

# The Geometry of Class II Correction with Extractions

CLARENCE BRYK, DDS, MS  
LARRY W. WHITE, DDS, MSD

**N**otwithstanding the criticism of today's nonextraction advocates, the extraction of teeth often results in more realistic treatment plans, better therapy, and superior function.<sup>1</sup> For some patients, there is no reasonable alternative.

Nevertheless, many extraction strategies were formulated for the treatment of adolescents who would continue to grow throughout therapy. Forward and downward mandibular growth does occur in most adolescents, and that is often the salvation for the orthodontist who extracts four premolars in Class II cases.<sup>2</sup> When the forward growth of the mandible exceeds that of the maxilla, a satisfactory result can be achieved<sup>3</sup> (Fig. 1). Without growth, however, it can be virtually impossible to achieve a Class I correction.

In the standard Class II malocclusion, the maxillary teeth are a full unit forward of the mandibular teeth. To achieve a Class I occlusion in a child patient with an unfavorable growth pattern or in an adult patient, when maxillary and mandibular premolars are removed, almost all of the mandibular extraction space must be occupied by the molars and premolars. If as much as one-third of the mandibular extraction space is used to correct the arch-length discrepancy and/or to allow retraction of the incisors, it becomes impossible to achieve Class I canines and premolars (Fig. 2).

There are few desirable alternatives for adult patients or unfavorably developing adolescents. Success with a maxillary headgear will be totally dependent upon its ability to push the maxillary teeth distally,<sup>4</sup> which is difficult under the best of circumstances. Ordinary Class II mechanics such as elastics or bite jumpers will displace the mandibular teeth forward and risk elevating the mandibular molars, pushing the mandible downward and backward and further complicating the Class II correction.<sup>5</sup>

In short, without growth or the ability to favorably alter growth, success depends on mak-

ing dentoalveolar compensations that bring the teeth into a Class I occlusion while minimizing the side effects that often accompany Class II mechanics.

## Traditional Strategies for Overcoming Maxillary Space Deficiencies

Several strategies have been developed to contend with maxillary arches in which the canines and premolars remain in less-than-ideal Class I occlusion after the extraction spaces have been closed.

Forces can be used to distalize the maxillary molars if there is space for them to move into. Obviously, the presence of second and third molars will make this problematic. If reasonable-size third molars are available, then the additional extraction of maxillary second molars can make distal movement of the first molars easier and quicker.<sup>6</sup> In any case, it is difficult to maintain the distal positions of maxillary first molars while they are serving as anchorage for the retraction of anterior teeth. Clinicians will have trouble keeping their molar arch-length gains even when using a constant force such as a Herbst\* appliance. The best that can be said for the strategy of second-molar extractions and distal movement of first molars is that the final gains are likely to be meager and perhaps not worth the sacrifice imposed on the mouth.<sup>7-10</sup>

Some would prefer to remove the maxillary first molars and use reciprocal anchorage to retract the anterior teeth. This is what Begg may have figured out intuitively when he recommended removing first molars, which gave him the additional space to move the premolars and canines into a Class I arrangement.<sup>11</sup> The literature does not indicate, however, that the extraction of first molars has many supporters.

\*Registered trademark of Dentaaurum, Inc., 10 Pheasant Run, Newtown, PA 18940.

Dr. Bryk is a retired U.S. Air Force orthodontist and currently a volunteer clinical instructor in the Tri-Service Orthodontic Residency Program at Wilford Hall Medical Center, Lackland Air Force Base, Texas. Dr. White is Editor of the *Journal of Clinical Orthodontics*. Contact Dr. White at 8018 Glen Albens Circle, Dallas, TX 75225; e-mail: larrywhite@hotmail.com.

