Comparison of Changes in Mandibular Third Molar Angulation Following First/Second Premolar Extraction versus Non-Extraction Orthodontic Treatments

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Abstract

Objective: Extraction of premolars is believed to affect the eruption of third molars. This comparative study aimed to assess the change in angulation of third molars following first/second premolar extraction versus non-extraction orthodontic treatments.

Methods: This historical cohort study was conducted on patients assigned to three treatment groups: extraction of mandibular first premolars (group A), extraction of mandibular second premolars (group B) and non-extraction orthodontic treatment (group C). Each group included 30 third molars. Patients were in the age range of 11-19 years and the third molars were in Nolla's6-8 stage of tooth development. Pre- and post-treatment panoramic radiographs were analyzed.

Results: The angle between the long axis of the mandibular third molar and mandibular plane increased by 7 (2.2°) in group A and 5.2° in group B and the increase in both groups was statistically significant ($p<0.05$). Angular changes in group C were not statistically significant ($p>0.05$). The angle between the long axes of mandibular first and third molars decreased by 6.83 (0.3°) in group A. This reduction was statistically significant ($p<0.05$).

Conclusion: In extraction orthodontic treatments (versus non-extraction treatments), mandibular third molars tend to straighten up and become upright so the risk of their impaction may be decreased.

Key words: Mandible, Orthodontics, Premolar, Third molar, Tooth angulation, Tooth extraction.

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Introduction:

Eruption of third molars and its effect on dental arch has long been a subject of debate in dentistry. Incomplete eruption of third molars is a serious issue due to its high prevalence and clinical consequences. Impacted third molars may be associated with pathologic processes such as periodontitis, cysts and neoplastic lesions (1). Also, third molar impaction can cause complications like tooth caries and root resorption (2).

As the third molar tooth develops its angulation changes. The tooth rotates to gain a favorable position for eruption. These rotational movements occur when the third molar tooth bud is placed in close approximation to the second molar tooth. Studies have reported that in the age range of 10 to 15, the angulation of mandibular third molar tooth changes averagely by 11.2° relative to the mandibular plane. Therefore, its tendency for eruption increases (3). If this change of angulation does not occur properly, there is a chance that this tooth will become impacted. Orthodontists should be well aware of the relationship of mandibular third molars with other teeth. On the other hand, the majority of studies have investigated the effect

of third molar tooth on other teeth rather than the effect of other teeth on the third molars.

Some researchers believe that extraction treatments cause mesial movement of mandibular molars and increase the retro molar space but the effect of these changes on the degree of impaction of third molars has yet to be fully understood. Space shortage is among the main causes of tooth impaction. Thus, there is a possibility that extraction of premolar teeth in patients (whose treatment plan includes premolar extraction) may eliminate the anterior crowding and create space for eruption of third molar teeth (1). Based on the results of Behbahani *et al*. in 2006, premolar extraction can enhance the eruption of third molar teeth by 63% (4). Also, Salehi and Danaie in 2008 showed that first premolar extraction can enhance the eruption of third molars by 42% while this rate was 12% in non-extraction treatment group and the difference in this respect between the two groups was statistically significant (5).

The selection of extraction or non-extraction orthodontic treatment has always been a matter of debate. In extraction treatments, the mandibular first premolar is usually selected for extraction due to the strengthening of anchorage, retrusion of lips, better intercuspation between canines and second premolars and the fact that first premolars are closer to anterior crowding (6).

However, at present, extraction of second premolars is also routinely performed by orthodontists due to the advantages such as smaller effect on the form and position of lips, easier mesial movement of posterior teeth and its effect on mandibular rotation (6). Extraction of second premolars can cause less tooth size discrepancy compared to the extraction of first premolars because the difference in size of upper and lower second premolars is greater than that of first premolars (6). Since the second premolarsare located more posteriorly and closer to the third molars, their extraction is mostly indicated in cases where the treatment goal is mesial movement of posterior teeth. There is a possibility that the effect of second premolar extraction on third molar tooth may be different from that of first premolar extraction. Limited studies have compared the effects of first and second premolar extractions on third molar tooth (7). Thus, the present study was designed aiming at comparing angular changes of mandibular third molars in first/second premolar extraction versus non-extraction orthodontic treatments.

