International Journal of Current Advanced Research
ISSN: O: 2319-6475, ISSN: P: 2319-6505, Impact Factor: 6.614
Available Online at www.journalijcar.org
Volume 10; Issue 06 (B); June 2021; Page No.24575-24581
DOI: http://dx.doi.org/10.24327/ijcar.2021.4895.24581

Research Article

A TYPICAL EXTRACTION IN ORTHODONTICS – A PARADIGM SHIFT

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ARTICLE INFO

Article History:

Received 06th March, 2021
Received in revised form 14th April, 2021
Accepted 23rd May, 2021
Published online 28th June, 2021

Key Words:

Atypical extraction, therapeutic extraction, borderline cases, incisor extraction

ABSTRACT

Introduction - An essential goal of an orthodontic treatment is to attain a normal relationship of the teeth and their surrounding soft tissue structures. Retaining all the teeth requires a satisfactory balance towards total tooth material and the available supporting bone. Conventional extractions of first or second premolars are sometimes not able to fulfill the objectives required in such cases. Therefore, atypical extractions of other teeth is carried out.

Material and method - A comprehensive literature from orthodontic relevant sources and information was searched with the help of Pubmed, Medline, Google scholar, Scopus using keywords like atypical, asymmetric extractions.

Results - In borderline cases, compensatory orthodontic treatment may be a viable option, since the esthetic balancing of the face is not always the major motive for treatment.

Conclusion - Proper treatment planning in conjunction with good patient cooperation, appliance selection and management of the treatment are essential to achieve acceptable, aesthetic and functional occlusion.

INTRODUCTION

An essential goal of an orthodontic treatment is to attain a normal relationship of the teeth and their surrounding soft tissue structures. The implication is that the dentition should be placed in a healthy, stable position to promote symbiosis between all parts of the masticatory mechanism. Dr. Edward H. Angle determined that each dental unit was required to provide the desired skeletal, soft tissue, and dental health, as well as facial esthetic harmony[1]. But the teeth and jaws are rarely matched in size and position, resulting in malocclusion beyond hope of self-correction[2].

Earlier, it was considered unacceptable to extract any tooth to correct a malocclusion. But gradually orthodontics recognize that, in certain malocclusion, the retention of all the teeth in a stable alignment for long periods is impossible. Thus the reduction of tooth material becomes an acceptable compromise in orthodontic practice[3].

Retaining all the teeth requires a satisfactory balance towards total tooth material and the available supporting bone[5]. In cases of borderline space discrepancy, especially in the mandibular arch, a better option is to follow an atypical therapeutic extraction *i.e.* extracting one or two mandibular incisors. Conventional extractions of first or second premolars are sometimes not able to fulfill the objectives required in such cases. Therefore, atypical extractions of other teeth is carried out. However, in borderline cases, compensatory orthodontic treatment may be a viable option, since the esthetic balancing of the face is not always the major motive for treatment[6]. Thus the purpose of this article is to review the literature and get an insight to the cases treated with an atypical extractions protocol, in order to achieve a stable and functional occlusion as similar to a natural occlusion as possible.

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Factors to be considered for treatment planning

In borderline cases, the choice of selecting the non-extraction approach or going for reduction of tooth material depends on a number of factors[22], as follows:

1. Esthetics of the patient
2. Degree of arch length discrepancy present
3. Post treatment stability of the occlusion
4. Functional requirements
5. Correction of sagittal inter-arch relationship
6. Direction and status of growth
7. Ease of treatment and risk / benefit consideration.

Wellington J Rody and Eustaquio Afonso[27] (2002) developed a wigglegram that can be used to help make extraction decisions in borderline cases. The vertical central line represents the norms of the various measurements. Any values to the left or right of the central line are either above or below the average. The largest and the smallest acceptable values are plotted to produce the zigzag lines of the wigglegram, which thus depicts

the parameters of a borderline malocclusion. Conditions that favour extractions are on the left side, and conditions weighing against extractions on the right (fig.10). Each horizontal increment corresponds to one unit, except for the nasolabial angle, where the scale is 2^{o} due to the higher standard deviation.

