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Original Articles

Mesial force from unerupted third molars

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Abstract

TOP

Erupting mandibular third molars are implicated as a cause of anterior crowding of mandibular teeth. The goal of this two-part investigation was to measure the mesial force exerted by unerupted mandibular third molars. We hypothesized that such a force increases the tightness of all proximal posterior tooth contacts mesial to the mandibular second molar, and that surgical removal of third molars relieves the tightness by eliminating this force. The contact tightness between mandibular posterior teeth was measured bilaterally in 20 patients with bilateral unerupted mandibular third molars, immediately before and after unilateral removal of a third molar. We found unexpectedly that mean proximal tightness decreased *bilaterally* in all contacts that were measured after *unilateral* removal of a third molar, and we did not detect a mesial force exerted by unerupted third molars. We suspected that this bilateral relief of contact tightness resulted from placing the patients in a supine position for surgery. The second part of the experiment was conducted to determine the effects of postural change on proximal contact tightness where no surgery had been performed. For ten subjects we discovered a mean decrease in the tightness of all mandibular posterior contacts 2 hours after the patient had been moved from an upright to a supine position. The greatest mean decrease (-32% , $p < 0.0001$) was found at the most posterior tooth contact. We conclude that surgical removal of unerupted mandibular third molars does not significantly reduce proximal contact tightness, but that simple movement from an upright to a supine position relieves such tightness dramatically. The effects of posture overwhelm any effects from erupting third molars on interdental forces. There are many valid reasons for removing unerupted mandibular third molars. However, the results of this study indicate that removing these teeth for the exclusive purpose of relieving interdental pressure and thereby preventing mandibular incisor crowding appears to be unwarranted. (AM J ORTHOD DENTOFAC ORTHOP 1991;99:220-5.)

Amarked increase in crowding of mandibular incisors often occurs in the teenage years,^{1,2} and mandibular third molars have been cited as contributing factors in this crowding. As early as 1859, Robinson³ stated that tooth irregularity frequently results from mesially directed third molar pressure.

A number of studies have attempted to determine whether unerupted third molars cause mandibular teeth to crowd. Vego⁴ found more tooth crowding in subjects with erupting third molars than in subjects with a congenital absence of third molars. Lindqvist and Thilander⁵ reported less tooth crowding in 70% of subjects on the side where unerupted third molars had been extracted than on the contralateral, nonextraction side. After a review of evidence presented in the literature, Richardson⁶ implicated the presence of third molars as a cause of lower-arch crowding.

To the contrary, Bjork and Skieller⁷ could find no clear evidence that crowding was caused by eruption of third molars. Kaplan,⁸ in a study of patients treated orthodontically, concluded that the presence of unerupted third molars does not produce a greater degree of lower anterior crowding after retention. Shanley,⁹ who compared lower incisor crowding and procumbency in three groups of subjects with bilaterally impacted, erupted, and congenitally absent mandibular third molars, found no significant differences and concluded that mandibular third molars exert little influence on crowding or procumbency of mandibular anterior teeth. Ades et al.¹⁰ reported no postretention differences in the crowding of mandibular incisors among groups of subjects with functional third molars, third molar agenesis, third molar impaction, and third molar extraction.

Clearly, there is a lack of agreement regarding the influence of third molars on dental crowding, and such confusion can affect treatment regimens. For example, in a survey of more than 600 orthodontists, Laskin¹¹ reported that 65% believed third molars produce mandibular anterior tooth crowding. For many patients, the decision to have unerupted third molars removed may be predicated on the hope of improved orthodontic posttreatment stability, a hope that may be unfounded.

Detection of a mesial force exerted by unerupted mandibular third molars could help to clarify the relationship between these teeth and mandibular incisor crowding. The goal of this study was to measure this force.

Experimental hypothesis

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Previously we measured the proximal contact tightness between mandibular teeth and reported that it increases on the side of the arch subjected to a mesially directed force from the second molar.¹² In this previous study the mesially directed force was generated by axial loading of the second molar. We reasoned that a **mesial force from unerupted third molars** would similarly increase the tightness of contacts mesial to the second molars. A test of this hypothesis would consist of measuring mandibular contact tightness in patients with bilaterally unerupted third molars immediately before and after unilateral removal of one third molar. A decreased magnitude of contact tightness on the extraction (experimental) side, as compared to an unchanging contact tightness on the nonextraction (control) side, would indicate that the extracted third molar had been exerting a mesial force on the other teeth and that this force had been relieved. Bilaterally unchanging values of contact tightness would indicate either that a mesial third molar force had not existed or that it was too small to be detected.

