

# OVERVIEW

## Extraction Treatment Part 2 Guidelines for Making the Extraction Decision

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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.)*

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In the first part of this Overview (JCO, December 2014), we examined the history and foundations of the extraction vs. nonextraction debate. This month, we will analyze factors that today's orthodontist should consider in making the extraction decision, including vertical dimension, lip proclivity, crowding, sagittal dimension, incisor-

mandibular plane angle (IMPA), and midline (Table 1). Although many of these criteria have long been taught as definitive, some still lack high-quality evidential support, as you will see.

### Vertical Dimension

Orthodontists generally believe that brachyfacial patterns (skeletal deep bite) are best treated without extractions, whereas dolichofacial patterns (skeletal open bite) typically benefit from extractions.<sup>73</sup> Forward movement of the posterior teeth after first-premolar extractions is thought to result



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**TABLE 1  
GENERAL GUIDELINES FOR NONEXTRACTION VS. EXTRACTION TREATMENT**

<b>Criterion</b>	<b>Nonextraction</b>	<b>Borderline</b>	<b>Extraction</b>
Vertical skeletal pattern	Deep bite		Open bite
Dental bite depth	Deep bite		Open bite
Procumbent lips or strained lip seal			X
Maxillary protrusive teeth/lips			X
Bidental protrusion			X
Crowding in a pleasing face	0-4mm	5-9mm	> 9mm
Combination of crowding and protrusion			X
Spacing	X		
IMPA			> 95°
Midline correction			X
Janson Type 1			Three premolars
Janson Type 2			One maxillary premolar
Retroclined teeth	X		
Class II or III camouflage		X	

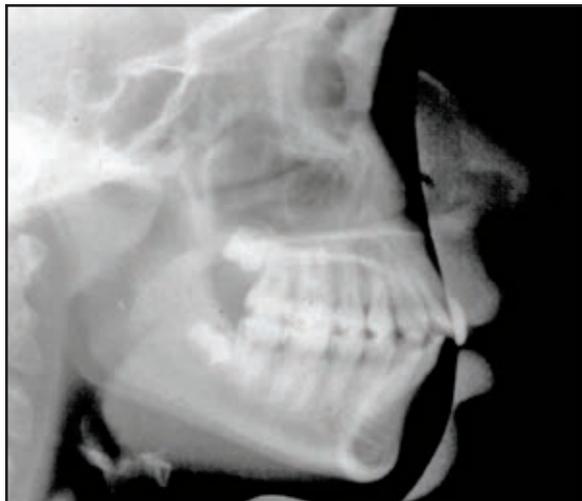
in a decrease in the vertical dimension. In a narrative review by Pepicelli and colleagues, citations were given to justify an extraction protocol for dolichofacial patients.<sup>90,91</sup> Vaden also strongly supported the extraction of premolars in dolichofacial patterns.<sup>92</sup> On the contrary, Klapper and colleagues found that if premolars are extracted in dolichofacial patients, the vertical dimension will often increase.<sup>93</sup> The same study mentions, however, that the vertical dimension could increase even more if the same patients were treated without extractions. In a clinical trial, Janson and colleagues reported greater stability of open-bite treatment with extractions than without extractions.<sup>94</sup>

Sivakumar and Valiathan, in a comparison of normodivergent Class I Indian subjects, found an increased vertical dimension in both the extraction and nonextraction groups, but more in the extraction patients.<sup>95</sup> In the extraction group, mesial movement of the maxillary and mandibular teeth caused extrusion, resulting in an increased vertical dimension with no effect on the mandibular plane angle. A systematic review by Huang and colleagues reported that contrary to popular belief, there is no substantial difference in deep-

bite correction or stability between extraction and nonextraction protocols.<sup>96</sup>

**Lip Procumbency**

Xie and colleagues developed an artificial neural network model based on the decisions of multiple clinicians in 200 patients, weighting components of the initial exam that were most crucial in determining whether to extract teeth.<sup>97</sup> Absence of lip seal was the most important factor in the decision-making process, followed by the IMPA. Another study involving discriminate analysis of extraction decisions among orthodontists found lower crowding to be the most important factor, followed by the lower lip to E-plane.<sup>4</sup> Kocadereli, in a comparison of the post-treatment soft-tissue profiles of 40 Class I extraction and 40 Class I nonextraction patients, concluded that premolar extractions are indicated when the clinician needs to reduce lip procumbency<sup>98</sup> (Fig. 5). Numerous studies have demonstrated, however, that premolar extractions are unpredictable in terms of both soft-tissue or lip response and the ratio of maxillary incisor retraction to lip retraction.<sup>99-102</sup> Talass and



