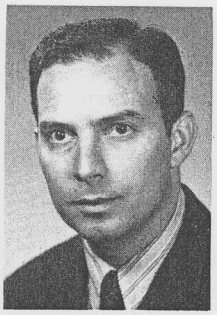

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Third molars: A review

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The influence of the third molars on the alignment of the anterior dentition is controversial. There is no conclusive evidence to indict the third molars as being the major etiologic factor in the posttreatment changes in incisor alignment. Various aspects related to the management of thd molars are discussed, and specific situations in which third molar extractions are contraindicated are illustrated.

Key words: Third molars, review, posttreatment changes, prediction, lower anterior crowding

The role of mandibular third molars in the relapse of lower anterior crowding following the cessation of retention in orthodontically treated patients has provoked much speculation in the dental literature. In 1859 Robinson[1] wrote: "The dens sapientiae is frequently the immediate cause of irregularity of the teeth by the pressure exerted toward the anterior part of the mouth." Since that time a large number of investigators have discussed in detail the various aspects of third molar development and its effect on the lower arch.[2–12]

The purpose of this article is to discuss some of the major considerations and the present controversy surrounding third molars as they relate to orthodontics. It should not be viewed as an overview of all the available literature on the subject.

THE PRESENT CONTROVERSY

As recently as 1971, in a survey of more than 600 orthodontists and 700 oral surgeons, Laskin[13] found that 65 percent were of the opinion that third molars sometimes produce crowding of the mandibular anterior teeth.

As a result of such opinions as Laskin reported, the removal versus the preservation of third molars became the subject of contention in dental circles. The different views range between the extremes expressed in two different statements: (1) Third molars should be removed, even on a prophylactic basis, because they frequently are associated with future orthodontic and periodontic 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 periodontic problems.

THIRD MOLAR AGENESIS

Prevalence

Third molars are the teeth that are most often congenitally missing. Estimates of the percentage of persons with one or more third molars missing range from 9 percent to 20 percent. There are more females than males with congenital absence of third molars; a 3:2 ratio exists, according to Richardson.[14]

The average age for third molar crypt formation is 7 years. Its earliest occurrence was reported at 5 years and its latest at 15 years.[15–16]

According to Banks,[17] it is most common for two third molars to be missing, followed by one, four, and three. Nanda[18] found the frequency to be one, two, three, and four.

Richardson[14] indicated that if third molar formation is delayed beyond the age of 10 years, the possibility of all four third molars developing is reduced by about 50 percent. She found no significant differences in the size of early- and late-developing third molars. Furthermore, she noted that the size of the rest of the teeth did not significantly differ between persons with and without congenitally missing third molars.

THIRD MOLAR IMPACTIONS

Dachi and Howell[19] examined a series of 3,874 full-mouth radiographs. From their study, several findings concerning impacted teeth could be noted: (1) The incidence of patients with at least one impacted tooth was 16.7 percent. (2) The teeth most often impacted, in order of frequency, were the maxillary third molars, the mandibular third molars, the maxillary canines, and the mandibular premolars. Of the total number of third mo-

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lars present, 29.9 percent of the maxillary third molars and 17.5 percent of the mandibular third molars were impacted.

No sex differences were noted in the impaction of third molars, and there was no significant predisposition toward bilateral or unilateral impaction.

Among maxillary third molars, 15 percent had radiolucencies and 2.1 percent of these were diagnosed as having dentigerous cysts. Thirty-seven percent of the mandibular third molars had radiolucencies surrounding their crowns, and 3.8 percent of these were diagnosed as having dentigerous cysts.

FACTORS WHICH CAN INFLUENCE THE SPACE AVAILABLE FOR THIRD MOLARS

Björk and colleagues[20] examined 243 cases to estimate the relationship between the space available for mandibular third molars and their impaction. They indicated that, in cases of impaction, the alveolar arch space distal to the second molar is considerably reduced in 90 percent of the cases.

Björk identified three skeletal factors that are separately influencing third molar impaction: (1) reduced mandibular length, measured as the distance from the chin point to the condylar head; (2) vertical direction of condylar growth as indicated by the mandibular base angle; and (3) backward-directed eruption of the mandibular dentition determined by the degree of alveolar prognathy of the lower jaw.

The rank order of the three skeletal developmental factors in third molar impaction are vertical direction of condylar growth, small mandibular length, and backward-directed eruption of the dentition. The combination of the three skeletal factors of mandibular development with retarded maturation of third molars accounted for 80 percent of the cases with bilateral third molar impaction.

