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ENHANCED CPD

GDC anticipated outcome: C
CPD hours: one

Topic: Orthodontics

Educational aims and objectives:

To present some of the factors that influence decision-making on tooth extraction in orthodontic treatment, the pros and cons relative to orthodontic extractions and relevant literature. This article qualifies for one hour of enhanced CPD; answer the questions on page 70.



There has been much debate over extraction or non-extraction orthodontic treatment over the years. Angle (1907) believed everyone could have all 32 teeth in functional occlusion and this would provide the best aesthetics for each patient. Arch expansion would be stabilised by remodelling bone with Wolff’s law – bone would form in response to stress.

Angle (1964) strongly criticised Angle’s non-extraction philosophy of its effect on facial aesthetics. Non-extraction produced excessive protrusion on facial profile and expansion of arches not stable in the long term.

Tweed (1944) and Begg (1954) independently abandoned the non-extraction policy due to concerns about relapse and stability.

In the 1940s, Tweed retreated relapse cases with four premolar extractions and showed the resulting occlusion more stable. Tweed’s philosophy was that malocclusion is genetically determined due to mismatch between tooth and jaw size.

Begg (1954) was concerned about relapse and believed that the lack of attrition in modern diet could be compensated by extraction.

The extraction debate was reopened in the 1960s, and Begg’s and Tweed’s philosophies unsubstantiated.

Riedel (1957) believed that the public preferred a fuller profile based on a cephalometric and photographic appraisal of the dentofacial patterns of a group of Seattle Seafair princesses (ie non-extraction/expansion/protrusion).

Proffit (1994) performed a 40-year review of extraction frequency in the United States and showed a marked reduction in orthodontic extractions with 30% extraction treatment in 1953, 76% in 1968 and 28% in 1993.

The reasons for the downward trend in extraction may be the concerns of facial aesthetics, TMJD

and not guaranteed stability. Also, changes in orthodontic techniques such as the development of the straight wire appliance, self-ligation, extraoral traction, anchorage and the use of mini-implant screws (TADs).

FACTORS TO CONSIDER

There are several general and malocclusion factors to consider when deciding on extraction or non-extraction orthodontic treatment.

General factors

- Age of patient
- Growth and development
- Any relevant medical history
- Gross pathology (caries, periodontal conditions, hypoplasia)
- Presence or absence of teeth
- The prognosis of teeth
- Gross teeth displacement and abnormal morphology.

Malocclusion factors

- Patient’s dental, facial aesthetics and facial profile
- Anterior-posterior (AP) skeletal pattern – the more severe the crowding the less space is available for camouflage (Bjork, 1969)

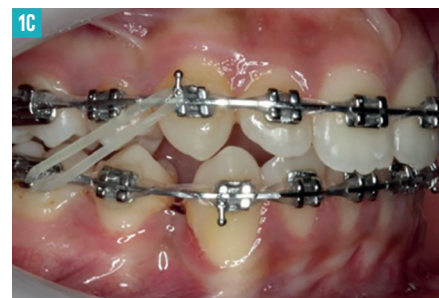
DEFINITIONS

- Extraction treatment: the creation of space to facilitate orthodontic treatment by a reduction in number of dental units
- Non-extraction treatment: the creation of space by means other than the reduction in the total number of dental units to facilitate orthodontic treatment.

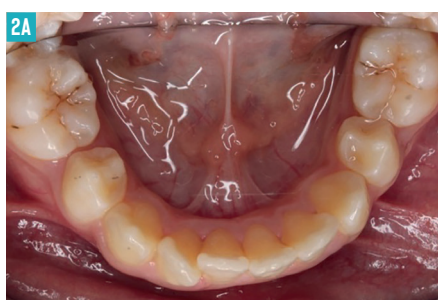


Avan Mohammed and Yan Huang discuss different factors that influence decision-making on tooth extraction in orthodontic treatment, the pros and cons relative to orthodontic extractions and relevant literature

Extraction versus non-extraction



FIGURES 1A, 1B and 1C: Severe upper arch crowding (buccal UR3) and an increased overjet treated with extraction of UR4 UL4



FIGURES 2A, 2B and 2C: Orthodontic alignment of severe lower arch crowding of LR5 and LL5, treated with extraction of LR4 and LL4 and fixed appliances

- Vertical dimensions – extraction spaces are more difficult to close in low angle patients (Möller, 1966)
- Transverse dimension – elimination of crossbites (Ackerman and Proffit, 1997)
- Soft tissue factors (large, flaccid tongue and lips)
- Degree of crowding (mild/moderate/severe) and site of crowding (anterior crowding usually more anchorage demanding than posterior)
- Need for AP movement of teeth for orthodontic camouflage (reduction of an increased OJ), camouflaging class III incisal relationship)
- Space requirements (flattening curve of Spee, reduction of overbite, retroclination of incisors to reduce AOB, centreline correction, correction molar relationship)
- To eliminate local crossbite
- Anchorage requirements of proposed tooth movements (tip and torque adjustments planned for incisors and inclination of the canines)
- Anchorage balance and requirements
- Age of patient (more difficult to close space in older patient)
- Ease of extraction.