**Fig. 5** Pre- and post-treatment cephalometric x-rays show change in lip procumbency in adolescent patient treated with premolar extractions.

colleagues associated the amount of maxillary incisor retraction in female Class II, division 1 patients with incisal-edge retraction, thinner soft tissue before treatment, a thicker upper lip before treatment, and a greater amount of vertical nasal growth during treatment.<sup>103</sup> Still, these factors accounted for only about half of the maxillary lip response.

Bowman and Johnston evaluated 70 extraction and 50 nonextraction Caucasian Class I and

II patients who had the same average values for lip procumbency before treatment.<sup>104</sup> The extraction group's esthetic improvement was positively correlated with lip procumbency, but in cases where the lips were retrusive (2-3mm behind the E-plane), the esthetics were worse after extractions. Nonextraction treatment had little effect on profile esthetics when the soft tissues were within normal limits. In other words, an orthodontist who does not extract due to pressure from the patient or general dentist will be less likely to improve the profile of a procumbent patient.

It is also important to consider the patient's race when deciding on extraction vs. nonextraction treatment. African Americans generally prefer a more protrusive profile than Caucasians do,<sup>105-107</sup> but also appreciate the profile reduction of extraction treatment in cases of severe protrusion.<sup>108</sup>

### Crowding

In patients with pleasant facial esthetics and no accompanying protrusion or lip procumbency, Proffit and colleagues recommended nonextraction treatment for less than 4mm of crowding and extraction treatment for 10mm or more of crowding, with 5-9mm representing a borderline decision<sup>109</sup> (Fig. 6). Significant protrusion may itself be an indication for extractions in a case with little or no crowding; a combination of crowding and protrusion can also support extraction treatment.

A recent investigation of 542 randomly selected Class I patients attempted to determine what led orthodontists to extract in borderline cases.<sup>4</sup> The most important factor, as determined by discriminate analysis, was lower crowding. Gianelly maintained that most of the gain in arch length could be attributed to unstable intercanine expansion, and that reciprocal mandibular expansion following rapid palatal expansion would not be enough to resolve lower-incisor crowding.<sup>73</sup> In Class I and II cases, the extraction decision should be based on crowding in the lower (diagnostic) arch, since its perimeter and intercanine widths should not be altered with routine orthodontic treatment.

*(continued on next page)*



Fig. 6 Pre- and post-treatment photographs show results of four-premolar-extraction treatment in severely crowded dentition.

### Sagittal Dimension

Anteroposterior relationships can also affect the extraction vs. nonextraction decision. Janson and colleagues found that half-cusp Class II patients had better outcomes from nonextraction treatment than full-cusp Class II patients did, indicating the importance of malocclusion severity in determining whether to extract teeth.<sup>110</sup>

### Incisor-Mandibular Plane Angle

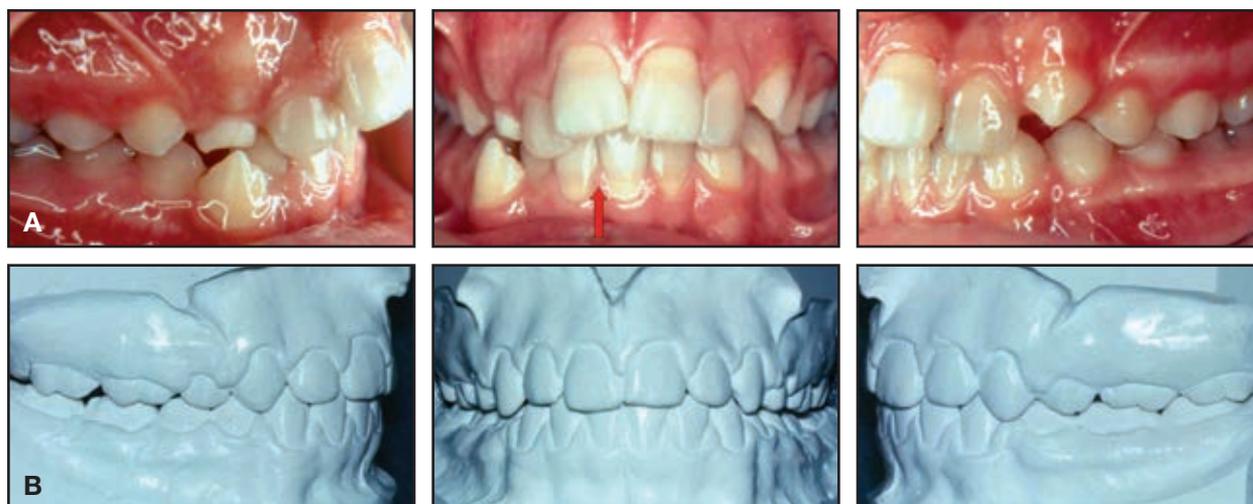
Tweed believed that tooth sizes are determined very early, and that disruptions in bone development between age 3 and adolescence can lead to a discrepancy between tooth size and basal bone.<sup>111</sup> According to Tweed, if extractions are not performed in a crowded case, protrusive mandibular incisors will result. Tweed presumed that stability and esthetics are maximized when the mandibular incisors are centered ( $\pm 5^\circ$ ) over basal