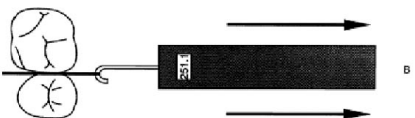
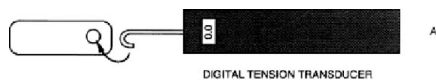
Materials and methods

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A technique for measuring proximal contact tightness

The technique used to measure contact tightness was previously discussed and is based on concepts of frictional force.^{12,13} Briefly, a 0.038 mm thick stainless steel strip (Healthco, Boston, Mass.), 6 mm wide and 15 mm long, was slipped between two teeth (Fig 1, A and B) and withdrawn with a digital tension transducer (Accuforce Cadet Force Gauge, Ametek, Largo, Fla.), which has an accuracy of 0.1 gm.

Fig. 1. Measurement technique. **A**, The tension transducer was hooked through a perforated 0.038 mm stainless steel strip. **B**, The strip was slipped interproximally and withdrawn.



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The tightness of contact between the teeth was related to the frictional force that resisted withdrawal (F_f) of the strip, and the coefficient of dynamic friction (μ) between tooth enamel and stainless steel by the following equation:

$$\text{Contact tightness} = F_f/2\mu \quad (1)$$

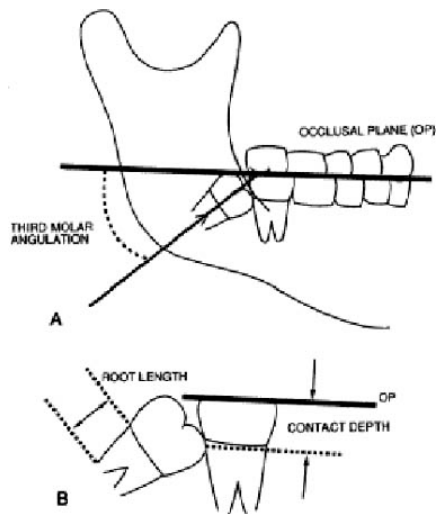
Subject selection and experimental procedure

Fourteen male and six female patients with a mean age of 20.6 years (SD = 2.0 years) participated. All subjects had complete dentitions from the second molars forward and bilaterally unerupted mandibular third molars in contact with the second molars. An unerupted tooth was defined as one that was visible on panoramic radiographs but not visible intraorally.

Panoramic radiographs were made for each patient. Although both mandibular third molars would eventually be removed, one third molar was chosen for extraction in this experiment. For 17 of the 20 patients, the right mandibular third molar was selected, since initial right-

side removal was the usual protocol for the participating oral surgeon. Morphologic factors that could affect an eruptive force were measured for this third molar from the radiograph. These factors included the angle of the longitudinal axis of the third molar in relation to the functional occlusal plane (third molar angulation), the depth of the third molar-second molar contact below the occlusal plane, and the length of the third molar root (Fig. 2, A and B).

Fig. 2. Third molar radiographic measurements. **A,** Third molar angulation. **B,** Third molar root length and depth of the third molar-second molar contact below the occlusal plane.

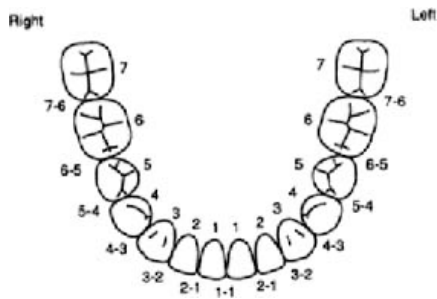


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This method was designed to provide reliable third molar measurements, although the values are not as accurate as those produced by cephalometric means. Third molar root development was staged according to Nolla.¹⁴

While seated in an upright position, each patient was given 180 mg lidocaine with 0.09 mg epinephrine as an intraoral local anesthetic. The frictional forces were measured first at the mandibular 6-5 proximal contact on the extraction side (tooth contact designations are shown in Fig. 3).

Fig. 3. Proximal tooth contact designations.



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Difficulties in access precluded readings from the 7-6 contact. The stainless steel strip was withdrawn 2 to 4 mm, and the frictional force resisting withdrawal was recorded from the digital tension transducer. Two recordings were made and averaged to provide a single value for the frictional force at the contact. The procedure was repeated for mandibular contacts 5-4 and 4-3 on the extraction side and then for contacts 6-5, 5-4, and 4-3 on the nonextraction side. The patient was then placed in a supine position on the operating table, and the unerupted third molar on the designated extraction side was removed surgically. After removal of the third molar, measurement of frictional forces at all contacts was immediately repeated bilaterally. The frictional forces resisting strip withdrawal were converted to contact tightness magnitudes by equation 1.