Olive and Basford[21] found that the ratio between the inter-second molar width and the inter-ramal width, as measured from posteroanterior cephalograms, is an important factor in the identification of possible impaction of mandibular third molars.

Björk[20] estimates that impaction of the mandibular third molars may occur in every fourth or fifth adult male in the Scandinavian dental population.

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, according to Björk.[20]

On the other hand, Richardson[22] found that the original angulation of the occlusal surface of the third molar to the mandibular plane is significantly lower in those persons in whom third molars have erupted early.

THIRD MOLARS AND CROWDING

Studies relating third molars to crowding

Two studies are going to be reviewed since they have been widely quoted in the literature as evidence of a cause-and-effect relationship between third molars and crowding.

Bergstrom and Jensen,[23] in a study designed to determine the extent to which third molars are responsible for secondary tooth crowding, cross-sectionally examined sixty dental students, of whom thirty had unilateral agenesis of the upper third molars, twenty-seven had agenesis of the lower third molars, and three had one third molar absent or lost. 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.

The results suggested that there was more crowding in the quadrant with a third molar present than in the quadrant with a third molar missing. There was a mesial displacement of the lateral dental segments on the side with the third molar in the mandibular arch, but not in the maxilla. They found no evidence of a correlation between age and the degree of crowding or mesial tooth displacement. They indicated that the presence of a third molar did not seem to effect the midline.

Bergstrom and Jensen[23] 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, Vego[24] longitudinally examined forty patients with lower third molars present and twenty-five 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. The first measurement was taken after eruption of the second molars at an average age of 13 years, while the second measurement was taken at an average age of 19 years. Crowding was defined as loss of arch perimeter. This is manifested either as closure of space or by slipping of contacts, resulting in rotation and/or adverse movement of teeth.

Vego found that in all sixty-five 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 molar can exert a force on the approximating teeth and indi-

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

Studies indicating a lack of correlation between mandibular third molars and post-retention crowding

Kaplan,[25] in 1974, investigated whether mandibular third molars have a significant influence on posttreatment changes in the mandibular dental arch and specifically on anterior crowding relapse. The research material consisted of pretreatment, posttreatment, and 10 years postretention study models and lateral cephalograms of seventy-five orthodontically treated patients.

The sample was divided into three groups: The first group consisted of thirty 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 twenty persons with bilaterally impacted third molars. All patients were candidates for surgical removal of the third molars on the basis of postretention periapical radiographs. The third group consisted of twenty-five patients with bilateral agenesis of the mandibular third molars.

The following variables were measured on the study models: (1) arch length, (2) intermolar width, (3) intercanine width, (4) lower anterior crowding, and (5) lower anterior rotations. The cephalometric analysis included measurements of the following variables: (1) angle of lower incisor to mandibular plane, (2) anteroposterior position of the lower incisor along the x axis, (3) anteroposterior position of the lower first molar along the x axis, and (4) mandibular length from articulare to pogonion.

Kaplan's data indicated that some degree of lower anterior crowding relapse occurred in the majority of cases. When the three groups (with third molars erupted, impacted, and congenitally missing) were compared, however, there were no significant differences in any of the parameters examined, whether premolars were extracted or not. Kaplan concluded that the presence of third molars does not produce a greater degree of lower anterior crowding and/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.

OTHER FACTORS RELATED TO THIRD MOLAR EXTRACTION

Enucleation of third molars and their prophylactic extraction

Third molar enucleation at the age of 8 years has been practiced in England since 1936 by Henry and Morant.[26]

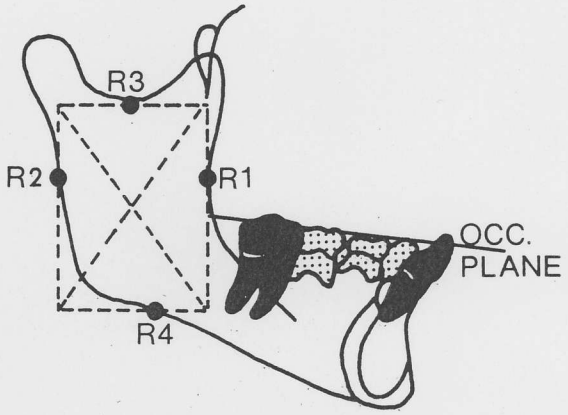

Fig. 1. Location of Xi point.