Methods:

This historical cohort study was conducted on 90 teeth. The samples were divided into three groups of mandibular first premolar extraction (group A), mandibular second premolar extraction (Group B) and non-extraction orthodontic treatment (group C). In each group, 30 third molars were evaluated. Patients' dental records were collected from the archives of the Department of Orthodontics, Shahid Beheshti University, School of Dentistry and a private office. Patients' characteristics are summarized in Table 1.

Table 1- Patients' characteristics

Type of treatment	Mean age (yrs.)	Mean degree of crowding (mm)	M.P.A[1] (degree)	S.P.A[2] (degree)	Y-axis (degree)	Duration of treatment (month)
First premolar extraction	13.8	5(2.9)	37.5(4.8)	397.1(4.4)	68.4(4.3)	11-40
Second premolar extraction	14.3	5.9(2.6)	36.5(3)	396.7(6.4)	69.6(3.1)	15-40
Non-extraction treatment	14.9	2.3(2.5)	34(5.5)	394(6.6)	67(7.3)	16-36

M.P.A[1]: Mandibular plane angle

S.P.A[2]: Sum of the posterior angles (saddle+ articular+ gonial angles)

The inclusion criteria were as follows:

1. No craniofacial syndromes or systemic disease
2. Age range of 11-19 years
3. Third molars had to be in Nolla's6-8 stage of tooth development
4. All patients had to have vertical growth pattern based on the size of MPA, Y-axis and SPA.
5. All patients had to have pre- and post-treatment panoramic radiographs
6. The extraction groups were matched in terms of degree of crowding

Pre- and post-treatment panoramic radiographs were scanned and copied into the AutoCad software. Using this software, angles were drawn and measured. For definition of angles three lines were considered as follows:

1. Long axis of the tooth: If the respective tooth had a furcation area, the cusp tip markings were connected with straight lines to produce an occlusal surface. Then a line was drawn from the furcation area to the center of this line. If the third molar tooth did not have a furcation area, the occlusal surface was drawn and the line perpendicular to its center was considered as the long axis of the tooth (Figure 1).

Figure 1- Determination of the long axis of the tooth

2. Occlusal plane: The line passing through the cusp tips of the first molar tooth (Figure 2)

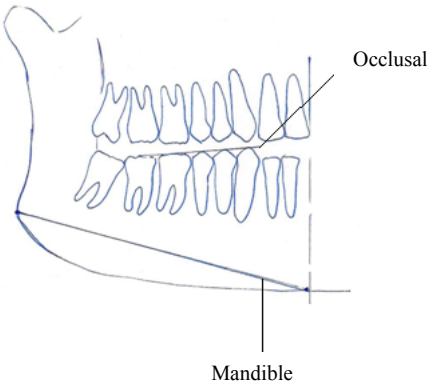

Figure 2- Determination of occlusal and mandibular planes

3. Mandibular plane: The line connecting the gonion (gonial angle)and menton(symphysis at midline) (Figure 2)

Measured angles are demonstrated in Figure 3. All angles were measured by one person with 1° precision. In order to ensure the reliability of measurements, all measurements were repeated in 10 random specimens. Intra-class correlation coefficient (ICC) was calculated to be >0.7 indicating the acceptable reproducibility of measurements.

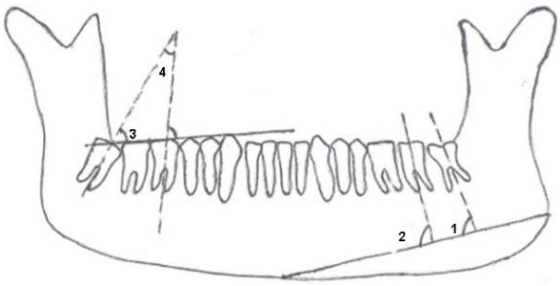

Figure 3-Measured angles
1. The angle between the long axis of third molar tooth and mandibular plane, 2. The angle between the long axis of second molar tooth and mandibular plane, 3. The angle between the long axis of third molar tooth and occlusal plane, 4.The angle between the long axis of first molar and third molar teeth

SPSS version 15 software was used for data analysis. Before and after values (pre- and post-treatment values) in each group were compared

using Repeated Measures ANOVA. For pair-wise comparison of groups, interaction p-values were calculated. If the interaction was significant, paired t-test was applied for the comparison of pre- and post-treatment values in each group.

