Class II, Division 2 Malocclusion

To Extract — or Not Extract?

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Identical 13-year-old twin boys with Class II, division 2 malocclusions are treated at the same time, one with a full complement of teeth and the other with extraction of the first bicuspids.

KEY WORDS: CLASS II, DIVISION 2 MALOCCLUSION, EXTRACTION

In 1907, ANGLE described the dental symptoms of Class II, division 2 malocclusion as "characterized specifically by distal occlusion of the teeth in both lateral halves of the lower dental arch, indicated by the mesiodistal relations of the first permanent molars, but with retrusion instead of protrusion of the upper incisors."

HELLMAN (1931) took a broader look at the overall facial morphology surrounding the occlusion described by Angle, stating "The face in Class II, division 2 differs from that in Class II, division 1 in that in division 2 the mandible is in a relatively normal position, while in division 1 the mandible is in a more posterior position."

Some 28 years later, after the development of radiographic cephalometrics as a diagnostic aid, STRANG (1958) said "The Class II case presents a mandible in distal relationship with the facial and cranial anatomy." He did not mention any underlying differences between divisions 1 and 2.

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After a radiographic cephalometric study, HEDGES (1958) came to the following conclusions:

1 Class II, division 2 is not a specific stereotypical clinical syndrome
2 It may arise as a result of eruptive disharmony, muscular pressure and/or compensatory variation
3 Clinical treatment plans should be based on the specific variations within the individual.

HITCHCOCK (1976) found significant differences between the radiographic cephalometric measurements of a group of Class II, division 2 patients and both a group of Class II, division 1 patients and a control group with normal occlusions. His conclusion, contrary to HEDGES (1958), was that "although not stereotyped, Class II, division 2 does represent a specific clinical syndrome."

More recently, in an extensive radiographic cephalometric evaluation of patients with Class II, division 2 malocclusion, CLEALL AND BEGOLE (1982) stated that *on the average*, Class II, division 2 patients have essentially normal skeletal patterns outside the immediate dental area.

Reviewing the orthodontic literature regarding Class II, division 2 malocclusion confirms Hitchcock's 1976 statement that "obviously much controversy exists as to what a Class II, division 2 malocclusion actually looks like."

Attempts at describing the problem continue, often in contradictory fashion, focusing on what are essentially the same combination of dental symptoms described by Angle in 1907.

Considering the problems in the orthodontic treatment of Class II, division 2 malocclusion, it is important that we understand its etiology and development. An understanding of the dynamic development of this particular clinical problem is far more relevant to the needs of the clinician than the clarification of its description.

Implant studies by BJÖRK (1955, 1968, 1963) AND BJÖRK AND SKIELLER (1972, 1976, 1977) have shown that, regardless of the molar relationships, the forward growth rotation of the mandible and maxilla in patients with Class II, division 2 malocclusion leads to less than normal increases in maxillary arch length, anterior dental crowding, and deepening of the anterior dental and skeletal vertical relationships.

Treatment

The clinical management of Class II, division 2 malocclusion still remains a seldom-investigated mystery that continues to present diagnostic, treatment and retention problems for the orthodontist.

CLEALL AND BEGOLE (1982) cited several possible treatment options that are commonly employed in the orthodontic treatment of Class II, division 2 malocclusion. Based on the assumption that division 2 is simply a variant of Class II, division 1, STRANG AND THOMPSON (1958) AND RICKETTS ET AL. (1979) described initial simple proclination of the upper central incisors and the use of Class II elastics, extraoral traction, bite planes, and/or functional appliances as the treatment approaches of choice. TIMMONS (1972) suggested the proclination of the upper incisors in the expectation that this would permit the mandible, assumed to be posteriorly displaced in Class II, division 2, to move forward into a better occlusal relationship.

Various extraction patterns have also been proposed to deal with the unique characteristics of Class II, division 2 malocclusion. Some clinicians have suggested the extraction of only the upper first bicuspids, finishing the occlusion with a Class II molar relationship, in order to minimize the maxillary incisor retraction that could lead to an increased flattening of the profile and possible root

resorption. This approach also tends to minimize the need for Class II elastic traction and possible resultant advancement of the lower dentition. Others have advocated maxillary second molar extraction followed by distalization of the maxillary dental arch.

In the presence of lower arch crowding, other combinations of extractions have also been proposed. Four first bicuspids, maxillary first and mandibular second bicuspids, maxillary first bicuspids and one mandibular incisor, or simply one mandibular incisor, have all been suggested as possible therapeutic extraction patterns in Class II, division 2 malocclusion with lower arch crowding. Mandibular molar extractions have also been suggested for cases with marked lower arch crowding.

Still other extraction patterns have been suggested in Class II, division 2 where some teeth (such as the lower second bicuspid) are congenitally missing.

HITCHCOCK (1977) described the treatment of two patients with lower second bicuspids congenitally missing in a Class II, division 2 malocclusion. He described the limited choice of treatment procedures with the congenital absence of the bicuspids, and presented his results as "fairly good under the circumstances."

In the first patient, because of pronounced proclination of the lower incisors and the absence of a lower bicuspid, both upper first bicuspids and the remaining lower second bicuspid were extracted. Posttreatment evaluation showed that only the lower incisor position and the overbite remained outside the limits of natural variation.

In the second patient, both lower second bicuspids were congenitally missing. "Because of her straight profile and prominent chin," she was treated without upper arch extractions to a Class III molar relationship. Posttreatment photographs revealed a retrusive dentition and a flat or dished-in facial appearance.

Several authors have described combined orthodontic and surgical correction of Class II, division 2 malocclusion in adults. ARVYSTAS (1979), STOELINGA AND LEENEN (1981) AND DIETZ ET AL. (1977) have presented case reports demonstrating, individually or in combination, the maxillary anterior alveolar osteotomy, the sagittal split ramus osteotomy, and the sagittal segmented osteotomy surgical procedures for correcting Class II, division 2 malocclusion in combination with orthodontic treatment.