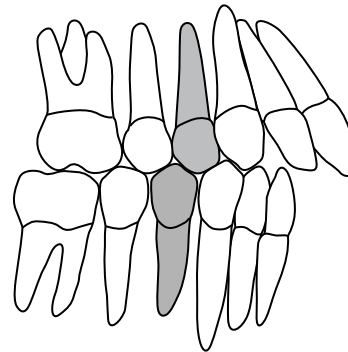


Dr. Bryk

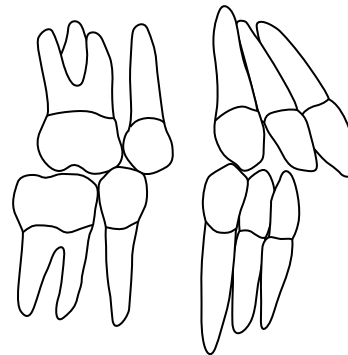


Dr. White

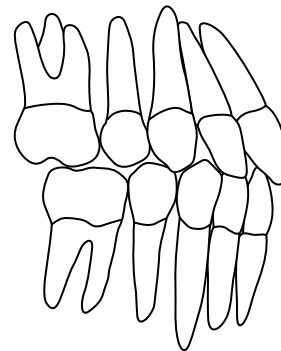
**Fig. 1 In an adolescent Class II, division 1 patient with a favorable growth pattern, . . .**



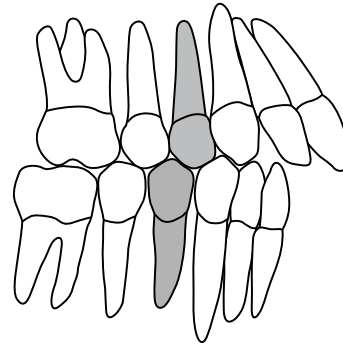
**. . . treatment involving four premolar extractions . . .**



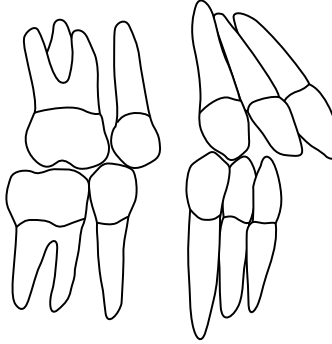
**. . . can produce a satisfactory result through a combination of restraint of the maxillary molars and downward and forward growth of the mandible.**



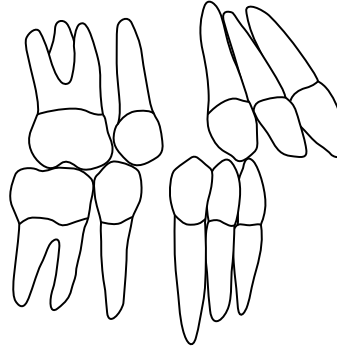
**Fig. 2 In a Class II, division 1 patient with no growth remaining or an unfavorable growth pattern, . . .**



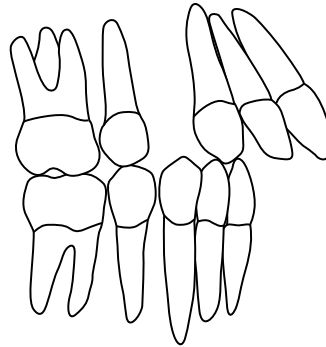
**. . . when four premolars are extracted to compensate for arch-length discrepancies or to permit retraction of the incisors, all of the mandibular extraction space is needed to allow the posterior teeth to move forward into a Class I relationship.**



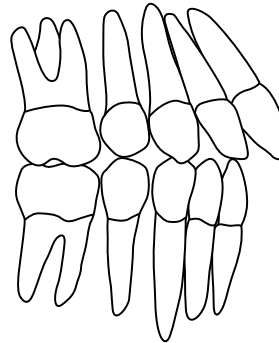
**If as much as one-third of the mandibular extraction space is used to correct mandibular anterior crowding or upright the mandibular incisors, . . .**



