be attributed to the very young age of the patients they included in their study (their sample ranged from 4 to 20 years old). Higher frequency of M3 germs was reported for black Americans compared to white Americans.¹⁹ These racial differences are interesting and suggest that some polygenetic inheritance on formation of M3 germs may differ among populations and races.

According to our results, it is most common for four M3s to be present (79.1%), followed by three (8.6%), two (7.7%), none (2.7%), and one (1.8%) (Table 4). The same tendency was noted for the Turkish^{14,18} and Asian–Indian¹¹ populations. Nevertheless, studies performed in Jordanian,¹⁵ Czech,²⁰ and Spanish⁶ patients showed different results with regard to the order of frequency of present M3s.

The incidence of just one of any of the M3s congenitally missing in our study group occurred in 20.9%, which is significantly lower than that reported for Spanish children (62%)⁶ and lower but closer to that recorded for the Chinese population (28.5%).¹⁶ In contrast, our results were significantly higher than that recorded for Czech patients (10.9%).²⁰ Interestingly, percentages recorded in the present study were very close to the data reported by Kazanci et al¹⁴ for a Turkish population (23.8%), suggesting that the prevalence and distribution of M3s in the Turkish population show the same tendency with the Greeks.

Intersexual comparisons revealed no significant differences in the incidence of M3 agenesis, despite the higher percentage noted for males than that for females (11.8% and 9.1%, respectively) (Table 4). The male predominance of M3 agenesis agrees with the results reported for Jordanian students¹⁵ but differs from data reported for Turkish¹⁸ and Asian–Indian¹¹ populations. However, all the above-mentioned investigators concluded that intersexual differences were not statistically significant, which is in agreement with our findings. No significance was also reported for the Turkish,^{14,21} Chinese,¹⁶ Japanese,¹⁷ and Spanish⁶ populations.

On the other hand, Rozkovicová et al^{20,22} and Liu et al²³ reported that the intersexual differences were statistically significant, with M3 agenesis being more common in men than in women. A greater male–female difference was also found in whites compared to blacks.¹⁹ In blacks the frequencies of agenesis were not statistically different, but in whites a statistical difference was found. White females were 1.8 times as likely to have a missing mandibular M3 than males.¹⁹

According to the results of a survey conducted by Daito et al⁴ in Japanese people, 9.5% of the males and 12% of the females had no M3s. In contrast, in our study the agenesis of all M3s was found significantly lower and equal for both sexes (1.4%) (Table 4). The number of absent M3s was also evaluated for both sexes in a Czech population, and the authors reported that in males, the most frequent agenesis was of one, next of two, then of three, and last of four M3s, while in females, agenesis of two was in first place, then that of one, and last and equal of three and of four M3s.²⁰ Our observations, however, showed different frequencies of agenesis in both sexes. In males, it was most common for one M3 to be absent, followed by two, four, and three, while in females in most cases there was agenesis of two M3s, next of one, then of four, and last of three M3s (Table 4).

The incidence of M3 agenesis was found equal for both sides in our study (Table 5). Hence, our findings are in accordance with data reported by many other investigators who showed that the differences between the two sides were not significant.^{11,14–17,23} Moreover, according to our results no sexual dimorphism was found in the number of M3s between the two sides (Table 5). These data may indicate a genetic trend for no predilection in the agenesis of M3s regarding the sides in both males and females.

Studies performed in different populations demonstrate that the majority of missing M3s were located in the maxilla, with the differences being statistically significant.^{14,16,17,21} Hattab et al¹⁵ and Sandhu and Kaur¹¹ also reported that congenitally

missing M3s showed a greater predilection for the maxilla over the mandible. They found that bilateral agenesis of M3s in the maxilla compared to the mandible was higher with a ratio of 2:1 and 3:1, respectively.^{11,15} In the present study, the ratio for the bilateral agenesis of M3s in the maxilla compared to the mandible was approximately 1:1 (Table 5). Moreover, no significant difference was found between the frequencies of at least one M3 missing in the maxilla and the mandible. Our results may indicate a population-specific feature for this Mediterranean race, but further studies need to be conducted in wider samples of the Greek population to support our findings.

In the present study, the χ^2 statistic revealed a significant relationship indicating that there was a correlation between the distribution of M3s on the left and the right side (Table 6) (Fisher's exact test = 100.788; $P = 0$). When both M3s were present on the right side, M3s were present on the left side as well. Accordingly, when both right side M3s were absent, both left side M3s were more frequently absent too. Lastly, when one M3 was found on the one side, another one was found on the opposite side as well. These findings suggest that the two sides show the same tendency toward the presence or absence of M3s.

Additionally, a correlation was also found between the distribution of maxillary and mandibular M3s (Fisher's exact test = 24.372; $P = 0$) (Table 7). It seems that in each jaw, the presence or absence of M3s is highly related to the number of M3s found on the other jaw. When one M3 is found in either the maxilla or the mandible, most frequently two M3s are expected to be found in the other jaw, and when two M3s are present in either the maxilla or the mandible, two M3s are also expected to be present in the other jaw.

Conclusion

The present results showed that in this orthodontic population from northern Greece, M3 presence accounted for 79.1% and M3 agenesis for 20.9%. Differences with other studies were noticed with regard to the frequencies of missing M3s in the upper and lower arches. According to these reports, the frequency of M3 agenesis was found greater in the upper jaw, while in our study no significant difference was found between the frequencies of M3 presence in the maxilla and the mandible. Such differences among studies of the prevalence of M3s performed in different populations may be attributed to differences in sample sizes, statistical methods, diagnostic criteria, and the selection of the target population. Environmental and genetic etiological factors may also explain these deviations. Therefore, variations in the prevalence of M3s seem to be inevitable among different populations.

Disclosure

The authors report no conflicts of interest in this work.

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