Premolar Enucleation

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Extraction of permanent teeth has been accepted by most orthodontists using multibanded appliances. Serial extraction procedures also are commonly employed in cases of mixed dentition arch-length deficiencies to shift posteriorly the crowding of the readily-visible anterior segment. The majority of these cases are followed with the removal of permanent teeth and orthodontic treatment. However, the abundance of techniques and varied results with serial extraction have been confusing, and it is not uncommon to find clinicians who avoid the issue and miss a valuable opportunity for guiding the eruption of permanent teeth during the mixed dentition period.

Instead of maximizing this potential, the thrust of serial extraction literature seems to be directed as a warning to those outside of orthodontics and those dabbling in orthodontics to beware the pitfalls of extraction of permanent teeth during this stage of development. These warnings were and still may be justified if the misconception remains, that serial extraction will lessen or eliminate the need for multibanded appliance therapy.

Serial extraction and, specifically, premolar enucleation are important procedures that can improve the ease of orthodontic treatment in those cases where permanent tooth extraction is required. However, the use of such procedures should not lure the clinician into a compromise of orthodontic treatment standards.

The elimination of gross crowding due to serial extraction procedures and the reduction in treatment time due to autonomous adjustment that occurs should be utilized by the orthodontist as an opportunity to perfect the occlusion and not merely as a means to avoid full-banded orthodontic mechanotherapy.

This study will explore:

1. Whether enucleation of premolars can be used to minimize the severity of crowding in arch-length deficiency cases.
2. Whether or not enucleation is damaging to the remaining teeth and alveolar process when the procedure is accomplished with good surgical technique.
3. Whether enucleation of mandibular first premolars is preferable to mandibular second premolars in most cases and also a better alternative in borderline arch-length deficiency cases than removal of mandibular second premolars.
4. Whether enucleation of various combinations of teeth might be advantageous in select cases.

REVIEW OF LITERATURE

Enucleation can be defined as the surgical removal of unerupted permanent teeth, usually premolars, to minimize crowding. Loss of buccal or lingual cortical plate of bone and clefting associated with incomplete closure of the extraction site are the most common disadvantages attributed to premolar enucleation.

Dewel has written extensively on serial extraction since 1954 showing many successful results but has consistently warned those with limited experience to proceed cautiously.[3-8]

Lloyd used enucleation of the mandibular first premolars in cases where he felt certain that the mandibular cuspid would block the eruption of the first premolar.[13]

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Tweed felt that enucleation was rough on both the child and the oral surgeon and preferred to extract the deciduous first molars initially followed by the first premolars and deciduous canines. Enucleation was utilized on a limited basis when the mandibular first premolars failed to erupt before the permanent canines. The serial extraction procedures he advocated are routinely used and Tweed felt that judicious use of these techniques could save from seven to nine months of treatment.[18,19]

Mayne has summarized serial extraction considerations in a precise manner and stated that enucleation was a severe procedure with limited necessity.[14]

Graber states that enucleation is "a most hazardous step," but also acknowledges the gratifying autonomous adjustment in the properly chosen case.[10]

Glauser, in an evaluation of serial extraction among Navajo Indian children, used enucleation of mandibular second premolars in a few of the mild Class II crowding cases to help correct the molar relationship, prevent trapping of premolars, and minimize uprighting of the lower incisors. In this study, comprehensive appliance therapy was not considered following the serial extraction procedures.[9]

Enucleation has been recently reevaluated by Weber[20] and Joondeph[12] and the results demonstrate that the procedure need not produce loss of buccal plate and associated clefting when the surgical procedure is performed with proper technique. It has also been demonstrated that an excellent degree of autonomous adjustment can be gained in the permanent dentition and the procedure, therefore, should no longer be ignored.

Joondeph compared samples of maxillary first premolar and mandibular second premolar enucleation with the enucleation of all four first premolars and concluded that the mandibular second premolar enucleations were more desirable. It is the opinion of this clinician that properly-timed enucleation of four first premolars is more desirable in most cases and it is this difference of opinion that prompted this study.

