Australian Society of Orthodontists

University of Sydney

Extraction versus Nonextraction:

THE FACTS

Creating Brighter Futures

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History

The extraction versus nonextraction debate has spanned over a century.[1] The extraction-directed practices of the late 19th century were dictated by technique limitations. However by the 1930's, treatment strategies reflected Angle's nonextraction dogma that a full complement of teeth should be maintained.[2] Despite some opposition,[3] the nonextraction philosophy remained largely unchallenged until reports by Tweed,[4] advocating greater stability with upright mandibular incisors over basal bone, and Begg's theory of arch perimeter loss due to interproximal wear in the stone age man's dentition,[5] tilted the balance towards extractions.

Refinements in growth modification techniques, the advent of bonding brackets and more flexible archwires, as well as a shift in public perception of facial aesthetics, have led to a nonextraction approach being adopted once again.[6] The rate of premolar extractions declined from 76% in 1968 to 28% in 1993.[7] Indeed, nonextraction treatments have increased in popularity as concerns over the possibility of dished-in profiles, compromised aesthetics, condylar displacement, and reduced airway dimensions have become linked with extractions. However, the reported decline in extractions is also attributed to the greater proportion of patients with less severe malocclusions seeking orthodontic treatment in recent times. Nonextraction therapy may be appropriate for less severe cases but many severe orthodontic problems still require extractions.

To Extract or Not Extract?

The decision to extract or not for orthodontic treatment is influenced by a number of factors. These include:[8]

1. Severity of crowding
2. Incisor protrusion
3. Extent of overjet
4. Soft tissue profile
5. Anteroposterior discrepancy
6. Tooth size anomalies
7. Midline deviations
8. Periodontal condition
9. Gingival biotype (thin/thick)
10. Presence of lip strain
11. Excepted soft tissue changes
12. Stability influenced by a number of factors

Many patients, but by no means all, can be treated nonextraction. The most common reasons for extractions are to compensate for crowding, excessive incisor protrusion, and skeletal discrepancies.[8]

In terms of crowding, extractions form just one part of the clinician's armamentarium for gaining space, alongside expansion[9], proclination[10], distalization[11], interproximal stripping[12] and utilization of leeway space[13]. Proffit, *et al.*[10] advised that extractions are generally required when the arch length discrepancy is greater than 10mm. Either nonextraction and extraction treatment can be considered in less severe crowding of 5-9mm, and extractions are rarely indicated in cases of mild crowding of less than 4mm.

Compensating for skeletal discrepancies may also require extractions to attain adequate space for incisor retraction or buccal segment mesialization. Similarly, excessive lip procumbency may improve with incisor retraction subsequent to extractions.

Facial Profile

In general, nonextraction treatment results in more prominent teeth, while extractions reduce their prominence. Although unacceptable aesthetics can result from either excessive protrusion or retrusion, some clinicians have placed great emphasis on the alleged "dished-in" appearance linked to extractions. The consensus of the peer reviewed literature is that while extractions can lead to lip retraction, properly planned extractions do not dramatically or detrimentally modify the profile.[14,15] Profile changes are influenced by amount of incisor retraction, pretreatment lip strain, and variations in lip morphology.[16,17]

The relative impact of a protrusive or retrusive dentition on aesthetics depends on the associated soft tissues. Thick, full lips may accommodate incisor prominence that would be less ideal in a patient with thin lips. A prominent nose and chin may be accentuated by excessive incisor and lip retraction.[10] In contrast, lip retraction subsequent to incisor retraction would be desirable in the management of bimaxillary protrusion. A recent systematic review looking at non-growing patients with bimaxillary protrusion treated with extractions of premolars found that lip procumbency improved with upper lip retraction ranging from 2-3.2mm and lower lip retraction ranging from 2-4.5mm.[18]

Figure 1: Pretreatment (left) and post-treatment (right) profile of adult female extraction patient. Rinchuse et al., 2014.

