Extractions In Orthodontics: An update

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ABSTRACT

The aim of this article is to review the current main criteria for tooth extractions in the prophylaxis and treatment of malocclusions and dentofacial deformities. Dental extractions are an essential therapeutic weapon in the management of certain malocclusions. They are indicated for obtaining arch space, improvement of facial aesthetics and achievement of balanced occlusion, among others.

"Conventional" standards of therapeutic extractions correspond to different combinations of symmetrical extraction of premolars; however, atypical extractions which do not follow a definite pattern are becoming increasingly frequent. They are more common in adult patients and are performed for reasons related to the pathology of the extracted tooth itself or to the demands of unconventional malocclusion treatment. Examples of atypical extractions are that of a lower incisor with indications, contraindications and undesirable effects which are well defined.

Temporary teeth extractions may be performed as part of an eruption guide programme, which must be adapted to the situation of each patient and never considered as a rigid scheme of general application.

KEYWORDS

Extractions; Malocclusion; Orthodontics; Eruption guide; Facial aesthetics.

Figure 1: A. Edward H Angle and B. Calvin S Case.

BACKGROUND

The need to perform extractions as part of the treatment plan for some malocclusions remains one of the great controversies in orthodontics.

Since the dawn of the specialty, Angle passionately defended the conservation of all teeth for perfect occlusion. He eventually accepted the need to abandon this ultraconservative position and to take into account the impact on the profile, stability and other constraints, such as periodontal health and declared to have acted to maintain the complete dental provision of some of his patients at all costs. On the other hand, Calvin Case, who could be considered a contemporary scientific adversary, advocated the use of permanent teeth extractions, if necessary, to successfully resolve malocclusion (Figure 1).

Since then, there have been swings in prevailing currents of opinion regarding therapeutic extractions in orthodontics. On the one hand, these movements have been based on the different fashions presiding over facial aesthetics at different historical times; but also on the availability of therapeutic techniques and instruments of varying scientific bases, replacing what were previously inevitable extractions for handling certain malocclusions. Fundamental among these was the introduction of the palatal arch bar by Cetlin, distalisers, microscrews, and self-ligating bracket systems.

This review discusses the most relevant aspects surrounding the application of this important therapeutic tool in orthodontics, in the light of information found in the literature. We will focus on the indications for extractions and the patterns of teeth to extract.

I. INDICATIONS FOR EXTRACTION IN DENTISTRY

Therapeutic extractions in orthodontics are primarily done for the following reasons:

1. **Achieving arch space**: To correct negative osseodental discrepancy (DOD), which usually manifests as crowding.
2. **Facial aesthetics:** To reduce dentoalveolar protrusion.
3. **Occlusion:** To properly connect both arches in normo-occlusion.
4. **Stability:** To better maintain the results achieved.
5. **Others:** For example, periodontal health, dental and medical pathology.

1. Extractions and arch space: DOD

One of the most important and common indications for orthodontic extractions is the lack of space in the arch that usually manifests as more or less localised crowding.

Achieving proper dental alignment in their bony bases requires consideration of the compromise between the size of the teeth themselves and the size and shape of their bases within the framework of the dentofacial skeletal relationship for each patient. The orthodontist can act on the maxillomandibular skeleton well using orthopaedic means in children, as well as in adolescents with residual growth or with surgical care where there is no such growth. In every case, the limits imposed by the individual maxillomandibular anatomy must always be assessed when deciding whether a malocclusion with negative DOD can be resolved conservatively or whether one must resort to extractions.

Some multibracket systems, particularly self-ligating, have entered the market declaring they are able to re-

duce the need for extractions in a number of cases of negative osseodental discrepancy, where it would have been essential to remove teeth if conventional techniques had been applied. However, disputes in this regard are very important. Many authors consider that these techniques only produce a dental overexpansion of the arch which does not correspond to real production of alveolar bone to neutralise the DOD, and instead could lead to an unacceptable weakening of the alveolar bone tables.

Distalisation devices to prevent extractions by mesialisation of the maxillary molars where there is a lack of space deserve a special mention. Distalising these molars can lead to recovery of space in the arch that could otherwise only be obtained by extracting premolares[7-10].

