the Journal of CONTEMPORARY DENTAL PRACTICE at www.thejcdp.com
Volume 3 Number 2 May 15, 2002

Pathologic Status and Changes in Mandibular Third Molar Position During Orthodontic Treatment

Metin Güngörmüş, DDS, PhD

Abstract

Purpose: The purpose of this study was to evaluate the changes in mandibular third molar (M3) position and pathologic status associated with M3 in the cases orthodontically treated.

Materials and Methods: This study was carried out on a total of 76 subjects, 42 males and 34 females ranging in age from 18 to 23 years. Thirty of them were treated without extractions (non-extraction group), 26 were treated with the extraction of four first premolars (extraction group), and 20 did not receive orthodontic treatment (control group). Positional changes of third molars and pathologic status associated with M3s in the cases treated orthodontically were evaluated radiographically and clinically. Data were analyzed with parametric and non-parametric tests.

Results: It was clinically observed that 18% of third molars in the non-extraction group and 15% of those in the extraction group erupted in normal position; 83% of third molars in both groups erupted partially in a mesioangular position. However, it was determined that 43% of the teeth that partially erupted developed pericoronitis and 4% had dental caries. It was determined radiographically that there was insufficient space for most of the M3s to erupt in the orthodontically treated cases and the angulations of these teeth were not sufficiently improved.

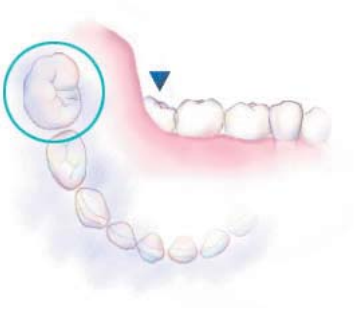
Conclusions: In this study, it was determined that 83% of the M3s in orthodontically treated cases partially erupted in a mesioangular position and 43% of these teeth were associated with pericoronitis.

Keywords: Orthodontic treatment, mandibular third molar

Citation: Güngörmüs M. Pathologic Status and Changes in Mandibular Third Molar Position During Orthodontic Treatment. J Contemp Dent Pract 2002 May;(3)2: 011-022.

Introduction

Third molar impaction is a major oral health problem. Unerupted or partially erupted third molars are often associated with various pathologic conditions such as pericoronitis, dental caries, root resorptions, cystic processes, and benign or malignant tumors of odontogenic origin.[1-11] Also, they have an impact on arch crowding and stability of orthodontic treatment.[12,13] The mandibular third molar (M3) is by far the most frequently impacted tooth after the maxillary third molar.[14] The prevalence of M3 impactions is variable in different populations, ranging from 9.5% to 39%.[15] The primary cause of third molar impaction is lack of alveolar arch space distal to the second molar.[16,17] However, it has been stated there is a greater increase in molar space in cases treated orthodontically with premolar extractions than those without the use of premolar extractions; third molars may erupt more often in the cases treated with premolar extraction.[17-19] In light of these findings and due to the controversy among dentists whether and when to extract third molars, the purpose of this study was to evaluate the changes in M3 position and the pathologic status associated with the M3 in cases treated orthodontically.



Materials and Methods

Patients

This study was carried out on a total of 76 subjects, 42 males and 34 females, ranging in age from 18 to 23 years. Thirty of the subjects were treated without extractions (non-extraction group) and 26 were treated with the extraction of the four first premolars (extraction group).

Orthodontic records were obtained from the clinic at the Department of Orthodontics, Atatürk University. All of the patients in the extraction and non-extraction groups were treated with completely fixed appliances using the edgewise technique. Orthodontic treatment continued for 2 years. A control group of 20 cases in which M3s had completely erupted in normal position was selected to compare with post-treatment findings of extraction and non-extraction groups. These subjects had not received any orthodontic treatment and none of them had any orthodontic problems. In addition, their M3s did not have any problems such as pericoronitis, dental caries, or cysts.