Disadvantages of extractions

The following disadvantages of extractions have been found:

- Detrimental to facial profile
- No guarantee of stability
- Inducing TMJD
- Longer and more difficult treatment – six

to eight months longer than non-extraction treatment (Vig et al, 1990; Bishara and Jakobsen, 1997)

- Pain, anxiety and other possible adverse effects of the actual extraction procedure.

EXTRACTION AND STABILITY

Stability can be defined as the maintenance of the position of teeth and corrected features of the malocclusion without change.

Relapse is the return, following correction, of the features of the original malocclusion.

Some clinicians claim that extraction is required to ensure stability. However, extraction-based treatment has also been shown to be unstable.

Tweed (1944) instigated extraction therapy after treating Angle's cases and believed they would be more stable with extractions.

Little, Wallen and Riedel's (1981) study on 65 patients who underwent extraction of all first premolars showed that after 10 years of completion of orthodontic treatment, 70% became crowded with 20% of markedly crowded need of retreatment. Mean crowding was 5.25mm.

The study was redone on 31 cases after 20 years and found that crowding increased by 1mm on average, whereas, both arch length and width reduced and only 10% patients had a clinically acceptable result. They found no significant predictors of stability of lower incisor alignment (Little et al, 1988). These two studies generally had small sample sizes and no randomisation.

However, similar findings have demonstrated by others (Vaden, Harris and Gardner, 1997).

Expansion is the main method of relieving crowding in non-extraction cases. Little, Riedel and Stein (1990) followed 26 cases for six years and found that the group that had active expansion in mixed dentition showed the worst relapse and 89% demonstrated crowding. McReynolds and Little (1991) found similar relapse in second premolar extraction cases.

Paquette, Beattie and Johnston (1992) did a 14-and-a-half-year post-treatment reviews of extraction and non-extraction treatment and found 50% of non-extraction group and 75% of extraction group had less than 3.5mm incisor irregularity.

Erdinc, Nanda and Isiksal (2006) assessed long-term stability of incisor crowding in extraction and non-extraction cases and found that in both groups' incisor irregularity increased, inter-canine width decreased, inter-molar width was stable, overbite and overjet increased and incisors returned to pre-treatment position.

Orthodontic relapse is a long-term occurrence and extractions do not definitively confer long-term stability. There are also lifelong maturational changes to consider.

Arch length, inter-canine width and intermolar width decrease post-treatment while incisor irregularity will increase with or without dental extractions.

Long-term retention is the main method of fighting relapse and ensuring maintenance of