Mention must also be made of the unquestionable contribution that micro-implant development has made in preventing many extractions; in fact, this is one of its numerous indications.

When there is a negative osseodental discrepancy due to excess transverse dimensions in the teeth, it is feasible to reduce this by a stripping technique. However, one or more teeth will have to be removed in many cases, even after reasonable expansion of the arches. This method does not exclude extractions, but in many cases is complementary to them; i.e. achieving a suitably wide arch is a goal in itself, which will not always guarantee that DOD extractions will be avoided.

2. Extractions and facial aesthetics

One of the main indications for orthodontic extractions is to achieve a more harmonious profile in patients with excessive facial convexity secondary to dental biprotrusion. It must be noted, in this regard, that the concept of the ideal profile has changed notably throughout the last century[6]. Several decades ago, the ideal Caucasian profile was flat or even slightly biretrusive, with relatively thin lips; while in recent times more convex profiles have become more popular with a marked lip relief and a wide smile with buccal corridors. This change in tastes for greater facial convexity is mainly for women and in Caucasians; whereas in the male and in oriental races, the flat profile is still considered more harmonious. Obviously, this is not the case in negroid races, one of whose most characteristic features is precisely biprotrusion.

The greater tolerance to convexity in our environment has naturally reduced the need for extractions due to biprotrusion and DOD. For example, Proffit performed a study on the changes in the pattern of extractions in the treatment of malocclusions during the last 60 years. It showed that the frequency of extractions was around 30% for the years 1953 and 1993: 40 years apart. However, interestingly, the analysis in 1968 gave a result of 76%. The explanation given for this high percentage was the trend at the time for removing all teeth outside of the arch. At present, this proportion is limited to 5%; 20% down on most studies[1].

However, there are some facial features linked to excessive convexity which are objectionable in any aesthetic framework and put a limit on the extraction option. One of those features is the hyperactivity of the muscles of the chin associated with biprotrusion which, in an effort to close the lips, gives the chin a kind of "golf ball" appearance.

The positive effect on the profile of extracting the bicuspids in patients with a normal vertical dimension or a little short and a marked biprotrusion, especially if associated with crowding, is generally clear; thus, there is usually agreement among authors for its indication[1]. This does not occur in the biprotrusive patients with a pattern of mandibular posterorotation and dolicofacial growth. The aesthetic result in these patients of resolving biprotrusion with extractions is unpredictable, if not clearly wrong; so the clinician is often faced with the choice of obtaining good occlusion at the risk of worsening facial aesthetics, or not altering the profile and accepting the limitations in the resolution of the malocclusion. Obviously, in cases where the dentofacial deformity is more severe, orthognathic surgery allows for both goals, facial and occlusial.

