

CLINICIANS' CORNER

Third molars: A dilemma! Or is it?

Samir E. Bishara, BDS, DOrtho, DDS, MS

Iowa City, Iowa

The purpose of this article is to review some of the pertinent studies related to the management of third molars in an orthodontic context. The clinician should base his or her decision to extract or not extract third molars on the most current scientific information and what is best for each individual patient. (*Am J Orthod Dentofacial Orthop* 1999;115:628-33)

The greatest enemy of truth is very often not the lie—deliberate, contrived, and dishonest, but the myth—persistent, persuasive, and unrealistic.

John F. Kennedy, Yale University, June 11, 1962

THE PRESENT CONTROVERSY

The role that mandibular third molars play in lower anterior crowding has provoked much speculation in the dental literature. In 1859, Robinson wrote "the dens sapientiae is frequently the immediate cause of irregularity of the teeth."¹ In a survey of more than 600 orthodontists and 700 oral surgeons, Laskin² found, that 65% were of the opinion that third molars sometimes produce crowding of the mandibular anterior teeth.

As a result of such opinions, the removal versus the preservation of third molars became the subject of contention in dental circles. The differing views ranged between extremes, and can be expressed in two different statements:

1. Third molars should be removed even on a prophylactic basis, because they are frequently associated with future orthodontic and periodontal complications as well as other pathologic conditions.
2. There is no scientific evidence of a cause-and-effect relationship between the presence of third molars and orthodontic and periodontal problems.

The purpose of this presentation is to discuss some of the major considerations and the present controversy surrounding third molars as they relate to orthodontics. Specifically it will attempt to answer three concerns that are important to the clinical orthodontist: (1) What is the relationship between third molars and lower incisor crowding? (2) Are third molar impactions predictable? and (3) Is there a rationale on how to handle third molars at the end of orthodontic treatment?

RELATIONSHIP BETWEEN THIRD MOLARS AND INCISOR CROWDING

Before we discuss the role third molars play in lower incisor crowding, it might be important to review the changes in the lower incisors that occur with time in both the untreated as well as the orthodontically treated populations.

Untreated Normals

Bishara et al^{3,4} evaluated the changes in the lower incisors between 12 and 25 years of age, and then re-evaluated the same subjects, at 45 years of age. Their findings indicated that there was an increase in the tooth size-arch length discrepancy with age. The average changes amounted to 2.7 mm in males and 3.5 mm in females. These changes were attributed to a consistent decrease in arch length that occurred with age. Similar findings have been observed on untreated normal subjects by Lundstrom⁵ and Sinclair and Little.⁶

Orthodontically Treated Patients

In 1970, Fastlicht⁷ found that in orthodontically treated subjects, 11% of the cases had third molars but 86% had crowding. In 1981, Little et al⁸ observed that 90% of the extraction cases that were well treated orthodontically ended up with an unacceptable amount of lower incisor crowding. Furthermore, it was difficult to predict the 10% of the cases that remained acceptable.

These long-term studies have indicated that the incidence as well as the severity of mandibular incisor crowding increased during adolescence and adulthood in both the normal untreated individuals as well as the orthodontically treated patients, after all retention is discontinued.⁵⁻⁸ As a result, Bramante⁹ observed that many clinicians consider some form of indefinite

³Professor of Orthodontics, College of Dentistry, University of Iowa, Iowa City. Reprint requests to: Samir E. Bishara, BDS, DOrtho, DDS, MS, Professor of Orthodontics, College of Dentistry, University of Iowa, Iowa City, IA 52242. Copyright © 1999 by the American Association of Orthodontists. 0889-5406/99/\$8.00 + 0 8/1/90182

retention to avoid incisor crowding at later stages of maturation.⁹

Studies Relating Third Molars to Crowding of the Dentition

Two studies suggested that the presence of third molars is an etiologic factor in lower incisor crowding.^{10,11} They have been widely quoted in the literature as evidence of a cause-and-effect relationship between third molars and crowding.