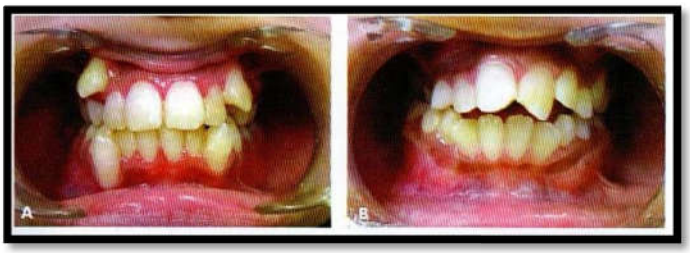

Fig 1 Tooth material in excess of arch length causes crowding of teeth. (A) Severe crowding due to tooth material arch length discrepancy (B) Fanning of lower anteriors is an indication of arch length deficiency

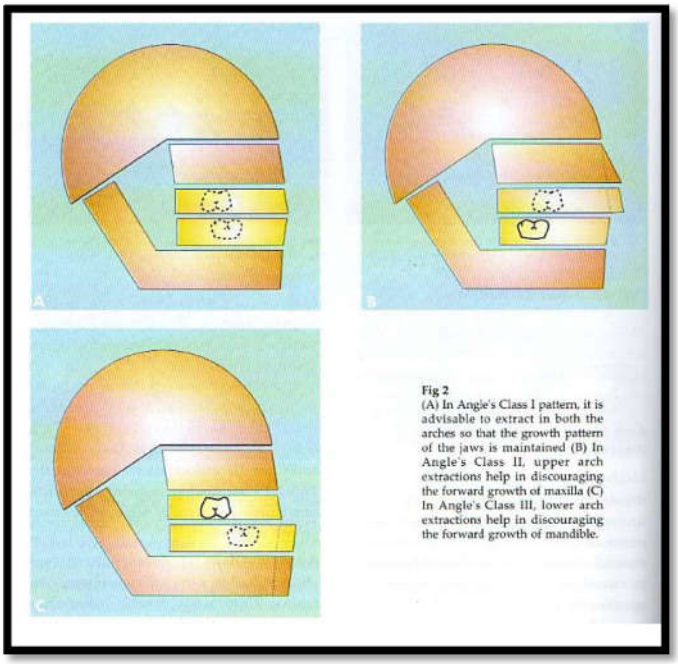

Fig 2 (A) In Angle's Class I pattern, it is advisable to extract in both the arches so that the growth pattern of the jaws is maintained (B) In Angle's Class II, upper arch extractions help in discouraging the forward growth of maxilla (C) In Angle Class III, lower arch extractions help in discouraging the forward growth of mandible

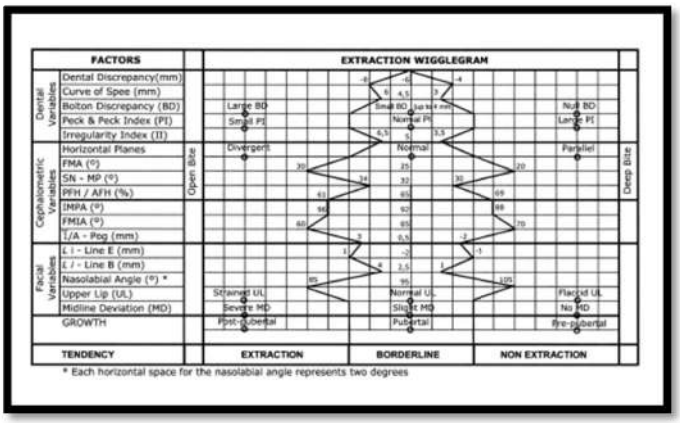

Fig 3 Wigglegram

Atypical extraction

Extraction of upper incisors

The maxillary incisors are rarely extracted as a part of orthodontic therapy. However, the upper labial segment is particularly at risk from trauma, especially in Class II Division I cases with large overjets. There are certain conditions when one or more of the upper incisors may have to be sacrificed, the following are some of them:

1. An unfavourably impacted upper incisor that cannot be brought to normal alignment.
2. A buccally/lingual blocked out lateral incisor with good contact between the central incisor and canine can be extracted (fig.4).
3. If one of the lateral incisor is congenitally missing, the opposite lateral may have to be extracted in order to maintain arch symmetry.
4. A grossly carious incisor that cannot be restored that may have to be sacrificed.
5. Malformations of the incisor crown that cannot be restored by prosthesis may necessitate their extraction (fig.3).
6. Trauma or irreparable damage to incisors by fracture may indicate their removal.
7. An incisor with dilacerated root cannot be efficiently moved by orthodontic therapy. Thus it is preferable to extract them.