The articles cited above constitute most of the orthodontic literature on treatment protocols used for the correction of Class II, division 2 malocclusion.

The treatment approach selected for *any* patient must include consideration of numerous variables. Facial morphology and growth pattern, integumental form and function, available dental arch length, vertical relationships, anteroposterior dentoalveolar dysplasia, tooth width relationships, and projected or anticipated patient cooperation are all factors which can be critical in the selection of a treatment plan.

Orthodontists are still confronted with a fundamental dilemma. The data on which we must base our treatment decisions is empirical, with clinical experience serving as the safety net that we must rely on.

Objectives and Rationale

This paper is an attempt to deal primarily with one of the many empiricisms prevalent in orthodontics, that of avoidance of dental extractions in the treatment of Class II, division 2 malocclusion. The treatment of identical twin boys treated at the same time, one with extraction and one without, is reported and evaluated.

We are all aware that the extraction of teeth, although necessary in certain instances for the achievement of satisfactory treatment results, may also lead to various side effects often regarded as inherent. Those most commonly associated with extraction in Class II, division 2 cases are a tendency toward flattening of the facial profile, and deepening of the bite. We are also aware from clinical experience that such changes are an inherent part of the developmental pattern in this type of case, making any additional increase resulting from the clinical management of a Class II, division 2 malocclusion difficult to identify. Nevertheless, this is still generally regarded as a negative effect to be avoided if possible.

Given these empiricisms, what should we do when faced with a young person with a Class II, division 2 malocclusion, marked arch length insufficiency, a relatively straight facial profile, prominent chin, large nose and a significant potential for additional facial growth?

The following treatment records of two identical twin brothers are presented as examples of two solutions to this dilemma.

Nonextraction

Figs. 1, 2 and 7

G.B. was 13 years old at the time that he presented for treatment. The mandibular arch length insufficiency in his Class II, division 2 malocclusion was 11.5mm. Visual facial evaluation revealed an apparent skeletal Class I brachycephalic facial type with a normal nasolabial angle, a prominent nose and chin, and a somewhat concave soft tissue profile.

Cephalometric morphologic analysis confirmed the facial form description, showing a bimaxillary prognathic face with mandibular dentoalveolar retrusion, retroclined incisors and both dentoalveolar and skeletal deep bite. The forward inclination of the symphysis, shape of the lower border of the mandible, curvature of the mandibular canal, and thickness of the cortical bone at the inferior aspect of the symphysis, demonstrate most of the characteristics associated with forward mandibular growth rotation as described by BJÖRK (1969).

Because of the retroclination of the maxillary and mandibular incisors, the prominence of his nose and chin, and a projected continued forward mandibular growth rotation, this patient was treated without dental extractions. The overriding factors in this decision were concern for future facial form, and the knowledge that the lower dentition could be expected to move forward on the jaw base in patients with this facial morphology.

Edgewise appliances and a transpalatal arch were placed on the maxillary dentition. A cervical headgear was worn for 14 hours each day. After advancement and alignment of the maxillary anterior teeth, edgewise appliances were also placed on the mandibular arch, supplemented by a full-time lip bumper. Through the combined effects of the lip bumper, cervical headgear and expanding archwires with reverse occlusal curves to level the arches, all of the teeth were aligned and incorporated into the expanded arch forms. Treatment time was 42 months.

Treatment Results

Although the soft tissue profile is somewhat concave, facial appearance in both frontal and profile views is acceptable. In spite of significant labial movement of both maxillary and mandibular incisors, the facial appearance characteristically associated with Class II, division 2 malocclusion and forward jaw rotation remains.

Dental relationships after treatment

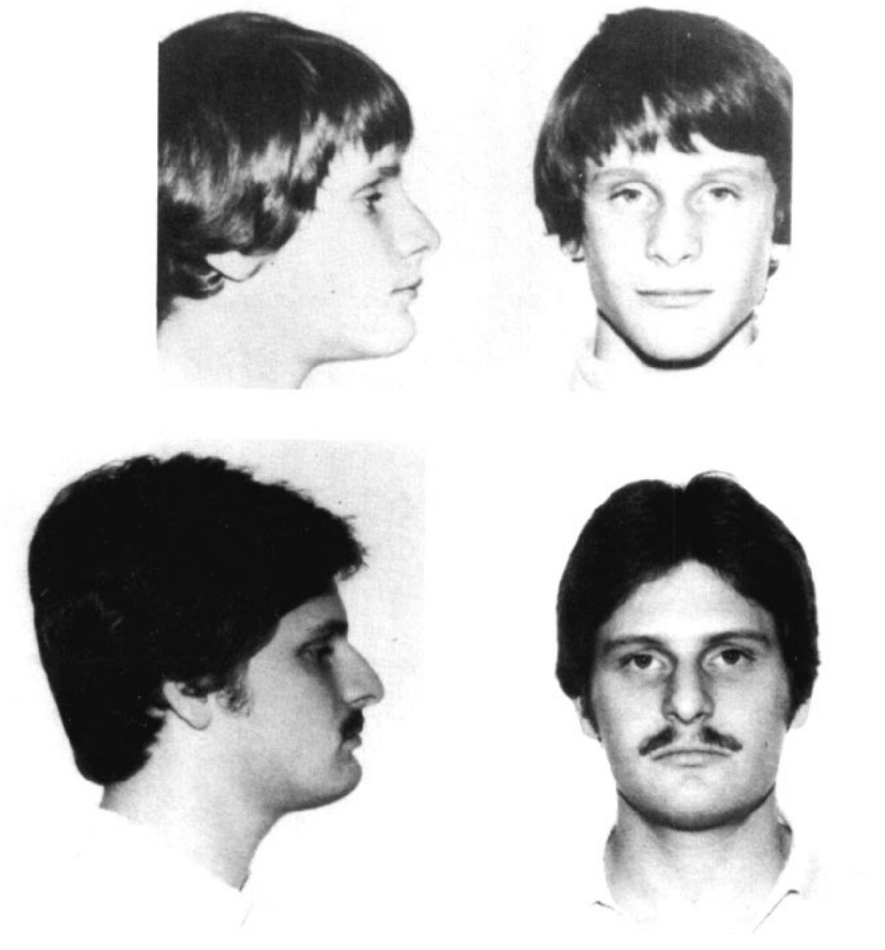


Fig. 1 Patient G.B. ***above*** before treatment
below after treatment

were compromised by the non-extraction treatment. Due to the extreme labial movement of the incisors resulting from the dental expansion, and the asymmetrical distribution of the pretreatment crowding, neither complete alignment of the dental midlines nor ideal posterior occlusion were achieved.