Clinical Procedure

Post-treatment clinical status of M3s (extraction and non-extraction groups) were recorded according to the following criteria:

1) unerupted, if the tooth was not clinically visible
2) partially erupted, if the crown was partially visible
3) erupted, the crown was completely visible

In addition, the pathologic status associated with these teeth was noted.

Radiological Procedure

Radiological evaluation was completed on cephalometric radiographs and panoramic radiographs for all three groups. Radiographs were evaluated using a standardized technique of tracing the images of the molar teeth on matte acetate paper overlying the radiographs.

The occlusal line was constructed through the cusp tips of the first molar and the second premolar. The mandibular line was constructed as a tangent to the two lowest points on the anterior and posterior borders of the mandible. The ramus line was constructed through the two most distal points of the ramus. The longitudinal axis of the M3 and the mandibular second molar (M2) were drawn through the occlusal middle point and the bifurcation point of the roots. Mesiodistal crown width of the M3 was measured as the greatest

distance between the mesial and distal surfaces of the crown. Third molar (retromolar) space was measured as the distance between the distal contact points of the second molar and the junction of the anterior border of ramus with the body of the mandible. M3 or M2 angulations were measured as the anterior angles formed between long axes of these teeth with mandibular line. (Figure 1)

The third molar space/crown width ratio was calculated by dividing the retromolar space by the mesiodistal crown width of the third molar. The gonial angle (Go) was measured as the angle formed by bisecting the ramus and mandibular lines.

The level of eruption was evaluated as the depth of the third molar in relation to the adjacent second molar. According to its eruption level, each third molar was assigned to one of four groups:

- Group 1, the highest part of the third molar was on the same level as or above the occlusal plane of the adjacent second molar

- Group 2, the highest part of the third molar was below the occlusal plane but above the cervical line of the second molar

- Group 3, the highest part of the third molar was on the same level as the cervical line of the second molar

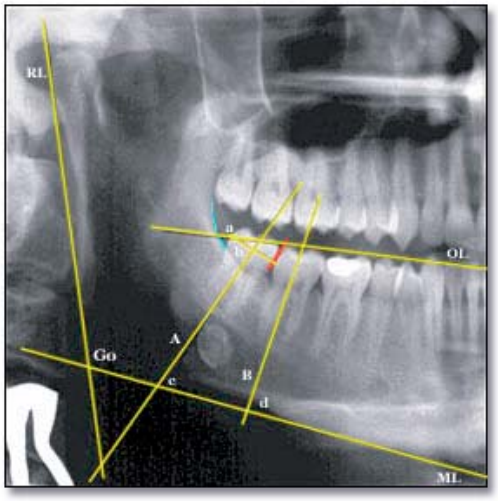


Figure 1. The occlusal line (OL), the mandibular line (ML), the ramus line (RL), the long axis of the mandibular third molar (A), the long axis of the mandibular second molar (B), third molar (retromolar) space (a), meslo-distal crown width of mandibular third molar (b), M3 angulation; the anterior angle formed between long axes of M3 with mandibular line (c), M2 angulation; the anterior angle formed between long axes of M2 with mandibular line (d). the gonial angle (Go)

- Group 4, the highest part of the third molar was below the cervical line but above the cementoenamel junction of the second molar

Error of the Method

In order to test the reliability of the angular measurements made on panoramic radiographs, the values of the Go taken from pantographs were compared with those of cephalometric radiographs.

Table 1. Clinical findings of extraction, non-extraction and control groups.

	Control (n=20)	Extraction (n=26)	Non-extraction (n=30)
Age	22.1 ± 0.3	20.7 ± 0.6	21.3 ± 0.5
Sex			
Female	9(45 %)	11(42 %)	14(47 %)
Male	11(55 %)	15(58 %)	16(53 %)
A number of M3 evaluated	40(26.32 %)	52(34.21 %)	60(39.47 %)
Clinical status of M3*			
Erupted		8(15 %)	11 (18 %)
Partially erupted		44(85 %)	49 (82 %)
Unerupted		-	-
Complications*			
Pericoronitis		18(41 %)	22(45 %)
Dental caries		1(2 %)	3(6 %)
No-problem		25(57 %)	24(49 %)

Mean ± SD, *Chi-square test

Table 2. Post-treatment and pre-treatment findings of non-extraction group.