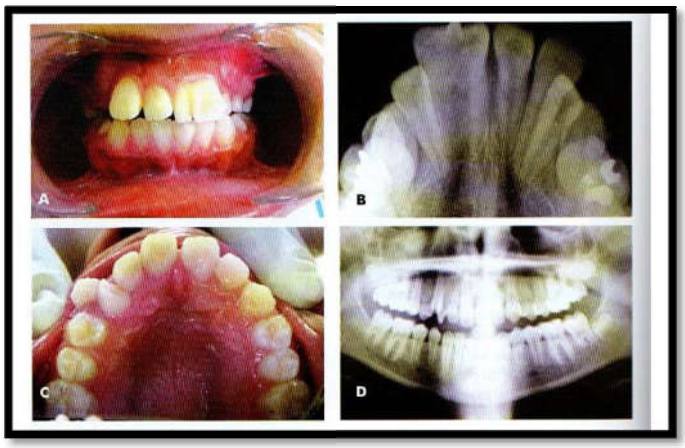

Fig 4 (A) Macrodontic incisor indicated for extraction (B) Radiograph of the same patient (C) and (D) Supplemental lateral incisor indicated for extraction

Fig 5 (A) and (B) Pretreatment photograph of a patient who was treated by extraction of one maxillary lateral incisor. The extraction of lateral incisor was done as there was good contact between the canine and the central incisor. (C) and (D) Post treatment photograph of the same patient

Extraction of lower incisor

Extraction of lower incisors should as far as possible be avoided. The extraction of a lower incisor to relieve lower anterior crowding is often followed by the narrowing of lower

inter-canine width, retroclination of lower incisor, deep bite and reappearance of crowding. This lead to a collapse of the lower arch. The reduction in lower inter-canine width often leads to a transverse deficiency. This leads to a subsequent decrease in the transverse dimensions of the upper canines as well as they seek to contact and match the lower incisors. Decrease in the upper intercanine width would lead to mild to moderate crowding in the upper arch. Thus a sequelae of disasterous chain reaction begins with the extraction of a lower incisor. To be on the safer side, one should always avoid extracting the lower incisor until it is absolutely necessary. There are however some conditions when a lower incisor may have to be extracted (fig. 5).

Fig 6 (A), (B), (C) and (D) Pretreatment photographs of a patient treated by extraction of one lower incisor. The boltons analysis showed a 5mm mandibular tooth material excess and therefore it was decided to extract one mandibular incisor. (E), (F), (G) and (H) Post treatment photographs of the same patient.

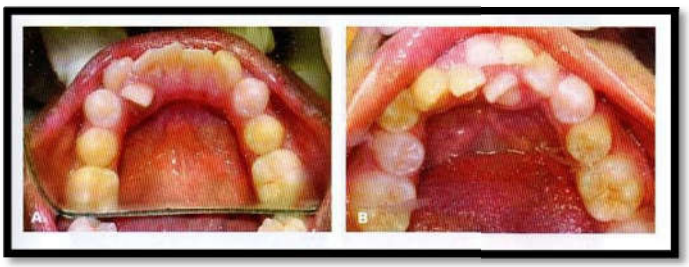

Fig. 7 (A) and (B) Lower lateral incisor totally blocked lingually with contact between the central incisor and canine. Such laterals may be extracted

1. If one of the incisor is completely out of the arch with good inter-dental contact between the rest of the teeth (fig.7).
2. A lower incisor that was traumatized, or exhibiting severe caries, gingival recession or bone loss may have a poor prognosis.
3. Presence of severe arch-length discrepancy is often characterized by the presence of fan-shaped flaring out of the lower incisors crown. In these cases it may not be possible to flatten the lower anterior segment by extracting teeth further distally in the arch. Thus one of the incisor may have to be extracted so as to improve the crowding and axial inclination of rest of the incisors.
4. In mild Class III cases with lower incisor crowding, one of the lower incisor may be extracted to achieve normal overjet, overbite and to relieve crowding.
5. Cases where a tooth size discrepancy exists, for example upper peg shaped laterals or missing upper/lower lateral incisors, it may be of benefit to extract a lower incisor (fig.6).
6. Treatment of Class I Cases with moderate lower labial segment crowding of upto 5mm (i.e. the size of a lower incisor) may be treated with loss of a lower incisor.
7. Extraction of one lower incisor can be considered in adults who have had previous loss of premolars in each quadrant and present with late lower labial segment crowding.