Statistical analyses were performed with the aid of the SAS¹⁵ statistical software package. Paired *t* tests were used to detect changes in the tightness of bilateral contacts between the teeth after unilateral extraction. Paired *t* tests were also used to compare changes in tightness between corresponding contacts in the extraction and nonextraction sides. Correlation analysis was used to quantify relationships between changes in mandibular contact tightness after unilateral extraction and each patient's age, the stage of development of the extracted third molar root, the angulation of the extracted third molar, the root length, and the depth of third molar-second molar contact below the functional occlusal plane. An α level of 0.05 was set for the significance level of all statistical tests.

On the basis of clinical impressions gained during the first part of this study, a second experiment was conducted to determine the effects of postural changes on mandibular contact tightness where no surgery had been performed. Ten adult subjects with complete dentitions from the second molars forward participated. While the patients were seated upright, measurements of tightness were obtained at the

mandibular 6-5, 5-4, and 4-3 contacts. For five subjects these measurements were taken on the right side of the arch, and for five subjects they were taken on the left. The subjects were then placed in a supine position for 2 hours, after which time the measurements were repeated. Paired *t* tests were used to detect changes in the tightness of contact between the mandibular teeth after the change in posture.

Results

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The mean tightness of all contacts decreased bilaterally after unilateral third molar extraction. Relief of the tightness decreased significantly in the 6-5 and 4-3 contacts on the extraction side *and* in the 6-5 contact on the nonextraction side (Table I).

Proximal Contact	Extraction side				Nonextraction side				Difference	SE
	Before (gm)	After (gm)	Mean change (gm) (%)	SE	before (gm)	After (gm)	Mean change (gm) (%)	SE		
6-5	782.5	679.9	-103.6* (-13.4)	37.0	726.7	647.6	-79.2** (-10.8)	25.3	-26.6	41.4
5-4	492.4	460.2	-32.2 (-6.5)	25.8	498.8	482.7	-16.1 (-2.0)	16.2	-22.1	24.8
4-3	537.7	496.1	-41.5* (-7.7)	18.8	389.1	369.4	-19.7 (-5.0)	11.5	-21.8	23.6

†Measured in grams.
‡Difference = (Mean change, extraction side) - (Mean change, nonextraction side). There was no significant difference in contact tightness changes between the extraction and nonextraction sides (*p* < 0.05).
**p* < 0.05.
***p* < 0.01.

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Although the greatest overall mean change (-13.4%) occurred on the extraction side, the largest change in the nonextraction side was nearly as great (-10.8%). The difference between decreased contact tightness in the extraction and nonextraction sides, a measure of the mesial force exerted by the unerupted third molar, was insignificant. That is, no third molar mesial force was detected.

No significant correlations were found between changes in mandibular contact tightness after unilateral extraction and any of the following variables: patient age (\bar{x} = 20.6 years, SD = 2.0 years), stage of third-molar root development (\bar{x} = 9.5, SD = 0.8), third molar angulation (\bar{x} = 38.1°, SD = 23.8°), third molar root length (\bar{x} = 10.9 mm, SD = 1.8 mm), or depth of third molar-second molar contact below the functional occlusal plane (\bar{x} = 8.2 mm, SD = 2.5 mm).

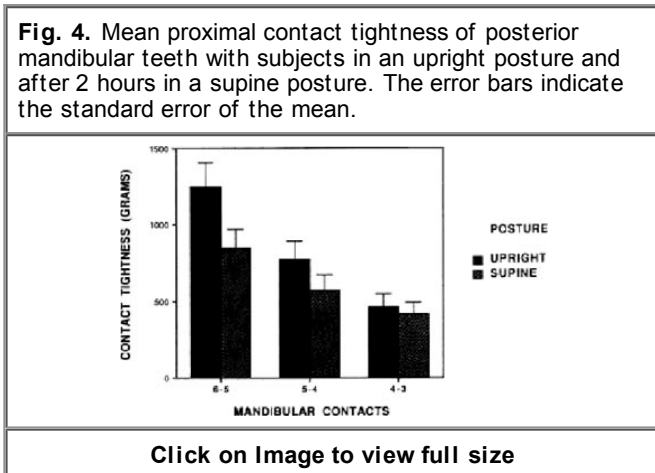
In the second experiment, the mean tightness of all measured mandibular contacts decreased after the patient was moved from an upright to a supine posture (Table II).

Proximal Contact	Mean Change (gm) (%)	SE
6-5	-400.7**** (-32.1)	60.7
5-4	-203.1** (-26.1)	38.6
4-3	-46.6 (-10.1)	25.9

***p* < 0.001.
*****p* < 0.0001.

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The greatest reduction of contact tightness (-32%) was found at the mandibular 6-5 contact (*p* < 0.0001), and the smallest decrease (-10%) was measured at the mandibular 4-3 contact (Fig. 4).