Bergstrom and Jensen's study¹⁰ was designed to determine the extent to which third molars are responsible for secondary tooth crowding. They cross-sectionally examined dental students 30 of whom had unilateral agenesis of the upper third molar; 27 had agenesis of one lower third molar. From plaster casts, they performed left-to-right comparisons of the space conditions on both sides of each arch and the mesiodistal asymmetries of the lateral arch segments. They also measured midline displacement. Their results suggested that there was more crowding in the quadrant with a third molar present than in the quadrant with a third molar missing and there was a mesial displacement of the lateral dental segments on the side with the third molar present in the mandibular arch but not in the maxilla. They also observed that the unilateral presence of a third molar did not seem to have an effect on the midline. Bergstrom and Jensen concluded that the presence of a third molar appeared to exert some influence on the development of the dental arch but not to the extent that would justify either the removal of the tooth germ, or the extraction of the third molars, other than in exceptional instances.

In another study, Vego¹¹ longitudinally examined 40 individuals with lower third molars present and 25 patients with lower third molars congenitally absent. None of the selected patients had undergone orthodontic treatment. Each individual arch was measured for the amount of crowding at two time intervals: after the eruption of the second molars at 13 years of age, and later at an average age of 19 years. In Vego's study, crowding was defined as loss of arch perimeter manifested either as closure of space or the slipping of contacts and resulting in rotation or adverse movement of teeth.

Vego found that in all 65 cases, the arch perimeter showed a decrease from the first to the second casts. This was expressed as an increase in the severity of rotated or malaligned teeth. The decrease in arch perimeter was less noticeable in persons without lower third molars.

Vego concluded that the erupting lower third molars can exert a force on the neighboring teeth. He also indi-

cated, that there are multiple factors involved in the crowding of the arch.¹¹

The Bergstrom and Jensen and Vego are the two most widely quoted studies that relate third molars to crowding of the incisors.

Retrospective Studies Indicating a Lack of Correlation Between Mandibular Third Molars and Postretention Crowding

On the other hand, a number of studies found no correlation between third molars and lower incisor crowding. Kaplan¹² investigated whether mandibular third molars have a significant influence on posttreatment changes in the mandibular arch, specifically on anterior crowding relapse. The sample consisted of 75 orthodontically treated patients on whom pretreatment, posttreatment, and 10 years postretention study models, and lateral cephalograms were obtained. The sample was divided into three groups: The first group consisted of 30 persons with both third molars erupted to the occlusal plane, in good alignment buccolingually, and of normal size and form. The second group consisted of 20 persons with bilaterally impacted third molars. All patients in this group were candidates for surgical removal of the third molars on the basis of postretention periapical radiographs. The third group consisted of 25 patients with bilateral agenesis of the mandibular third molars.

Kaplan's data indicated that some degree of lower anterior crowding relapse occurred in the majority of cases. When the three third molar groups were compared, however, there were no significant differences in any of the parameters examined. This was true whether premolars were extracted or not. Kaplan concluded that the presence of third molars does not produce a greater degree of lower anterior crowding or rotational relapse after cessation of retention. According to Kaplan, the theory that third molars exert pressure on the teeth mesial to them could not be substantiated.¹²

In a cephalometric study on a similar sample, Ades et al¹³ in 1990, found no significant differences in mandibular growth patterns between the various third molar groups whether erupted, impacted or congenitally missing, also with and without premolar extractions. They observed that in the majority of cases there was incisor crowding. They concluded that there is no basis for recommending third molar extractions to alleviate or prevent mandibular incisor crowding.

Lifshitz¹⁴ in 1982 evaluated the effect of lower premolar extraction versus nonextraction as well as the presence or absence of lower third molars, on mandibular incisor crowding. He concluded that in all groups evaluated, there was a significant decrease in

arch length and a significant increase in crowding, but there were no significant differences between the groups that did or did not have premolar extractions or whether third molars were present or missing.

