

Navigating the Gray Area: Managing Borderline Cases in Orthodontics

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Abstract:- Borderline cases in orthodontics present unique challenges to orthodontists, as they often require tailored treatment approaches to achieve optimal outcomes. Firstly, borderline cases encompass a spectrum of orthodontic issues, including mild to moderate malocclusions, skeletal discrepancies, and asymmetries. Treatment planning for these cases involves a complete assessment of the patient's skeletal and dental characteristics, as well as individual treatment goals and preferences. Orthodontists must employ a combination of traditional fixed appliances, such as braces or clear aligners, and adjunctive techniques such as functional appliances, temporary anchorage devices (TADs), or orthognathic surgery when indicated.

I. INTRODUCTION

“Borderline case is defined as the case which is wedged between the conflict of non-extraction and extraction.” A Borderline case is when permanent teeth must be extracted in order to have a stable and functional occlusion yet the patient has good facial aesthetics that might be compromised by extractions¹. There is empirical data about these patient’s uncertainty². Major challenge in Contemporary Orthodontics is Paradigm Shift. Paradigm shift in diagnosis and treatment planning focuses more on the soft tissue response to treatment. Recent trend towards fewer dental extractions in borderline cases compared to the past due to concerns about flattening profiles and reducing lip support³.

Table 1 E.H. Angle Paradigm Versus the Soft Tissue Paradigm

Parameter	E.H. Angle paradigm	Soft tissue paradigm
Primary treatment goal	Ideal dental occlusion	Normal soft tissue proportions and adaptations
Secondary treatment goal	Ideal jaw relationships	Functional occlusion
Hard/soft tissue relationships	Ideal hard tissue proportions produce ideal soft tissues	Ideal soft tissue proportions define ideal hard tissue relationships
Diagnostic emphasis	Dental casts, cephalometric radiographs	Clinical examination of the soft tissues
Treatment approach	Obtain ideal dental and skeletal relationships and the soft tissues will be acceptable	Plan ideal soft tissue relationships, then place the teeth and jaws accordingly
Function of emphasis	Temporomandibular joint in relation to dental occlusion	Soft tissue movement in relation to dental display
Stability of result	Related primarily to dental occlusion	Related primarily to soft tissue pressures and equilibrium effects

II. EXTRACTION VERSUS NON-EXTRACTION DEBATE⁴

➤ Facial Profile:

The impact on the soft tissue profile is the main consideration when deciding whether to extract or not. While some argue that extractions are unnecessary in some situations because they might cause the profile to become overly full and jeopardise periodontal health, others argue

that extractions “dish in” the face. One potential confusing element may be the fact that, due to mandibular growth outpacing maxilla growth, the profile naturally straightens over time, independent of treatment mode. The face has a propensity to flatten even in maturity. This is referred to as the fourth dimension by Sarver and Ackerman⁵ and they advise orthodontists to take soft-tissue growth, maturation, and ageing into account when designing their treatments.

➤ *TMD and Extractions:*

In the case of Brimm v. Malloy, the 16-year-old girl had received orthodontic treatment, which includes headgear and premolar extractions, for her Class II, division 1 malocclusion. Patient’s family sued the orthodontist, arguing that TMD was brought on by the therapy. A general dentist and "functional orthodontist" who testified on behalf of the plaintiff, said that the usage of headgear and extractions caused the upper incisors to over-retract, which in turn caused internal derangement due to distal displacement of the jaw. The orthodontist was found guilty by the jury of abuse, and the case received a lot of attention from the dentistry world. However, the orthodontic community reacted in the early 1990s with excellent research that suggested there was no connection between TMD and orthodontic treatment. The argument that orthodontic therapy of any kind has a neutral impact rather than causing, lessening, curing, or preventing the development of TMD is generally supported by the literature⁶.

➤ *Buccal Corridor:*

The negative area between the inner walls of the cheeks and the buccal surfaces of the posterior teeth is known as the buccal corridor, according to Frush and Fischer. Some orthodontists stated that removing maxillary premolars narrows the dental arch, widening the buccal corridors and producing an unsightly outcome. Conversely, the data demonstrates that the extraction of maxillary premolars does not cause the arch to become narrower and that broad buccal corridors are not always or consistently unattractive⁷.

