Original Article

Patterns of third-molar agenesis in an orthodontic patient population with different skeletal malocclusions

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ABSTRACT

Objective: To examine the relationship between third-molar agenesis and different skeletal malocclusion patterns.

Materials and Methods: Pretreatment records of 1046 orthodontic patients (aged 13–17 years; mean age, 14.07 ± 1.27) were used. Third-molar agenesis was calculated with respect to genders, number of missing teeth, jaws, and skeletal malocclusion patterns. The Pearson chi-square test was performed to determine potential differences.

Results: Among the 1046 subjects, 237 subjects were diagnosed with third-molar agenesis (22.7%) with no statistical gender difference ($P > .05$). It was more common in the maxilla than in the mandible or in both jaws ($P < .01$). The prevalence of patients with a third-molar agenesis was the most commonly found type ($P < .001$). The prevalence of third-molar agenesis in those with a Class III malocclusion was significantly higher than in those with Class I or Class II ($P < .05$). However, there was similar prevalence among the hyper-divergent (24.5%), normal (23.8%), and hypo-divergent (19.2%) groups ($P > .05$).

Conclusion: These results suggest that agenesis of the third molar does not depend on vertical patterns of the skeletal malocclusions, but does depend on sagittal skeletal malocclusions in this orthodontic patient population. (*Angle Orthod.* 2012;82:165–169.)

KEY WORDS: Third-molar agenesis; Hypodontia; Skeletal malocclusion

INTRODUCTION

The third molar (M3) is a tooth characterized by the variability in the time of its formation, its widely varying crown and root morphology, and its varying presence or absence in the oral cavity.[1] Agenesis of one or more permanent teeth is a common anomaly in man and many reports on M3 agenesis have been published for different populations over the last 50 years.[1–10] The frequency of M3 agenesis in these studies ranged from 14% to 51.1%. The wide range of prevalence of this anomaly might be attributed to the differences in the methods of sampling and examination, age and sex distribution, and racial origin of the subjects. According to Nanda[11] and Celikoglu et al.,[4] the most frequent agenesis was of one, two, three, and four M3s; whereas, for Mok and Ho[12] and Banks,[13] the most frequent agenesis was of two M3s followed by one, four, and then three M3s.

M3 agenesis has been associated with dental numeric and structured variations. Garn et al.[14] have suggested that when a M3 is absent, agenesis of the remaining teeth is 13 times more likely. According to some authors, M3 agenesis seems to predispose for reduced size and delayed development of certain teeth.[11]

On the other hand, the relationship between M3s and crowding has been debated for many years.[2,3,15] Posterior crowding is thought to have an inhibitory effect on eruption of the second and third molars and may cause relapse after orthodontic treatment, regardless of whether premolars have been extracted.[6]

A limited number of studies have been carried out to evaluate the relationship between M3 agenesis and different skeletal malocclusion patterns. On the basis of these facts, the aim of this study was to examine the relationship between M3 agenesis and different skeletal malocclusion patterns.

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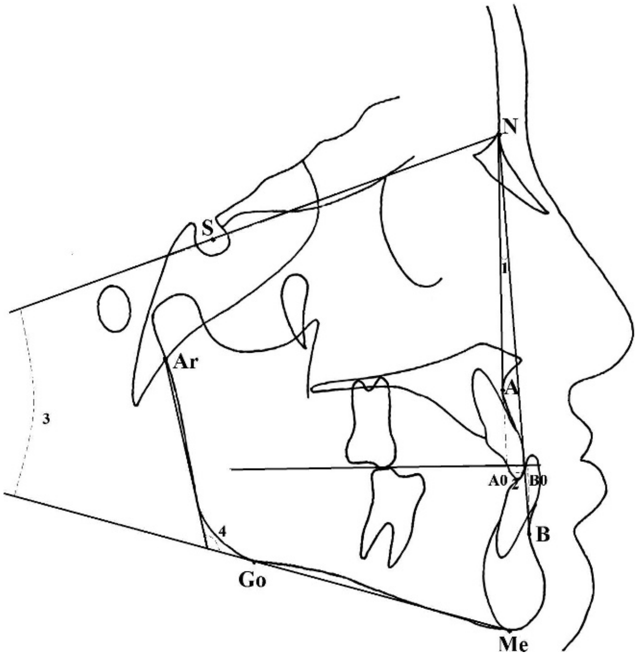

Figure 1. The measurements used in this study to determine sagittal and vertical skeletal relationship: S indicates sella; N, nasion; A, point A; B, point B; Go, gonion; Me, menton; Ar, articulare. (1) ANB (°); (2) Wits (mm); (3) SN-GoMe (°); (4) Gonial (°).