Prospective Studies Evaluating the Possible Effects of Extraction of Third Molars

In another interesting series of studies, the effect of extracting third molars was evaluated prospectively rather than retrospectively.

Lindqvist and Thilander¹⁵ in 1982 attempted to determine the effect of the prophylactic removal of mandibular third molars on the lower incisors. They extracted a third molar on one side at an average age of 15.5 years and left the third molar on the other side as a control. They measured study casts and cephalograms (lateral, frontal, and oblique) on these patients 3 years postoperatively. They evaluated numerous parameters but were unable to predict which patients would benefit from such a procedure as both sides essentially had similar changes. They felt that an important variable that influences the dental arch changes is the presence of correct proximal contacts.

Southard et al¹⁶ in 1991 measured proximal contact tightness between the mandibular teeth in cases with bilaterally unerupted third molars. The measurements were taken before and after the unilateral removal of one third molar. They found that the surgical removal of the third molar did not have a significant effect on contact tightness. On the other hand, they found that changing the position of the patient from upright to supine relieved the tightness dramatically.

Pirttiniemi et al¹⁷ in 1994 evaluated the effect of removal of impacted third molars on 24 individuals in their third decade of life. Dental casts were evaluated before and 1 year after extractions. They found that the extractions allowed for slight distal drift of the second molar but had no significant change in the lower anterior area.

In summary, one has to conclude from the available data that third molars do not play a significant, ie, quantifiable, role in mandibular anterior crowding.

THIRD MOLAR IMPACTIONS

Third molar impaction is one of the clinical problems that the orthodontist may face when considering the management of adolescent patients. In that respect, the following questions need to be considered:

1. Are there any morphologic factors that may affect the eruption or impaction of third molars?
2. Should we enucleate third molars at an early age if we think they will be impacted?
3. How predictable is the ultimate third molar position, from earlier observations of its inclination?

What Are the Morphologic Factors That Can Influence the Space Available for Third Molars?

Björk et al¹⁸ examined 243 cases to estimate the relationship between various cephalometric parameters and the space available for mandibular third molars. They identified three skeletal factors that may influence third molar impaction: (1) vertical direction of condylar growth as indicated by the mandibular base-ramus angle; (2) reduced mandibular length measured as the distance from the chin point to the condylar head; and (3) backward-directed eruption of the mandibular dentition as determined by the degree of alveolar inclination.

An estimation of the rank order of these three skeletal developmental factors indicated that the vertical direction of condylar growth has the greatest effect, followed by a small mandibular length and then by the backward directed eruption of the dentition. In individual cases, the three variables may either amplify or neutralize each other. Another variable that was found to be significant was the retarded maturation of third molars. The combination of the three skeletal factors of mandibular development with retarded maturation of third molars accounted for 80% of the cases with bilateral third molar impactions. Björk et al¹⁸ indicated that in cases of impaction the space distal to the second molar is considerably reduced in 90% of the cases.

Capelli¹⁹ in a 1991 study evaluated 60 patients who had four first premolar extractions. The findings from pretreatment and posttreatment cephalograms suggested that third molar impactions were more likely to occur in patients with predominant vertical mandibular growth. A long ascending ramus, short mandibular length, and greater mesial crown inclinations of the third molars, seem to be indicative of third molar impaction.

In summary, it can be concluded that there are some morphologic factors that are related to a greater incidence of third molar impaction.

Enucleation of Third Molars and Their Prophylactic Extraction

It might be of interest to note that in the Scandinavian male population, Björk et al¹⁸ estimated a 20% to 25% risk of impaction of third molars. This is fairly close to the reported incidence in the USA.²⁰ As a result of this significant incidence of third molar impactions, the enucleation of third molars at earlier stages of dental development was advocated by some clinicians.