➤ *Stability and Impaction Risk:*

Bowman cautioned that many patients would not benefit from strict adherence to a nonextraction strategy. Patients with crowding and protrusion are more likely to have unsatisfactory orthodontic treatment, therefore even in seemingly conservative circumstances, a nonextraction approach may not result in the best possible aesthetics, function, periodontal health, and stability. However, there is also data to suggest that removing premolars in order to reduce crowding in addition to orthodontic treatment may not improve stability.

III. FACTORS TO BE CONSIDERED FOR EXTRACTION/NON-EXTRACTION CASES⁸

A. Dental Variables

➤ *Tooth-Size Arch Length Deficiency (TSALD):*

The most prevalent kind of malocclusion that orthodontists treat is TSALD. Carey has designated a borderline condition of 2.5–5 mm TSALD⁹. McNamara established arbitrary 3–6 mm¹⁰.

Table 2: Factors affecting Extraction Decision

Dental factors	Cephalometric factors		Soft tissue factors	Other factors
	Skeletal parameters	Dental parameters		
TSALD	FMA	IMPA	Position of upper and lower lip A	Growth status
Curve of Spee	SN-MP	FMIA	Naso labial angle	Midline deviation
Boltons discrepancy		1-A-Pog line	Upper lip morphology	Patient's preference
Peck and peck analysis		Upper and lower central incisor to N-A and N-B line		
Irregularity index				

➤ *Curve of Spee:*

The necessity for extraction increases with the depth of the curve of Spee. Roth¹¹ measured 3-6 mm of curve of Spee as mild (1.5-3.0 per side), and Baldrige¹² stated that a curve greater than 6 mm is severe.

➤ *Bolton's Discrepancy¹³:*

A disparity between a tooth's individual sizes is called a tooth-size discrepancy (TSD). The size of the mandibular and maxillary teeth must be proportionate for a healthy occlusion. Bolton (1958) reported that the anterior reduction might be limited up to 4 mm. If the difference is more than this, extraction could be required.

➤ *Peck and Peck Analysis¹⁴:*

The MD length of the mandibular incisor divided by its labiolingual width yields the peck and peck analysis. The mandibular lateral incisors have MD and faciolingual (FL) index values of 90-95, whereas the mandibular central incisors have values of 88-92. Patients have to undergo slenderness if their MD/FL indices are higher than the acceptable ranges. Extractions are warranted for index values below the typical range.

➤ *Irregularity Index¹⁵:*

Little added the linear lengths between the five neighbouring anterior contact sites to create the irregularity index and mandibular anterior irregularity. The score is 0 when the incisors are properly aligned. Notably, a score of more than 6.5 mm denotes a significant irregularity and, thus, a higher probability of extraction.

➤ *Cephalometric Variables:*

• *Skeletal Variables:*

For a clinician, the vertical dimension is the most crucial. The FMA¹⁶ angle and the Sella-Nasion and mandibular planes (SN-MP) angle¹⁷ are two crucial angles for the evaluation of vertical dimension. The FMA typically has a value between 20 and 30°. Skeletal deep bite is usually associated with values below these normal ranges, while skeletal open bite is frequently associated with values above these levels. Regarding extraction and non-extraction therapy, these measures agree, regardless of the clinician's method of vertical evaluation. In situations of skeletal open bite, treatment aimed at achieving face equilibrium is more likely to extract; in cases of skeletal deep bite, it is less likely to extract.

B. Dental Variables:

➤ *Incisor Mandibular Plane Angle (IMPA):*

Tweed suggested that in balanced, normal faces, IMPA should be $90^\circ \pm 3^\circ$ and this number varies according to ethnicity¹⁸ and can range from 85° to 95° . Values outside of this range suggest that an extraction may be necessary to correct functional and aesthetic imbalances.

➤ *A To Pogonion (A-Pog) Line¹⁹:*

McNamara discovered that the mandibular incisor should be positioned 1-3 mm anterior to a line from point A-Pog in a well-balanced face, regardless of age. Maxillary and mandibular incisor ideal locations were determined by Steiner to be 4 mm and 22° and 4 mm and 25° anterior to the lines that join Nasion and point A and point B, respectively. As incisor placements and angles surpass these values in horizontal planes, extraction becomes more probable.

➤ *Soft Tissue:*

The basic goal of orthodontic diagnostic and treatment planning should be to achieve a pleasing soft tissue profile.