Results:

1. The angle between the long axis of third molar tooth and the occlusal plane increased by 5.5 (2.0°) in group A, 1.4 (1.7°) in group B and 3.7 (14.2°) in group C. However, the increase was not significant in any group and the difference in this respect among groups was not significant either (p>0.05) (Diagram 1).
2. The angle between the long axis of third molar and first molar teeth only decreased in group A by 6.8 (0.3°) and this reduction was statistically significant (p<0.05). This angle decreased by 1.2 (0.5°) in group B and increased by 4.1±6.1°in group C but none of these changes were significant (p>0.05) (Diagram 2).

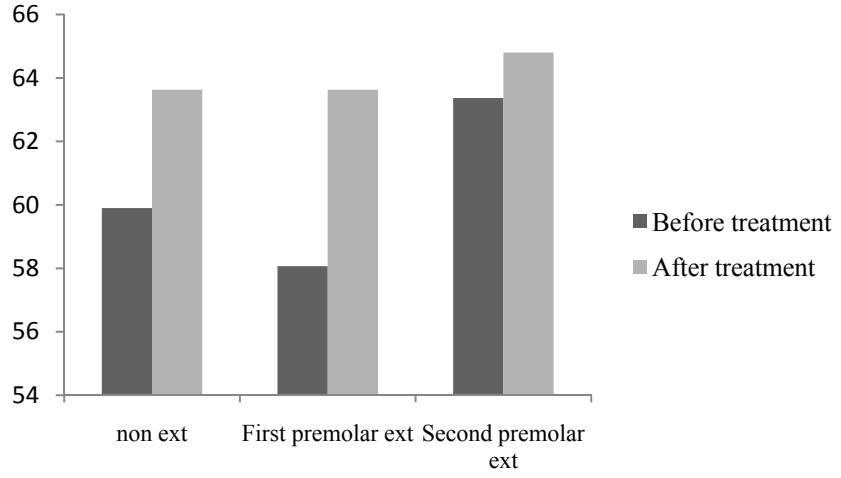

Diagram 1- The mean angle between the long axis of third molar and occlusal plane before and after treatment in the three groups

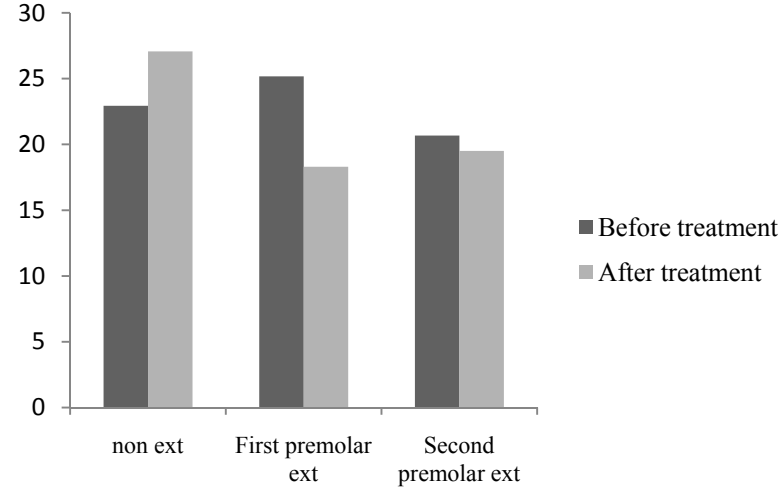

Diagram 2- The mean angle between the long axis of third molar and first molar teeth before and after treatment in the three groups

3. The angle between the long axis of third molar and mandibular plane increased by 7 (2.2°) in group A and 5.2°in group B. The increase in both groups was statistically significant (p<0.05). This angle decreased by 1.3 (5.4°) in group C which was not significant (p>0.05)(Diagram 3).