After *unilateral* extraction of unerupted mandibular third molars, we anticipated finding either (1) a decrease in proximal contact tightness on the extraction side and unchanging contact tightness on the nonextraction side (demonstrating the existence of a detectable third-molar eruptive force) or (2) unchanging contact tightness bilaterally (demonstrating the absence of a detectable third molar force). Instead we found that the mean tightness of contacts between mandibular teeth had decreased *bilaterally* and that the difference in changes between the extraction and nonextraction sides was not significant. Clearly, some factor other than a mesially directed third-molar eruptive force had exerted a pronounced effect on interdental forces.

The second experiment was conducted to determine whether the relief in interdental force could be attributed to postural change alone. Moving a subject from an upright to a supine posture dramatically reduced mandibular proximal contact tightness bilaterally. Apparently the tightness of proximal contacts is not a static feature of occlusion. It varies widely as a function of body posture throughout the day and may possibly vary with head posture alone. It is also apparent that the dramatic changes in interdental forces caused by simple postural movement overwhelm any effect of erupting third molar pressure on interdental forces.

An alternative explanation could be offered to explain the results of the first experiment. That is, if the unerupted third molar acted as a wedge, then unilateral extraction could have resulted in a progressive decrease in tightness from the 6-5 contact on the extraction side, along the anterior of the arch, to the 6-5 contact on the nonextraction side. However, we have previously shown that the magnitude of the anterior component of occlusal force, which is generated by mandibular second molars under normal chewing loads, decreases exponentially as it proceeds toward the front of the mouth and cannot be detected between posterior teeth on the contralateral side.¹² since a force from third molars would be transmitted anteriorly in a similar manner through proximal contacts, the distribution of the third molar force should resemble the distribution of the anterior component of force, decreasing exponentially as it proceeds anteriorly and dissipating before it reaches the posterior teeth on the nonextraction side. Because both the extraction and nonextraction sides showed nearly the same percentage of decrease in tightness at the 6-5 contact, this alternative explanation for the results of the first experiment is not probable.

The lack of correlation between changes in the tightness of tooth contacts after surgery and other variables such as patient age, stage of third molar root development, third molar angulation, third molar root length, and depth of third molar-second molar contact below the functional occlusal plane is not surprising. That is, if unerupted third molars *do* generate a mesial pressure, it was of insufficient magnitude to be detected by the instrumentation and technique in our experiment. In the absence of a detectable third molar force, no correlation of this force with the aforementioned factors could be expected.

When a stainless steel strip is slipped between the teeth, they will eventually separate, and the tightness of the contact between the teeth will decrease as a result of viscoelastic relaxation of the periodontal ligament. One could therefore argue that the decrease tightness attributed to moving the patients from an upright to a supine position was actually nothing more than viscoelastic relaxation of the periodontal ligament after repeated insertions of the stainless steel strip. However, we have also reported that the mean tightness of posterior proximal contacts increases after a return from a supine to upright posture¹⁶—a finding which demonstrates that the observed effect of posture is not simply a result of viscoelastic relaxation of the periodontal ligament.

One may also argue that the subjects included in the first part of this study were in their late teens or early 20s and that the majority of their third molars had complete root formation and could no longer generate an eruptive pressure. However, the mean age of these subjects equals the mean age for mandibular third molar eruption reported by Hellman.¹⁷ Further, the eruptive mechanism remains intact even after a tooth has come into occlusion and function has been established.¹⁸ If a significant third molar pressure existed, it should have been detectable in these patients.

We are not suggesting that third molar mesial pressure is nonexistent. We anticipate that the mean difference we found between the tightness of contacts on extraction and nonextraction sides will be construed by some as evidence of third molar-eruptive force. In fact, if a third molar mesial eruptive force exists, its magnitude is too small to be detected by the technique described here. Nor are we claiming that third molar pressure has absolutely no effect on interdental forces or that body posture alone determines the tightness of contacts between posterior teeth. Indeed, from other preliminary research we are currently conducting, it appears that the magnitude of such tightness is based on a number of physiologic factors, including the duration and magnitude of chewing force. What we *are* claiming is that the long-acting effects of posture, and possibly other factors, overwhelm any effect from unerupted third molars on interdental forces.

We conclude that removal of unerupted mandibular third molars does not significantly relieve proximal contact tightness but that simple movement from an upright to a supine posture relieves such tightness dramatically. There are many valid reasons for removing unerupted mandibular third molars. However, the results of this study indicate that extracting these teeth for the exclusive purpose of relieving interdental pressure and thereby preventing mandibular incisor crowding appears to be unwarranted.

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Publishing and Reprint Information

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This article is referenced by these articles:

Third molars: A dilemma! Or is it?

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[ABSTRACT](#)

[FULL TEXT](#)

In this era of evidence-based dentistry the question must be asked: How and by whom is the evidence evaluated?

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