**. . . it becomes impossible to attain a Class I relationship.**



**Four premolars have been extracted, but a firm Class I relationship cannot occur.**



Anchorage choices will determine whether the maxillary or mandibular teeth will be displaced. If an appliance such as a Distal Jet,\*\* Jones Jig,\*\* Gianelly nickel titanium wire, or Pendulum\*\*\* is used, the clinician must anticipate that the maxillary incisors will move forward,<sup>12</sup> and that their subsequent retraction will tax the maxillary molar anchorage. If Class II elastics and compressed springs are used as anchorage against the maxillary molars, then some anterior displacement of the mandibular teeth can be expected.<sup>3</sup> Jasper Jumpers\*\* or Churro Jumpers can effect some positive changes, but have some of the same deleterious effects of Class II elastics.<sup>5,13</sup> Clinicians may

\*\*American Orthodontics, 1714 Cambridge Ave., Sheboygan, WI 53082.

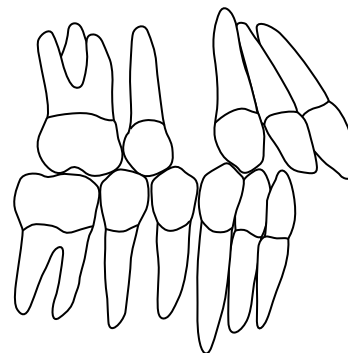
\*\*\*Ormco/"A" Company, 1717 W. Collins Ave., Orange, CA 92867.

choose a functional appliance such as the Herbst or Mandibular Protraction Appliance<sup>14</sup> (MPA) to perform dentoalveolar compensations, but these also displace the mandibular incisors forward.<sup>15</sup> Ultimately, some kind of occlusal compromise is almost always necessary when such appliances are used to correct Class II malocclusions.

### Alternative Strategies

Whenever possible, a better strategy for these types of Class II patients is to avoid mandibular extractions altogether<sup>16</sup> (Fig. 3). This may not be an easy choice if the mandibular arch-length discrepancy is large or the treatment plan calls for lingual retraction of the mandibular incisors. Nevertheless, there are several available treatment options that may make it a more appealing approach.

**Fig. 3 A preferable strategy for treating a Class II, division 1 patient with no growth remaining or an unfavorable growth pattern may be to extract only the maxillary bicuspids . . .**