As one might expect, however, there is a dichotomy of opinion regarding both the need and the consequences of early enucleation. Those opposed to the procedure explain that by the age of 35 one out of five Americans is wearing a full upper denture and has lost many lower teeth as well. In addition, during adolescence some persons develop severe dental caries which can result in the loss of the first or second molars. Furthermore, those who oppose prophylactic extraction of third molars point to the risk of complications during surgery.[27]

On the other side of the dichotomy are the proponents of removal of third molars on a prophylactic basis. They believe that many young adults between the ages of 18 and 22 experience problems with their third molars and that at later ages pathologic changes often occur.[28] They believe that orthodontic treatment is enhanced, particularly when third molar extraction creates space for lower incisors or when, during anchorage preparation, 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 and his co-authors[28] further indicated that removal of the third molar bud at the age of 7 to 10 years is surprisingly simple and relatively atraumatic. This contrasts to the difficulty of extraction of deeply impacted teeth in adults.

Prediction of third molar behavior

Ricketts and associates[28] examined 200 skulls with complete dentitions and determined the relationship of erupted 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

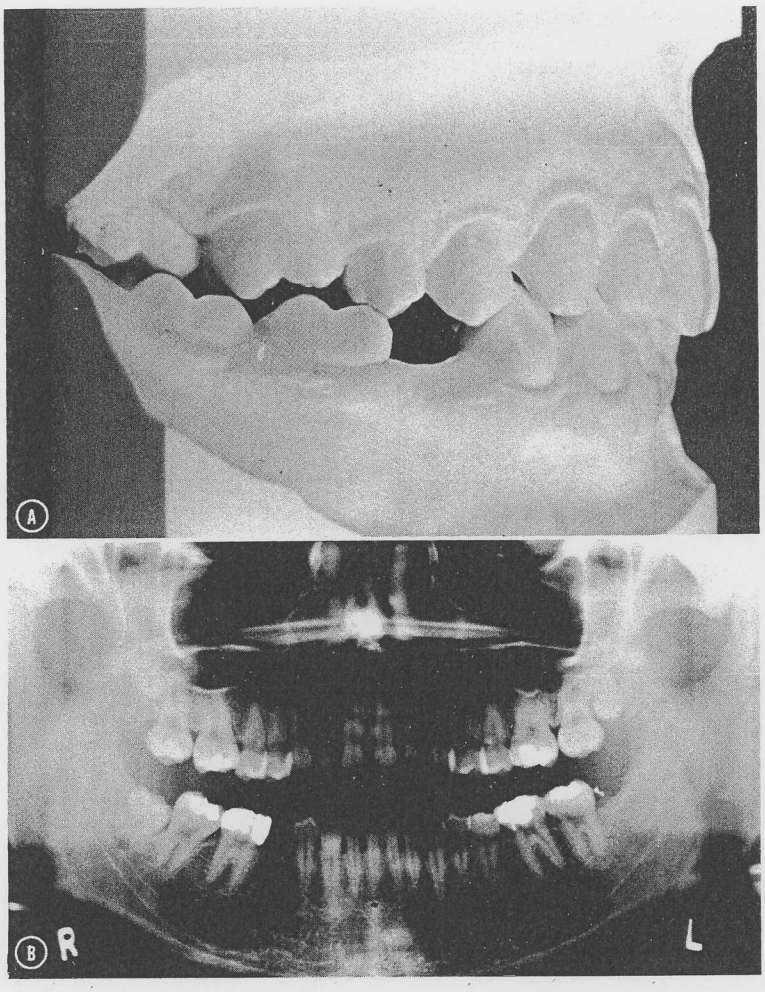

Fig. 2. Patient with congenitally missing lower right second premolar. Treatment plan is to protract lower right first molar to a Class III relationship. Note the occlusion of the second molars.

the occlusal plane (Fig. 1). They indicated that the standard error for the prediction is 2.8 mm. If the predicted distance is 30 mm. or greater, it would indicate sufficient space for the third molars. On the other hand, if the distance is 20 mm. or less, the space is considered inadequate.

To estimate the probability of impaction, Ricketts and his colleagues used the curves developed by Turley.[28, 29] 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 percent accuracy.

Olive and Basford[30] investigated the reliability and validity of various radiographic techniques used for assessing lower third molar behavior. They examined the reproducibility of estimates of the space width radio, which is the ratio of the distance between the lower second molar and the ramus divided by the mesiodistal width of the third molar. It is estimated that a ratio of 120 percent or greater indicates a high probability of impaction.

