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Effects of orthodontic treatment and premolar extractions on the mandibular third molars

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Background: The space available for an unerupted mandibular third may depend on the choice of premolar extracted.
Aims: To investigate the effects of orthodontic treatment and premolar extractions on the inclinations of the mandibular third molars and the space available for their eruption, and to compare these changes with a nonextraction group.
Methods: The pre- and post-treatment panoramic radiographs of 54 subjects (20 males, 34 females) were used. Eighteen of these subjects had the four first premolars extracted, 16 subjects had four second premolars extracted and 20 subjects were treated nonextraction. Changes in the inclinations and spaces available for the unerupted third molars were compared.
Results: In the nonextraction group the third molars uprighted approximately 1 degree and in the second premolar extraction group the third molars uprighted 10 degrees. The spaces available for the third molars increased significantly in the first and second premolar extraction groups as compared with the space available in the nonextraction group.
Conclusions: Orthodontic treatment and extraction of the second premolars improved the inclinations of unerupted third molars and the space available for their eruption into the arch. The changes in inclination and eruption space were less marked following first premolar extractions.
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Introduction

Third molars are more frequently impacted than any other tooth in the dental arches. Incomplete eruption of mandibular third molars may be accompanied by infection, pain, cysts, tumours, caries and root resorption of the second molars.[1–3] The prevailing view is that extraction of lower second premolars followed by orthodontic treatment improves the positions and angulations of unerupted third molars so that some third molars erupt fully.

Factors under the control of the clinician include the premolar extracted and the mechanics used e.g. Class II traction vs molar uprighting. First premolar extractions are thought to provide less space for unerupted third molars and nonextraction treatment the least amount of space. A number of biological factors also play a part in determining whether a third molar becomes impacted or whether it erupts into position. Some of these include: growth in the length of mandible, the direction of condylar growth, the pattern of eruption of the mandibular dentition, the path of eruption of the third molars and the retromolar space.[4–6]

Previous studies have investigated the angulations of the mandibular third molars after either second molar or first premolar extractions, but there have been few reports of the effects of different premolar extractions on the positions and angulations of the mandibular third molars.[7,8] The aims of this study were to investigate the effects of orthodontic treatment and premolar extractions on the inclinations of the mandibular third molars and the space available for their eruption, and to compare these changes with a nonextraction group.

Material and methods

This retrospective study used the standardised panoramic radiographs of 54 subjects (20 males,

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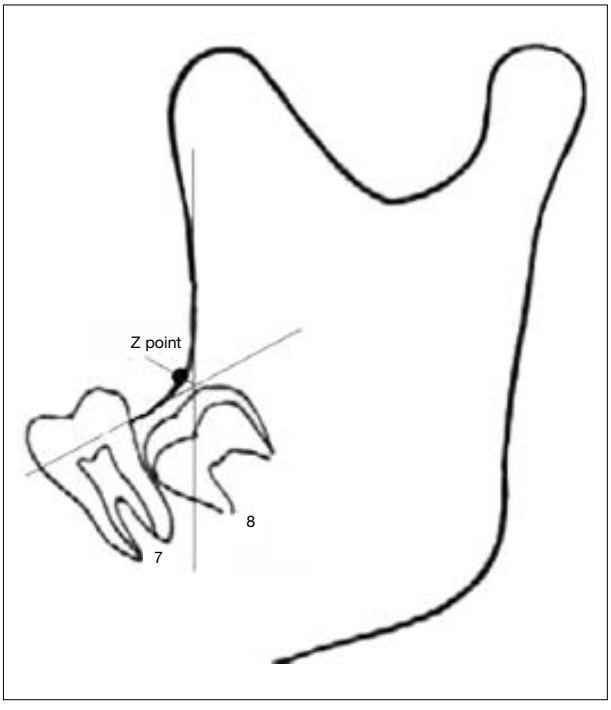


Figure 1. Definition of Z point: the constructed point on the retromolar outline and the bisector of the angle between the tangents to anterior border of ramus and superior surface of the body of mandible.