Methods and Materials

The sample of 27 cases was selected from 116 patients that had enucleation of premolars. Of the cases selected, there were 19 girls and 8 boys. The average age at the conclusion of the study was 12 years 10 months. All 27 cases chosen for evaluation met the following requirements:

1. Four first premolars had been enucleated simultaneously and no mechanical devices of any kind were introduced to influence the effect of space closure.
2. A closed lateral cephalometric radiograph, intraoral radiographs, plaster models, and photographs were taken just prior to the surgical procedure.
3. The follow-up material included a closed lateral cephalometric radiograph, intraoral radiographs, or a panoramic radiograph and plaster models.

Surgical Procedure

The surgical technique basically involves removal of the unerupted premolars using a keyhole or tunnel approach directly through the socket of the extracted deciduous tooth.

In the case of first premolar removal, both deciduous cuspid and deciduous first molar are extracted. The medullary alveolar bone is removed with hi-speed bone burs providing exposure of the unerupted premolar below the depth of the deciduous socket. At this point slight reduction of the buccal and lingual bone encasing the convex surfaces of the premolar is accom-

plished to provide relief for easy removal. At no time are the cortical plates removed.

A large round bur, #8 or #10, is then used to penetrate the occlusal surface at a slight angle and allowed to stop within the premolar crown to bind the bur within tooth structure. Handpiece bur and tooth are lifted vertically to accomplish removal of the tooth. Fully 90 percent of the premolars are removed in this fashion. However, if there is extreme resistance to movement, the bur is removed and a straight elevator used to split the tooth longitudinally. The buccal and lingual fragments are then easily elevated from the developmental crypt along with any follicular remnants.

The surgical area is irrigated with normal saline solution, the mucoperiosteum repositioned and closed in a routine manner. Antibiotic therapy is not provided on a routine basis and postoperative sequelae such as edema and discomfort are minimal. The approximate duration of the procedure for the extraction of four first premolars is usually 40 minutes.[1]

Results

Bone Changes

Bone loss following enucleation of four first premolars was studied to evaluate the results of the surgical procedure. A subjective evaluation was made clinically from the patient at the time the impressions were taken and once again from the models.

Overbite Changes

To evaluate the changes following enucleation of the four first premolars, the overbite was measured. Critics of mandibular first premolar enucleation claim that the enucleation permits more lingual tipping of mandibular incisors and, thus, greater increase in overbite than mandibular second premolar enucleation.[12]

Plaster models were viewed from the lingual aspect with the models handheld in centric occlusion. A visual assessment was noted whether the tips of the mandibular incisors were closer to or farther from the palatal portion of the maxillary model. This method was used because it was difficult to evaluate overbite changes with the conventional measurements of vertical overlap of incisors from the labial in this age group. The vertical overlap of the upper incisor over the lower incisor varies considerably in mixed dentition cases because eruption may not be completed. Even in the permanent dentition, the standard overbite measurements are confusing since the lengths of the clinical crowns of the permanent incisors vary considerably. This clinician felt that the distance of the incisal edge of the lower anterior teeth from the palatal tissue is the most important clinical consideration and the best way to evaluate overbite change in the preorthodontic treatment age group. Prolonged lower incisor contact with the palatal tissue lingual to the maxillary anteriors is a potential area for periodontal breakdown and is, therefore, of clinical importance.

Overjet Changes

The overjet was measured to suggest the degree of treatment difficulty that the sample displayed before surgical procedures compared with the results following autonomous adjustment after enucleation. This measurement was made with a rectangular wire inserted from the lingual incisal edge of the most labially-inclined maxillary central incisor to the labial incisal edge of the most procumbent mandibular incisor. If an extreme rotation existed that would distort the true relationship of the upper to lower incisor overjet, the measurement was subjectively adjusted. The wires were marked with a file to the exact overjet distance and the final

measurements were made with a Boley gauge.

Space Remaining in the Mandibular Arch

The space remaining in the mandibular arch was evaluated as an indication of the degree of difficulty in mechanical treatment that would be needed following autonomous adjustment subsequent to enucleation. The measurement was limited to the mandibular arch because the position of the teeth in this arch is the foundation from which treatment is based. Autonomous closing of the maxillary spacing from the distal does not present much difficulty regardless of the type of serial extraction procedure employed. A Boley gauge was used to measure the space remaining and no attempt was made to allow for headplate correction, rotation, or curve of spee.