Olive and Basford[30] used lateral cephalograms, rotational tomograms, intraoral bitewing films, and 60-degree cephalograms taken on direct skull material. They determined the validity of these estimates when compared to each other as well as to direct measurements on the skulls. They also compared the relationship between the dimension from Xi point to the lower second molar and the space width ratio derived from direct measurements on the skulls. They concluded that the rotational tomogram, the intraoral bitewing film, and the 60-degree rotated cephalogram were superior to the lateral cephalogram for estimating the space width ratio. In their opinion, the poor reproducibility of the lateral cephalograms was probably caused by difficulties of landmark location as well as the projection angle.

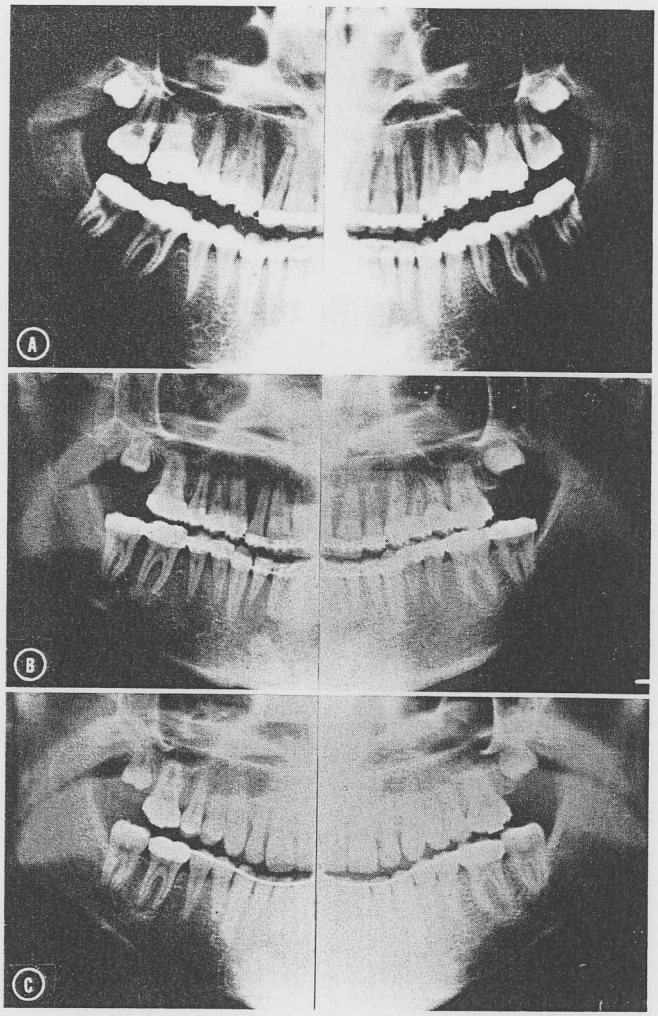

Fig. 3. Patient whose maxillary second molars were extracted. **A,** Before extraction. **B,** After extraction of second molars. **C,** Two years posttreatment; maxillary third molars have not yet erupted.

Olive and Basford[30] found a strong positive correlation ($r = 0.76$) between the dimension from Xi point to lower second molar and the space width ratio derived from direct measurements. They also indicated that any direct assessment of one variable from the other, in the individual case, is of doubtful value. Olive and Basford concluded that, at present, prediction of impaction or eruption based on Xi point to the lower second molar is *not* sufficiently reliable.

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 percent.

The economic factor

There are three major areas of economic concern in third molar extractions: (1) Can the cost of the "routine" removal of the third molars as a preventive procedure be justified? (2) What are the risks and cost involved in the routine use of general anesthesia? (3) What are the added costs of hospitalization, particularly in instances in which a patient has medical insurance that will pay for hospital care but not for office treatment?

PATHOLOGIC CHANGES ASSOCIATED WITH THIRD MOLARS

According to Lilly,[31] these pathologic changes can be divided into two categories: (1) those associated with erupted or partially erupted third molars (caries, periodontitis and other inflammatory conditions, malocclusion, fractures, neuropathies, etc.) and (2) those associated with unerupted or impacted teeth (follicular cysts, benign neoplastic disease such as ameloblas-

toma, resorption of second molar roots and neuropathies).