Extraction of canines

Canines are not frequently extracted as a part of orthodontic treatment. The extraction of canines is said to cause flattening of face, altered facial balance and change in facial expression. The loss of a canine makes canine guidance impossible and may compromise a good functional occlusal result. In addition the contact produced between the premolar and lateral incisor is rarely satisfactory. However if the condition does require the extraction of an upper canine, the first premolar can be aligned with a mesial inclination and rotated mesiopalatally to hide the palatal cusp and provide a better esthetic result. Some of the condition under which canines may have to be extracted are:

1. The canines develop far away from their final location. In addition they have a long path of eruption from their site of development to their final position in the oral cavity. Thus the canines are highly susceptible to ectopic eruption and impaction (fig.8). Such unfavourably impacted canines or canines that have erupted in unusual locations may have to be removed.
2. A canine that is completely out of the arch with reasonably good contact between the lateral incisor and first premolar is an indication for its extraction (fig. 8G&9).
3. Premature shedding of deciduous canine usually indicates the extraction of deciduous canine on the opposite side of the arch to restore symmetry.
4. In Class II cases, sometimes lower deciduous canines are shed prematurely; the upper deciduous canines should also be removed to avoid increase in the overjet.
5. In Class III cases if the upper deciduous canines are shed early, it may necessitate the extraction of the lower deciduous canines to avoid worsening of the pre-normalcy(Class III tendency)
6. Deciduous canines may be extracted as a part of serial extraction procedure.

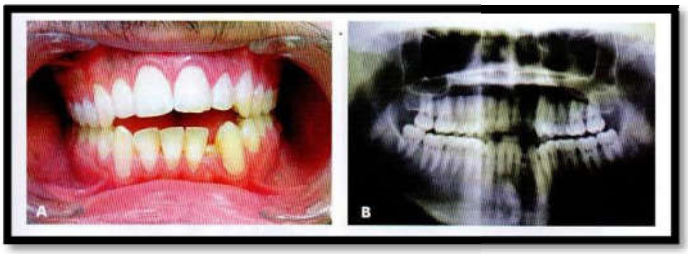

Fig 8 Lower lateral incisor impacted. Position of lower incisor is deep and is unfavourable for surgical exposure followed by orthodontic treatment. (B) Radiograph of the same patient