Inclination of the Lower Incisors

The lower incisor inclination was measured to determine the amount of lingual tipping that could be anticipated following enucleation of the four first premolars. Advocates of mandibular second premolar enucleation claim that excessive lingual tipping of mandibular incisors occurs following enucleation of mandibular first premolars. The mandibular plane was established by drawing a line from the cephalometric landmark gonion to gnathion. The angle formed by this line with the axial inclination of the most procumbent mandibular incisor was recorded. A template was used to help estimate the axial inclination of the lower incisor.

Mandibular Rotation and Facial Axis

The mandibular plane was measured prior to and following enucleation from a closed lateral cephalometric radiograph using the lines GoGn-SN. This was an important measurement, relating to the degree of treatment difficulty of the sample following the surgical procedure, and offered some information whether the mandible actually tends to rotate in a counterclockwise direction due to extraction without treatment.

An independent analysis of mandibular rotation was also made commercially utilizing the facial axis (Pt to Gn). Pterygoid point is defined by Ricketts as the point at the lower border of the orifice of foramen rotundum. The intersection of this line with the Ba-Na plane has been shown to have no average change without treatment in periods of as long as ten years. Mandibular rotation was evaluated utilizing both the mandibular plane and the facial axis because a more meaningful comparison with the commercial untreated sample could be made. The norm for this measurement is 90 degrees with a standard deviation of 3.5. It was hoped that this would give some information concerning the facial patterns of the sample.

Clefting or Bone Loss

Of the 27 cases evaluated no evidence of clefting due to loss of buccal or lingual cortical plate could be found.

Advocates of mandibular second premolar enucleation have stated that less bone loss is observed in those cases compared with first premolar enucleation. This may be true if the cases are not followed with orthodontic treatment. The lingual uprighting of the lower incisors and the distal movement of the mandibular cuspid in most cases does not deliver an ideal periodontal contour especially if excessive space remains. In enucleation cases, regardless which teeth are removed in the mandibular arch, clefting can appear if the extraction site remains open more than three millimeters for an extended period of time. This is the same situation the clinician finds following permanent teeth removal where mechani-

cal therapy was delayed for too long a period of time permitting bone loss and an immutable space. This unalterable condition cannot be blamed on the deficiency of the surgical technique or the selection of teeth extracted, but instead on the failure to mechanically treat the case in time to complete space closure and root paralleling.

Overbite Measurements

Of the 27 cases evaluated for overbite changes following enucleation of four first premolars, 11 patients showed increases (deeper bites), 11 showed decreases, and 5 were unchanged.

The data are inconclusive but agree to some extent with a recent longitudinal study of incisor overbite from five to eleven years of age concluding that the predictability of overbite development in younger ages is unreliable.[11] Glauser found that overbite did not increase in the Navajo Indian following serial extraction procedures and believed this was due to the genetic pattern of his sample.

In this enucleation sample, variation occurred in some instances because minor open bites were evident initially and settled into a more closed or ideal position following the surgical procedure. Whether the settling was influenced by extraction or a normal eruption pattern is difficult if not impossible to evaluate. Many of those unchanged overbites were patients in whom the lower incisors, prior to extraction, were already touching the palatal tissue limiting the possibility of further increase.

Overjet

The overjet following the simultaneous enucleation of four first premolars revealed that 18 of the 27 cases showed decreased overjet, 5 showed increased overjet, and 4 cases remained unchanged.

Space Remaining in the Mandibular Arch

The space left in the mandibular arch following enucleation of four first premolars ranged from 5.8 mm to 0.0 mm. The average space remaining was 1.9 mm and 15 of the 27 cases studied had less than 2.0 mm of space remaining demonstrating conclusively that most of the extraction space can be closed autonomously if the diagnosis and extraction techniques are correct.*

As previously mentioned, no adjustment was made for arch-length deficiency factors like headplate correction or leveling of the curve of spee; therefore, many of the cases showing no remaining space had been allowed to drift too long before treatment was started making banding more difficult than necessary. Many cases with severe arch-length deficiency would probably show a severe amount of recrowding if the cases were not followed with appliance therapy and removal of third molars.

