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OVERVIEW

Extraction Treatment Part 1 The Extraction vs. Nonextraction Debate

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(Editor's Note: In this regular column, JCO provides an overview of a clinical topic of interest to orthodontists. Contributions and suggestions for future subjects are welcome.)

For at least the past two decades, there has been a noticeable trend toward nonextraction orthodontic treatment. Pressure may be felt by orthodontists from their referring general dentists, pediatric dentists, and other dental specialists to treat without extracting teeth, particularly the premolars. But while nonextraction treatment is often perceived as conservative, many dentists are unaware of the literature supporting extraction in certain cases. A systematic review of such a broad topic would be impractical and likely inconclusive. Here, however, we present what we believe to be the first published comprehensive Overview of the evidence and guidelines for extraction vs. nonextraction orthodontic treatment.

The debate began in earnest in the early 20th century, when Dr. Edward Angle advocated that all 32 teeth could be aligned orthodontically without the need for extractions. At the 1911 National Dental Association meeting, Dr. Calvin Case argued the need for extractions in some situations against a nonextractionist, Dr. Martin Dewey. During the debate, Dewey mocked Case's use of "evolution", a novel argument, to defend his beliefs. Dewey's opinion prevailed, and extractions subsequently fell out of favor.[1]

At the 1944 AAO meeting in Chicago, Dr. Charles Tweed described the retreatment with extractions of 300 of his failed nonextraction cases, claiming to show enhanced stability.[2] Tweed's

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Fig. 1 From pretreatment (left) and post-treatment (right) profile views of adult female extraction patient, it is impossible to determine whether treatment involved extractions.

influence inspired a rise in extraction rates, which peaked in the mid-1960s at about 75%. This was followed by a decline in the 1980s to about 20%; in the 1990s, the percentage was reportedly 15-20%.[3] Extraction rates appear to be higher in countries outside the United States: in a recent random sampling of 542 Class I patients at the University of Athens, Greece, the extraction rate was 26.8%,[4] and a 1993 survey indicated extraction percentages of 29% in Ireland.[5]

Topics of Debate

Facial Profile

The major issue involved in the extraction vs. nonextraction decision is its effect on the soft-tissue profile. Nonextractionists claim that extractions "dish in" the face, while extractionists contend that without extractions in certain cases, the profile will be too full and periodontal health will be compromised.[6-9] In one study, however, neither general dentists nor orthodontists were able to distinguish between facial profiles of extraction and nonextraction subjects (Fig. 1), the difference being no more predictable than a coin toss.[10] Other studies of follow-up photos of matched extraction/nonextraction patients have reported similar findings.[11-13]

Authors generally agree that extraction treatment does not "dish in" the face, and in fact can produce more pleasing esthetic results than nonextraction treatment in patients with fuller profiles. Recent three-dimensional soft-tissue analyses following extraction treatment demonstrate that the greatest changes are seen in patients with the most protrusion, and that lip retraction is directly related to retraction of the upper and lower incisors. Most of the change in lip fullness is observed in the anterior dentition.[14] Therefore, clinicians who properly plan cases—including anchorage requirements—should see no unfavorable profile effects due to over-retraction of the anterior segment.[15] Indeed, orthodontists can actually make extractions work in their favor to reduce protrusive profiles.

A confounding factor could be that the profile tends to straighten with time irrespective of treatment modality, simply because the mandible grows more than the maxilla.[16] Even throughout adulthood, the face has a tendency to flatten.[17] Sarver and Ackerman call this the fourth dimension—time—and caution orthodontists to consider soft-tissue growth, maturation, and aging in their treatment planning.[18]

Extractions and TMD

A landmark 1987 district court case, Brimm v. Malloy, involved a 16-year-old girl with a Class II, division 1 malocclusion who had been treated orthodontically with premolar extractions and headgear.[19] Her family sued the orthodontist, claiming that the treatment had caused TMD. The plantiff's expert witness, a general dentist and

Fig. 2 Adult female patient before (left) and after (right) surgical expansion of maxillary dentition by more than 10mm. Significant buccal corridors reduced but still present.

"functional orthodontist",[20] argued that the extractions and use of headgear led to over-retraction of the upper incisors, and that this resulted in internal derangement from distal displacement of the mandible.[21,22] The jury convicted the orthodontist of mistreatment, and the case was widely discussed in the dental community. Even though most orthodontists did not believe premolar extractions could cause TMD, the lawsuit heightened their fear of malpractice suits if they extracted teeth. In the early 1990s, however, the orthodontic scientific community responded with high-quality evidence showing no direct relationship between orthodontic treatment and TMD. The literature broadly supports the contention that orthodontic treatment of any type does not cause, lessen, cure, or prevent future development of TMD, but rather has a neutral effect.[23-32]

Buccal Corridors

Frush and Fischer defined buccal corridors as the negative space between the buccal surfaces of the posterior teeth and the inner walls of the cheeks (Fig. 2).[33] Some orthodontists believe buccal corridors should be considered in making the extraction decision[34]—more specifically, that extraction of maxillary premolars narrows the dental arch, resulting in wider buccal corridors and thus an unattractive result.[35] To the contrary, the best available evidence shows that extraction of maxillary premolars does not narrow the arch,[36,37] and, moreover, that wide buccal corridors are not necessarily—or predictably—unattractive.[38-40]