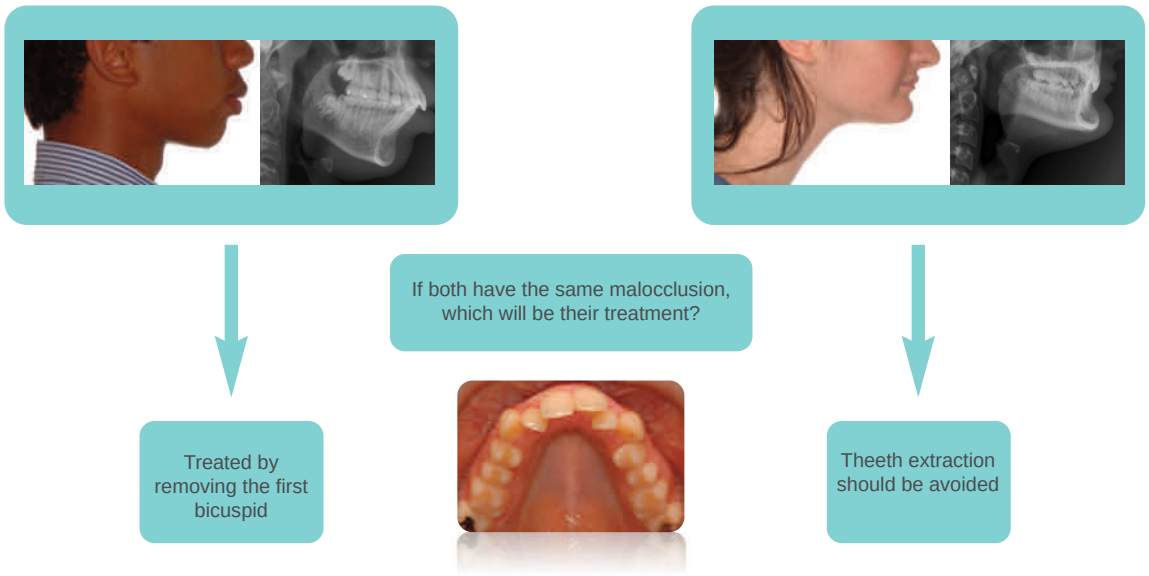

Figure 2: Patient A has a dentoalveolar biprotrusion with convex profile. Patient B has dentoalveolar biretrusion with concave profile. If both have the same malocclusion with crowding, patient A should be treated by removing the first bicuspid, while teeth extraction should be avoided in patient B if possible, due to potential undesirable effects in facial aesthetics.

A trait that also determines the indication for therapeutic extractions and the management of orthodontic appliances in these cases is the presence of overbite or open bite. Extractions tend to increase overbite, which is positive when there is a tendency to open bite and undesirable in patients with a deep bite.

In short, the indication of therapeutic orthodontic extractions is subject to multiple circumstances which need to be carefully assessed in the treatment plan. In fact, an identical malocclusion will require a conservative or extractive approach depending precisely on a rigorous evaluation of these circumstances. Figure 2 outlines this unquestionable reality (Figure 2).

3. Extractions and normalising occlusion

Achieving a class I canine is not an objective to be waived with a malocclusion; although in exceptional circumstances limitations have to be accepted in this regard, especially in adult patients.

However, although desirable, an Angle class I molar seems inessential for either oral or joint health. Nevertheless, the orthodontist usually tries to achieve it. When the patient is in growth, the use of orthopaedic and functional appliances may contribute to achieving this desired molar class I, linked to the normalisation of the skeletal relationship. When no residual growth remains, apparatus specifically aimed at the normalisation of occlusal relationships can be used. There are numerous molar distalisation devices to treat Class II teeth[7-9] and designs with microscrews for classes II, III and open bites, for example[10]. However, it is often not possible to achieve the objective of the molar normal occlusion, so extractions need to be resorted to for a class I canine, and other aesthetic or periodontal goals, for example. As discussed below, these can be planned according to a typical pattern (class II upper premolars and class III lower ones), or atypical patterns can be used, depending on the circumstances of each case.

4. Extractions and stability of results

One of the key aspects in the success of orthodontic treatment is the stability of long-term results, which depends on certain parameters such as the interincisive angle, overbite, overjet, appropriate transverse dimensions and good periodontal health. There is no general agreement on the impact of therapeutic extractions on the post-treatment stability of each of these parameters. One of the advantages that have

been claimed for extractions is that they promote stability, both with overjet and crowding. However, not all authors agree, and some view the possibilities of extractions with scepticism and say that, over time, the lower incisors tend to come together again, regardless of the treatment modality: conservative or not conservative[1]. Others point out that the key issue is the proper location of the teeth relative to the alveolar bone to maintain stability and periodontal health; such that the only thing that would ensure stability would be obtaining a proper interincisive angle (Figure 3).

One experience shared by orthodontists is that deep overbite in extraction cases tends to recur more than in cases where no extraction takes place[12].

5. Extractions and intrinsic pathology

Sometimes, in planning the treatment of a malocclusion that could be treated without extractions, removal of one or more teeth is included simply because they have intrinsic pathology or are periodontally compromised. If ignored, this condition can compromise medium- or long-term viability or hinder the treatment of the malocclusion itself. At other times, it is the requirement of an interdisciplinary treatment where other experts make the decision to extract. The most common pathology in this sense is partly periodontal (including recessions and severe dehiscence) and partly pulpar of an infectious or traumatic nature. Although morphological abnormalities and ectopic eruption are other reasons.

II. PATTERNS OF TEETH TO BE REMOVED IN ORTHODONTICS

1. Conventional or typical patterns

Table I Shows the most common tooth extraction patterns used and their main indications for treating malocclusions. It is open to multiple qualifications and exceptions but is basically an indicative scheme.