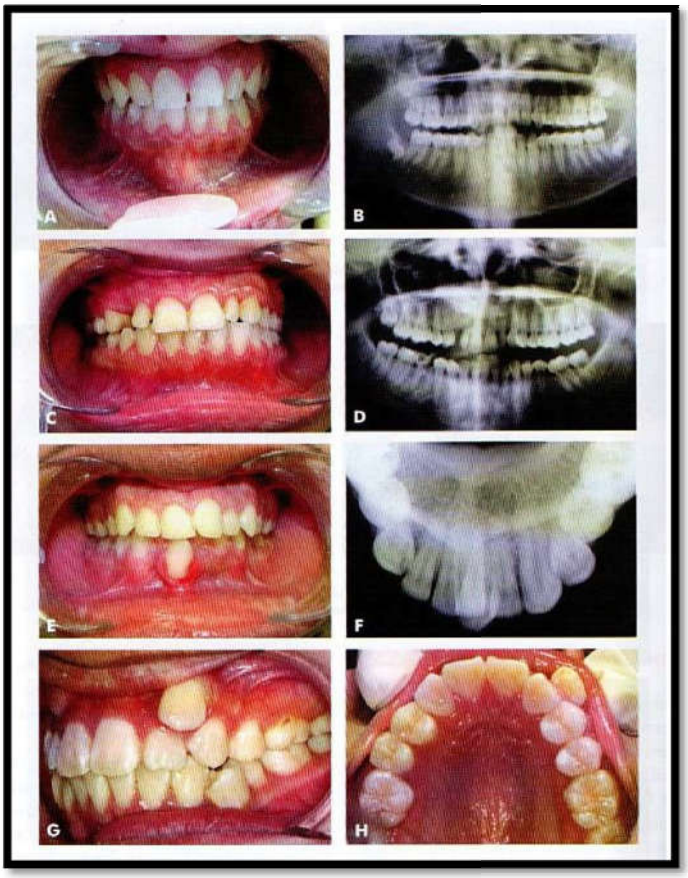

Fig 9 (A) Ectopic locations of the lower right canine close to midline. Such a canine may be indicated for extraction after surgical exposure (B) Radiograph of the same patient (C) An unfavourably impacted upper right canine can be extracted as it is difficult to surgically expose and align with orthodontic treatment. (D) Radiograph of the patient (E) Ectopic eruption of the lower left canine close to midline indicated for extraction (F) Radiograph of the patient (G) and (H) Bucally blocked canine with good contact between the lateral incisor and the first premolar may be extracted.

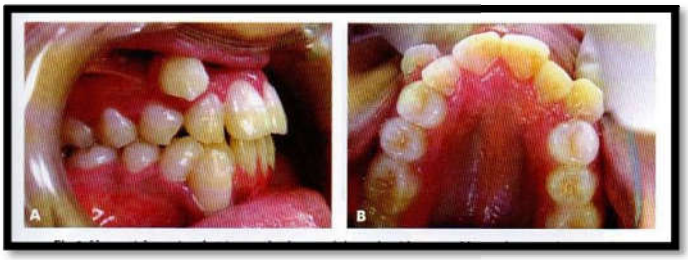

Fig 10 upper right canine that is completely out of the arch with reasonably good contact between the lateral incisor and first premolar. Such canine may be extracted

Extractions of first premolars

The first premolars are the most commonly extracted teeth as part of orthodontic treatment. These are commonly extracted for relief of crowding or retroclination of the proclined anterior teeth. The reason for their extraction is as follows:

1. It is positioned almost near the center of each quadrant of the arch. Their location in the arch is such that the space gained by their extraction can be utilized for correction both in the anterior as well as posterior segments.
2. The perfect contact between the canine and second premolar can be obtained.
3. The extraction of the first premolar leaves behind one premolar and molars which form the posterior segment that offers adequate anchorage for the retraction of the sixanterior teeth.
4. First premolar extraction is the least appropriate to upset molar occlusion and is the best alternative to maintain vertical dimension.

The following are some of the indications for first premolar extraction[29]:

1. They are the teeth of choice for extraction to relieve moderate to severe anterior crowding in both the arches (fig.11).
2. The first premolars are extracted for correction of moderate to severe anterior proclination as in Class II division 1 malocclusion or a Class I bimax protrusion[30].
3. In high anchorage cases, first PM takes preference over second PM as the tooth to be extracted.
4. As a part of serial extraction

Timing of extraction The four first premolars should not be extracted more than three weeksbefore starting active treatment to avoid mesial migration of posteriorteeth and therefore leaving insufficient space for retraction or relief ofanterior crowding[31].

Extraction of second premolars

The indications for second premolar extractions are[32]:

1. The extraction of second premolars instead of the first premolars result in the anchorage of the anterior segment being strengthened. Thus an environment is created that favours mesial movement of the posterior teeth. The second premolars are usually extracted to treat mild anterior crowding. The remaining space might be closed by controlled mesial movement of the molars.
2. The second premolars are usually extracted when 4-5mm of anchorage loss is deliberately desired.
3. Whenever the second premolars are unfavourably impacted, it is preferred to extract them rather than the first premolars (fig12.b).
4. If extractions are to be undertaken in open bite case, it is preferable to extract the second premolars as their extraction encourages deepening of the bite.
5. In case of grossly carious or deeply filled second premolars, it is wise to extract them and preserve the first premolars.
6. Early loss of a deciduous molar may cause forward movement of the first permanent molar leaving inadequate space for the second premolars to erupt. In such cases, the second bicuspid erupts completely out of the arch. Such a tooth may be indicated for extraction[33] (fig 12.a).