	Pre-treatment (n=60) Mean ± SD	Post-treatment (n=60) Mean ± SD	P
M2 Angulation*	90.952 ± 7.496	95.589 ± 9.632	0.005
M3 Angulation *	64.512 ± 12.587	68.458 ± 13.548	0.0025
Space/width ratio *	0.321 ± 0.157	0.465 ± 0.347	0.001
Eruption Level **	2.587 ± 0.645	2.502 ± 0.658	>0.05

*Paired t test, ** Wilcoxon Paired test

Figure 2a. A sample pre-treatment panoramic radiograph from the non-extraction group.

Figure 2b. A post-treatment panoramic radiograph of the same patient from the non-extraction group.

There was no statistical difference between both measurements (P>0.05). All radiographs were evaluated and recorded by the same investigator. The evaluation was repeated by the same investigator two weeks later. The differences between the two evaluations were not statistically significant (P>0.05).

Statistical Analysis

Data were analyzed with the use of the computer program, Microsoft SPSS 6.0 for Windows. Pre-treatment radiographic findings of extraction and non-extraction groups were compared with the Student's t-test and with the Mann-Whitney U test. The post-treatment clinical findings of these patients were analyzed with the Chi-square test. The radiographic changes in the pre-treatment and the post-treatment of orthodontically treated cases were compared with the Paired t-test and with the Wilcoxon Pairs test. The differences between groups (control group and post-treatment extraction and non-extraction groups) were analyzed with a one-way analysis of variance (ANOVA) and with the Kruskal-Wallis test. The Duncan test and Mann-Whitney U test for pairwise comparisons were performed when the ANOVA and Kruskal-Wallis test indicated significant differences.

Results

Clinical Results

Clinical results are shown in Table 1. In the clinical study, the post-treatment status of 112 M3s were examined. The non-extraction group contained 60 teeth and the extraction group contained 52 teeth. It was observed that 11 (18%) of the M3s in the non-extraction group erupted in a normal position and 49 (82%) partially erupted. Eight (15%) of the M3s in the extraction group erupted in normal positions and 44 (85%) of the M3s partially erupted. It was determined there was not a clinically significant difference between extraction and non-extraction groups both in eruption status (X2=0.172) of third molars and in complications (X2=1.155) associated with third molars (P>0.05). However, it was observed that a total of 93 (83%) third molars, which partially erupted in both groups, erupted in a mesioangular position and in 40 (43%) of which pericoronitis occurred (18 cases; extraction group and 22 cases; non-extraction group) and 4 of them (4%) had dental caries.

Radiographic Results

In the pre-treatment group, there was no statistical difference in the eruption level of M3, M2, and M3 angulations and space/width ratio between extraction and non-extraction groups (P>0.05).

Table 3. Post-treatment and pre-treatment findings of extraction group.

	Pre-treatment (n=52) Mean ± SD	Post-treatment (n=52) Mean ± SD	P
M2 Angulation*	91.258 ± 8.632	92.547 ± 8.643	>0.05
M3 Angulation *	65.954 ± 12.395	67.251 ± 12.593	>0.05
Space/width ratio *	0.355 ± 0.351	0.599 ± 0.538	0.0001
Eruption Level **	2.852 ± 0.854	3.462 ± 0.765	>0.05

*Paired t test, ** Wilcoxon Paired test

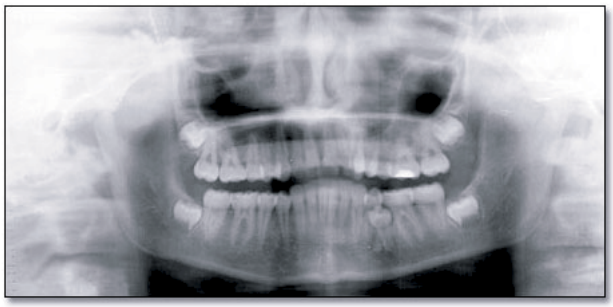


Figure 3a. A sample pre-treatment panoramic radiograph from the extraction group.