Lower Incisor Inclination

The lower incisor inclination, following enucleation of four first premolars simultaneously, revealed that the lower incisor tipped lingually in 21 out of 27 cases. Four increased in lower incisor inclination and two remained unchanged. The maximum amount of lingual tipping was 13.0 degrees and the mean of those tipped lingually was 4.1 degrees.

Since lower incisor uprighting has been one of the greatest faults attributed to enucleation of the mandibular first premolars, it appears that this criticism is exaggerated since the uprighting over a four-year period was of little clinical significance since appliance therapy was planned.

Mandibular Rotation and Facial Axis

The measurements of the mandibular plane changes revealed that GoGn-SN decreased in 21 of the 27 cases,

*Raw data for all measurements may be obtained from the author.

four cases increased in steepness, and two were unchanged. This represented a mean of 2.06 degrees closing with a standard deviation of 2.25 degrees.

Utilizing the facial axis to observe mandibular rotation changes showed that the average closure of the 27 cases was 1.15 degrees with a standard deviation of 1.59. The t statistic was 3.76 which for a sample of 27 is significant at the .001 significance level. It could, therefore, be concluded that a counterclockwise rotation of the mandible can be accomplished by enucleation of four first premolars without orthodontic treatment.

Mean Facial Axis

The mean facial axis measurement was 89.2 degrees with a standard deviation of 3. The norm for this measurement is 90 degrees with a standard deviation of 3.5.[15] Therefore, it must be concluded that the facial patterns were quite average if a little on the retrognathic side.

Discussion

On the basis of the author's clinical experience and evaluation of the preceding data, some observations and advantages should be discussed in relation to four first premolar enucleation cases.

1) Fewer extraction visits are required with enucleation, therefore, there is less trauma and emotional disturbance for a child than with the conventional serial extraction procedures. A good case can be made for not enucleating in the maxillary arch because the eruption of the maxillary first premolars normally takes place before the maxillary cuspids, and the maxillary first premolars could be extracted after they erupt achieving the same degree of uncrowding. This is true except for the fact that the child will need to undergo additional surgical procedures if we delay the enucleation in the maxillary arch.

2) The patient needs fewer follow-up appointments by the orthodontist since most of the teeth needing extraction have been simultaneously removed. The basic decisions remaining at this stage are:

When should the mandibular deciduous second molars be removed to permit the case to settle into a Class I molar relationship?

How much space should be permitted to close before treatment begins? Enough space is still required for banding, rotational corrections, leveling the curve of spee, and anchorage considerations. Figure 2 shows that the lower anterior teeth have crowded subsequent to enucleation because the patient was allowed to drift for 3 years and 8 months. In clinical practice the operator should permit autonomous adjustment only as long as the case is improving.

3) Planned premolar enucleation allows more consistent autonomous adjustment in the mandibular arch compared with conventional serial extraction because the mandibular cuspid often erupts before the mandibular first premolar creating a blocking problem. When this happens, the clinician must decide whether to let the crowding increase, or extract the second premolar possibly necessitating a holding arch, or to surgically enucleate the offending first premolar. In cases of severe mandibular arch crowding where the labial gingival recession or "stripping" is taking place, the cuspid may erupt with a bulge to the mesial and labial. In such cases the adjustment may be poor following conventional serial extraction procedures even though the premolar made it to the surface first in the classical manner.

4) Mechanical retraction of permanent cuspids is greatly simplified or eliminated since these teeth translate with minimal tipping if enucleation is not delayed too long.

5) In severe crowding in the mixed dentition combined with excessive protrusion of the maxillary anterior teeth, the enucleation of maxillary first pre-

molars gains space immediately for the retraction of anterior teeth reducing the possibility of blocking the eruption of the maxillary cuspids or maxillary first premolars.

6) In arch-length deficiency cases where the profile is concave and the possibility of expanding cuspids or advancing the mandibular anterior teeth would be detrimental, enucleation permits the maximum anchorage loss.

7) The crowded high mandibular angle cases with open-bite tendency are easier to treat mechanically since the space is available to move posterior teeth mesially, and the mandibular plane has a better chance to rotate in a counterclockwise direction.