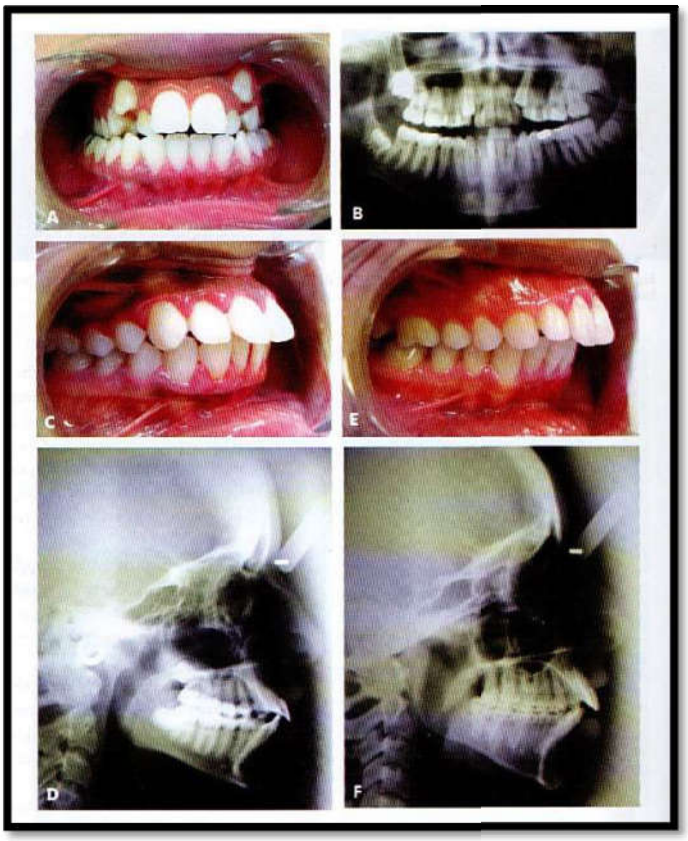

Fig. 11 Indications for first premolar extraction (A) and (B) Severe crowding is usually treated by extraction of first premolar (C) and (D) Bimaxillary protrusion are also treated by extraction of first premolars. (E) and (F) Proclination in Class II division 1 is often corrected by extraction of first premolars

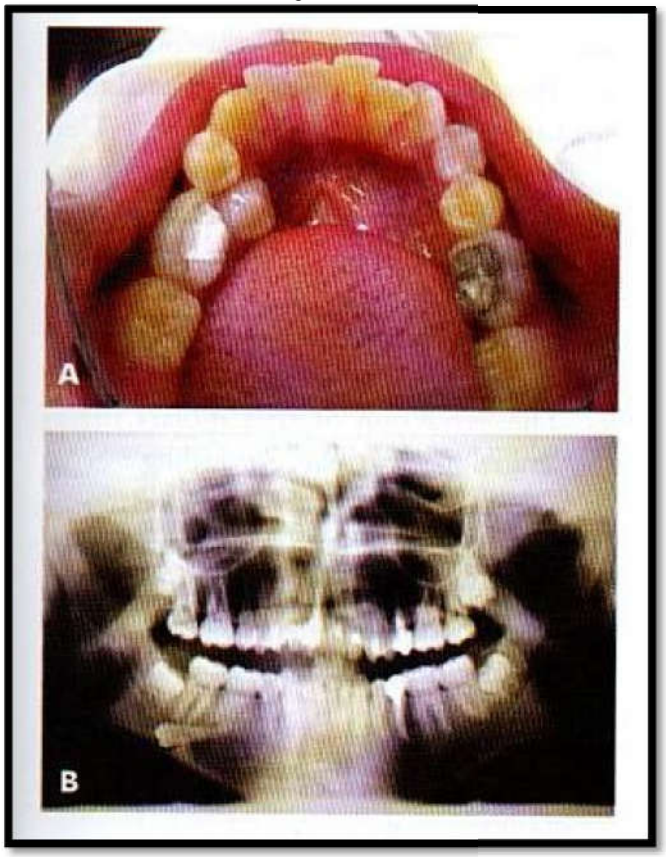

Fig 12 Indications for second premolar extraction (A) Second premolar that is entirely blocked lingually. This often occurs due to early loss of deciduous second molar resulting in the first permanent molar drifting mesially. The second premolar in such cases may erupt lingually due to inadequacy of space (B) ectopic second premolar

Extraction of first molars

The first molars are not commonly extracted in conjunction with orthodontic therapy. The first permanent molars are often the first permanent tooth to erupt into the mouth. Their deep occlusal fissures predispose them to caries. In addition poor tooth brushing combined with a higher sugar intake, may result in gross caries. Heavily restored or decayed first molars should be considered for removal over other non-carious teeth. First molar extraction requires careful planning. Their position in the arch means that whilst relief of premolar crowding is achieved the space created is far from the site of any incisor crowding or overjet reduction. Extractions of the first permanent molars is avoided for the following reasons:

1. The extraction of the first molar does not provide adequate space in the incisor region.
2. In deep bite cases extraction of molars is avoided because it worsens deep bite.
3. The second premolar and molar may tip into the extraction space.
4. Mastication may be affected.

