

Mesial Migration Effect on Root Morphology of Mandibular Third Molars

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ABSTRACT

Objective: To test the hypothesis that there is a relationship between forward mandibular third molar migration and root curvature of the mandibular third molars.

Materials and Methods: The study is comprised of 64 patients who had a history of unilateral mandibular first molar extraction before 16 years of age with no other missing teeth or prosthetic restorations in the mandible. The extraction space was fully or partly closed. The mean remaining space was 1.1 ± 0.41 mm. The root angles for the mesial and distal roots of the mandibular third molars were measured on the panoramic radiographs by calculating the differences between the angle formed by the long axis drawn perpendicular to the occlusal plane of the crown of mandibular third molar and the central line of the lower one ninth of the root through the root apex. The differences between the extracted and nonextracted sides for mesial and distal roots were analyzed using a paired sample *t*-test.

Results: Both mesial and distal roots were approximately 8° more vertical on the extraction sides than on the nonextraction sides. The differences were statistically significant.

Conclusion: Mesial tooth migration of mandibular third molars reduces the amount of root curvature developing on this tooth.

KEY WORDS: Mandibular third molars; Mesial and distal root curvature; Extraction

INTRODUCTION

Human teeth are provided mostly with distally curved roots, although a large variation is described in the literature.^{1,2} Mandibular third molars show variations in tooth and root size within a population that could be the result of environmental factors.³ Although many studies have described the effect of genetic factors on dental development,⁴⁻⁶ it is not clear whether the angulation of the roots is related to genetic disorders or whether it has multiple causes, including environmentally acquired conditions such as infection,

trauma, scar formation, orthodontic treatment, inadequate space, or tooth migration during tooth formation.^{2,7-10}

Yamaoka et al⁹ evaluated the relationship between third molar impaction and root curvature. They reported that angulated roots are related to environmental factors because they found that angled roots occur more frequently with incomplete impaction than with full eruption.

Marklund and Persson¹⁰ investigated the relationship between mandibular morphology and root curvature in two groups of subjects and indicated that some of the variation in root curvature could be explained by mandibular morphology. They stated that this is associated to the mandibular growth pattern, which in turn is correlated with the magnitude of forward tooth migration.

The mesial migration pattern of the dentition may be different between individuals.^{11,12} The differences in root forms may be related to variations in the mesial migration of the dentition.

The aim of this study was to investigate the relationship between mesial tooth migration and root curvature of mandibular third molars in subjects with unilateral first molar extraction before the age of 16.

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Figure 1. Panoramic radiograph showing the angled roots of the right third molar. Notice the vertical root form of the left third molar caused by early extraction of the left first molar.

MATERIALS AND METHODS

The study was comprised of 64 patients (29 male, 35 female) ranging in age from 18 to 40 years with a median of 25.7 years. Patients' records were selected from the records of individuals treated in the Department of Oral and Maxillofacial Surgery of Cumhuriyet University from September 1997 to February 2004. A total of 3450 patients and their panoramic radiographs were surveyed, and 128 third molars of 64 patients were selected.

All patient records showed a history of unilateral lower first molar extraction before 16 years of age with no other missing teeth or prosthetic restorations in the mandible (Figure 1). All third molars on the extracted side were erupted, whereas 28 of the 64 third molars on the nonextracted side were fully or partially impacted. The third molar was considered impacted when it was not fully erupted to the presumed normal functional position at the occlusal plane. First molar extraction spaces on the extraction sides were fully or partly closed. The average of remaining space was 1.1 ± 0.4 mm. Patients with trauma, with odontoma in the mandible or with any conical fused root, with molars impacted in the buccolingual or horizontal direction, or

who had received prior orthodontic treatment were not included in this study. Of the 64 patients selected, 32 had a missing lower left first molar and the other 32 had a missing lower right first molar. All third molars showed no decay or periapical lesions, and all had completed root formation.

The mesial and distal root angles for the mandibular third molars were measured on the panoramic radiographs. Mesial and distal roots were divided into three equal parts, and the most apical third into thirds again (Figure 2). Apical root curvature was measured using the angle between the long axis drawn perpendicular to the occlusal plane of the crown and a central line of the most apical ninth of the root through the root apex.

Statistical Analysis

Mesial and distal root curvatures of third molars on the extraction side and the nonextraction side were compared. The results were calculated with the statistical analysis for differences between the two sides done with the paired *t*-test.

All measurements were evaluated by the same investigator. The measurements were repeated after 3

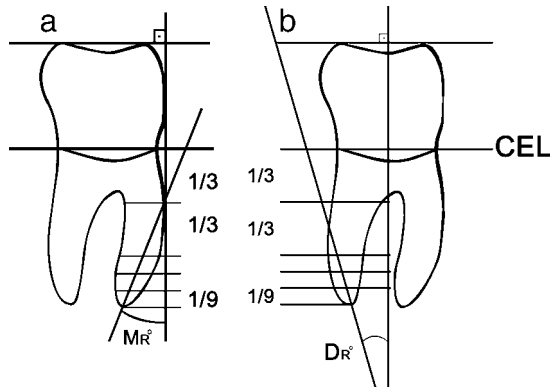


Figure 2. The angle of the mesial and distal roots was measured in relation to the change in angles MR and DR. The figure demonstrates the angle from the long axis of the third molar shown by the line drawn perpendicular to the occlusal table of the third molar to the midline of the lower third of each root through the apex. The reference line that is perpendicular to the occlusal table of the third molar was carried parallel to the midpoint of the cementum-enamel line to measure angle DR. In the measurement of angle MR, this time line was carried parallel to a tangent to the mesial surface of the third molar.