The successful effort to maintain the mandibular molars distally on the mandible while alleviating the anterior crowding contributed to a continued left posterior arch length insufficiency. This resulted in a pericoronal abscess and bone destruction around the mandibular left second molar, which was subsequently extracted together with the maxillary left second molar.

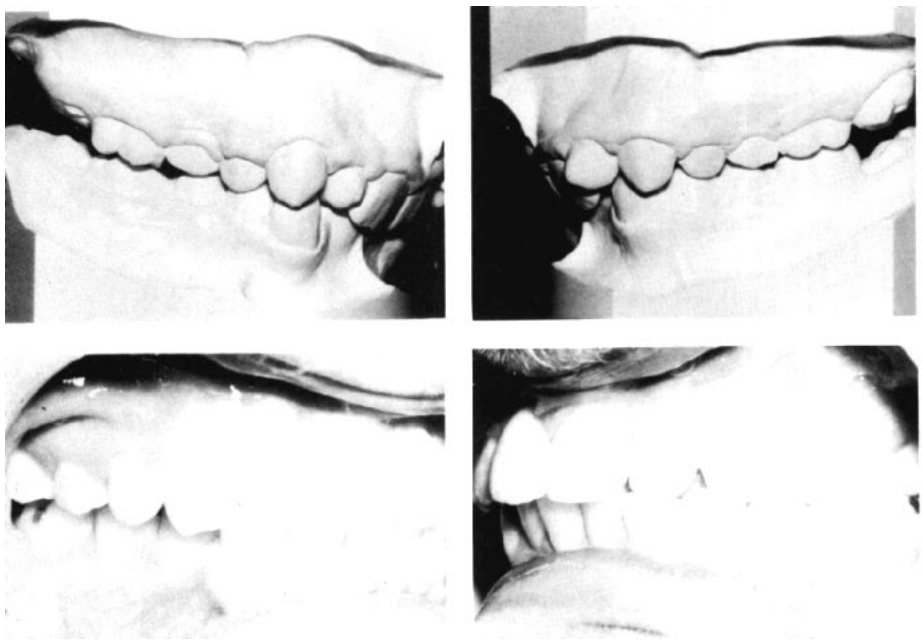


Fig. 2 Patient G.B. ***above*** before treatment
below after treatment

Treatment Evaluation

Figure 3

Posttreatment changes were evaluated following the structurally oriented methods described by BJÖRK (1968).

General facial growth was observed by superimposing lateral cephalometric tracings on stable structures in the anterior cranial base region.

Maxillary growth and treatment changes were evaluated by superimposing on the anterior surface of the zygomatic process of the maxilla, keeping the apposition at the floor of the orbit quantitatively the same as the resorptive lowering of the nasal floor (BJÖRK AND SKIELLER 1977). This makes it possible to identify rotational changes of the maxilla as the resultant changes in the inclination of the nasion–sella lines. It should be noted that the nasion–sella line is carried forward from the pretreatment tracing to the posttreatment tracing by superimposing them on the stable structures in the cranial base.

Mandibular growth and treatment changes were evaluated by superimposing on the anterior portion of the symphysis and the cortical outline of the mandibular canal. Mandibular growth rotation with respect to the cranial base can then be observed as the change in inclination of the nasion–sella lines. The original nasion–sella line is carried forward as in the maxillary superimposition technique.

Changes in maxillary and mandibular dentitions were evaluated in all three dimensions by an integrated analysis of the cephalometric radiograph and 1:1 occlusal photographs of the study casts.