But as one might expect, there is a dichotomy regarding the need as well as the consequences of enucleation. Those who oppose prophylactic extraction of

third molars point to the risk of complications during surgery. In addition, there are three major areas of economic concern in third molar extraction: (1) Can the cost of the "routine" removal of the third molars as a preventive procedure be justified for the 80% who will not have impacted third molars? (2) What are the added costs of such a procedure on the cost of health insurance? (3) What are the risks involved with the procedure and the use of general analgesia or anesthesia?²¹

On the other side of the dichotomy, are the proponents of removal of third molars on a prophylactic basis.²² Those in favor of enucleation believe that many young adults between the ages of 18 and 22 years experience problems with their third molars and that at later ages, pathologic changes often occur. They believe that orthodontic treatment is enhanced, particularly during anchorage preparation, when distal movement of the first and second molars may be required. Such movement might limit the space available for the second molars and might result in severe impaction of the third molars. Ricketts et al²² further indicated that removal of the third molar buds at the age of 7 to 10 years is surprisingly simple and relatively atraumatic. This contrasts to the difficulty of extracting deeply impacted teeth in adults.

Prediction of Third Molar Position

So where is our dilemma? In essence, clinicians need to be able to predict the ultimate disposition of these teeth from the available information at age 7 to 10 years! In this regard there are two variables that need to be determined: (1) predicting the future availability of space for third molars, and (2) predicting the changes in the angulation of the third molars.

Prediction of Space Availability for Third Molar Eruption

Ricketts et al²² examined 200 skulls with complete dentitions and determined the relationship of the mandibular third molars to the anatomy of the ramus. They suggested the use of cephalometric head films, taken as early as 8 or 9 years of age, for predicting the dimension at adulthood of the distance from Xi point to the distal aspect of the second molar along the occlusal plane. If the predicted distance is 30 mm or greater, it would indicate that sufficient space for the third molars is available. On the other hand, if the predicted distance is 20 mm or less, the space is considered inadequate. The standard error for the prediction was 2.8 mm. To estimate the probability of impaction, Ricketts et al²² used prediction curves developed by Turley.²³ According to these curves, the probability of either impaction or full

eruption could be diagnosed at the age of 8 or 9 years with 90% accuracy.

Is this approach reproducible? Olive and Basford²⁴ examined the reproducibility of Ricketts' estimates and also calculated the Space Width Ratio, which is the ratio of the distance from the lower second molar to the ramus divided by the mesiodistal width of the third molar. They estimated that a ratio of less than 120% will indicate a high probability of impaction. Olive and Basford²⁴ found a significant correlation $r = 0.76$, between the distance from Xi point to the lower second molar, and the space width ratio, as derived from direct measurements. One should realize that a correlation coefficient of 0.76, although significant at the 0.001 level of confidence, can improve the estimate of prediction by only 58%. As a result, Olive and Basford indicated that any direct assessment of one variable from the other in an individual patient is of doubtful value. They also concluded that at present, prediction of impaction or eruption, based on the distance between Xi point to the lower second molar or using the space width ratio, are *not* sufficiently reliable.

Inclination of Third Molars and Their Impaction

According to Björk,¹⁸ the prospects of estimating the risk of impaction from the degree of inclination of third molars at the preadolescent stage does not appear to be promising. On the other hand, Richardson²⁵ found that in general the original angulation of the occlusal surface of the third molar in relation to the mandibular plane is significantly smaller in those persons in whom third molars have erupted early. But again, this is not of predictive value for the individual patient.

Kahl et al^{26,27} evaluated orthopantomograms of 58 orthodontically treated patients with asymptomatic impacted third molars. In a 15 year follow-up, they observed that some of the maxillary and mandibular molars have rotated to a more upright position, while others had an increase in the mesio or distoangulation. They found that age, period of impaction, extent of space deficiency, developmental stage, level of eruption, and bone conditions had no predictive value. As a result, they suggested that third molars should be periodically evaluated.