Contraindicating Premolar Enucleation Situations

1) When a true arch-length deficiency does not exist and the case would best be treated on a nonextraction basis.

2) Those cases with adequate arch length but where the profile considerations demand extraction; for example, the bimaxillary protrusion cases with spacing would have little to gain by enucleation. Early anchorage loss in this type of case might greatly compromise the final result.

3) When the patient is unwilling or unable to pay for the services of an oral surgeon to perform the enucleation and the risk of loss of buccal or lingual cortical plate would be increased.

4) Cases demonstrating a lack of total facial height due to a deficiency of alveolar process, i.e., cases with an excessively flat mandibular plane. In these patients the posterior teeth do not drift readily and space closure, even with appliances, is more difficult.

5) Enucleation of premolars may be more expensive for the patient than conventional serial extraction.

6) The occlusal table is diminished radically so that there might be temporary difficulty in mastication.

7) If surgical procedures are poor, damage could result to the adjacent developing tooth buds. Deep enucleation increases this possibility, therefore, doing the procedure before 8.5 years of age is of little value unless labial gingival recession is taking place in the mandibular incisor area.

8) The decision of extraction involving specific teeth must be made without being able to assess the morphology of these teeth. However, the same disadvantage exists with conventional serial extraction techniques unless the clinician waits for all permanent teeth to erupt nullifying any previously reached benefits.

Clinical Considerations in First Premolar Enucleation

The removal of $\frac{4DC \quad CD4}{4DC \quad CD4}$ simultaneously can be used in any arch length deficiency where the requirement of premolar extraction is necessary. An example of this combination is illustrated in Figures 1 and 2. In cases of excessive labial procumbency or maximum anchorage considerations, holding arches can be placed to preserve anchorage. However, in this study no holding arches or bite plates have been placed and the teeth have been permitted to adjust autonomously.

In some extreme arch-length deficiencies and excessive labial protrusions, a holding arch may be needed to prevent mesial molar drift. Some operators prefer bite plates with finger springs to influence vertical dimension and improve the Class I relationship. The author objects to the use of removable appliances to gain a trivial advantage in enucleation cases, especially if one knows in the final analysis that fully banded appliances will be uti-