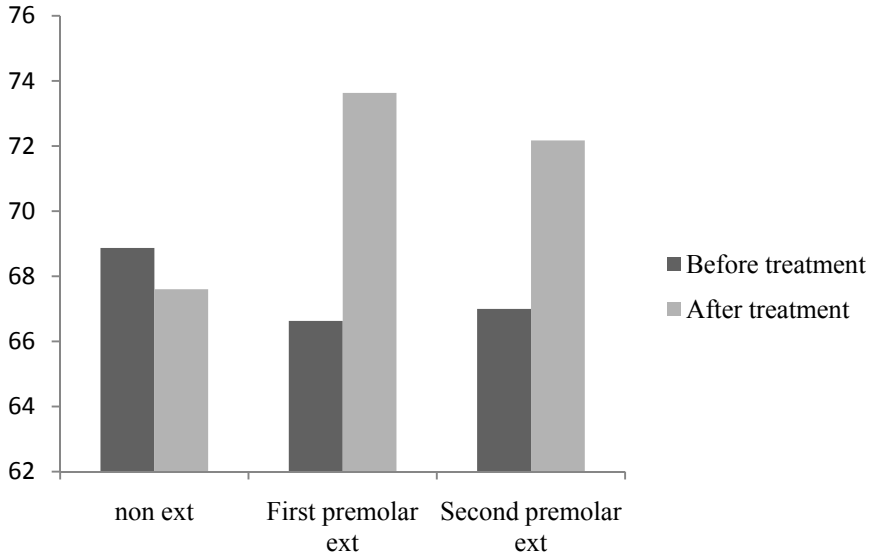

Diagram 3- The mean angle between the long axis of third molar and mandibular plane before and after treatment in the three groups

4. The angle between the long axis of second molar and mandibular plane increased by 3 (0.3°) in group A, 4.4 (4.2°) in group B and 2.07 (2.9°) in group C. The increase in all 3 groups was statistically significant (p<0.05). But no significant difference existed between the three groups in this respect (Diagram 4).

Findings are summarized in Table 2.

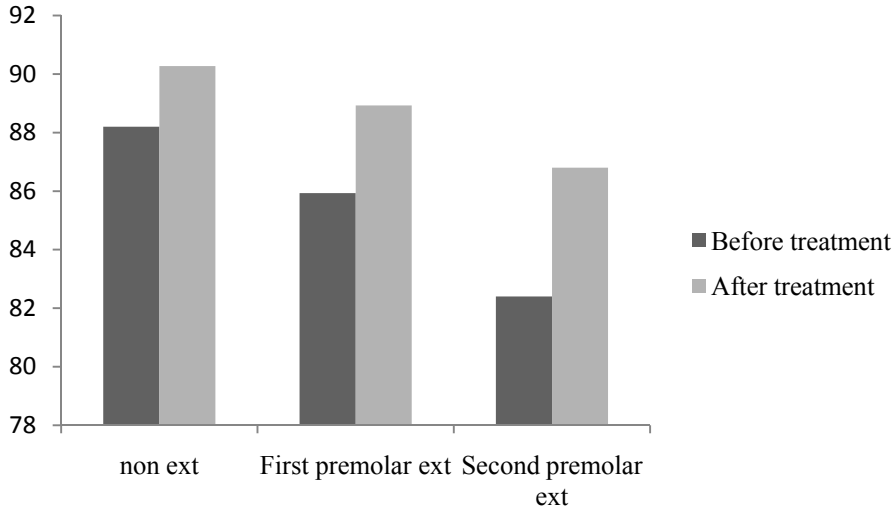

Diagram 4-The mean angle between the long axis of second molar and mandibular plane before and after treatment in the three groups

Table 2- The mean values before (T1) and after (T2) treatment and the difference between before and after values (T1-T2)

Variable		Before treatment (T1)		After treatment (T2)		T1-T2		P-Value
		mean	SD	mean	SD	Mean difference	SD	
First premolar ext	occ.8	58.1	8.1	63.6	8.3	5.6	0.2	$p>0.05$
	6.8	25.2	10.1	18.3	10.4	-6.8	0.3	$p<0.05$*
	Man.8	66.6	8.1	73.6	14.4	7	2.2	$p<0.05$*
	Man.7	85.9	7.2	88.9	7	3	0.3	$p<0.05$*
Second premolar ext	occ.8	63.4	8.8	64.8	10.5	1.4	1.7	$p>0.05$
	6.8	20.7	9.7	19.5	9.2	-1.2	0.5	$p>0.05$
	Man.8	67	9.4	72.2	9.4	5.2	0	$p<0.05$*
	Man.7	82.4	6.1	86.8	10.3	4.4	4.2	$p<0.05$*
Non extraction	occ.8	59.9	8.9	63.6	23.1	3.7	14.2	$p>0.05$
	6.8	22.9	11.2	27.1	5.1	4.1	6.1	$p>0.05$
	Man.8	68.9	9	67.6	14.4	-1.3	5.4	$p>0.05$
	Man.7	88.2	9	90.3	6.1	2.1	2.9	$p<0.05$*