CONSENSUS DEVELOPMENT CONFERENCES ON REMOVAL OF THIRD MOLARS

Two consensus conferences were dedicated to the management of third molars, one sponsored by the National Institute of Dental Research in 1979²⁸ and the other by the American Association of Oral and Maxillofacial Surgery in 1993,²⁹ in an attempt to reach a general agreement on when and under what

circumstances third molar extraction is advised. Detailed reports on the areas of consensus were published,^{28,29} but only the areas related to orthodontics will be addressed here. Some of the points of consensus were:

1. Crowding of the lower incisors is a multifactorial phenomenon that involves a decrease in arch length, tooth size, shape and relationship, narrowing of the intercanine dimension, retrusion of the incisors, and growth changes occurring in adolescence. Therefore, it was agreed that there is little rationale based on the available evidence for the extraction of third molars solely to minimize present or future crowding of the lower anterior teeth. If adequate room is available for third molar eruption, every effort should be made to bring these teeth into functional occlusion.
2. Orthodontic therapy, in both maxillary and mandibular arches, may require posterior movement of both first and second molars by either tipping or translation, which can result in the impaction of third molars. To avoid impacting third molars and to facilitate retraction, it may be deemed advisable in some cases to remove third molars before starting retraction procedures.
3. There is no evidence to suggest that a third molar is needed for the development of the basal skeletal components of the maxilla and mandible.
4. There was agreement that postoperative pain, swelling, infection, and other possible consequences of surgery are minimized when surgery is performed in patients who are dentally young, as judged by the third molar roots being about two thirds developed. As a result, it is important to instruct the clinician in recognizing the benefit of early removal of third molars in those cases in which extraction is definitely indicated.
5. Although there are orthodontic reasons for the early removal of third molars, the consensus was that enucleation of third molar buds based on measurements obtained at age 7 to 9 years is not acceptable. This is because the present predictive techniques for third molar eruption or impaction are not highly reliable and should be used with caution.
6. Patients should be informed of potential surgical risks including any permanent condition that has an incidence greater than 0.5% or any transitory condition that occurs with an incidence of 5% or more. On this basis, patients should be informed about hemorrhage, pain, swelling, alveolar osteitis, trismus, and nerve injury.

In conclusion, the Workshops identified a number of well-defined criteria for the removal of third molars. Included among others are infection, nonrestorable carious lesions, cysts, tumors, and destruction of adjacent teeth and bone.^{28,29}

What To Do with Asymptomatic Impacted Third Molars?

There is still no consensus on the subject of removal of asymptomatic impacted teeth with no evidence of pathosis. Long range studies on this subject are still needed. But it was generally agreed, that the impaction or malposition of a third molar is an abnormal state, and may justify its removal.

WHY ARE THIRD MOLARS EXTRACTED?

A 1988 study evaluated the reasons given for the extraction of third molars in a controlled clinical setup. The reasons were obtained by Lysell and Rohlin³⁰ from the records of 870 Swedish patients treated in 23 clinics in Sweden. The stated indications for the removal of the mandibular third molars were as follows: prophylactic (27%), earlier bout of pericoronitis (25%), orthodontics (14%), caries and pulpitis (25%), cysts, tumors, root resorption (3%) and other factors (18%). Note, that the data indicated that 54% of the third molars removed were asymptomatic.

CONCLUSIONS

From the present review the following can be concluded:

1. The influence of the third molars on the alignment of the anterior dentition may be controversial, but there is no evidence to incriminate these teeth as being the only or even the major etiologic factor in the posttreatment changes in incisor alignment. The evidence suggests that the only relationship between these two phenomena is that they occur at approximately the same stage of development, ie, in adolescence and early adulthood. But this is not a cause and effect relationship.
2. The clinician has to have a justifiable reason to recommend the extraction of any tooth.
3. The clinician has to consider the impact of the extraction decision on any future treatment plan from an orthodontic, surgical, periodontic, or prosthodontic aspect.
4. If extraction is indicated, third molars should be removed in young adulthood rather than at an older age.

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