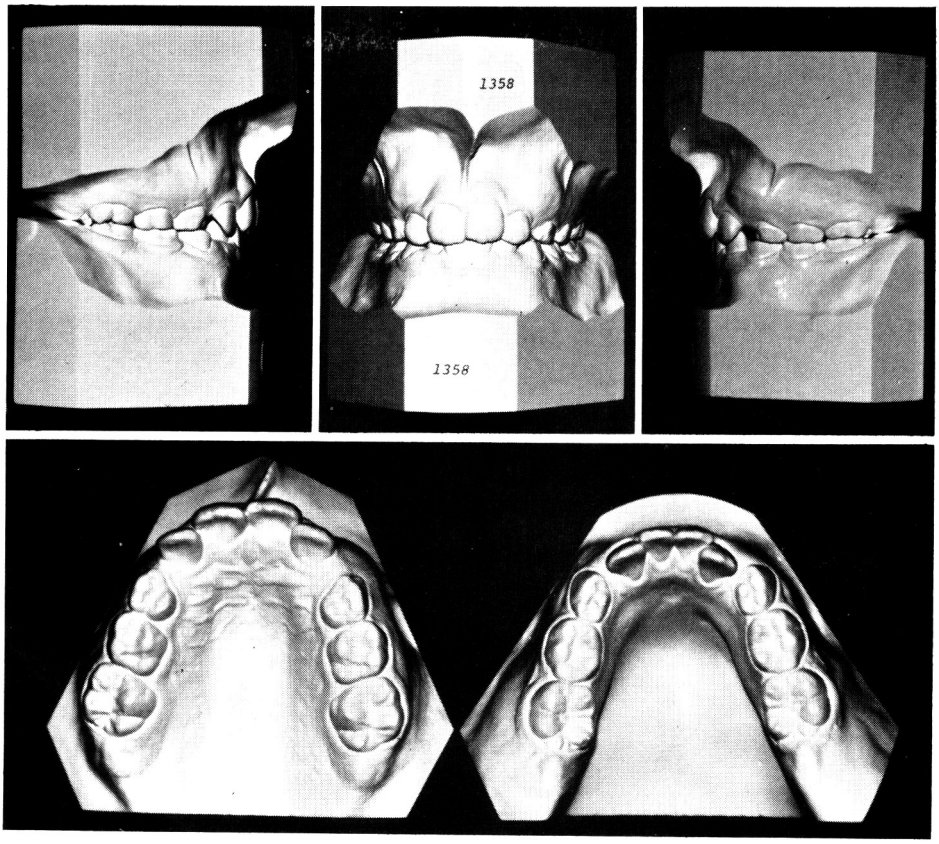

Fig. 1

lized. The total cost of treatment is raised by this type of overmanagement and only serves to give the patient the feeling that something is being done. Prolonged and unnecessary use of appliances in the mixed dentition may "turn off" the patient and make the orthodontist more reluctant to continue the treatment to completion, that is, until the second molar positions are perfected. However, severe Class II skeletal relationships and crossbite corrections are exceptions to this rule and should be treated early to maximize the adjustment following the surgical procedure.

The surgical removal of these teeth usually requires the subsequent removal of mandibular deciduous second molars to permit the permanent mandibular molars to adjust into a Class I relationship and to lose additional mandibular anchorage. One might ask, "Since such a radical procedure has been utilized to get maximum drifting and anchorage loss, why not extract the mandibular deciduous second molars at the same time?" This can only be done if the mandibular deciduous second molar roots have been two thirds resorbed since the permanent mandibular first molars may tend to tip mesially and block the second premolars. Another disadvantage of removing mandibular deciduous second molars simultaneously with this combination of extractions is the vast though temporary reduction of occlusal

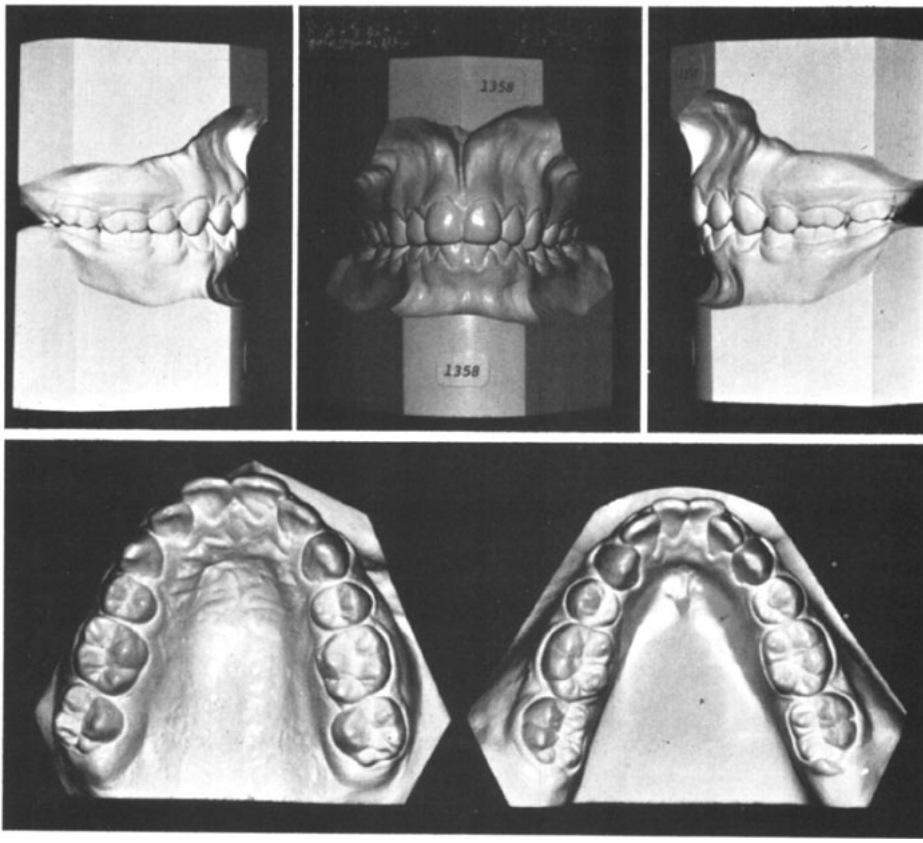

Fig. 2

table possibly permitting the development of a lateral tongue thrust habit. A third disadvantage of early removal of mandibular deciduous second molars would be the possibility of delaying rather than speeding up the eruption of the mandibular second premolars.