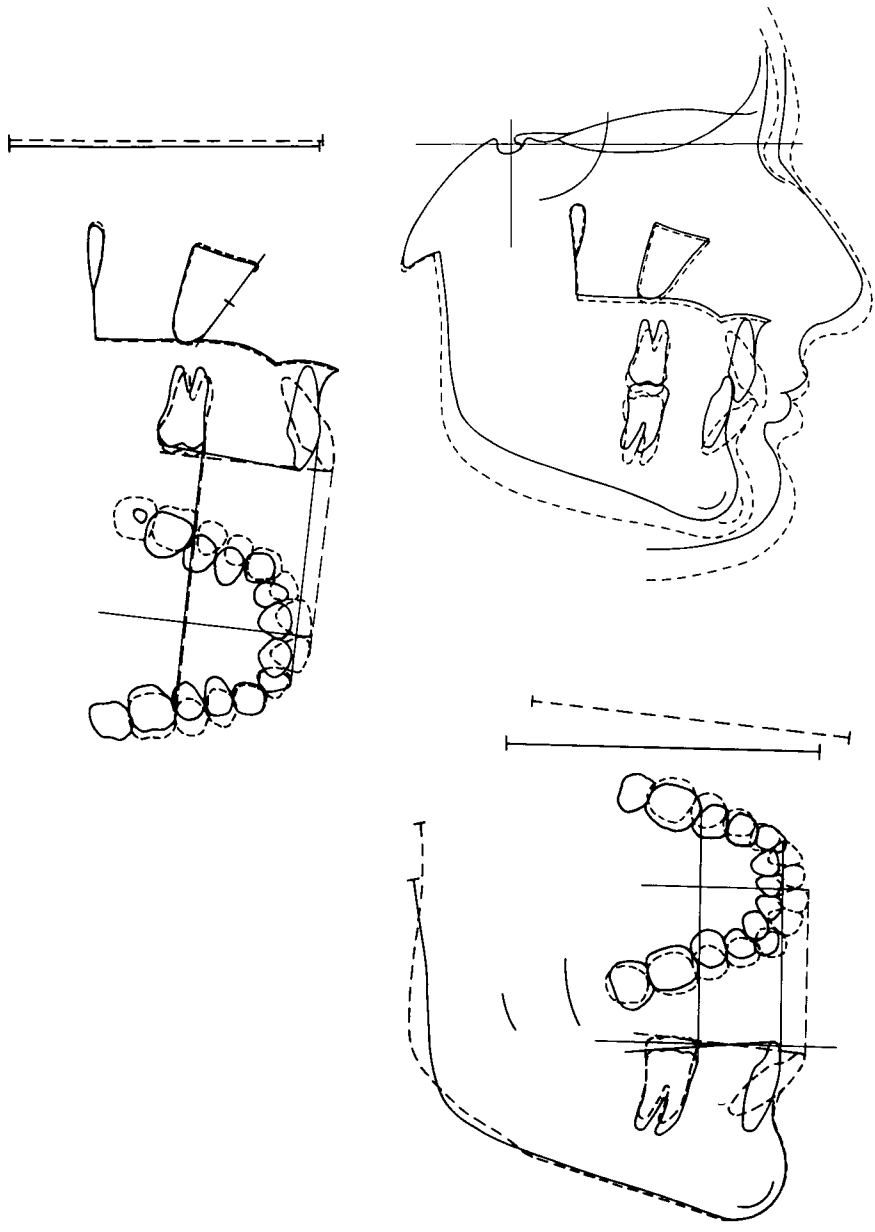


Fig. 3 Patient G.B, nonextraction therapy
Cephalometric and dental arch superimpositions

After superimposing on the stable structures described above, the jaw outlines, incisors and first molars were traced from the cephalometric films. Occlusal planes were constructed from upper incisor edges to the distobuccal first molar cusps. A plane midway between the pretreatment and posttreatment planes was then drawn to provide the base for the reference plane drawn parallel to it as shown in Fig. 3.

The anterior limit of the occlusal plane reference line was demarcated by a perpendicular erected tangent to the labial surface of the incisor. This line was then used to orient the occlusal view of the dental casts, rotated to the plane of the lateral tracing.

Molar changes were evaluated on the tracing of the occlusal view of the casts, measuring to perpendiculars erected from the sagittal plane to the mesial contacts of the first molars.

This reference system presents a 3-dimensional analysis of dental changes on the 2-dimensional lateral cephalometric format.

General facial growth

Facial growth was characterized by slight descent of the maxilla and significant forward growth of the mandible during the treatment period.

Maxillary growth and dental arch changes

The total amount of sutural lowering of the maxilla was very small, and no maxillary rotation relative to the anterior cranial base was observed during the treatment period.

The maxillary incisors were tipped forward and the arch expanded on the jaw base. Maxillary molars erupted in a vertical direction under the influence of the headgear, with no mesial movement. This combination of labial tipping of the incisors, transverse expansion of the arch and vertical eruption of the molars, provided enough space for elimination of the crowding in the maxillary arch.

Mandibular growth and dental arch changes

The direction of condylar growth, *as determined from the change in position of articulare*, was primarily vertical in relation to the initial occlusal plane. During the treatment period there was significant (6.5°) rotation of the mandible, and moderate resorptive remodeling just anterior to the gonial angle.

The mandibular incisors were tipped forward and the arch expanded. The mandibular molars erupted in a vertical direction relative to the lower occlusal plane, with little or no mesial movement, probably as an effect of the labial musculature operating through the lip bumper.

The sagittal correction of the occlusion from a Class II to a Class I relationship seemed to be largely dependent on the forward growth of the mandible. The deep dental overbite was corrected by the combined effects of the relative intrusion of the maxillary and mandibular incisors and the extrusion of the maxillary and mandibular molars.

Extraction

Figs. 4, 5 and 8

D.B. was the 13-year-old identical twin brother of G.B., and presented for treatment at the same time. His facial form, dental alignment and skeletal relationships were nearly identical to those of his brother. His 12.5mm mandibular arch length insufficiency was slightly more than his brother's 11.5mm.

Cephalometric morphologic analysis again suggested that strong forward mandibular growth rotation could be expected throughout the treatment period.

Fig. 4 Patient D.B. ***above*** before treatment
below after treatment

Because of ambivalence about treating his twin brother's malocclusion without dental extractions, and in spite of the same concern for future facial form and balance, this patient was treated with the extraction of four first bicuspids.

The uncertainty whether extraction or non-extraction treatment would provide the best results, as well as the advantages and disadvantages of both treatment approaches, were explained to the patients and their parents. All agreed to participate in this human experiment with the understanding that *either* treatment approach should lead to a successful but possibly less than ideal result.

The four first bicuspids were extracted and edgewise appliances placed on the maxillary arch. After advancement of the maxillary anterior teeth, full edgewise