Although Lilly reported on the incidence of some of these changes in various populations around the world, he stated that at the present time there are no available data on the incidence of various pathologic changes associated with third molars in the United States population.

CONSENSUS DEVELOPMENT CONFERENCE ON REMOVAL OF THIRD MOLARS

A conference dedicated to third molars was sponsored by the National Institute of Dental Research Nov. 28 to 30, 1979. Approximately 250 dentists and scientists, representing all disciplines within the profession, met in an effort to reach a general agreement on when and under what circumstances third molar extraction is advised and to identify areas in which further research is needed.

The conferees were divided into five workshops to explore the following issues: the effect of third molar removal on growth and development, timing and technical considerations for third molar removal, periodontal considerations, prosthodontic considerations, and, finally, the morbidity of third molar removal.

A detailed report on the areas of consensus has been published elsewhere.[32] Some of the areas of consensus are related to orthodontic therapy and include, in part, the following:

Crowding of lower incisors is produced by many factors which include tooth size, tooth shape, narrowing of the intercanine dimension, retrusion of incisors, and growth changes occurring in the adolescent stages of development. Therefore, it was agreed that there is little rationale, based on present evidence, for the extraction of third molars solely to minimize present or future crowding of lower anterior teeth.

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.

The consensus was that impacted third molars are probably not the cause of the forward relapse after posterior movement of both first and second molars.

The Workshop agreed that it is necessary to instruct the student and practitioner in recognizing the need for early removal of third molars in those instances in which extraction is definitely indicated.

It was decided that the absence of a third molar on a routine dental film, without a history of prior extraction, demands more extensive radiographic examination.

The Workshop recommended that patients should be informed of potential surgical risks, including any permanent condition that has an incidence greater than 0.5 percent or any transitory condition that occurs with an incidence of 5 percent or more. On this basis, patients should be informed about hemorrhage, pain, swelling, alveolar osteitis, trismus, and nerve injury.

In conclusion, the Workshop identified a number of well-defined criteria for the renoval of third molars. Included, among others, are infection, nonrestorable carious lesions, cysts, tumors, and destruction of adjacent teeth and bone.

What to do with asymptomatic impacted third molars?

There was no consensus on the subject of removal of asymptomatic impacted teeth with no evidence of pathosis, but it was agreed that the impaction or malposition of a third molar is an abnormal state and may justify its removal.

The Workshop also identified several areas of insufficient knowledge related to management of third molars and suggested that they should also be subjects of research.

Some of the areas pertaining to orthodontics are (1) the relation of third molar to crowding of the dentition, growth and development of tuberosity and retromolar areas, as well as the relationship of the third molars to alveolar arch and length, and (2) the optimal method for predicting third molar eruption.

It needs to be emphasized that what has been presented is only part of the consensus report, and we strongly recommend that readers familiarize themselves with the complete text.

ORTHODONTIC CONTRAINDICATIONS FOR EXTRACTION OF THIRD MOLARS

From an orthodontic standpoint, clinicians should attempt to persuade both the general practitioner and the oral surgeon to postpone the decision for the removal of third molars in patients with malocclusions until the orthodontic treatment plan is completed. Of course, this is provided that there are no other pressing indications for extractions.

Certain situations need special attention:

1. When mandibular premolars are extracted or are congenitally missing. If the orthodontic treatment plan calls for closure of the available space in the lower arch and a nonextraction approach in the upper arch, then the first molar relationship will become Class III. The

maxillary second molar will have little or no occlusal contact with the opposing tooth, that is, the mandibular second molars (Fig. 2). The preservation and proper alignment of the mandiublar third molars will allow them to interdigitate with the maxillary second molars.

2. When the orthodontic treatment plan calls for extraction of first or second permanent molars, particularly in nongrowing persons with Class II malocclusions or open-bite tendencies.

3. When first or second molars have been extracted because of extensive caries and periapical involvement. In any situation in which extraction of first or second permanent molars is considered, it is important to evaluate the size and morphology of the unerupted third molars by taking periapical radiographs before the extractions are recommended. One has to recognize that the presence of a normally developing third molar does not automatically mean that the tooth will erupt into the line of occlusion (Fig. 3).

CONCLUSIONS

The influence of the third molars on the alignment of the anterior dentition is still controversial. There is no conclusive evidence to indict the third molars as being the major etiologic factor in the posttreatment changes in incisor alignment.

Various aspects related to the management of third molars have been discussed and specific situations in which third molar extraction is contraindicated have been illustrated.

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