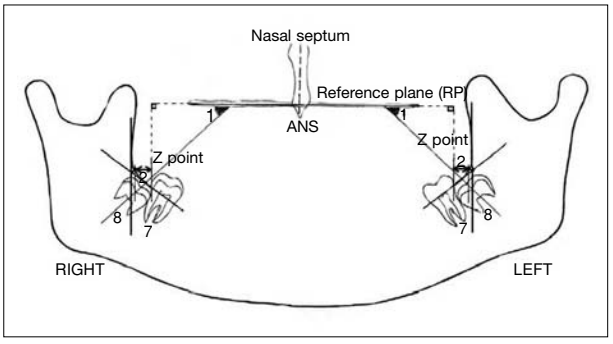


Figure 2. 1, third molar angulation to the reference plane (RP); 2, eruption space measured between the Z point and the most distal point on the outline of the second molar.

34 females) treated in the Department of Orthodontics, Ataturk University. All subjects had Class I skeletal and dental relationships with moderate anchorage requirements (crowding between 6 and 9 mm) prior to orthodontic treatment. Eighteen subjects (7 males, 11 females) had four first premolars extracted (Group I), 16 subjects (6 males, 10 females) had four second premolars extracted (Group II) and 20 subjects (7 males, 13 females) had nonextraction treatment (Group III). The subjects were age-matched at the start to ensure that each group started with the same potential for resorption on the anterior border of the ramus.

All subjects were treated with upper and lower straight-wire appliances for at least 24 months and the second molars were not banded or bonded. Mechanics that could either hold or tip the lower first molars distally (e.g. uprighting bends, lingual arches) or mesially (e.g. Class II elastics) were not used.

All pretreatment panoramic radiographs were taken within one month prior to the start of the orthodontic treatment. The post-treatment radiographs were taken either on the day the active orthodontic appliances were removed or within two weeks of debonding. All radiographs were taken by an experienced X-ray technician using an orthopantomograph (Planmeca Proline CC 2002, Helsinki, Finland) with a magnification factor of 1.2.

The outlines of the mandible, nasal septum, hard palate and the mandibular second and third molars were traced. The outline of the nasal septum was bisected and a horizontal reference plane (RP) was drawn perpendicular to the midline bisector and through the outline of the hard palate. The angles between RP and the long axes of third molar buds and the distances between the most distal points of the second molars and the right and left Z points were measured on the pre- and post-treatment films by the same investigator (Figures 1 and 2). Three weeks after the first set of measurements, 30 films were randomly selected, remeasured and intraclass coefficients were calculated to estimate the method errors. The coefficients for all measurements fell between .92 and .96, and were considered acceptable.

The changes in the eruption spaces and inclinations of the third molars to RP were compared with one-way ANOVA and Tukey post-hoc tests. The significance level was set at $p < 0.05$ for all tests.

Results

The subjects' ages ranged from 14.20 to 15.20 years and the observation periods from 2.04 to 2.30 years. As there were no statistically significant gender differences in either the mean ages or the observation periods, the data for the males and females were

Table I. Comparisons of the pretreatment ages and periods between the pre- and post-treatment radiographs.

	Sex	N	Mean age (years)	SD	*p*	Observation period (years)	SD	*p*
Group I	Male	7	14.76	1.59	0.574	2.09	0.19	0.365
	Female	11	14.20	2.22		2.30	0.58	
Group II	Male	6	14.57	0.85	0.215	2.13	0.28	0.980
	Female	10	15.17	0.96		2.13	0.24	
Group III	Male	7	14.73	1.15	0.177	2.04	0.11	0.311
	Female	13	15.37	0.87		2.15	0.27	
Group I		18	14.42	1.97	0.264	2.22	0.47	0.615
Group II		16	14.94	0.94		2.13	0.24	
Group III		20	15.15	0.99		2.12	0.23	

Group I: first premolar extraction; Group II: second premolar extraction; Group III: nonextraction

Table II. Comparisons of the pre- and post-treatment angulations and positions of the mandibular third molars.

	Group	Pretreatment Mean ± SD	*p**	Post-treatment Mean ± SD	Mean difference ± SD	*P*† Group I vs II	*P*† Group I vs III	*P*† Group II vs III
Third molar angulation (degrees)	I	45.22 ± 8.98	0.188	49.44 ± 11.93	4.22 ± 9.44	0.123	0.433	**0.006**
	II	43.13 ± 8.18		53.03 ± 10.34	9.91 ± 11.26			
	III	40.43 ± 6.78		41.30 ± 7.04	0.88 ± 2.08			
Third molar eruption space (mm)	I	6.69 ± 3.03	0.167	9.78 ± 2.57	3.08 ± 1.31	**0.000**	**0.000**	**0.000**
	II	5.00 ± 3.66		10.31 ± 2.80	5.31 ± 2.39			
	III	4.85 ± 2.98		5.28 ± 3.00	0.43 ± 0.73			

Group I: first premolar extraction; Group II: second premolar extraction; Group III: non-extraction
Significant values in bold
* ANOVA
† Tukey HSD test

combined (Table I). The pretreatment angulations of the mandibular third molars and the pretreatment space available for their eruption among the groups were also compared and no statistically significant differences were found (Table II).