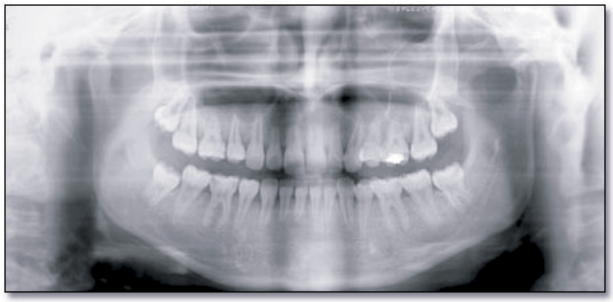


Figure 3b. A sample post-treatment panoramic radiograph of the same patient from the extraction group.

When comparing post-treatment findings with pre-treatment findings of non-extraction group, it was determined there was a statistically significant difference both in space/width ratio (P=0.001), M2 angulation (P=0,005), and M3 angulation (P=0.0025) as shown in Table 2. (Figure 2) However, it was determined there was only a statistically significant difference in the space/width ratio in extraction group (P=0.0001) as shown in Table 3. (Figure 3)

In the control group, it was observed the retromolar space/lower third molar mesio-distal width ratio was approximately 1. The angle between longitudinal axis of the M3 with the corpus plane was 95 degrees and the M2 angulation was 94 degrees. (Figure 4)

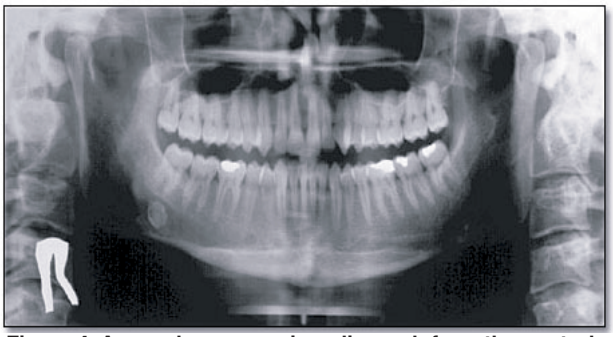


Figure 4. A sample panoramic radiograph from the control group.

It was determined there was a significant difference among groups (control group, post-treatment extraction, and non-extraction groups) in the other parameters (P=0.0001) except for M2 angulation.

The results of the Duncan test (P<0.05 level) indicated there was a statistically significant difference in the following:

- M3 angulation (P<0.05)
- the space/width ratio (P<0.05)
- the eruption level of M3 (P=0.0001) between both extraction and non-extraction groups and the control group

In addition, there was a significant difference between the extraction and non-extraction groups in eruption level of the M3 (P=0.0001) and space/width ratio (P=0.0001). (Table 4-5)

Discussion

The M3 is by far the most frequently impacted tooth after the maxillary third molar.[14] The prevalence of M3 impactions is variable in different populations, ranging from 9.5% to 39%.[15] The primary cause of third molar impaction is lack of alveolar arch space distal to the second molar.[16,17] Third molars erupt if there is enough space and if the inclination of the tooth is favorable.[17,20]

Table 4. Radiographic results of extraction, non-extraction and control groups.