*Significant

OCC.8= The angle between the long axis of third molar tooth and occlusal plane, 6.8= The angle between the long axis of first molar and third molar teeth, Man.8= The angle between the long axis of third molar tooth and mandibular plane, Man.7= The angle between the long axis of second molar tooth and mandibular plane

Discussion:

Third molar tooth starts its development in mandibular ramus at the age of 8-9 years. During its developmental process, tooth angulation changes to gain a favorable position for eruption. In some cases, the angulation change does not occur properly and the tooth remains impacted. Some studies have shown that orthodontic treatment can affect the eruption or impaction of third molars. The majority of studies have evaluated and compared the effect of first premolar extraction and non-extraction treatment on angular changes of third molar tooth and only a few studies have compared the effects of extraction of first and second premolars in this respect. Also, in the majority of studies, the degree of crowding had not been matched in patients; whereas, in our study, the degree of crowding was matched between the extraction groups and was about 5 mm. Thus, the present study was carried out based on the hypothesis that third molar angulation is different in extraction of first or second premolar and non-extraction orthodontic treatments. In our study, it was demonstrated that orthodontic treatment along with the extraction of premolar teeth had a positive effect on the angle between the long axis of third molar tooth and mandibular plane leading to straightening of the third molar tooth. With such treatment, we may be able to reduce the risk of impaction of third molars. In this regard, the two groups of first and second premolar extraction were not different; whereas, these changes were not observed in the non-extraction group.

Furthermore, the angle between the long axis of third molar tooth and mandibular first molar showed a significant reduction in group A (first premolar extraction) that confirms the previous

results. This finding indicates that the third molar tooth during extraction treatment tends to straighten up. Changes in the angle between the long axis of third molar tooth and occlusal plane were not significant in any group; which may be attributed to the changes in occlusal plane during orthodontic treatment.

Tarazona *et al*. in their study in 2010 showed that changes in the angles between the long axis of third molar tooth and mandibular plane, occlusal plane and long axis of the mandibular first molar in the three groups were statistically significant and towards the straightening of the third molar tooth (7). In their study, no difference was found between the treatment groups; whereas, our study showed that extraction of premolars could result in straightening of third molar tooth but the non-extraction treatment did not have such effect.

Jain and Valiathan in 2009 confirmed our obtained results regarding the extraction of first premolar tooth. According to their findings, third molar tooth tends to straighten up as the result of first premolar extraction (3). However, their obtained results regarding non-extraction treatment were not in accord with ours and revealed that non-extraction treatment could also lead to straightening of third molar tooth.

Saysel *et al*. in 2005 reported an increase in the angle between the long axis of third molar tooth and occlusal plane as the result of first premolar extraction. They demonstrated that third molar tooth in extraction treatment groupdemonstrated an improvement in angulation relative to the occlusal plane (8) which is in agreement with our findings. Their results regarding non-extraction treatment were also in concord with our results revealing that non-extraction treatment had no significant effect on the angulation of third molar tooth.

Results of Artun's study in 2005 were in contrast to our findings and reported that extraction and non-extraction treatments had similar effects on third molar angulation and could similarly lead to straightening of mandibular third molar tooth (9). It should be noted that in their study, it has not been mentioned whether the differences were statistically significant or not. They only mentioned that the changes were similar in both groups. Also, extraction of first and second premolars was not separately evaluated. Thus, they could not conclude that tooth extraction treatment can facilitate the eruption of third molar tooth.

Eslamian and Ebrahimi in 2007 also demonstrated that extraction of first premolar teeth does not guarantee the eruption of third molarsor proper change in their angulation (1). Such conflicting results may be due to the different degrees of crowding in and use of different planes for the assessment of changes in third molar angulations.

The present study was a retrospective one and therefore had some limitations. Future prospective studies are required with the consideration of type of anchorage in orthodontic treatments. Thus, the effect of the amount of mesial movement of posterior teeth on angular changes in third molar tooth can be better evaluated.

Conclusion:

It seems that in moderate crowding cases (about 5 mm) evaluated in the present study, first and second premolar extractions had similar effects on angular changes in third molar tooth. Both treatments may lead to straightening of this tooth and decreaseits risk of impaction. Such changes were not observed in non-extraction treatment group.

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Conflict of Interest: "None Declared"

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