The indications for the first molar extraction are as follows:

1. Minimum space requirement for the correction of mild anterior crowding or mild proclination.
2. Grossly decayed molar or heavily filled teeth.
3. Openbite cases can benefit from extraction of first molar, as there is a tendency for the bite to deepen after extraction of first molars.

Extraction of second molar

Mandibular second molar is positioned distally at the end of the dental arch and therefore is away from the site of crowding. Its extraction does not help in relieving the crowding[34]. The extraction of second permanent molars although not common, is advocated for a number of reasons, as follows:

1. To prevent third molar impaction: The removal of second molars has been advocated for the prevention of lower third molar impaction[35]. Since the position of eruption of third molar is variable, extraction of second molar is not usually indicated to relieve third molar impaction. The cases that benefit from such extractions are those:

- Where the third molars are upright or its long axis is not tilted mesially more than 30degree to the long axis of second molar.
- When second molar is extracted only after calcification of third molar crown or just after root formation of third molar has started, usually between 12-14years. Upper second molar extraction if carried out prior to the eruption of third molars, results in satisfactory third molar position. Maxillary tuberosity should be insufficient to accommodate all 3 molars.

2. To relieve impaction of second premolar: The premature loss of deciduous second molars is usually followed by forward drift of the first permanent molars leaving inadequate space for the second bicuspids to erupt. The extraction of second molars in such cases may allow the distal movement of the first permanent molars thereby offering sufficient space for the second premolars to erupt.
3. Lower incisor crowding: very mild crowding in the anterior part of the arch can be relieved by extraction of

the second molars. Some authors suggest that the extraction of second molars minimizes anterior imbrication and crowding.

4. To enable distallization of first molars: In cases where the first permanent molars are to be distallized, the extraction of the second molars can benefit the procedure.
5. Open bite cases: the extraction of the second molars deepens the bite. Thus they can be considered in open bite cases.

Extraction of third molars

Extraction of third molar during orthodontic treatment does not yield space for decrowding or reduction of proclination which is usually present in the anterior segment[36].

Indications

1. Impacted third molar: third molar are commonly impacted and unless other teeth are missing or have been extracted, there is rarely room to accommodate them in the arch. Such impacted third molars that are unable to erupt into ideal position are usually extracted.
2. The erupting third molars have been implicated to be the cause for late lower anterior crowding or imbrication. In adolescence and early adult life, progressive crowding of anterior teeth is commonly seen[37]. Late crowding develops around the eruption time of third molars due to the pressure from third molars. Although this theory has not been confirmed it nevertheless may has some role in lower anterior crowding. In fact, late anterior crowding often develops in individuals whose lower third molars are congenitally missing.
3. Malformed third molars that interfere with normal occlusion

CONCLUSION

Proper treatment planning in conjunction with good patient cooperation, appliance selection and management of the treatment are essential to achieve acceptable, aesthetic and functional occlusion. The diagnosis and careful planning, with the help of the diagnostic setup, is essential for the decision of treatment with atypical extractions. Despite the difficulties or limitations that may arise during treating cases with atypical extractions, an orthodontic case can be successfully treated, provided proper protocol of treatment planning and evaluation is followed. Considering the particularities of each case, it can be stated that, extraction contributes effectively in the treatment of certain malocclusions, seeking excellence in orthodontic treatment outcomes (maximum function, esthetics and stability).

According to the reviewed literature, asymmetric extractions could simplify and facilitate orthodontic treatment and mechanics in some specific cases. Even though, first molars relationship could differ for right or left sides and this asymmetry would not bring functional or esthetics problems. However, the orthodontist must have total control of the mechanics used to achieve the best final results at the end of the treatment.

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How to cite this article:

Mushahid Hasan *et al* (2021) 'A Typical Extraction In Orthodontics – A Paradigm Shift', *International Journal of Current Advanced Research,* 10(06), pp. 24575-24581. DOI: http://dx.doi.org/10.24327/ijcar.2021.4895.24581

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