The patient's age should also be considered in treatment planning. Soft tissue profile changes occur throughout life, with the nose and chin moving gradually forward resulting in a flatter profile.[19-21] Nonextraction treatment may therefore be preferable to maintain lip fullness. However, long-term studies examining the effects of extraction versus nonextraction on profiles have reported minimal differences.[22-24] Comparing patients with class II division 1 malocclusions that were equally amenable to extraction or nonextraction treatment, Paquette, *et al.* [25] observed that the profile of the nonextraction group appeared 2mm 'fuller' compared to the extraction group after a post-treatment interval of 15 years. Notably, patients and orthodontists did not rate the profile of nonextraction patients higher than that of extraction patients at post-treatment review.[24,25]

Long-term changes are not dictated by treatment modalities, rather by the individual variability in profile changes with age.[24,26] The soft tissue thickness and morphology, degree of incisor protrusion, and potential soft changes associated with growth should be considered to anticipate the effects of extraction and nonextraction treatments.[16] Current findings suggest that the extraction/nonextraction decision, if based on solid diagnostic criteria, does not have a detrimental effect on the facial profile.[27]

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Smile Aesthetics

There are suggestions that extraction treatment results in narrower dental arches, which in turn, leads to a less aesthetic smile marred by 'negative spaces' lateral to the buccal segments.[28] The literature however is unsupportive. Several authors have reported that orthodontic extractions do not have detrimental effects on the aesthetic outcome, as judged by laypersons and orthodontists.[29-32] In terms of buccal corridor display, studies have shown that extractions of maxillary premolars do not narrow the upper arch width and reduce buccal corridor display.[32-34] Moreover, increased buccal corridor display has not been found to be necessarily unattractive.[35,36]

Figure 2: Increased buccal corridor display has not been found to be unattractive. Meyer et al., 2014.

Stability

The extraction directed treatment philosophies of Tweed and Begg were based on the notion that extractions allow better stability.[7] However, landmark studies by Little et al. do not support this.[37,38] Most dentitions with severe irregularity prior to orthodontics still exhibit irregularity in the long-term despite extractions. However, the same research group also reported that 89% of patients treated with nonextraction arch development demonstrated unsatisfactory alignment after six years post-retention. In fact, they displayed the poorest long-term results of all treatment therapies examined by Little and co-workers.[39]

The reason behind the instability in expansion cases is the long established precept that intercanine expansion is highly unstable, particularly in the mandible where post-retention mandibular intercanine width approximates its initial dimensions.[40-42] In the 1980's, arch expansion gained popularity as a method for resolving crowding.[43-45] A typical regime would include an upper rapid or slow maxillary expansion appliance with a lower Schwarz appliance. This was reported to achieve an additional 1.7mm of mandibular expansion.[46] The introduction of more flexible archwires has allowed similar outcomes to be achieved with full fixed appliances. However, considering the well-documented instability in expanding the lower arch, as well as the potential periodontal co-morbidities of expansion,[47] the value of mandibular expansion to gain space is questionable. Currently, this inherent instability of expansion is being countered or delayed by the use of long-term fixed retention in both extraction and nonextraction cases.

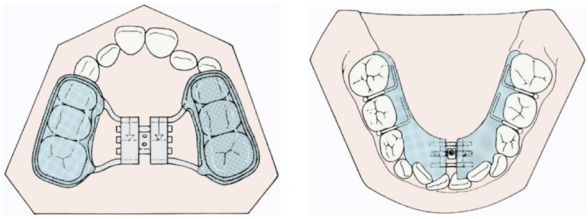

Figure 3: Rapid maxillary expander and mandibular Schwarz appliance. O'Grady et al., 2006.

Periodontal Health

Incisor proclination may alleviate some crowding. Incisors that are tipped lingually away from the lip can be proclined more than upright incisors though it may still be limited by lip pressure.[10] Although nonextraction treatment may be adequate in borderline crowding cases, the periodontal implications of overzealous proclination should be considered. Wennström[47] proposed that labial tooth movement *per se* does not cause gingival recession, but the resultant thin gingiva associated with facial tooth movement leads to a predisposition to recession in the presence of aggressive tooth brushing or bacterial plaque accumulation. A recent systematic review found that contradictory results have been reported.[48] The tentative conclusion is that the movement of incisors out of the osseous envelope of the alveolar process appears to lead to a predisposition to gingival recessions. Baseline recession, thin biotype, and gingival inflammation affect the development of recession with the difference in the recession between proclined and non-proclined incisors being small. Yared, *et al.*[49] reported that proclining the mandibular incisors greater than 95° in areas with gingival thickness of less than 0.5mm increases the amount of recession. Thus, the patient's periodontal condition or biotype is important when considering an extraction/nonextraction decision. Proclination of lower incisors with thin biotype is more likely to contribute to gingival recession than proclination with a thick biotype.