Table 1. Mesial and Distal Root Angles for Mandibular Third Molars on Extraction and Nonextraction Sides

Root	Side	Angulation			
		n	Range	Median	Difference, <i>P</i>
Mesial	Extraction	64	0-61	24.41	<.05
	Nonextraction	64	0-80	31.98	
Distal	Extraction	64	0-63	4.57	<.05
	Nonextraction	64	0-62	12.91	

weeks on 28 randomly selected subjects from the original sample to test the reproducibility of the method. No significant differences between the two measurements were found according to the results of a Wilcoxon nonparametric test ($P = .811$).

RESULTS

All mesial roots of third molars in both extraction and nonextraction sides investigated in this study were found to be angulated. A total of 121 of 128 distal roots in 64 patients were curved to the mesial, whereas 7 roots were curved to the distal. Three of the distally curved distal roots were on extraction sides and the other four were on nonextraction sides.

The results of the study are summarized in Table 1. A significant difference in root angulation between nonextraction and extraction sides was present. Both mesial and distal roots of the third molars were more angulated on the nonextraction side.

The mesial roots of the mandibular third molars were more distally curved on the nonextraction side (M_R° nonextraction = 31.98°) than on the extraction

side (M_R° extraction = 24.41°). The difference between both sides was statistically significant ($P < .05$).

Distal roots were also more mesially curved on the nonextraction side (D_R° nonextraction = 12.69°) than the extraction side (D_R° extraction = 4.44°). The difference between two sides was statistically significant ($P < .05$).

DISCUSSION

There are many definitions for the assessment of root curvature mentioned in previous studies. The lower one third of the root was chosen for identification of angled roots in this study. There are very few studies about possible effects on apical root curvature in the literature. In one of these studies, Yamaoka et al⁹ investigated the relationship between third molar impaction and roots identified as angled by having an angle of more than 45°. Their results showed that angled roots occur more frequently in women with incomplete impaction than in those with full eruption. According to their interpretation of these findings, “incomplete impaction may produce large forces or strains, and a change in the regulation of root morphogenesis, resulting prevention of root formation.” They also stated that “a suitable environment may produce full eruption and a normal shaped root.”

In this study, all third molars on the extracted side were erupted, whereas 28 of the 64 third molars on the nonextracted side were fully or partially impacted. In this study, both the mesial and the distal roots on the extraction sides were approximately 8° more vertical than the corresponding roots on the nonextraction sides. Incomplete eruption of third molars caused by limited space may result in angled roots through induction of root formation. This was a result of mesial movement of the second molar caused by early extraction of the first molar. This situation created an increase in the eruption space for the third molar, thus relieving the compression exerted on the roots. Similar predictions have been reported about root form in previous studies wherein mesial movement of the molars was reported because of interproximal attrition, and extraction therapy increased the eruption space of the third molar,¹³⁻¹⁷ with the roots developing more vertically.

In another study, Marklund and Persson¹⁰ tested the hypothesis of a relationship between mandibular morphology and root curvature on low- and high-angle subjects in whom migration patterns of dentition were different from each other. They indicated that the apical portion of the roots in mesially-migrating teeth would develop more distally in first molars and first premolars. They concluded that migration of teeth with immature roots would probably result in a gradual dis-

placement of already-formed hard tissue in relation to developing soft tissues and that mesially-migrating teeth would thus develop distally-curved roots. They also explained this finding by possible other local factors influencing tooth migration, such as early tooth loss, ankylosis, or orthodontic treatment. However, the effect of migration because of tooth extraction on root angulation was not investigated in their study. The results of this study were not similar to our findings. Mesial migration or mesial drift of third molars caused more vertical roots in our study, whereas Marklund and Persson¹⁰ reported the opposite results. This difference would lead us to consider that tooth migration cannot directly influence root curvature. Migration causes an increase in eruption space, thus relieving the compression exerted on roots.

Although a strong genetic component could influence intra-alveolar dental development in the mandible, local factors could be related to the incidence of angled roots unique to mandibular third molars.^{9,18} Ross and Evanchik¹⁹ reported that fused roots were seen in more than half of the mandibular third molars, and this was more than seen in mandibular first and second molars. Based on their findings, they concluded that, although roots could be programmed according to molecular regulation by growth factors, the apical portion of the roots is vulnerable to local effects. In the present study, the study sample was composed of patients who had a history of unilateral lower first molar extraction to minimize the influence of genetic factors, and those molars had been extracted before the patients were 16 years of age. This was done because mineralization of the third molar root has been found to start at 15 years age.²⁰

Our study indicates that the extraction of the first molar would increase the eruption space for the third molars, and thus compression in bone mass would be less on the extraction sides than on the nonextraction sides. The presumption is that this suitable environment may produce normally shaped roots.

CONCLUSIONS

- Beside genetic factors, root morphology is also affected by mesial migration because of tooth extraction.
- The root develops a better morphology when available eruption space is achieved.

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