**and retract the anterior segment, leaving the posterior occlusion in a Class II relationship.**

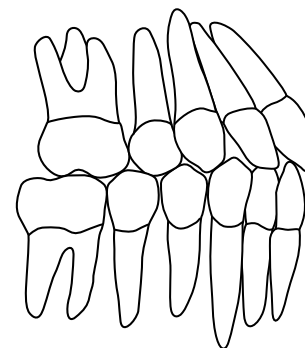


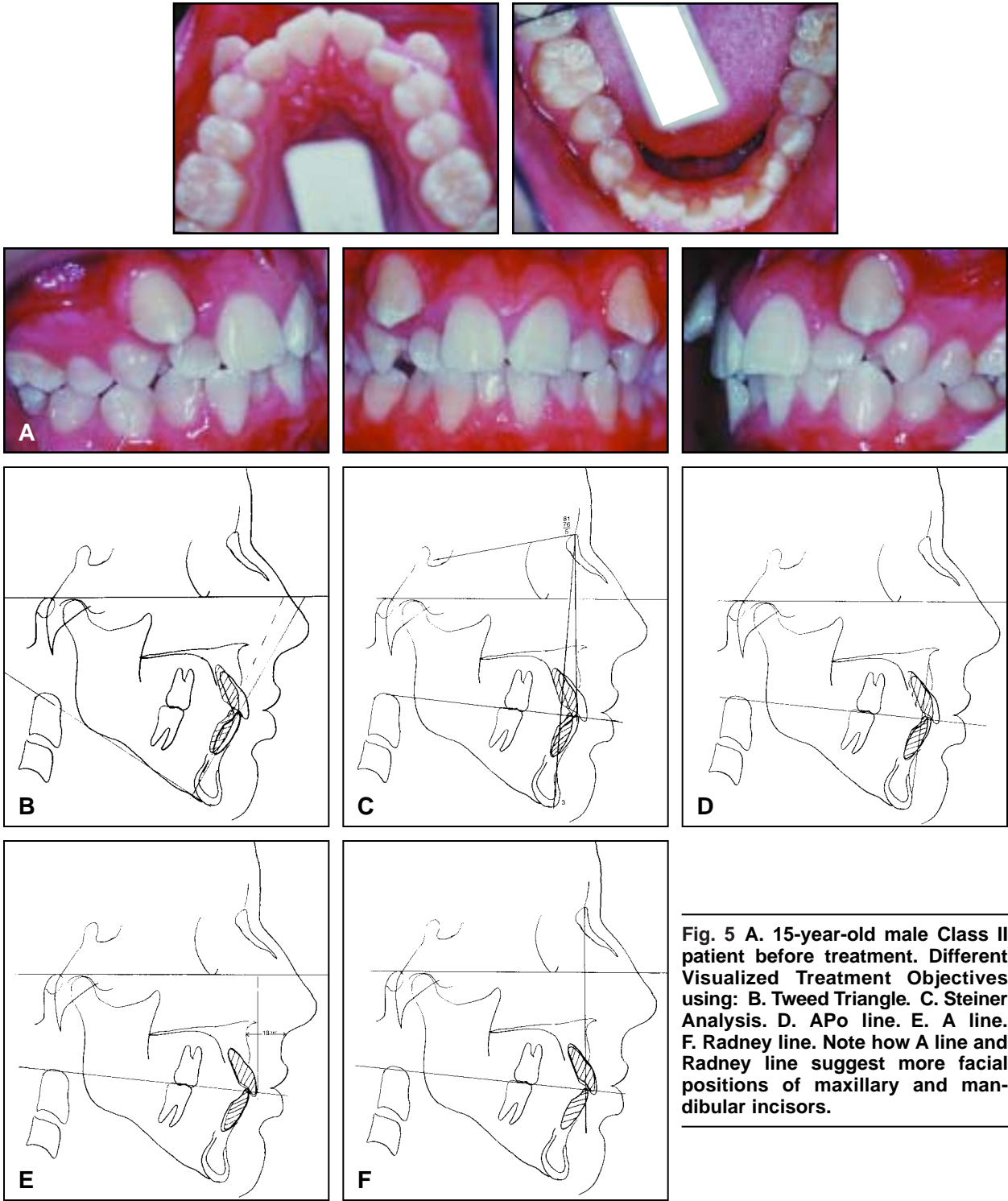


Fig. 4 A. Adult Class II patient before treatment. B. Fifteen months later, after maxillary premolar extractions and mandibular interproximal enamel reduction.

***Interproximal Enamel Reduction and Maxillary Premolar Extractions***

Sheridan<sup>17</sup> and others<sup>18-20</sup> have advocated reducing the interproximal enamel to make space for resolution of arch-length discrepancies. This has become a preferred technique when extractions are unwarranted or only marginally neces-

sary, and it offers a superlative method of addressing the Class II occlusal problems of non-growing patients (Fig. 4). Two maxillary premolars are removed, allowing the canines to be placed in a Class I relationship while leaving the molars Class II. With this approach, the clinician seldom has to worry about the inability to



**Fig. 5 A.** 15-year-old male Class II patient before treatment. Different Visualized Treatment Objectives using: B. Tweed Triangle. C. Steiner Analysis. D. APo line. E. A line. F. Radney line. Note how A line and Radney line suggest more facial positions of maxillary and mandibular incisors.

achieve Class I canines or good interdigitation of the posterior teeth.