The Group I third molars uprighted approximately 4 degrees, the Group II molars uprighted 10 degrees and the angulations of the Group III molars unchanged (Table II). Only the difference between Group II and III was statistically significant.

Extraction of the first premolars resulted in 3 mm of space for the unerupted third molars, and extraction of the second premolars provided 5 mm additional space for the third molars. The eruption space in Group III was less than 1 mm. There were significant group differences in the eruption spaces (Table II).

Discussion

Measurements of third molar angulations on lateral cephalograms may be biased due to the difficulty in measuring the angulations of the molars on superimposed images, but these problems can be overcome if 60-degree cephalometric films are used.[9–14] The angulations and positions of the third molars can be accurately measured on panoramic radiographs providing the same equipment is used for the entire study.[15–19] We used panoramic radiographs taken with the same equipment. Although some previous investigators have used the occlusal plane and/or the mandibular plane as the reference planes to assess the changes in the angulation and position of the third molars during orthodontic treatment, the occlusal plane may change during treatment and the mandibular plane may be affected by remodelling.[5,16,17,20–23]

The palatal plane is a more stable option to these planes as it is not usually affected by orthodontic treatment.[23] The treatment mechanics, in this study, were not so complex as to cause the palatal plane to tip. Our subjects had skeletal Class I malocclusions treated by levelling and aligning the arches and closing the extraction spaces.

Some orthodontists[24–26] believe that extraction of the second molars will improve the angulation of the third molars and will cause their eruption into the arch. According to some authorities, the mandibular third molars upright between 7 and 10 degrees following extraction of either the first or second mandibular premolars.[8,10,11,13,15] We found less than 7 degrees uprighting in our first premolar extraction group (4 degrees), but a similar amount of uprighting (10 degrees) in our second premolar extraction group. In the nonextraction group, there was no change in the angulation of the third molars.

The greatest increase in eruption space for the third molars was found in the second premolar extraction group and the smallest increase in the nonextraction group. As the additional space for the third molars in the nonextraction group was less than 1 mm, mesial movement of the first and second molars in the second and, to a lesser extent, first premolar extraction groups must have been responsible for increasing the eruption space, and not growth changes in the retromolar area as claimed by Capelli.[9]

The third molars erupt between 17 and 21 years of age, but their roots are not fully formed until 18 to 25 years of age. Because our subjects were less than 20 years of age at the end of treatment we could not determine the final outcome of the third molars. It is quite possible that some third molars in unfavourable positions at the end of treatment may erupt into position and that some molars with favourable positions and angulations may become impacted.[10] In a recent study, the prevalence of third molar impaction was found to be 40 per cent for the nonextraction group and 22 per cent for the first premolar extraction group.[10] As expected, low rates of third molar impaction occur following first and second molar extractions.[18,21,27,28] The closer an extraction is to an impacted/unerupted third molar the less likely the third molar will become impacted.[20] Third molars that become impacted may be useful replacements for heavily filled and carious first or second molars.[13]

The types of the mechanics used during treatment appear to have an important bearing on eruption of mandibular third molars. Mechanics that move the first and second molars mesially are likely to create space for unerupted third molars, and mechanics that hold or tip the first or second molars distally are likely to result in unerupted third molars becoming impacted. In the present study, Class II elastics were not required since the subjects had Class I skeletal and dental relationships with moderate anchorage requirements. Although we did not randomly allocate our subjects to the groups or match the subjects' third molar eruption status, we attempted to reduce selection bias by matching the ages of our subjects in the groups at the outset.

Conclusions

1. Orthodontic treatment and extraction of the second premolars improved the inclinations of unerupted third molars and the space available for their eruption into the arch.

2. The changes in inclination and eruption space were less marked following first premolar extractions.

3. Nonextraction treatment had little effect on the positions and angulations of the third molars.

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