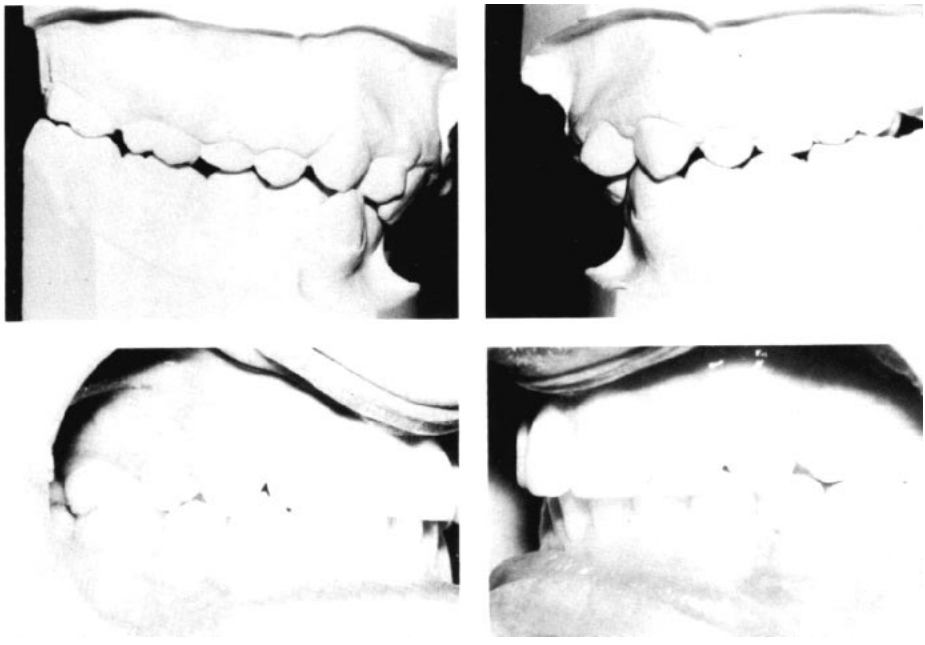


Fig. 5 Patient D.B. ***above*** before treatment
below after treatment

appliances were placed on the mandibular arch.

The mandibular anchorage was augmented by a lingual arch until the cuspids were retracted and the incisors aligned. Space closure was then begun in both arches, in combination with Class II elastic traction. After space closure was completed in the mandibular arch, Class II elastics were continued and intra-arch closing elastics added for continued maxillary space closure. Treatment time was 48 months.

Treatment Results

Facial appearance is again acceptable. Even though teeth have been extracted, the mandibular incisors are significantly labial to their pretreatment position. The maxillary incisors remain in approximately the same position in relation to the lips. The concave soft tissue profile remains, as was expected with such pretreatment facial characteristics and forward jaw rotation during the growth period.

Dental relationships are satisfactory, with the midlines in harmony, good intercuspation, and acceptable overbite and overjet. All four second molars are erupted into good positions.

General facial growth

Growth during the treatment period was characterized by moderate vertical growth of the maxilla and significant forward growth of the mandible.

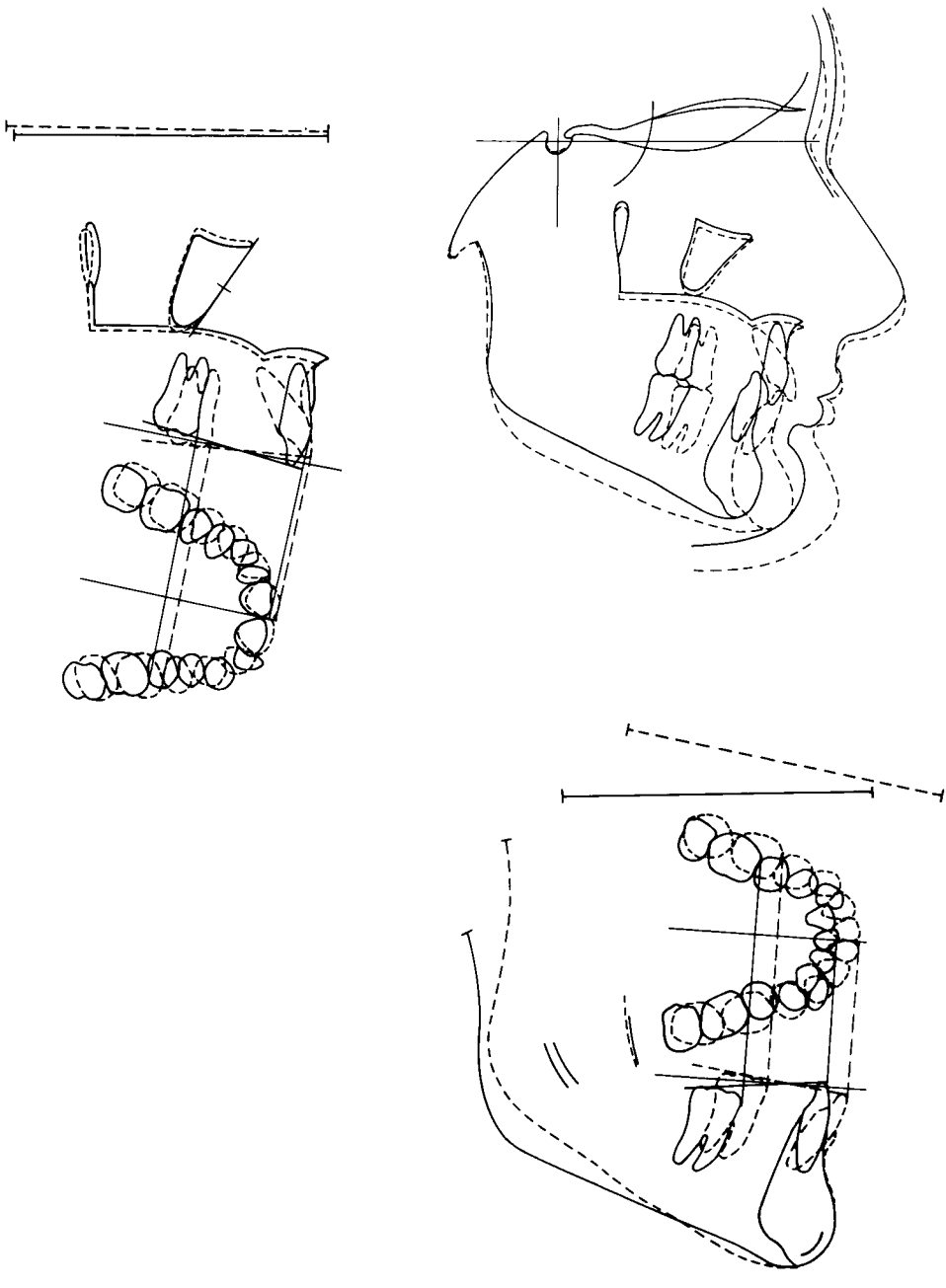


Fig. 6 Patient D.B, extraction therapy
Cephalometric and dental arch superimpositions

Maxillary growth and dental arch changes

The maxillary dentition showed a slight "anterior" rotation during the treatment period, descending more posteriorly than anteriorly. The dental arch was slightly expanded in the cuspid and bicuspid region, and the incisors were tipped labially. The molar eruption path was inclined mesially in response to the elastics used during space closure. The combined tipping of the incisors and mesially-inclined eruption path of the molars resulted in rotation of the maxillary occlusal plane.