### New Cephalometric Guides

Discriminating diagnostic analyses will often confirm the advisability of a limited extraction strategy. Alvarez<sup>21</sup> and Creekmore<sup>16</sup> have illustrated how traditional cephalometric methods of determining incisor position have a retractive bias in patients with other-than-average skeletal patterns. In other words, the maxillary and mandibular incisors are typically placed too far lingually for proper occlusal function and facial harmony (Fig. 5). Both authors accept a more forward position and encourage less lingual retraction of the incisors, which should result in fewer extractions, better esthetics, and better stability.

Alvarez suggests dividing the soft tissue from osseous A point to the lip into thirds and dropping a perpendicular to true horizontal to determine the best position for the facial surface of the maxillary incisor (Fig. 5E). Creekmore recommends using the line NA as a guide for positioning the maxillary and mandibular incisors (Fig. 5F). Either of these methods often

results in a more facial position, or requires less lingual movement, of the incisors.

### Occlusograms

Although occlusograms have been advocated as a means of accurately determining arch-length discrepancies for many years,<sup>22-24</sup> surveys consistently show only a minority of orthodontists uses the technique, and even that number has diminished over the past few years.<sup>25</sup>

Most clinicians use some form of the method popularized by Little at the University of Washington, which adds the displacements of the anatomical contact points of the anterior teeth<sup>26</sup> (Fig. 6A). Although Little warned against using this Irregularity Index as a method of determining arch-length discrepancies, many use it as a quick way to judge the amount of crowding on hand-held models. Unfortunately, it fails to account for the normal archform dictated by basal bone as well as how the teeth might fit within that arch. The difference between the Irregularity Index and an occlusogram is often considerable (Fig. 6B). Despite the time it takes to do an occlusogram manually, its accuracy is almost unassailable, and the errors it prevents

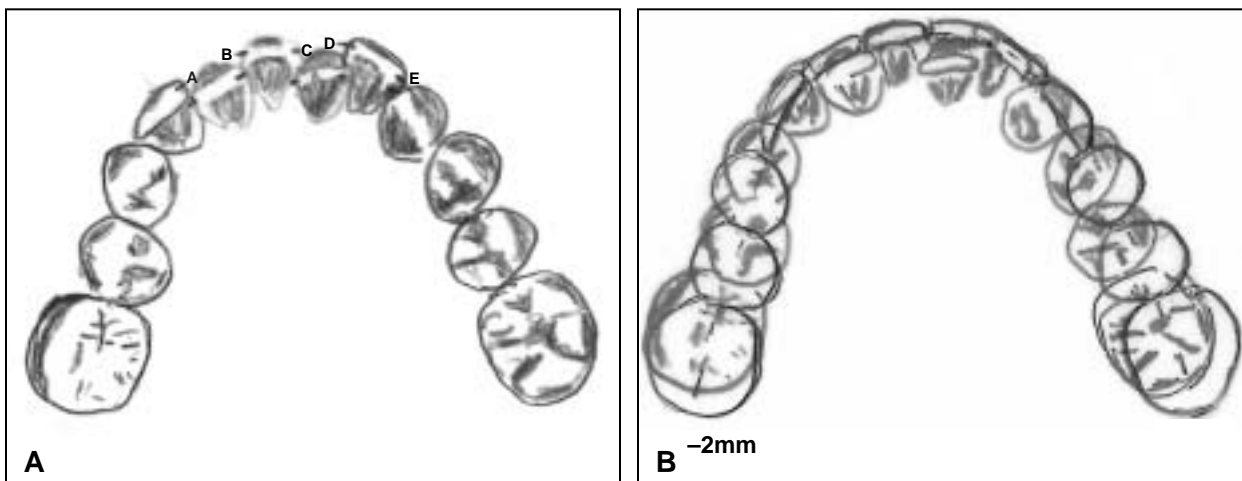


Fig. 6 A. Mandibular arch-length discrepancy measured with Irregularity Index, adding contact-point displacements: A(2mm) + B(2mm) + C(3mm) + D(3mm) + E(1mm) = 11mm. B. Mandibular arch-length discrepancy measured with occlusogram.

can make the difference between treatment success and failure. Furthermore, several computer imaging programs can now generate occlusograms automatically.