MATERIALS AND METHODS

This study was undertaken with the pretreatment records, including anamnesis and radiographs, of 1067 patients who were randomly selected from the files of the orthodontic patients treated at the department of orthodontics in the Karadeniz Technical and Kirikkale universities. The inclusion criterion was that the patients were between 13 and 17 years old and had not received previous orthodontic treatment. Subjects with congenital deformities, such as a cleft palate, and with radiographs of poor quality were excluded from the study. In addition, the subjects with a missing tooth other than a M3 were not included in the study. The subjects were also checked to confirm that they had not undergone surgical removal or extraction of one or more M3s. In line with these criteria, 21 subjects were excluded. Finally, a total of 1046 patients (mean age, 14.07 $\pm$ 1.27 years) were included in this study. Approval from the ethics committee was not required for this retrospective study.

A M3 was classified as developmentally missing when there was no evidence in the records that it had been extracted and when there was no sign of mineralization of the M3 tooth crown on the panoramic radiographs. Panoramic radiographs taken at the initial examination were used to determine the presence of M3 germs. In cases in which it was impossible to judge the presence of M3 germs from panoramic radiographs taken at the initial examination, subsequent panoramic radiographs taken before the age of 17 years were used. The lateral cephalometric films of all patients were traced and the anterior-posterior skeletal relationship of the maxilla and mandible was classified as skeletal Class I (with minor crowding or spacing, ANB angle between 1° and 5°), Class II (maxillary protrusion and/or mandibular retrusion, ANB angle >5°), and Class III (mandibular prognathism and/or maxillary retrusion, ANB angle <1°) using the measurements of the Wits and ANB angle. SN-GoMe and gonial angles were also measured from the lateral cephalometric films for classification of vertical skeletal relationship as being hypo-divergent, normal, and hyper-divergent (hypo-divergent: SN-MP angle <27°; normal: SN-MP angle between 27° and 37°; hyper-divergent: SN-MP angle >37°) (Figure 1).[16]

Table 1. The Comparison of Third-Molar Agenesis Between Genders

	Girls (%)	Boys (%)	Total (%)	*P*
Absence	145 (24.3)	92 (20.5)	237 (22.7)	
Existence	452 (75.7)	357 (79.5)	809 (77.3)	NS[a]
Total	597 (100.0)	449 (100.0)	1046 (100.0)	

[a] NS indicates nonsignificant.

All assessments were performed by one investigator in a darkened room with a radiographic illuminator to ensure contrast enhancement of tooth images. To avoid observer bias, each panoramic radiograph was coded with a number, and thus the observer was blinded for the skeletal patterns of the patient. The M3 agenesis was calculated with respect to genders, number of missing teeth, jaws, and skeletal malocclusion patterns. The Pearson chi-square test was performed to determine potential differences in the distribution of M3 agenesis when stratified according to the above parameters.

To determine the errors associated with digitizing and measurements, 50 radiographs were selected randomly. All procedures such as landmark identification, tracing, and measurements were repeated 3 weeks after the first examination by the same investigator. A paired *t*-test was applied to the first and second measurements. The difference between the first and second measurements of the 50 radiographs was insignificant. Intraclass correlation coefficients were performed to assess the reliability of the measurements as described by Houston,[17] and the coefficients of reliability of the measurements were between .92 and .97. In addition, randomly selected radiographs were evaluated by another researcher 4 weeks after the initial survey to determine the reliability of diagnosis of the M3 agenesis. There was 100% agreement between the investigators. All statistical analyses were performed using the SPSS software package (Statistical Package for Social

Table 2. Characteristic Features of Patients With Third-Molar Agenesis

	n	Prevalence (%)	P
Maxillary	99	41.8	<.01
Mandibular	59	24.9	
Maxillary/mandibular	79	33.3	
1 tooth agenesis	96	40.5	<.001
2 teeth agenesis	73	30.8	
3 teeth agenesis	26	11.0	
4 teeth agenesis	42	17.7	

Sciences, version 11.5, SPSS Inc, Chicago, Ill). A $P < .05$ was considered statistically significant.

RESULTS

Among the 1046 subjects, 237 were diagnosed with M3 agenesis. Therefore, the overall prevalence of M3 agenesis was 22.7% in this orthodontic population (Table 1). Girls (24.3%) were found to have more M3 agenesis as compared with boys (20.5%) ($P > .05$).