Mandibular growth and dental arch changes

The direction of condylar growth was upward and slightly forward in relation to the mandibular occlusal plane. During the treatment period there was an extreme (12°) forward rotation of the mandible. The mandibular incisors were tipped labially, while the molars erupted vertically and mesially in response to the Class II intermaxillary elastics used during treatment, thereby changing the cant of the mandibular occlusal plane.

Mesial movement of the mandibular molars was quantitatively the same as the mesial movement of the lower incisors, so the arch space gained as a result of the extraction of two mandibular bicuspids was utilized to alleviate the pretreatment crowding and level the extreme curve of Spee.

The sagittal correction of the malocclusion was accomplished through more mesial movement of the mandibular molar than the maxillary molar, as well as the rotation of the mandible. The dentoalveolar deep bite in this patient was corrected through the relative intrusion of the maxillary and mandibular incisors, extrusion of the maxillary and mandibular molars, and slight forward growth rotation of the maxilla.

Comparison of the two treatment protocols

Some interesting comparisons can be made between the two treatment approaches in these identical twins. Even though these interpretations are based on comparison of two very similar (but not completely identical) individuals, they must still be viewed with caution.

Condylar growth was essentially the same. The patient treated with bicuspid extractions exhibited more forward rotation of the mandible relative to the cranial base (12.0° vs. 6.5°), yet the ultimate position of the chin in the face is about the same in both.

Some dental and skeletal differences that might be attributed to the differences in treatment protocols and mechanics may still be seen in these similar faces (Figs. 7-9).

IN THE PATIENT TREATED WITH EXTRACTIONS —

- The posterior teeth are farther forward on the mandible, allowing the manifestation of more forward mandibular growth rotation.
- Significantly more resorptive remodeling occurred in the gonial angle region. BJÖRK (1955, 1963, 1968) relates this to forward mandibular growth rotation.
- The maxilla is positioned slightly farther back and inferiorly in relation to the cranial base. This may have been a response to the intermaxillary elastics.
- The maxillary and mandibular molars show slightly more vertical eruption.
- There is only slightly less lower anterior face height. Overall growth and the increased vertical eruption of the molars in response to elastic traction during space closure may have partially offset the expected effect of forward growth rotation on lower face height.

Patient	G.B. (non extraction)
Stage	Pre-treatment
SNA	88.5°
SNB	84.0°
ANB Apical base relationship	4.5°
SN:Pog	86.0°
AN:Pog Sagittal jaw relationship	2.5°
$\underline{1}$:NA	1.0mm
$\underline{1}$:NA	7.0°
$\overline{1}$:NB	2.0mm
$\overline{1}$:NB	11.0°
Pog:NB	6.0mm
$\underline{1}$:$\overline{1}$	163.0°
SN:Occ	8.0°
SN:GoGn	20.0°
ANS-PNS:GoGn Vertical jaw relationship	14.0°
SN:ANS-PNS	6.0°

Patient	G.B. (non extraction)
Stage	Post-treatment
SNA	87.5°
SNB	85.5°
ANB Apical base relationship	2.0°
SN:Pog	89.0°
AN:Pog Sagittal jaw relationship	-1.5°
$\underline{1}$:NA	7.0mm
$\underline{1}$:NA	38.0°
$\overline{1}$:NB	6.0mm
$\overline{1}$:NB	32.0°
Pog:NB	7.5mm
$\underline{1}$:$\overline{1}$	112.0°
SN:Occ	10.0°
SN:GoGn	13.0°
ANS-PNS:GoGn Vertical jaw relationship	8.0°
SN:ANS-PNS	5.0°

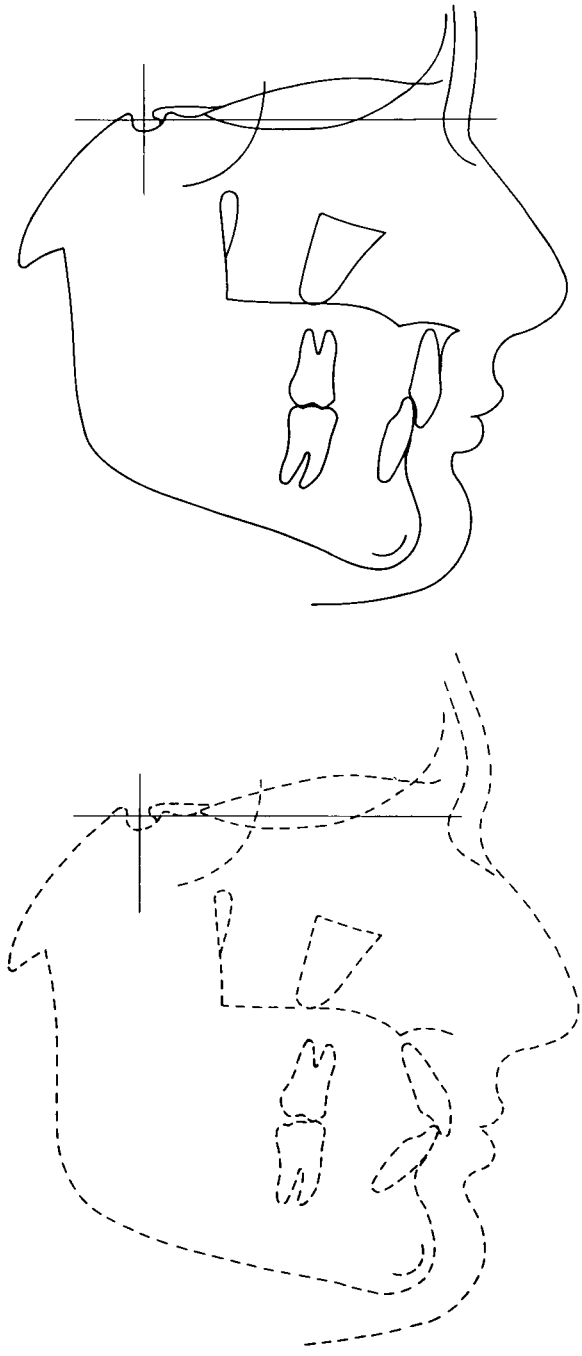
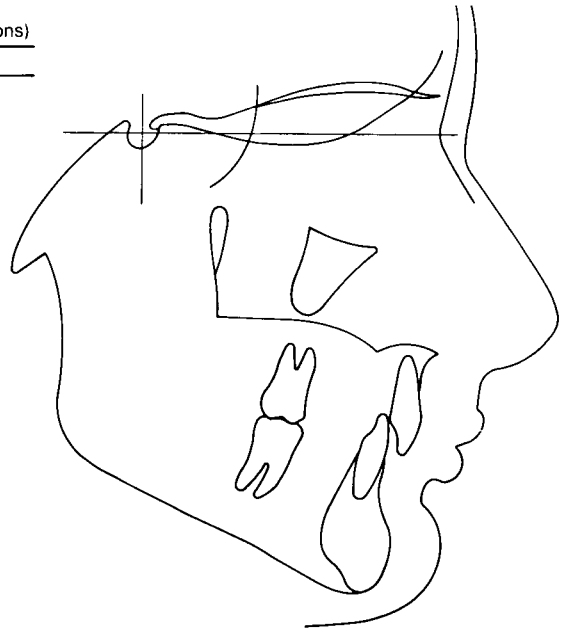