Janson and colleagues, in a high-quality systematic review,[39] cited Frush and Fischer, who found that "buccal corridors added the illusion of a natural dentition, whereas its absence gave the patient an artificial appearance."[33] Although the esthetics of buccal corridor width has been debated in the literature, there may not be a difference between extraction and nonextraction treatment. A recent study of pretreatment and post-treatment casts, frontal smiling photographs, and lateral cephalograms found no significant differences in buccal corridor widths between 30 extraction and 27 nonextraction patients.[41]

Studies of observer preference regarding the amount of buccal corridor display have shown varied results. Ioi and colleagues, who digitally modified patient photographs to widen buccal corridors in 5% increments, found that both dental students and orthodontists preferred broad (0%) to medium-broad (10%) smiles over medium-to-narrow smiles.[42] Other studies have supported the notion that minimal buccal corridors are preferred among lay persons and orthodontists.[43,44] In a factorial analysis of smile arcs and buccal corridors, however, Parekh and colleagues found that while absent and "ideal" buccal corridors were preferred by orthodontists and lay people, wider buccal corridors were rated acceptable as long as they were not accompanied by excessive smile arcs.[45] Furthermore, they found that once an ideal smile arc was

achieved, the buccal corridors became less relevant.

Addressing the influence of buccal corridors on smile attractiveness, Janson and colleagues' systematic review identified 10 studies that met their inclusion criteria.[39] Their conclusion was that neither four-premolar-extraction treatment nor nonextraction treatment has a predictable effect on smile esthetics, and that well-justified extractions have no detrimental consequences in terms of facial attractiveness. Regardless of observer preferences, a recent article found no difference in buccal corridor appearance between extraction and nonextraction treatment.[46] Both that report and Janson and colleagues' review refute the claim that extraction treatment has a negative effect on frontal facial esthetics.

Stability and Impaction Risk

Bowman warned that overzealous adherence to a nonextraction protocol may not be in the best interest of many patients.[47] Since the patients most likely to experience ineffective orthodontic treatment are those with crowding and protrusion, a nonextraction approach—while ostensibly conservative—may not provide optimum esthetics, function, periodontal health, and stability in such cases. On the other hand, there is also evidence that the extraction of premolars to alleviate crowding in conjunction with orthodontic treatment may not enhance stability.[48-51] Even a high-quality or perfect finish does not ensure stable results.[52]

The increasing popularity of nonextraction therapy may be correlated with an increased prevalence of mandibular second-molar impactions.[53,54] A Turkish study also associated nonextraction protocols with increased third-molar impactions: 81.8% of the patients treated without extractions had impacted third molars, compared to 63.6% of the premolar-extraction group.[55] Others have found more favorable angulation of third molars following extraction treatment,[56] as well as increased third-molar eruption space.[57]

Reasons for the Decline in Extractions

Besides the Brimm v. Malloy case described above, there are other reasons for the declining extraction rates observed in the 1980s and '90s. Bonding allowed more patients to be treated without extractions, since band thicknesses tend to promote crowding. Other factors encouraging a nonextraction treatment decision include air-rotor stripping (ARS), expansion, self-ligating brackets, preservation of leeway space, and increased patient autonomy.

Air-Rotor Stripping

ARS or interproximal enameloplasty, as promoted by Dr. Jack Sheridan,[58,59] had a huge impact on the orthodontic profession (Fig. 3). In 1989, Dr. Larry White, Editor of JCO, stated that "the most innovative technique developed to promote nonextraction therapy may be the air-rotor stripping (ARS) method championed by Jack Sheridan of LSU. Jack modestly refuses to accept full credit (or blame) for this concept, and rightly identifies Begg's work, along with that of Harvey and Sheldon Peck, as pivotal precursors to his clinical application. It just seemed reasonable to him that if Nature could reduce interproximal enamel without increased susceptibility to caries or periodontal disease, then modern orthodontists could, too—if they would fully exploit the advantages of full-arch bonding, which opens all the interproximal areas to reshaping."[60]

As much as 6-8mm of the space needed to resolve crowding, protrusion, or a combination of the two can be gained on a more precise, customized basis by using ARS rather than extracting whole teeth.[58,59] ARS is also more effective in preserving intercanine width and arch perimeter: in a study by Germec-Cakan and colleagues of borderline Class I patients, the extraction patients lost mandibular arch perimeter and gained mandibular intermolar width compared to those treated with ARS.[61] ARS does not generally damage dental surfaces, increase sensitivity, or cause periodontal breakdown, caries, or enamel roughness.[62]

Expansion

Expansion has long been used to alleviate

Fig. 3 Air-rotor stripping performed on adult patient with moderate lower crowding.