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Figure 4a: Pre-treatment frontal.

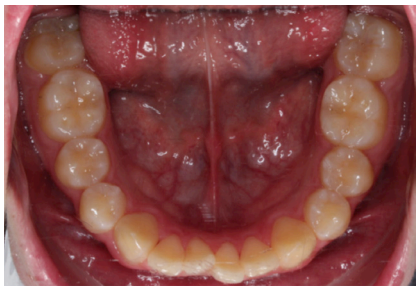

Figure 4b: Pre-treatment occlusal. Mild lower crowding.

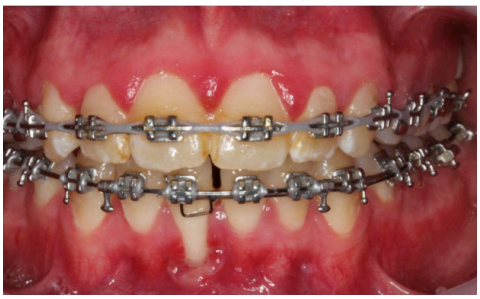

Figure 4c: Mid-treatment frontal. Recession associated with proclined 41.

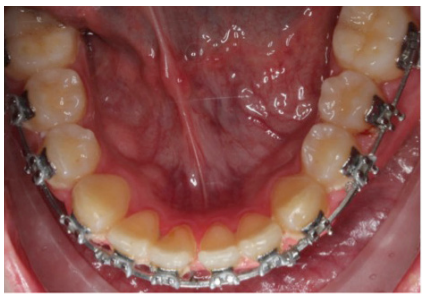

Figure 4d: Mid-treatment occlusal. Proclined 41.

Airways

The effect of extractions on the upper airway has recently received increased attention. A controversy exists as to whether the reduction in arch length from extractions deprives the tongue of its essential space, thereby reducing upper airway dimensions.[50] Constriction of the upper airway may potentially then lead to respiratory disorders, including snoring and obstructive sleep apnoea (OSA).

Despite the number of investigations that have examined the effect of extractions on the upper airway, the heterogeneity among studies prohibits a definitive conclusion.[51] This may be partly related to variations between investigations in the anchorage setup for space closure. Germec-Cakan, *et al.*[50] observed in a cephalometric investigation that the airway space increased in extraction patients treated with premolar extractions and molar mesialization, whereas it reduced in cases of incisor retraction to address bimaxillary protrusion. The nonextraction group displayed no significant changes in their upper airway dimensions. Notably, cephalometric studies only examine the airways two-dimensionally.

Age at time of treatment may also be a factor. Studies involving adult patients treated with orthodontic extractions and incisor retraction have reported a reduction in airway dimensions [52,53] while others involving adolescents have found no significant effect.[54-56] This may reflect the pronounced airway growth that occurs during adolescence.[57]

Notably, existing evidence on this association is not strong. Furthermore, as Hu, *et al.*[51] emphasize, no previous studies have examined the functional impact of a reduction in airway size on sleep quality and susceptibility to OSA. Moreover, whether reports of reduced airway space after extractions translate to reduced dimensions during sleep is questionable, as airway dimensions captured in the upright position differs from that in supine position.[58]

Although a narrow airway may play a part in the pathogenesis of OSA, upper airway size has not been consistently found to correlate with OSA severity. Indeed, the aetiology of OSA is complex and multifactorial and factors such as obesity, gender and age play significant roles.[59]

Temporomandibular Dysfunction (TMD)

The link between orthodontic extractions and TMD was scrutinized after the landmark 1987 case involving a teenage girl treated with premolar extractions and headgear. The family claimed that the orthodontic treatment had caused TMD and the jury convicted the orthodontist of mistreatment.[60] Significant research has since explored this alleged detrimental functional impact of extractions and studies have found that extractions have no effect on the development or progression of TMD.[61-65]

Conclusion

Conflicting views regarding the need for orthodontic extractions persist. Unfortunately, they are based largely on subjective impressions and orthodontic dogma derived from a variety of sources. Sound rationales and indications exist for both extraction and nonextraction treatment. It is not a matter of which treatment modality is better, but rather, under what conditions is one more appropriate for the individual patient.

References available on request

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