	Control (n=40) Mean ± SD	Non-extraction (n=60) Mean ± SD	Extraction (n=52) Mean ± SD	P
M2 Angulation*	94.428 ± 8.524	95.589 ± 9.632	92.547 ± 8.643	>0.05
M3 Angulation *	95.950 ± 8.148	68.458 ± 13.548	67.251 ± 12.593	0.0001
Space/width ratio *	1.064 ± 0.206	0.465 ± 0.347	0.599 ± 0.538	0.0001
Eruption Level **	1.00 ± 0.00	2.502 ± 0.658	3.462 ± 0.765	0.0001

*ANOVA, ** Kruskal-Wallis test

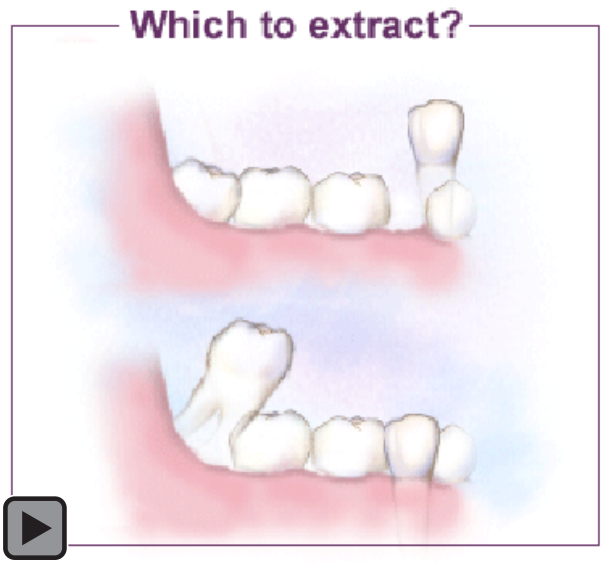
Table 5. The statistical differences among post-treatment extraction and non-extraction and control groups

	Control Extraction	Control Non-extraction	Extraction Non-extraction
M3 Angulation *	P<0.05	P<0.05	P>0.05
Space/width ratio *	P<0.05	P<0.05	P<0.05
Eruption Level **	P=0.0001	P=0.0001	P=0.0001

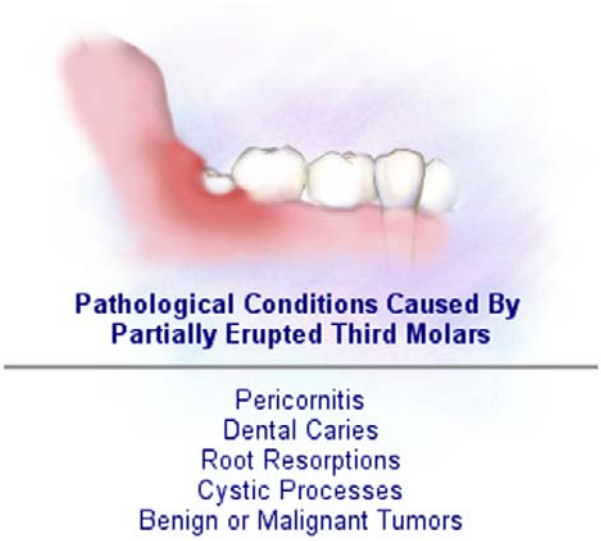
*Duncan test, **Mann-Whitney U test

Nevertheless, it has been reported that even if the space in the jaw is adequate, eruption cannot be guaranteed.[21] On the other hand, in the case of orthodontically treated teeth, it has been stated the extraction of the premolar helps to provide more space for eruption of the third molars, and third molars may erupt more often in the cases treated with premolar extractions.[18,19,22,23]

In this study, it was observed the retromolar space increased in both extraction and non-extraction groups (especially extraction group), and the angulation of the M3 improved during the treatment in the non-extraction group. In addition, it was determined that 15% of the M3s in the extraction group and 18% of those in the non-extraction group erupted in a normal position.