Table 2 shows the characteristic features of the patients with M3 agenesis. It was found more in the maxilla (total of 99 patients, 41.8%) than in the mandible (total of 59 patients, 24.9%) or in both jaws (total of 79 patients, 33.3%) ($P < .01$). Among the patients with M3 agenesis, the prevalence of patients with one, two, three, or four missing tooth/teeth were 40.5%, 30.8%, 11.0%, and 17.7%, respectively ($P < .001$). As can be seen in the table, there is a significant difference in the occurrence of M3 agenesis between the jaws ($P < 0.01$) and between the number of M3s ($P < .001$).

The subjects with lateral cephalograms were classified as having a skeletal Class I, II, or III malocclusion based on the cephalometric variables ANB angle and Wits appraisal. The prevalence of M3 agenesis in those with a Class I, Class II, or Class III malocclusion was 20.3%, 19.9%, and 28.4%, respectively. The prevalence of M3 agenesis in those with a Class III malocclusion was significantly higher than in those with a Class I ($P < .05$) or a Class II ($P < .01$). On the other hand, there was similar prevalence among the hyper-divergent (24.5%), normal (23.8%), and hypo-divergent (19.2%) groups ($P > .05$) (Table 3).

Distribution of M3 agenesis according to the different skeletal patterns is shown in Figure 2. In all skeletal malocclusion patterns, the M3 was most commonly absent in the maxilla. In addition, the most frequent agenesis was of one, two, four, and three M3s; whereas, for hyper-divergent subjects, the most frequent agenesis was of one M3 followed by two, three, and four M3s. When we assessed the distribution of the number of M3 agenesis among the skeletal classes, we found that subjects with Class III malocclusions more agenesis of two and four of M3 than the subjects with Class I and II malocclusions had ($P <$ .05). Maxillary M3s were more frequently found to be absent in the subjects with Class III malocclusion, whereas mandibular M3s were more frequently absent in the subjects with Class II malocclusion (Table 4).

DISCUSSION

The reports published by Gravely[1] and Garn et al.[14] suggested that the upper age limit for M3 genesis is 13 years of age. Additionally, there were some reports[13,18,19] showing that M3 development was as late as 14 or 15 years of age. Therefore, in cases in which it was impossible to judge the presence of M3 germs from panoramic radiographs taken at the initial examination, subsequent panoramic radiographs taken during orthodontic treatment were used.

The frequency of M3 agenesis in this study was 22.7%, which is more than that reported by Levesque et al.[20] for French Canadians (9.0%) and by Kruger et al.[21] for the New Zealand population (15.2%). However, the frequency of the M3 agenesis in the present study group is very similar to that noted by Lynham,[22] Grahnen,[10] and Kazanci et al.,[5] who noted that 22.7%, 24.6%, and 23.8% of the patients, respectively, had M3 agenesis. Differences of prevalence of M3 agenesis seen among studies on different populations might be due to racial variation, differences in sample sizes, and diagnostic criteria. Although Daito et al.[8] showed that M3 agenesis was more common in females than in males, the results of many reports[4,5,10,22] showed that significant sex difference was present. In agreement with those studies, we found that M3 agenesis was more common in girls.

Table 3. Distribution of Patients With Third-Molar Agenesis in Sagittal and Vertical Skeletal Malocclusions

		Absence	Existence	Total	Prevalence (%)	P
Sagittal skeletal malocclusions	Class I	74	290	364	20.3	<.05
	Class II	72	290	362	19.9	
	Class III	91	229	320	28.4	
Vertical skeletal malocclusions	Hypo-divergent	61	258	318	19.2	NS[a]
	Normal	85	272	357	23.8	
	Hyper-divergent	91	280	371	24.5	

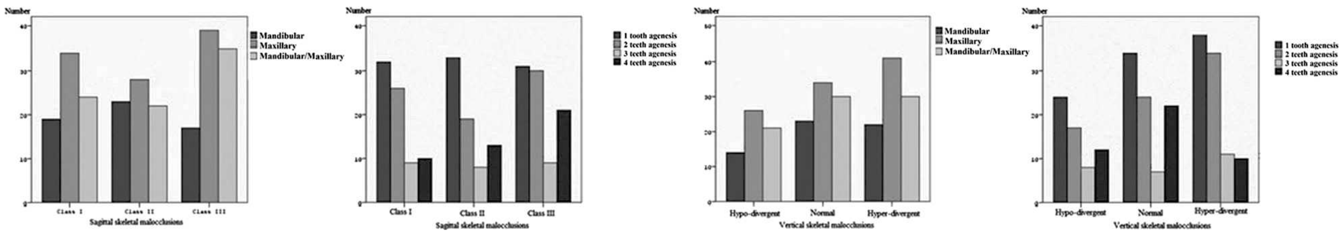

Figure 2. Distribution of the third-molar agenesis according to the different skeletal patterns.