First or Second Premolars?

As stated earlier, serial extraction procedures were not designed to eliminate full appliance therapy, but to facilitate the ease of treatment, to reduce the length of treatment time, and allow the operator to achieve optimal occlusion. The findings indicate that these goals were accomplished in the majority of cases studied since none of the cases showed detrimental effects due to the enucleation procedures nor were any of the cases difficult to treat following the procedure. In past debates over the extraction of mandibular first premolars as compared with the mandibular second premolars, the factor legitimizing the extraction of mandibular second premolars is the opportunity of easy loss of posterior anchorage, but it was readily conceded by the majority that the mandibular second premolar had the better occlusal morphology. If anchorage loss is the primary goal following permanent tooth removal, enucleation is an excellent approach since most of the space will close regardless of which combination of teeth is removed. The issue remaining is whether the lower first or lower second premolars should

be enucleated for admittedly there are situations where each approach should be considered. Advocates of mandibular second premolar enucleation believe this procedure will have less tendency to flatten the profile than the first premolar enucleation cases since less lingual tipping occurs in the lower incisors.[12]

If more lingual tipping does exist following enucleation of mandibular first premolars, the condition would be immediately altered with appliances usually by the time the first few archwires have completed their work. If the case was a mild dentoalveolar Class II malocclusion, a lingual inclination of the lower incisors would be advantageous as a source of stored anchorage from which Class II elastics could be used to avoid the necessity of extraoral gear.

De Castro[2] has recently attempted to justify the extraction of mandibular second premolars on a gnathological basis stating that "this fulfills in a better way the concept of canine protection since the mandibular first premolars produce proper cusp heights to assure canine rise during the protrusive masticatory cycle." This is a confusing and misleading statement since "canine protection" actually relates to the lateral excursions rather than the protrusive. The capability of establishing a protrusive contact with the upper canine and the lower first or second premolar is dependent on correct anterior guidance. This is a complex goal requiring exacting interrelationships of many factors such as the angles of the emenentiae that the condyles must traverse during protrusion, the interincisal angle between the maxillary and mandibular incisors, the amount of torque of the maxillary incisors and the overbite-overjet relationship.[15] Without belaboring this point it would seem that an orthodontist clever enough to establish ideal protrusive contact could perform the feat with either the mandibular first or second premolar!

What the issue finally boils down to is that overbite, profile considerations, bone loss, etc., are all superfluous in relation to the choice of tooth to be enucleated in the mandibular arch. The most important factor is retaining the tooth that will give the best occlusion.

If the mandibular second premolars are extracted, the contact of the mandibular first premolars with the mandibular first molars can be greatly improved by the mesiolingual rotation of the mandibular first premolars as illustrated by De Castro. However, this clinician has found that mandibular first premolar extraction cases posttreatment usually show a better contact relationship with the mandibular first molars. Another advantage of mandibular first premolar extraction cases posttreatment is the gain of two additional centric stops due to the presence of a lingual cusp and flat occlusal table on the mandibular second premolars. The first premolars by comparison are usually canine-form in shape.

Variation in Enucleation

There are many situations encountered that might necessitate a varied approach to enucleation. The combinations of extraction listed are not necessarily to be interpreted in an all or nothing manner. In clinical practice the operator may wish to extract in one arch only or in one quadrant only, whichever best suits the treatment objective.

The $\frac{4DC \quad CD4}{5EDC \quad CDE5}$ combination, for example, may be used if the eruption of the mandibular second premolars is blocked due to mesial tipping of the permanent mandibular first molars or when the morphology of the mandibu-

lar second premolars viewed radiographically is unacceptable.

In the mild Class I crowding cases where maxillary lateral incisors are small, the $\frac{5EDC\ \ CDE5}{4DC\ \ CD4}$ combination of extractions would permit more overbite and less of an end-to-end relationship and would also minimize the space distal to the maxillary lateral incisors. This can be accomplished because the maxillary first premolar usually has greater mesiodistal width than the maxillary second premolar.