**A Modified Steiner Box**

The problems described in this article in treating Class II extraction patients have probably evolved because of the profession's obsession with the Steiner Box<sup>27</sup> and its variants. Steiner and Tweed both used these boxes to determine the amount of space needed to make corrections (Fig. 7). They were convinced, and they subsequently convinced the rest of orthodontics, that the key to diagnosis, treatment planning, and therapy was the mandibular arch and, in particular, the position of the mandibular incisors. The Steiner Box has no space for maxillary anchorage needs (Fig. 8).

Little thought was paid to the maxillary arch in treatment planning until Holdaway published his epochal articles on the maxillary incisor as an important determinant of orthodontic diagnosis and treatment planning.<sup>28</sup> More

recently, Creekmore<sup>16</sup> has strongly suggested that orthodontists' reliance on the mandibular incisor, as advocated by Steiner,<sup>27</sup> Tweed,<sup>1</sup> Williams,<sup>29</sup> and Ricketts,<sup>30</sup> is misplaced.

In the illustrated patient (Fig. 9), interproximal enamel reduction of 5mm in the mandibular arch and extraction of only the maxillary first

Lower Arch	+	-
Discrepancy		-11
Expansion		
Relocation Lower Incisor		-4
Relocation Lower Molar		
E Space		
Intermaxillary Mechanics		-6
Extractions	15	
Total	15	-21
<b>Total Net</b>		<b>-6</b>

**Fig. 7 Typical Steiner Box for mandibular arch, with arch-length discrepancy measured according to Irregularity Index and Visualized Treatment Objective designed using APo line.**

	Mx	Md
Arch-Length Discrepancy	-17	-5
Arch Development		
Relocation Incisor		
Mesial Molar Movement		-10
Distal Molar Movement		
Curve of Spee		
Interproximal Reduction		
Extractions	15	15
Relocation of Mx 3s	-5	
Total	-7	0
<b>Total Net</b>	<b>-7</b>	