In previous studies, although it was noted clinical changes in the status of third molars took place by about the age of 32, the active changes occurring in the retromolar area and angulation of the M3 continued by about the age of 21.[17-28] Ganns et al.[17] reported the retromolar space/lower third molar width ratio remained almost constant between the ages of 13 and 20 in the impacted group, whereas there was an increase of 0.6 between the ages of 13 and 16 and 0.1 between the ages of 16 and 20 in the erupted group. Altonen et al.[20] determined the angulation of the third molar in relation to the second molar decreased by age, and this angle decreased more rapidly after the age of puberty than before it. Havaikko et al.[24] stated the initial angulation of the third molars might influence their subsequent eruption. They determined when the initial angle (approximately 13.5 years of age) between the longitudinal axes of second and third molars was parallel or less than 10 degrees, most of the M3s erupted (approximately 19.5 years of age). They also determined when the initial angle was between 20 and 30 degrees, one third of third molars erupted, and when the initial angle was larger than 30 degrees, the number of impacted third molars increased.



The various reports on the angulations of the M3 are difficult to compare because of the different recording methods used. For this reason, a control group was selected in this study to define the normal position of an erupted M3 in the oral cavity. It was observed the retromolar space/lower third molar mesio-distal width ratio in the control group was approximately 1; the angle between longitudinal axis of the M3 with corpus plane was 95 degrees, and the M2 angulation was 94 degrees.

This indicates that in order for M3s to erupt in a normal position, angulations of the M3 must be parallel or near the angulation degrees of the M2, which localize on the crest in the normal position. But it was observed that in extracted and non-extracted groups, the retromolar space/lower third molar mesio-distal width ratio was less than 1, all teeth partially erupted in a mesioangular position, and there was a difference of about 25 to 27 degrees between the M2 and the M3 angulations. This is an indication the eruption potential of the M3 will be less in the future. Ganns et al.[17] stated when the retromolar space/lower third molar width ratio was more than or equal to 1, almost 70% of third molars erupt at the age of 20. Furthermore, when that ratio was less than 1, the probability of the M3 being impacted increased. Dierkes[21] reported the extraction of premolars helped to provide more space for the eruption of the third molars than in the nonextraction group, but they were only slightly impacted and could not erupt. Haavikko et al.[24] reported the percentage of erupted M3 teeth was smaller in the normal group than in the extraction group, but the difference was not found to be statistically significant. Venta[29] reported that when the M3 was unerupted and in a mesioangular position during a person's 20s, it more often remained impacted (unerupted and partially erupted) than erupted. Venta et al.[25] reported that from the age of 20 to 32, many clinical changes in the status of third molars took place during these 12 years, but these position changes were not stationary except for some of the erupted teeth.

On the other hand, it is known that partially erupted third molars cause various pathologic conditions such as pericoronitis, dental caries, root resorptions, cystic processes, and benign or malignant tumors of odontogenous origin.[1-11]

Mesioangular positioned third molars are the most frequent among molars in all positions that have been associated with pericoronitis. Evidence indicates that third molars partially covered by soft tissue preceded many more pathologic problems than molars covered by tissue or erupted.[9-11] In this present study, it was determined that 83% of teeth in the extraction and non-extraction groups erupted in a mesioanguler position; 43% of which had pericoronitis and 4% had dental caries.

Conclusion

In this study, it was determined that 83% of the M3s in orthodontically treated cases partially erupted in a mesioangular position and 43% of these teeth were associated with pericoronitis.

Extraction of third molars is more important in the cases that were treated with extraction of 4 premolars for orthodontic treatment because if third molars are also extracted due to lack of improvement of their angulations, lack of arch space, or for pathologic reasons, 8 teeth will have been lost. This means that 1⁄4 of the adult dentition or 1⁄4 of the potential masticatory function would be eliminated at an early age. For this reason, it is more desirable to maintain the M3 teeth (especially in those cases treated with premolar extractions), unless there is a significant health reason for doing so that cannot be treated by alternative treatment methods.

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About the Authors

Metin Güngörmüş, DDS, PhD

Dr. Güngörmüş is an Assistant Professor in the Department of Oral and Maxillofacial Surgery in the Faculty of Dentistry at Atatürk University in Erzurum, Turkey. He is a member of the Turkish Oral and Maxillofacial Surgery Society.

e-mail address: gungormusm@yahoo.com