bone. Given a range of  $85-93^\circ$  in IMPA, based on research by Margolis,<sup>112</sup> Tweed considered an IMPA of more than  $90^\circ$  to be an indication for extractions.<sup>111</sup> On the other hand, Heiser and colleagues found the same amount of relapse in mandibular incisor positions in a comparison of non-extraction and extraction treatments.<sup>49</sup>

From a periodontal perspective, it seems that IMPA is an important reference marker for control of gingival recession. Yared and colleagues associated a combination of more than  $95^\circ$  of mandibular incisor proclination and a gingival thickness of less than .5mm with an increase in the severity and amount of recession.<sup>7</sup> Therefore, IMPA may be a factor to consider in nonextraction cases with mandibular crowding.

### Midline

Janson and colleagues categorized asymmetrical Class II, division 1 cases according to



**Fig. 7 A.** Pretreatment records of patient with severe crowding and mandibular midline deviation; arrow indicates mandibular dental midline. **B.** Patient after treatment with extraction of three premolars—both maxillary first premolars and mandibular left first premolar (case treated by Dr. Anthony A. Gianelly and published here by permission).

which side is Class I and which is Class II with midline deviation.<sup>113</sup> In Type 1, the maxillary midline is coincident with the facial midline; in Type 2, the mandibular midline is coincident with the facial midline. A Type 1 case typically calls for three premolar extractions—both maxillary first premolars and a mandibular first premolar on the Class I side (Fig. 7). In a Type 2 case, a unilateral maxillary premolar extraction may be needed on the Class II side.<sup>114</sup>

## Conclusion

To extract or not to extract can be a difficult decision in many cases. Struggling for an answer, some orthodontists attempt to use a system such as Invisalign's ClinCheck\* to visualize the outcomes of nonextraction vs. extraction treatment (unfortunately, soft-tissue analysis is not included).<sup>75</sup> Although a decision-making expert system could be developed to assist orthodontists in the future, a fairly complicated algorithm would be needed to integrate the numerous variables that are considered in each case. At this point, we have not

\*Registered trademark of Align Technology, Inc., Santa Clara, CA; [www.aligntech.com](http://www.aligntech.com).

even identified all the variables associated with the extraction decision.

Burrow, in his excellent paper on “The impact of extractions on facial and smile aesthetics”, concluded: “There are several problems with the ‘nonextraction’ argument, which advocates that everyone has the same genetic background, growth potential, skeletal framework, soft tissue (nose, lips, and chin), and facial proportions and as a result everyone can be treated nonextraction. Furthermore, there is no evidence to support nonextraction treatment, at any cost. In fact extractions, when needed, have been shown to greatly improve the profile and facial attractiveness. The esthetic value of the ‘nonextraction only’ treatment approach is not supported by current scientific research, although it is used as a marketing tool.”<sup>73</sup>

Identifying guidelines for the extraction vs. nonextraction decision in orthodontic treatment is a challenging and complex task. Other factors not discussed in this paper, such as Bolton discrepancies and skeletal anchorage, may also need to be considered. Nevertheless, we hope this Overview will stimulate further research and discussion about an important subject that has been debated for more than a century.

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