➤ *Position Of Upper And Lower Lip:*

An extraction can be a preferable option in a case that is borderline and has lip protrusion prior to treatment. Likewise, it is possible to enhance a more retrusive profile without removing teeth. Ricketts initially determined the aesthetic plane, by connecting lip position to a line that extends from the nasal tip to the soft tissue Pogonion²⁰. The lower lip of an adolescent is located around 2 mm behind the E line, or aesthetic plane.

➤ *Naso Labial Angle²¹:*

A preferred nasolabial angle value is $73.8^\circ \pm 8^\circ$, according to Burstone's lip relation assessment; more recent research reveal values in the $90-115^\circ$ range²². Drobocky and Smith²³ observed that the extraction of four bicuspids increased the nasolabial angle by 5.2° . Consequently, it is best to avoid extracting teeth from a borderline patient whose nasolabial angle is larger than the standard values.

➤ *Midline Deviation^{24,25}:*

Treatment planning that is appropriate for the circumstances should be carried out, and the dental midline evaluation should be evaluated in relation to the face. Tooth extractions are necessary when there is a significant deviation of the dental midline from the face, particularly in the lower arch. Asymmetric extractions, stripping, intermaxillary elastics, mini-implants, and unilateral mechanics may all be used to rectify minor midline shifts.

➤ *What are the Indications for Extracting Permanent Teeth?*

- Crowding correction
- To Correct inter-arch tooth size discrepancies
- To Correct proclination of Anterior teeth
- To Reduce lip procumbency (profile reduction)
- Correct midline
- Camouflage the skeletal malrelationships
- Decompensation of the dentition prior to orthognathic surgery

➤ *Why are Extractions Declined in Present Scenario?*

- Bonding made it possible to treat more patients without the need for extractions, because thicker bands tend to encourage crowding.
- Air-rotor stripping (ARS)
- Expansion
- Preservation of leeway space
- Self-ligating brackets

IV. SIX KEYS TO NON-EXTRACTION TREATMENT²⁶

➤ *Preservation of Leeway Space²⁷:*

Gianelly asserted that by maintaining the primary second molars' leeway space, or E-space, about 75% of Class I and II mild-to-moderate crowding cases may be settled without expansion or extractions. According to Brennan and Gianelly, the use of a lingual arch can relieve around 5mm of incisor crowding in the mixed dentition.

➤ *Uprighting of Posterior Teeth²⁸:*

The posterior teeth that are tilted always take up more room. When decay develops on the distal surface of a tooth and is not replaced at the proper time or with the optimum contour, or when the deciduous second molars fall out early, the molars tend to tip mesially. A 1 to 1.5 mm increase in arch length may result from molar uprighting. The best appliances to utilise for this are fixed appliances. Various screw gadgets or space regainers are also commonly utilised.

➤ *Derotation of Posterior Teeth:*

Rotated posterior teeth might help you reclaim the space. The amount of space recovered depends on the tooth in question and how far it has rotated. The molars take up more space than the premolars for a given degree of rotation, while the anterior teeth that are rotated take up less

space. The ideal way to achieve derotation on the lingual and buccal surfaces of the tooth is to use a couple, which are forces that are equal in amplitude but opposed in direction.

➤ *Proclination of Anterior:*

When anterior teeth are retroclined or their proclination won't negatively impact the patient's soft tissue profile or the stability of the outcome, it is acceptable to proceed with anterior tooth proclination. For this reason, any proclination spring (a "Z" spring, mattress spring, etc.) or fixed appliances can be utilised.

➤ *Proximal Stripping:*

Black described natural slenderization in 1902. Ballard is the first one to describe a technique to lessen the tooth material by reducing the enamel. Peck termed this procedure as reproximation²⁹.

➤ *Various Techniques*

- Abrasive strips: This procedure is very laborious and time consuming.
- Hand piece mounted reduction discs: It can be hazardous because to their near closeness to the tongue and other delicate tissues, such as the lips and cheeks.
- Air-rotar stripping: Sheridan was the first to describe air-rotar stripping. In order to alleviate mild to moderate crowding, air rotar stripping uses a fine air rotar diamond cutting bur mounted to the headpiece to decrease interproximal enamel. Removing no more than 1mm from the posterior contact sites and no more than .75mm of interproximal enamel between the anterior contact points is a cautious recommendation.
- Intensive Orthostrip system (GAC): Enamel is removed by back-and-forth shuttle movement using hand-piece driven abrasive strips with varying configurations and abrasive potential. The decreased proximal surface is additionally contoured and smoothed using flexible blades (proxy form) with varying abrasive grain sizes. Because interproximal reduction reduces point connections to surface contacts and stops the teeth from sliding, it may be helpful in avoiding relapse in the lower anterior.