According to Banks,[13] it is most common for two M3s to be missing, followed by one, four, and three. On the other hand, according to some studies,[23,24] the order of frequency for the M3 agenesis is one, two, three, and four M3s. The order of frequency for M3 agenesis in this study is incompatible with the reports published by those authors.[13,23,24] In agreement with a recently published paper,[4] the order of the frequency for M3 agenesis was found to be one, two, four, and three M3s. Furthermore, Kazanci et al.,[5] Daito et al.,[8] Mok and Ho,[12] and Sandhu and Kaur[25] reported that M3 agenesis was observed with a higher frequency in the maxilla; this was in agreement with our results. In addition, significant differences in the occurrence of M3 agenesis between the jaws ($P < .01$) and between the number of M3s ($P < .001$) were found in this study. The reason there may be a difference in M3 agenesis in the upper and lower arches is also not clear.[6]

There have been some reports[26,27] showing that the skeletal morphology of hypodontia patients includes a tendency toward skeletal Class III pattern. Unfortunately, there have been few reports on the relationship between the existence of M3 germs and facial structures. As shown in Table 3, the percentage of skeletal Class III subjects with M3 agenesis was higher than that of skeletal Class I ($P < .05$) and Class II subjects ($P < .01$). However, there was no specific trend observed in the vertical dimension for the examined patients with a similar prevalence in the hypo-divergent (19.2%), normal (23.8%), and hyper-divergent (24.5%) groups ($P > .05$). A limited number of studies[16,27] stated that the vertical relationship for hypodontia patients in the studied populations showed with a similar prevalence in hyper-divergent, normal, and hypo-divergent groups. In our study, we found that the M3 agenesis was the least for the patients with the hypo-divergent pattern. On the other hand, Sanchez et al.[28] found that agenesis of maxillary M3s was related to a reduced mandibular plane angle.

Distribution of M3 agenesis according to the different skeletal patterns, shown in Figure 1, gives valuable information. According to this new information, in all sagittal and vertical skeletal malocclusion patterns, M3s were most commonly absent in maxilla and least commonly in the mandible. Another interesting finding of this study was that the subjects with Class III malocclusions had more agenesis of two and four M3s than those with Class I and II malocclusions. In agreement with our finding, Kajii et al.[6] found that the prevalence of Class III subjects who had all four M3s was lower than that of subjects with Class II malocclusions. The authors stated that some polygenetic inheritance on formation of M3 germs may be related to genes that control maxillary and/or mandibular dimensions.

CONCLUSIONS

- M3 agenesis was most commonly observed in maxilla and less commonly in mandible for all skeletal patterns.
- The prevalence of patients with one M3 agenesis was the most commonly found type.
- The results suggest that agenesis of M3 germs depends on sagittal skeletal malocclusions in this orthodontic population.

Table 4. Characteristic Features of Patients With Sagittal Malocclusions

	Class I, n (%)	Class II, n (%)	Class III, n (%)	Total, n (%)	P
Agenesis of 4 M3s[a]	10 (23.8)	12 (28.6)	20 (47.6)	42 (100.0)	$<.05$
Agenesis of 3 M3s	9 (34.6)	8 (30.8)	9 (34.6)	26 (100.0)	NS
Agenesis of 2 M3s	24 (32.9)	19 (26.0)	30 (41.1)	73 (100.0)	$<.05$
Agenesis of 1 M3	32 (33.3)	33 (34.4)	31 (32.3)	96 (100.0)	NS
Presence of 4 M3s	290 (35.8)	290 (35.8)	229 (28.4)	809 (100.0)	NS
Maxillary	33 (33.3)	27 (27.3)	39 (39.4)	99 (100.0)	NS
Mandibular	19 (32.2)	23 (39.0)	17 (28.8)	59 (100.0)	NS
Maxillary/mandibular	23 (29.1)	22 (27.8)	34 (43.1)	79 (100.0)	NS

[a] M3 indicates third-molar agenesis; NS, nonsignificant.

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