The same combination could also be used in cases that are mildly Class III that have excessive crowding and require permanent tooth removal. No palatal holding arch would normally be required in this situation. This combination can also be used in mild Class I crowding cases when the clinician does not like the morphology or location of the maxillary second premolars as viewed in a radiographic evaluation. This combination in a Class I or mild Class II case might require a palatal holding arch or extraoral gear if banding is delayed and anchorage requirements so dictate.

These teeth also may be extracted in Class I patients where the crowding is limited to the mandibular arch. If the goal is maximum amount of anchorage loss, the clinician may intentionally permit the maxillary molars to drift toward a Class II relationship so that the advancing effects of Class II elastics can be applied to the mandibular arch. This is an effective way to avoid flattening the profile but can be embarrassing if too much anchorage is lost and an extraoral gear is needed to resolve the Class II problem that has been created.

The $\frac{4DC\ \ CD4}{EDC\ \ CDE}$ combination of extractions may be used in situations demonstrating congenitally missing mandibular second premolars with either mild or excessive arch-length deficiency and the treatment goal is the avoidance of bridgework. A face crib may be used in mild arch-length deficiency to move the mandibular first molars mesially without retracting the lower anteriors. There are many factors that might make bridgework the treatment of choice that should be evaluated before making the final decision.

The clinician might choose $\frac{EDCB\ \ BCDE}{4DC\ \ CD4}$ extraction if the maxillary lateral incisors are congenitally missing with the mandibular arch crowded and decision is made to use the canines in place of the maxillary lateral incisors. Extracting all of the teeth at one time in this combination could diminish the occlusal table making chewing difficult and encourage lateral tongue thrusting. Therefore, it would be practical to delay extraction of the maxillary deciduous second molars. A face crib might also be needed in this treatment plan.

In cases of missing maxillary second premolars combined with crowding in the mandibular arch, $\frac{EDC\ \ CDE}{4DC\ \ CD4}$ extraction can be used; however, a holding arch might be needed to help gain a Class I molar relationship. Obviously, no holding arch is required if the case has a Class III tendency.

A word of caution should be introduced following the above material. In the diagnosis of which teeth are to be enucleated, the same precise care that is needed for any extraction decision must be used and the author does not wish to suggest a cookbook approach. Obviously, there are mild arch length deficiency cases that are best handled with conventional serial extraction procedures and, in many cases, best handled by no extraction at all.

Summary and Conclusions

A study was made on 27 cases where enucleation of four first premolars was performed simultaneously without introduction of mechanical devices to influence space closure. The results suggested that:

1. Enucleation of premolars can be used to minimize the severity of crowding in arch-length deficiency cases.

2. There is no damage to the remaining teeth and alveolar process when enucleation is accomplished with good surgical technique.

3. The average amount of lingual tipping of the mandibular incisors in approximately four years subsequent to the enucleation procedure was 4.1 degrees.

4. This amount of lingual tipping compares quite favorably with the amount of lower incisor uprighting experienced during growth and could not be considered excessive.[16]

5. The mandible does tend to rotate in a counterclockwise manner following enucleation of four first premolars without appliance therapy. This rotation was considered significant in comparison with the amount of rotation that could be expected from an untreated sample.[17]

6. If orthodontic treatment is planned, the enucleation of the mandibular second premolars in borderline extraction cases to avoid excessive lingual tipping of the mandibular incisors would seem to be questionable.

7. Various combinations of enucleation and tooth extraction may be helpful in treatment planning.

8. With judicious timing the enucleation of four first premolars can minimize the severity of the malocclusion simplifying appliance therapy if proper diagnosis and good surgical technique are employed.

9. Although conventional serial extraction may accomplish similar ends, it would appear that enucleation would offer some advantages in terms of autonomous adjustment of the mandibular incisors and root positioning of mandibular cuspids.

10. Enucleation cases usually require fewer traumatic surgical procedures and less supervision by the orthodontist.

11. The parents should be informed that serial extraction procedures including enucleation may simplify but will not eliminate the need for appliance therapy.

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