Figure 7

Patient D.B. (four first bicuspid extractions)

Stage	Pre-treatment
SNA	88.0°
SNB	83.5°
ANB Apical base relationship	4.5°
SN:Pog	85.5°
AN:Pog Sagittal jaw relationship	2.5°
1:NA	1.0mm
1:NA	5.0°
$\bar{1}$:NB	2.0mm
$\bar{1}$:NB	10.0°
Pog:NB	6.0mm
1:$\bar{1}$	168.0°
SN:Occ	9.0°
SN:GoGn	22.0°
ANS-PNS:GoGn Vertical jaw relationship	15.0°
SN:ANS-PNS	7.0°



Patient D.B. (four first bicuspid extractions)

Stage	Post-treatment
SNA	86.5°
SNB	85.5°
ANB Apical base relationship	1.0°
SN:Pog	90.5°
AN:Pog Sagittal jaw relationship	-4.0°
1:NA	5.0mm
1:NA	33.0°
$\bar{1}$:NB	3.0mm
$\bar{1}$:NB	24.0°
Pog:NB	8.0mm
1:$\bar{1}$	123.0°
SN:Occ	8.0°
SN:GoGn	16.0°
ANS-PNS:GoGn Vertical jaw relationship	5.0°
SN:ANS-PNS	11.0°