2. Atypical extractions

In practice, they are very common and, although they may be necessary in patients of all ages, their frequency has increased proportionally with the incorporation of adult orthodontic consultations. They have multiple indications, whether related to the pathology of the extracted tooth itself or unconventional malocclusion treatment demands. These extractions are very commonly indicated in adult patients because, after a certain age, dental mutilations, periodontal disease and other conditions that will affect the malocclusion treatment plan are a constant feature in our environment.

Table II contains examples of reasons for unconventional or atypical extractions. Particular atypical extractions worth a mention are extraction of a lower incisor and the first molars, so these are particularly referred to from the orthodontic treatment point of view[34,35].

2.1 Extraction of a lower incisor

The frequency of extraction of a lower incisor in orthodontic clinics is highly variable. Most authors put the figure at 1.1-6% of all patients treated for malocclusion[33,36]. For example, Proffit in the 1950s recorded the extraction of a lower incisor in 20% of all malocclusive patients treated with extractions[6].

The main indications for extracting a lower incisor are:

- *Malocclusion of Angle Class III, light – moderate, with little negative overjet or 0 overjet and decreased overbite.*

This is the fundamental indication, but has the limitation of not properly resolving the molar and canine classes. Extracting a lower incisor involves a reduction in arch length and extrusion and retrusion of the remaining lower incisors; thus increasing the overbite and overjet. As a result, extraction of a lower incisor is only recommended in patients with an Angle Class III malocclusion to resolve mild to moderate anterior crowding not accompanied by excessive overbite or large negative overjet.

- *Malocclusion of Angle Class I or II with Bolton discrepancy*

The extraction of a lower incisor may be indicated for an increase in the transverse dimension of the lower incisors (lower discrepancy excess), but also when the patient has microdontia, or even agenesis, of the upper ones (upper discrepancy defect). In these cases, extraction of the lower incisor is considered over other possible alternatives, as would be stripping in the anteroinferior sector for lower discrepancy excess or remodelling of the upper incisors in upper discrepancy defect.

Specifically in class II with Bolton discrepancy, the extraction of a lower incisor may be combined with the use of some distalisation mechanism, or with the extraction of two upper bicuspids. Skeletal class II cases can be treated with orthognathic surgery, with the extraction of a lower incisor possibly being part of a presurgical orthodontic treatment plan.

Figure 3: Patient with dentoalveolar biprotrusion treated by extracting first bicuspids. An improvement in the profile can be seen. a, b, c, d, e, f: Initially. g, h, i, j, k, l: After treatment. m, n, ñ, o, p: After one year of retention.

C. Temporomandibular dysfunction with mandibular retroposition

It has been suggested that the removal of a lower incisor facilitates the anterior reposition of the mandible in patients with TMJ dysfunction and Angle Class I malocclusions without residual growth.

Table III lists the undesirable effects and contraindications of therapeutic extraction of a lower incisor[36].

2.2 Extraction of the first molars

The functional significance of the first molars means they are rarely suggested for extraction in the conventional treatment of malocclusion. However, it is not uncommon to find first molars affected by severe pathologies, such that their removal is considered within an interdisciplinary therapeutic plan. Among these pathologies are those that involve significant destruction of the crown which makes restorative treatment difficult; particularly extensive decay and severe enamel defects (isolated hypoplasia and incisor-molar syndrome).

Therapeutic removal of first molars may also be considered for eruption disorders, whether due to ankylosis or ectopies of difficult renewal. Extracting the first molar with a pathology may be an alternative to a first premolar. When there is no indication to extract premolars, the space left by the removal can be closed by mesialisation of the second molars and eventually the wisdom teeth. In this case, the final occlusal position should be considered beforehand, depending on the molars remaining after extraction.

In adult patients, the most common cause of permanent molar extraction is periodontal disease of the tooth.

2.3 Extraction of temporary teeth

Temporary teeth extraction is an important prophylactic weapon in the development of certain malocclusions. However, it is a subject of constant debate and clashes between orthodontists, who indicate the extractions, and paediatric and general dentists who have to perform them and do not always understand the need for them. Removing temporary teeth can be prescribed in a timely and well located manner either or within the framework of a programmed eruption guide.