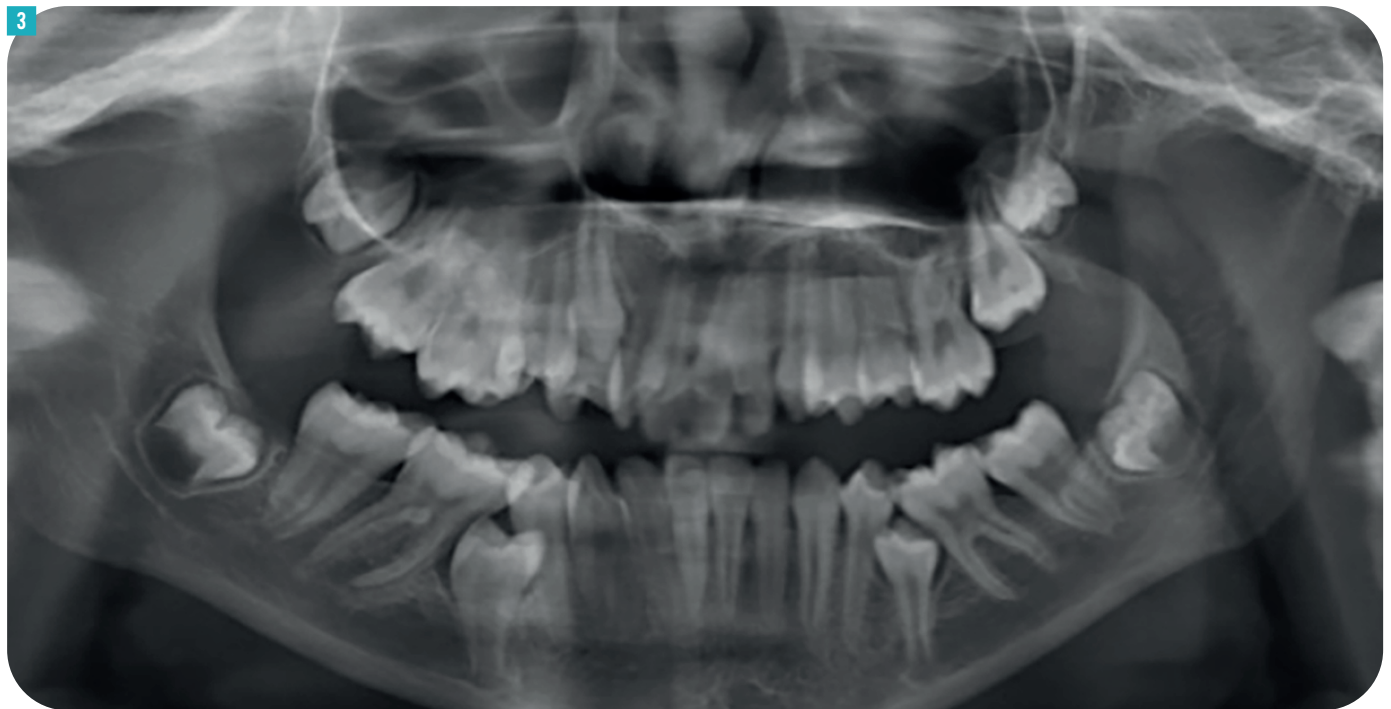


FIGURE 3: OPG X-ray showing impacted LR5 and LL5 due to severe crowding

results in the long term. Vertical growers and soft tissue factors outwit our control.

EXTRACTIONS AND FACIAL AESTHETICS

Skeletal foundation, dental support and soft tissue components of nose, chin, lip tone and thickness are the determinants of soft tissue contours of the face and therefore determine the facial aesthetics of an individual (Ackerman and Proffit, 1997).

Upper and lower lips become more retruded with respect to the E-line between the age of 15 and 45 years. There is little change in the angle of soft tissue convexity between five and 45 years. Greatest soft tissue changes for females occur at 10 to 15 years and 15 to 25 years for males (Bishara et al, 1998).

In addition, the patient's own perception, ethnicity, racial characteristics, and society/peer influence contribute to perception of facial aesthetics.

Extraction changes facial aesthetics: literature discussion

The effect of extractions on facial profile is a controversial issue. The extraction or non-extraction decision should be based on sound treatment planning, clinical assessment of patient's facial profile and appropriate space analysis criteria tailored to the individual patient.

Paquette, Beattie and Johnston (1992) compared borderline extraction and non-

extraction cases. They noticed that extraction cases did have slightly flatter profiles than non-extraction cases, but patients were no less pleased with the result. They also found incisor to lip retraction ratio to be 5:1.4 (upper lip retract 1.4mm for every 5mm upper incisor retraction). The relationship between lip retraction and amount of incisor retraction varies between patients and between studies.

Bowman and Johnston (2000) found that extraction potentially benefits those patients who had initial lip protrusion (more than 2-3mm behind Ricketts' E-line).

Konstantonis (2012) followed up extraction and non-extraction class I cases for 20 years and found that extractions lead to an average of 2mm retraction of lower lip to the E-line and a five degree of increase in nasolabial angle. However, this has minimal effect on aesthetics and facial profile.

Leonardia and colleagues (2010) carried out a systematic review of premolar extractions in non-growing patients. They found that both upper and lower lips were retruded (average 2-4mm) and nasolabial angle was increased following premolar extraction. There are large individual variations.

Extraction does not change facial aesthetics: literature discussion

Staggers (1990) compared extraction of first premolars and second molars and found greater retraction of incisors with first premolar

extraction group. However, no significant differences were found between the groups in upper lip protrusion or angle of facial convexity.

Bishara and Jakobsen (1997) carried out a study asking lay people to assess the changes in facial profile of extraction and non-extraction cases. They found that profiles of extraction cases were better perceived than non-extraction immediately post-treatment. Both groups perceived as more favourable after treatment. There is no significant difference in perception of extraction and non-extraction facial profiles overall.

Ismail and Moss (2002) found no significant effect of extraction on soft tissue profile when assessed with 3D laser scanning.

Stephens and colleagues (2005) found extraction and non-extraction patients ended up with similar profiles after treatment.

EXTRACTIONS AND FACIAL AESTHETICS: SUMMARY

The effect on lips and nasolabial angle (NLA) with extractions and incisor movement vary depending on the degree of tooth movement, incisor inclination, soft tissue thickness, lip length and form, NLA and nose form/shape/nasal tip.