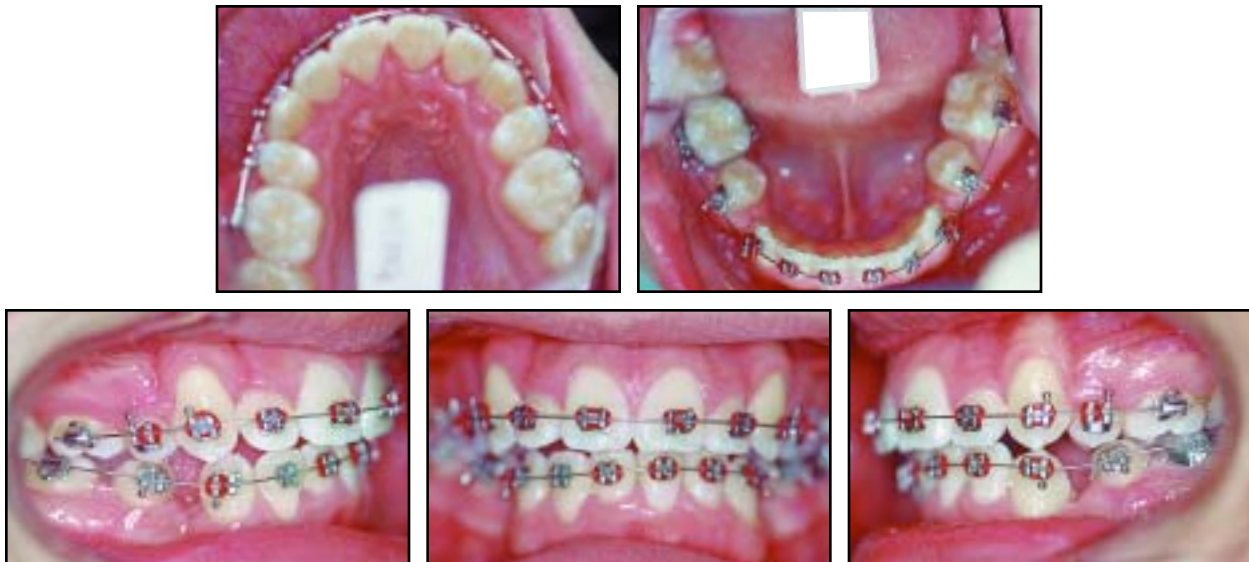
**A**

	Mx	Md
Arch-Length Discrepancy	-17	-5
Arch Development		
Relocation Incisor		
Mesial Molar Movement		
Distal Molar Movement		
Curve of Spee		
Interproximal Reduction	2	5
Extractions	15	
Relocation of Mx 3s		
Total	0	0
<b>Total Net</b>	<b>0</b>	

**B**

**Fig. 8 A. Modified Steiner Box, with arch-length discrepancies measured by occlusograms and VTO designed using A line. With mandibular premolar extractions, note additional maxillary space necessitated by retraction of mandibular canines. B. Modified Steiner Box, with arch-length discrepancies measured by occlusograms and VTO designed using A line. Without mandibular premolar extractions, additional maxillary space is not needed.**





**Fig. 9** After four premolar extractions and anterior retraction, insufficient space remains to correct posterior malocclusion. MPA IV appliance was placed after one year of treatment.

premolars would have been a better and more conservative treatment plan than extracting four first premolars. An excellent Class I canine relationship would have resulted, there would have been no risk of lingual displacement of the mandibular incisors, the maxillary dentition would not have had to be moved distally, and there would have been no excess mandibular extraction space to contend with. This is now hindsight, however, and the current treatment strategy is to use an MPA IV to close the mandibular spaces, without further retraction of the mandibular incisors, and to move the maxillary dentition distally.

### Conclusion

Class II corrections are difficult to achieve under the best of circumstances. But when favorable mandibular growth does not or cannot

occur, extracting four premolars makes the task even more difficult, if not impossible. The extraction of mandibular premolars in Class II non-growing patients geometrically foils ordinary space-closure mechanics and requires complicated strategies that may ultimately compromise the occlusion and prolong treatment. Therefore, it is wise to avoid such extractions whenever possible in adult patients or those with limited growth potential. More conservative strategies such as maxillary premolar extractions only, interproximal enamel reduction, or a combination of these methods, can be successful both functionally and esthetically (Fig. 4).

When mandibular premolar extractions are absolutely necessary in the treatment of Class II malocclusions, the clinician needs to be aware of the difficulties in store and make plans for addressing them before entering therapy—not afterward.