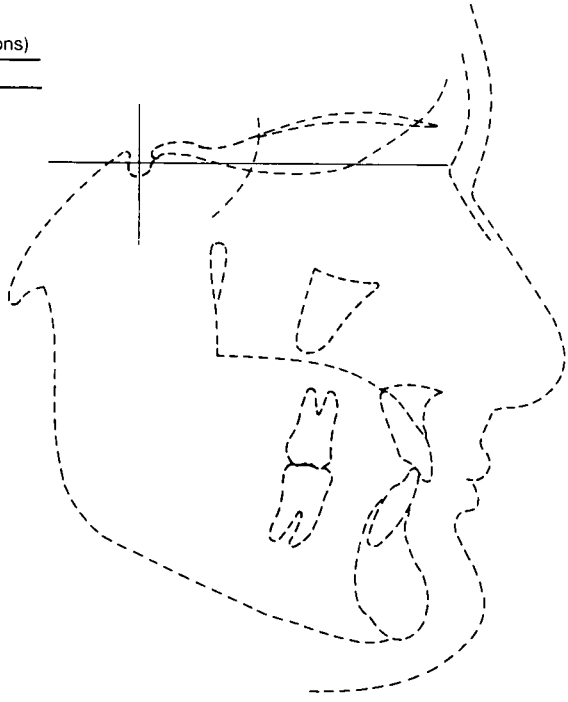


Figure 8

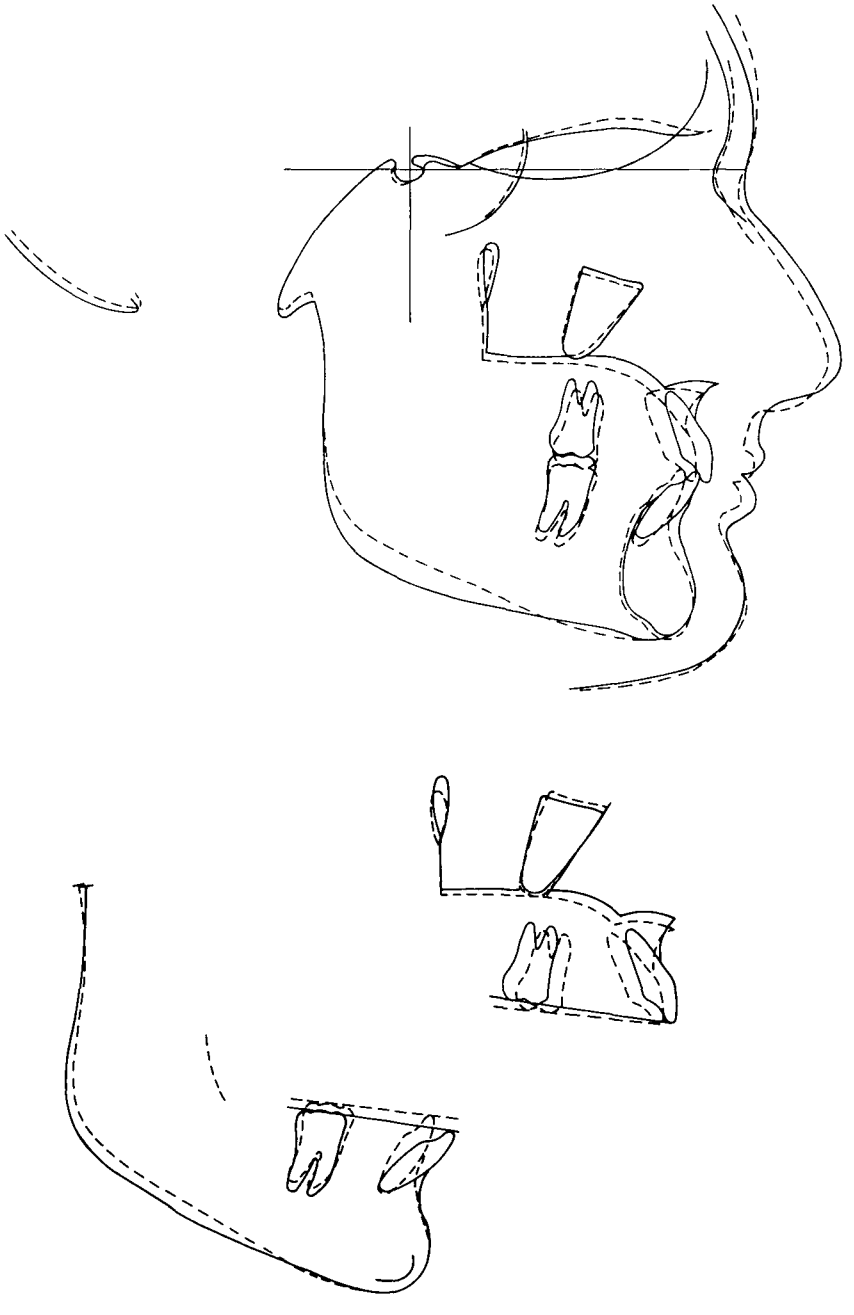


Fig. 9 Posttreatment superimpositions of G.B. (nonextraction, solid lines) and D.B. (four first bicuspid extractions, dashed lines).

While we are well aware of the possible variability within this experimental model, these twin boys do provide a rare opportunity to evaluate two very different treatment approaches to remarkably similar clinical problems.

It appears reasonable to conclude that a patient with a Class II, division 2 malocclusion and arch length insufficiency might be satisfactorily treated either with or without extraction of bicuspids.

The question of extraction in Class II, division 2 malocclusion, as in all malocclusions, seems appropriate only with full consideration of a much broader group of questions —

At what time –
in what ways –
and to what extent –

can we alter dentoalveolar and facial development to make people different from what they would have been without our intervention?

To answer these questions, and ask other meaningful questions, requires more understanding and better control over the biologic processes that contribute to the development of Class II, division 2 malocclusion.

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References

Angle, E. H. 1907. *Malocclusion of the teeth, Ed. 7* S. S. White Dent. Mfg. Co. p.50.

Arvystas, M. G. 1979, Treatment of severe mandibular retrusion in Class II, division 2 malocclusion *Am. J. Orthod.* 76:149-164.

Björk, A.

1955 Facial growth in man studied with the aid of metallic implants. *Acta Odontol. Scand.* 13:9-34.

1963 Variations in the growth patterns of the human mandible: Longitudinal radiographic study by the implant method. *J. Dent. Res.* 42:400-411.

1968 The use of metallic implants in the study of facial growth in children: method and application. *Am. J. Phys. Anthrop.* 29:243-254.

1969 Prediction of mandibular growth rotation. *Am. J. Orthod.* 55:585-599.

Björk, A., and Skieller, V.

1972 Facial development and tooth eruption. *Am. J. Orthod.* 62:339-383.

1976 Postnatal growth and development of the maxillary complex. In *Factors affecting the growth of the midface.* ed. McNamara, J. A., Jr., pp.61-99. Michigan: Ann Arbor.

1977 Growth of the maxilla in three dimensions as revealed radiographically by the implant method. *Br. J. Orthod.* 4:53-64.

Cleall, J. F., and BeGole, E. A. 1982. Diagnosis and treatment of Class II, division 2 malocclusion. *Angle Orthod.* 52:38.

Dietz, V. S., Gianelly, A. A., and Booth, D. F. 1977. Surgical orthodontics in the treatment of a Class II, division 2 malocclusion: a case report. *Am. J. Orthod.* 71:309-316

Hedges, R. B. 1958. Cephalometric evaluation of Class II, division 2. *Angle Orthod.* 28:197.

Hellman, M. 1931. What about diagnosis and treatment? *Inter. J. Orthod.* 17:143.

Hitchcock, H. P.

1976 The cephalometric distinction of Class II, division 2 malocclusion. *Am. J. Orthod.* 69:447.

1977 Treatment of two Class II, division 2 cases. *Am. J. Orthod.* Am. J. Orthod. 71:300-308

Ricketts, R. M., Bench, R. M., Gugino, C. F., Hilgers, J. J., and Schulhof, R. J. 1979. *Bioprogressive therapy*, pp. 183-188. Denver: Rocky Mt. Orthod.

Stoelinga, P. J. W., and Leenen, R. J. 1981. The surgical- orthodontic approach to the Angle Class II, division 2 anomaly. *Oral Surg.* 39:855-859

Strang, R. H. W. 1958. Class II, division 2 malocclusion. *Angle Orthod.* 28:213.

Strang, R. J., and Thompson, W. M. 1958. *Orthodontia,* pp.611- 622. Philadelphia: Lea and Febiger

Timmons, L. S. 1972. Induced change in the antero-posterior relationship of the jaws. *Angle Orthod.* 42:245-251.