relative and absolute posterior crossbites. In the 1980s, it gained popularity as an alternative to extraction treatment to resolve crowding even in the absence of posterior crossbite. Advocates of rapid palatal expansion (RPE) claim they are able to resolve borderline crowding (3-6mm in the mandible) in patients with narrow transpalatal widths. They contend that because the maxillary archform dictates the mandibular archform, RPE will usually result in reciprocal mandibular expansion.[63-65] Some research has also reported that RPE can facilitate a favorable change in the sagittal occlusal relationships between maxillary and mandibular teeth.[66-68] Adding a Schwarz appliance to an RPE protocol yields approximately 1.4mm more mandibular expansion than with RPE alone.[69,70] Nevertheless, Fields cautioned that "to date, there is no credible long-term postretention evidence that early intervention to prepare, develop, balance, or expand arches by any other name has any efficacy in providing a less crowded permanent dentition later".[71] Gianelly thought it a mystery why anyone would perform RPE in the absence of a posterior crossbite.[72]

Although several studies support the contention that intercanine expansion is unstable,[1,73-75] there is little evidence demonstrating the stability of expansion, particularly in the mandible. A 2003 investigation found that only 8% of patients who underwent mandibular expansion maintained their intercanine widths for six years and three months after fixed retention. The posterior arches, on the other hand, remained relatively stable, keeping 60-70% of the expansion achieved from first premolar to second molar.[76] It seems that mandibular arch expansion may not be worth the effort, but this will continue to be a subject of debate as more data become available.[77]

Other potential co-morbidities of expansion include the risks of creating a dehiscence due to overexpansion or of worsening protrusion in an already convex face. Treatment of moderate-to-severe crowding with expansion may cause the anterior teeth to move labially, whereas extractions may allow the teeth to move along the alveolus.

Self-Ligating Brackets

There have been claims that self-ligating brackets are more efficient and effective than conventional brackets, reducing treatment time and avoiding the need for extractions in most cases. From an evidence-based perspective, however, self-ligating brackets have not been shown to be more beneficial than conventional appliances except for two advantages: reduced chair-time (because it is easier to insert and remove archwires),[78-82] and control of proclination of the mandibular incisors.[78,79]

Preservation of Leeway Space

Gianelly contended that about 75% of Class I and II mild-to-moderate crowding cases can be resolved without expansion or extractions by preserving the leeway space of the primary second molars, also known as E-space (Fig. 4).[83,84] Brennan and Gianelly noted that roughly 5mm of incisor crowding can be resolved in the mixed dentition with the use of a lingual arch.[85]

For situations in which leeway space has

been lost, molars have drifted forward, and expansion is no longer an option, extraction may be the only choice to resolve moderate-to-severe crowding, especially when coupled with protrusion. Expansion of the lower arch is not an acceptable alternative to a lower lingual holding arch, since more than 1mm of lower intercanine expansion will be unstable.[86]

One potential liability of a passive lingual arch is that it is 10-20 times more likely to be associated with impaction of the mandibular second permanent molars than in the general population.[87] Rubin and colleagues showed increased eruption disturbances of the mandibular second molars when orthodontic appliances were used to maintain arch perimeter in the mixed dentition.[88]

Paternalism vs. Autonomy

Health care has historically been "paternalistic", or doctor-centered, with little regard to patient input. From the perspective of evidence-based clinical practice—which integrates evidence-based orthodontics, patient preferences, patient autonomy, clinical and patient circumstances, and clinical experience and judgment—the patient now has more involvement in treatment decisions than at any time in the past.[89] Autonomy means the patient has a right to participate in his or her health-care decisions as long as no harm is done. Unfortunately, this may allow a competing practitioner to offer a "conservative" nonextraction option, even if it is not in the best interest of the patient.

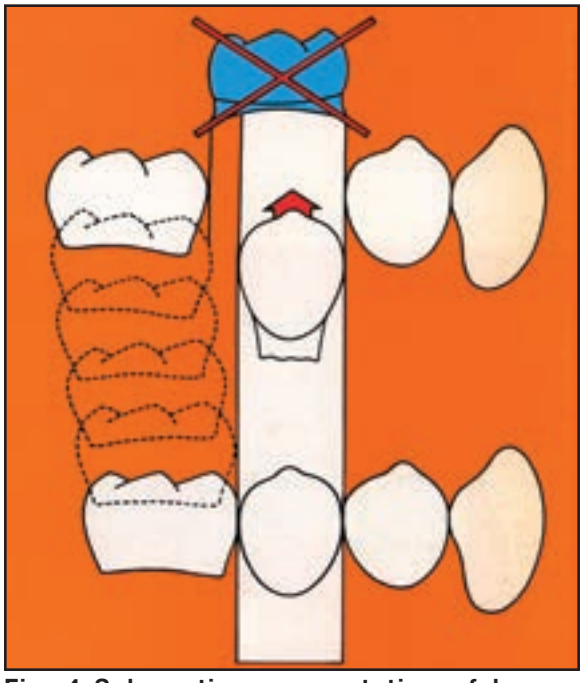

Fig. 4 Schematic representation of leeway space (reprinted with permission of Dr. Giuseppe Cozzani).

Next month, we will focus on specific factors that go into making the extraction vs. nonextraction decision.

(TO BE CONTINUED)

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