➤ *Molar Distalization – Indications*³⁰

- A straight profile, a temporomandibular joint that is normal and healthy, appropriate mandibular to maxillary relationship.
- Skeletally, normal or short lower facial height, Class I skeletal base, Maxilla with a brachycephalic development pattern, skeletal closed bite, and normal transverse breadth.
- Dental Class II molar relationship, deep overbite, Maxillary cuspids labially displaced, maxillary first molar mesially inclined decrease of arch length as a result of the premature loss of second deciduous molar.

➤ *Molar Distalization – Contraindications*³¹

- Convex profile
- Signs and symptoms of TMD
- Displaced condyles
- Class II skeletal bases
- Increased lower face height
- Dolicocephalic pattern
- Class I or III molar relation
- Dental open bite
- Maxillary first molar distally inclined.

➤ *Upper Molar Position:*

Is the one which shows indication or contraindication for molar distalization. Its mean value in patient's age in years plus 3 mm until growth is completed. In non-growing patients mean value is 18 mm.

➤ *Appliances used for Distalization:*

Headgear, Herbst Appliance, Jasper Jumper, Distal Jet Appliances, Atkinson Buccal Bar, Pendulum and Pendex Appliance, Mini Distalization Appliances, Wilson's Distalizing Arch, Repelling Magnetic Appliance, K-Loops, Sliding Jig etc. for molar Distalization in lower Arch, the appliances used are Lip Bumper, Modified Lingual Appliance and Distal Jet.

➤ *Expansion:*

Expansion can be divided into various arbitrary categories including orthodontic, passive, and orthopedic.

➤ *Slow Expansion Devices:*

• *Active Plates for Arch Expansion:*

The best applications for active plates occur when a few millimetres of extra space are required. Acrylic or a comparable (perhaps thermoplastic) baseplastic serves as the structure of an active plate. This acts as a foundation for clasps to be fastened to and through which screws or springs are inserted. Almost always, an active component of an expansion plate is a jackscrew positioned to keep the plate's components together. The parts of the plate are then separated by opening the screw using a key.

➤ *Quad Helix Appliance*³²:

• *Indications*

- ✓ Class III - Expansion needed
- ✓ Class II cases
- ✓ Cross- bite cases in which the upper arch needs to be widened
- ✓ Mild expansion in the mixed dentition which frequently exhibit lack of space for the upper laterals and in which the long range growth forecast is favorable.
- ✓ Thumb sucking or Tongue thrusting cases
- ✓ Cleft palate conditions either unilateral or bilateral

➤ *Rapid Maxillary Expanders:*

RME is an appliance of choice for expansion of maxillary halves when maxillary bases are constricted. Common appliances:

• *Derirshweiler Type:*

Tags are extended to the palatal aspects of all non-banded teeth, with the exception of the incisors, and welded and soldered to the palatal aspects of the bands to give attachment for the acrylic.

• *Hass Type:*

The palatal aspects of the bands are joined together by welding and soldering a length of 0.045 inch (1.5mm) stainless steel wire. The acrylic foundation, which finishes before the bands and teeth, is implanted with the free ends bent back. The split acrylic base's midline is secured with a special screw.

• *Isaacson Type:*

In order to avoid using acrylic, this device adapts and solders a Minne expander—a specific loaded screw—directly to the bands. By reducing the spring, tube, and rod, the screw may be made shorter to fit small arches.

• *Bidermann Type:*

Hyrax (Dentatum 602-813), Leaoe 620, or Unitex 440-160 are the specific screws needed for this device. These are welded and soldered to the palatal features of the bands, where they extend into strong gauge wire.

V. CONCLUSION

Our extraction rate is shrinking, and techniques that most of us have only read about in history books (e.g., expansion and bite jumping) are now seen and sold as important advances, if not for the treatment of patients, at least for the "management" of risk. A borderline case with pre-treatment lip protrusion may be better served with extraction. Hence in accordance to the soft tissue paradigm such a decision during the treatment planning should be paramount in making treatment decisions. Profile based treatment planning leads to better treatment results.

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