## REFERENCES

1. Tweed, C.H.: The diagnostic facial triangle in the control of treatment objectives, *Am. J. Orthod.* 55:651-657, 1969.
2. Coben, S.E.: Growth and Class II treatment, *Am. J. Orthod.* 52:5-26, 1966.
3. Schudy, F.F.: The rotation of the mandible resulting from growth: Its implications in orthodontic treatment, *Angle Orthod.* 35:36-50, 1965.
4. Elms, T.N.; Buschang, P.H.; and Alexander, R.G.: Long-term stability of Class II division 1, nonextraction cervical face-bow therapy, II: Cephalometric analysis, *Am. J. Orthod.* 109:386-392, 1996.
5. Cope, J.B.; Buschang, P.H.; Cope, D.D.; Parker, J.; and Blackwood, H.O.: Qualitative evaluation of craniofacial changes with Jasper Jumper therapy, *Angle Orthod.* 64:113-122, 1994.
6. Magness, W.B.: Extraction of second molars, *J. Clin. Orthod.* 20:519-522, 1986.
7. Bishara, S.E. and Burkey, P.S.: Second molar extractions: A review, *Am. J. Orthod.* 89:415-424, 1986.
8. Stagers, J.A.: A comparison of results of second molar and first premolar extraction treatment, *Am. J. Orthod.* 98:430-436, 1990.
9. Whitney, E. and Sinclair, P.M.: An evaluation of combination second molar extraction and functional appliance therapy, *Am. J. Orthod.* 91:183-192, 1987.
10. Romanides, N.; Servoss, J.M.; Kleinrock, S.; and Lohner, J.: Anterior and posterior dental changes in second molar extraction cases, *J. Clin. Orthod.* 24:559-563, 1990.
11. Begg, P.R.: *Begg Orthodontic Theory and Technique*, Saunders Publishing Co., Philadelphia, 1965, pp. 76-80.
12. Brickman, C.D.; Sinha, P.K.; and Nanda, R.S.: Evaluation of the Jones Jig appliance for distal molar movement, *Am. J. Orthod.* 118:526-534, 2000.
13. Castañon, R.; Valdes, M.S.; and White, L.W.: Clinical use of the Churro Jumper, *J. Clin. Orthod.* 32:731-746, 1998.
14. Coelho Filho, C.M.: Mandibular Protraction Appliance IV, *J. Clin. Orthod.* 35:18-24, 2001.
15. Pancherz, H. and Hansen, K.: Occlusal changes during and after Herbst treatment: A cephalometric investigation, *Eur. J. Orthod.* 8:215-228, 1986.
16. Creekmore, T.D.: Where teeth should be positioned in the face and jaws and how to get them there, *J. Clin. Orthod.* 31:586-608, 1997.
17. Sheridan, J.J.: Air-rotor stripping, *J. Clin. Orthod.* 19:43-59, 1985.
18. Peck, H. and Peck, S.: An index for assessing tooth shape deviations as applied to the mandibular incisors, *Am. J. Orthod.* 61:384-401, 1972.
19. Tuverson, D.L.: Anterior interocclusal relations, Part I, *Am. J. Orthod.* 78:361-370, 1980.
20. Boese, L.R.: Fiberotomy and reproximation without lower retention, nine years in retrospect, *Angle Orthod.* 50:88-97, 1980.
21. Alvarez, A.T.: The A line: A new guide for diagnosis and treatment planning, *J. Clin. Orthod.* 35:556-569, 2001.
22. Marcotte, M.R.: The use of the occlusogram in planning orthodontic treatment, *Am. J. Orthod.* 69:655-667, 1976.
23. White, L.W.: The clinical use of occlusograms, *J. Clin. Orthod.* 16:92-103, 1982.
24. Faber, R.D.: Occlusograms in orthodontic treatment planning, *J. Clin. Orthod.* 26:396-401, 1992.
25. Gottlieb, E.L.; Nelson, A.H.; and Vogels, D.S. III: 1996 JCO Study of Orthodontic Diagnosis and Treatment Procedures, *J. Clin. Orthod.* 30:615-630, 1996.
26. Little, R.M.: The Irregularity Index: A quantitative score of mandibular anterior alignment, *Am. J. Orthod.* 68:554-563, 1975.
27. Steiner, C.C.: The use of cephalometrics as an aid to planning and assessing orthodontic treatment, *Am. J. Orthod.* 46:721-735, 1960.
28. Holdaway, R.A.: A soft-tissue cephalometric analysis and its use in orthodontic treatment planning, *Am. J. Orthod.* 84:1-28, 1983; 85:279-293, 1984.
29. Williams, R.: The diagnostic line, *Am. J. Orthod.* 55:458-476, 1969.
30. Ricketts, R.M.; Roth, R.H.; Chaconas, S.J.; Shulhof, R.J.; and Engel, G.A.: *Orthodontic Diagnosis and Planning*, vols. 1 and 2, Rocky Mountain Data Systems, Rocky Mountain Orthodontics, Denver, 1982.