Specific indications for removal of temporary teeth without a predetermined pattern are very common; thus, only a few of the most frequent in orthodontic practice will be outlined.

Firstly, the prevention of permanent teeth impaction must be mentioned. Important in this area is the research by Ericson and Kurol on prophylaxis of the impaction of palatal maxillary canines in cases of eruptive deviation during the period of mixed dentition[40-41]. These authors showed that the extraction of canines, and eventually the first upper molars, in children with deviation of the permanent ones prevented their evolution to inclusion in 60-90% of

TABLE I: TYPICAL PATTERNS OF TOOTH EXTRACTIONS IN ORTHODONTICS: INDICATIONS

EXTRACTION PATTERNS	INDICATIONS
- First 4 bicuspids	- Angle class I with: - Crowding and/or - Biprotrusion and/or - Open bite.
- First 2 upper bicuspids	- Angle class II.
- First upper bicuspids and second lower	- Class II with: - Overjet and/or - Crowding.
- First 2 lower bicuspid	- Angle class III.

TABLE II. REASONS FOR ATYPICAL ORTHODONTIC EXTRACTIONS AND TEETH EXTRACTED

REASONS FOR EXTRACTION	TOOTH TO BE EXTRACTED
- Correction of the midline. - Asymmetric malocclusions	- Bicuspid
- Bolton Discrepancy - Lower crowding in Class III	- Lower Incisor
- Agenesis of a lateral incisor	- Upper lateral incisor (contralateral)
- Ectopy, impaction - Ankylosis	- Upper canines
- Intrinsic pathology	- Tooth affected

TABLE III: UNDESIRABLE EFFECTS AND CONTRAINDICATIONS FOR THERAPEUTIC EXTRACTION OF A LOWER INCISOR

UNDESIRABLE EFFECTS	- Excessive overjet and overbite. - Reopening of extraction space. - Inadequate posterior occlusion. - Loss of interincisor papilla with appearance of "black triangles". - Mesial inclination of the lower canines. - Excessive lingual inclination of the remaining lower incisors. - Inconsistency of midlines (inevitable).
CONTRAINDICATIONS	- Bolton Discrepancy, upper excess. - Increased overbite. - Triangular anatomy of lower incisors, especially with periodontal disease. - Increased overjet.

cases. This prophylactic extraction procedure of temporary canines deserves special consideration in patients with agenesis of the lateral incisors for its proven association with canines.

Another indication that is frequently suggested is the extraction of temporary second molars in cases of impaction of the permanent first with infraocclusion. In these cases, a distal reduction of the second temporary molar (slicing) can be performed; but if this is not enough, they must be extracted. Usually, the permanent molar erupts spontaneously afterwards, but is essential to control the loss of the space required for the premolar successor.

Finally, mention must be made of the extraction of the temporary incisors in the presence of eruptive alterations of the permanent successors. The etiology of their impaction is multiple: traumatic events with the incisor itself or its temporary predecessor; the presence of obstacles such as supernumerary teeth, odontomas or cysts; or jaw malformations, especially a cleft palate. In all these cases, when the temporary predecessor persists, usually removal is indicated, associated or not with other orthodontic or surgical procedures[28,42,43].

2.4 Guiding eruption

A programme of serial extraction of temporary teeth or, even better, a guide to eruption may facilitate the treatment of malocclusion in temporary or mixed dentition or prevent its full development[44].

However, many authors have pointed out the importance of extreme prudence and knowledge of the pathophysiology of the eruption when using this therapeutic tool. In inexpert hands, significant undesirable effects can occur by improperly handling the anchor and maintaining spaces, for example. In short, programmes guiding the eruption are far from being a rigid solution that apply in all cases; but must be tailored to each patient's pathology, ending or not in the removal of the first bicuspids[45].

CONCLUSIONS

Dental extractions are a highly useful weapon in the prophylaxis and treatment of numerous malocclusions. However, their use requires great caution and a thorough understanding of the pathophysiology of eruption, occlusion and facial aesthetics. The orthodontist is faced with numerous facial and dental deformities which cannot be managed by the rigid application of treatment plans; and this is particularly applicable to tooth extractions. Adult patients often have very complex pathologies which pose many challenges to the orthodontist, among which are the ability to remove or keep teeth and to manage this within an interdisciplinary approach.

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