Rathod and colleagues (2015) assessed long-term soft tissue response in premolar extraction group compared to untreated control groups. They found no differences in soft tissue profiles, but some directional changes. Changes in soft



FIGURE 4A: Before, severe crowding lower arch treated with extraction of LR4 and LL4

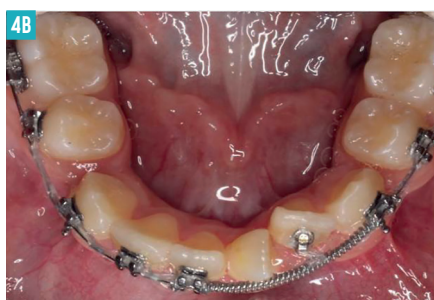


FIGURE 4B: After, severe crowding lower arch treated with extraction of LR4 and LL4



FIGURE 5A: Before, severe crowding lower arch treated with extraction of LR4 and LL4



FIGURE 5B: After, severe crowding lower arch treated with extraction of LR4 and LL4

tissue profile in the long term were greatest for lips and chin. In the untreated control group, these changes were in the downward and forward direction. In the extraction groups, the changes were in a more forward direction.

They concluded that extraction treatment does not adversely affect soft tissue profile changes over time.

Relief crowding (without excessive expansion)

To reduce overjet (O) and overbite (OB)

Anchorage considerations

Buccal segment relationship correction

Incisor relationship (eg in class III cases – lower incisor retroclination)

Camouflage of skeletal pattern

Decompensation to address skeletal pattern

TABLE 1: Reasons for extracting teeth in orthodontic treatment

Janson and colleagues (2016) performed a retrospective study looking at any effect of extractions on facial aesthetics in class II division 1 cases with non-extraction, two upper premolar extractions and four premolar extraction groups treated with a standard set of mechanics using edgewise mechanics.

They assessed post-treatment occlusal outcome and lateral and frontal photos by both orthodontists and lay panel. There was no significant difference in any of the measurements between the three groups at the post-treatment stage and eight years after treatment in facial aesthetics. They concluded that there is no evidence that extracting teeth as part of orthodontic treatment causes any harm to facial aesthetics of patients.

EXTRACTION AND SMILE AESTHETICS

The ideal smile has a 2-3mm incisor show at rest and a full incisor show plus 1-2mm gingivae show in smiling.

Most people prefer broad smiles with small buccal corridors (Moore et al, 2005). Roden-Johnson, Gallerano and English (2005) found no significant difference between attractiveness of smiles with larger or small buccal corridors.

Martin and colleagues (2007) used female photographs altered to display the six to six and the five to five. They found orthodontists and lay people rated small buccal corridors best, but lay people preferred five to five smiles best while orthodontists preferred six to six smiles.

Ghaffar and Fida (2011) also asked lay people to judge between extraction and no extraction smile aesthetics and found no difference noticed for any variables studied.

Meyer, Woods and Manton (2014) asked orthodontists, dentists and lay people to assess and evaluate post-treatment full face frontal smiling photographs of 30 premolar extraction cases and 27 non-extraction cases. They did not find any difference in buccal corridor widths or attractiveness of the smiles. Overall, there is no evidence to suggest that extractions contribute to narrowing of the smile.

EXTRACTIONS AND TEMPOROMANDIBULAR JOINT DISORDER

Bowbeer (1987) proposed that extractions cause the condyle to be displaced distally with incisor retraction into extraction spaces. This was mainly based on personal opinions.

Multiple studies have found that the frequency of temporomandibular joint disorder (TMJD) is the same in extraction and non-extraction samples, with no greater prevalence of TMJD in extraction cases (Paquette, Beattie and Johnston, 1992; Luppnapornlarp and Paquette, 1993; Beattie, Paquette and Johnston, 1994; Mohlin et al, 2004).

Luecke and Johnston (1992) assessed condylar position with extractions and found no association. Kremenak and colleagues (1992) found no difference 10 years post-treatment in incidence of TMJD in patients who had premolar extractions and no treatment.

Egermark, Magnusson and Carlsson (2003) performed a 20-year follow-up study and found that orthodontic treatment in childhood does not increase the risk of developing TMJD.

CONCLUSION

Premolar extractions seem to have a small effect on facial profile but not necessarily detrimental. The evaluation for profile is largely subjective and individual variation in response to extraction is large.

Inappropriate extraction will reduce lip support and inappropriate non-extraction will result in excessive lip fullness or lip protrusion.

The decision and pattern of tooth extraction should only be made after careful clinical and radiographic examination of an individual patient.

The orthodontist should understand the benefits and limitations associated with extraction and non-extraction treatment in order to provide the patient with the right treatment.

REFERENCES

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