To Extract or Not to Extract: Is That the Right Question?

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Terrell Root said, in 1979, "I feel there may be a deterioration in our orthodontic standards. We orthodontists have a moral obligation to our patients, our profession, and ourselves to deliver the highest quality treatment we are capable of providing. It is imperative that orthodontic goals be clear and distinct. We should not lower our goals for illusionary rewards but keep them high and ideal."[1]

Charles Tweed had earlier put it this way, "To remodel a bridge, skyscraper, submarine, aircraft carrier, requires plans that must be closely followed. In addition, there must be tools and 'know-how' to use them. The same is true in orthodontics if your objectives are to remodel the face and create harmonious facial esthetics and stable occlusions for our patients."[1]

Cecil Steiner, in the same vein, added, "We have to have something to judge by and be guided by. We have to have a concept or an ideal, otherwise our cases just might end up looking like a horse or a crocodile."[1]

Orthodontists, they suggest, need to set definite and precise, not approximate or vague, goals for themselves[1]; in their role as therapists, they can never accurately aim at these objectives unless they measure the available space, control anchorage, and evaluate growth possibilities. In their role as skilled operators their objectives should be to obtain results that are:

- Perfect functionally
- Pleasing esthetically
- Stable

From this point of view, "to extract or not to extract" is certainly not the first question that orthodontists should ask themselves in studying the records of a case to be treated. Neither should they wonder, "What's the quickest way to move the teeth?" What they really need to know is, "What's the best anchorage to use in order to accomplish the required tooth movements?"

In other words, they should think "anchorage" and not "tooth movement". It is this concept I'd like to elucidate by presenting a clinical case that illustrates the point well.

Casts made at the beginning of treatment of this 12-year-old female patient show an incisal overbite, a 3mm molar Class II relationship, and a complete Class II canine relationship of 5.5mm (Fig. 1).

The mesial rotations of the upper first molars around their palatal roots contribute 1.5mm each to the Class II molar relationships (Fig. 2A). The crowding of the lower anterior teeth and consequent forward movement of the cuspids explain why their Class II position is more severe than that of the molars (Fig. 2B). The curve of Spee measures only 1mm, but the lower second molars have not yet fully erupted (Fig. 2C). The profile cephalogram and the panoramic x-ray confirm the existence of a Class II relationship, the posterior crowding, and an anterior protrusion (Fig. 3).

The transfer records included no treatment plan beyond the laconic comment "nonextraction treatment with a full-banded .022" × .028" set-up". So we proceeded, first, with a clinical extraoral examination. We noted a retrusive profile, a prominent lower lip, and an excessive naso-menton angle (Fig. 4).

The intraoral examination, at the time of transfer, showed a Class II sagittal relationship, a

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Fig. 1 12-year-old female patient before original orthodontic treatment.

Fig. 2 A. Maxillary arch before treatment. B. Mandibular arch before treatment. C. Curve of Spee before treatment.

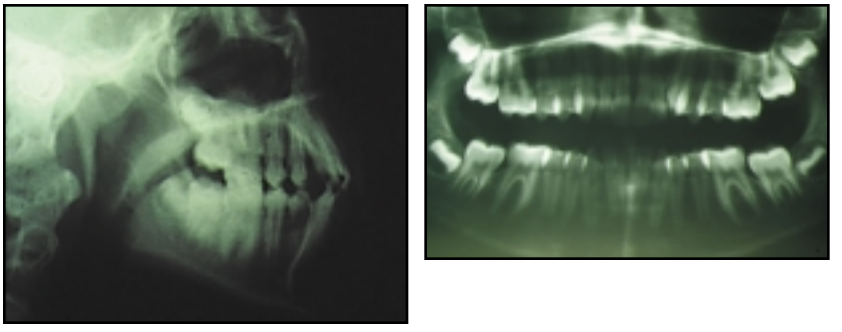


Fig. 3 Radiographic records before treatment.

persistence of the mesial rotations of the upper first molars, and an improvement in the incisal overbite resulting from torque correction of the maxillary incisors (Fig. 5). It also, unhappily, showed that the lower incisors, which had been inclined forward to begin with, had tilted still further labially, even though no Class II correction at all had been attained.

The casts revealed a status quo of the sagittal maxillomandibular relationship, an increase of 2mm in the curve of Spee, and unresolved posterior crowding (Fig. 6). The excessively forward position of the lower incisors put them at risk for periodontal disease and made them ineffective in serving as anterior guides in protrusive movements of the mandible. The absence of torque control in the unbracketed buccal segments as well the lack of canine protection also made free lateral excursion, unencumbered by cuspal obstruction, impossible.

The radiographs confirmed our clinical impressions (Fig. 7A). The cephalometric analysis revealed that the mandible was more retruded than the maxilla was protruded with the maxillary incisors in correct position. The lower incisors, judging by the Tweed analysis of their 104° inclination to the mandibular plane, were less inclined labially than the Steiner analysis—9.5mm and 38° to NB—would suggest. This results from a hyperdivergence, which is confirmed by the FMA of 31° and the GoGn/Sn of 36° (Fig. 7B).

Fig. 4 Facial photographs at time of transfer.

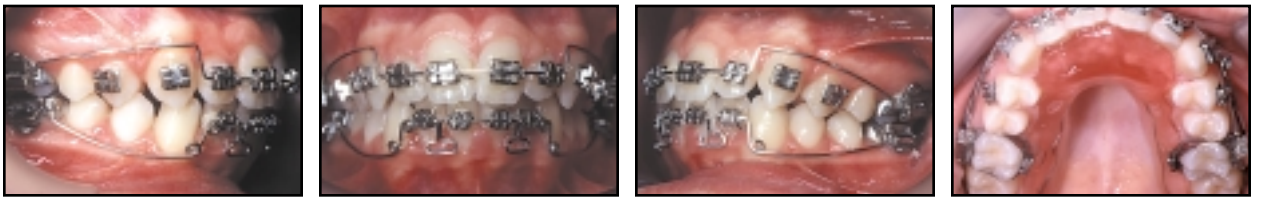


Fig. 5 Intraoral photographs at time of transfer.

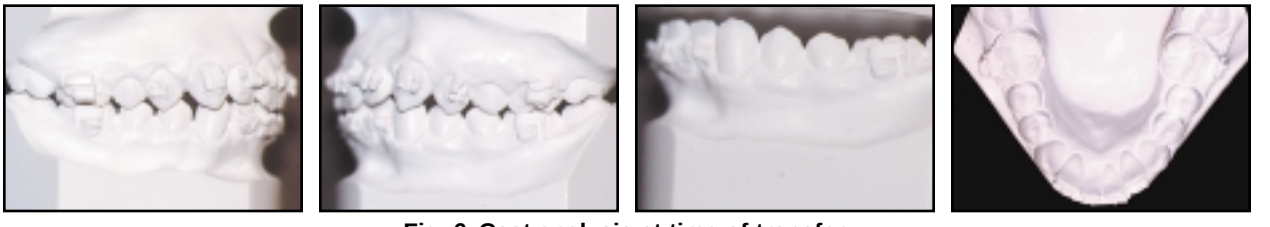


Fig. 6 Cast analysis at time of transfer.

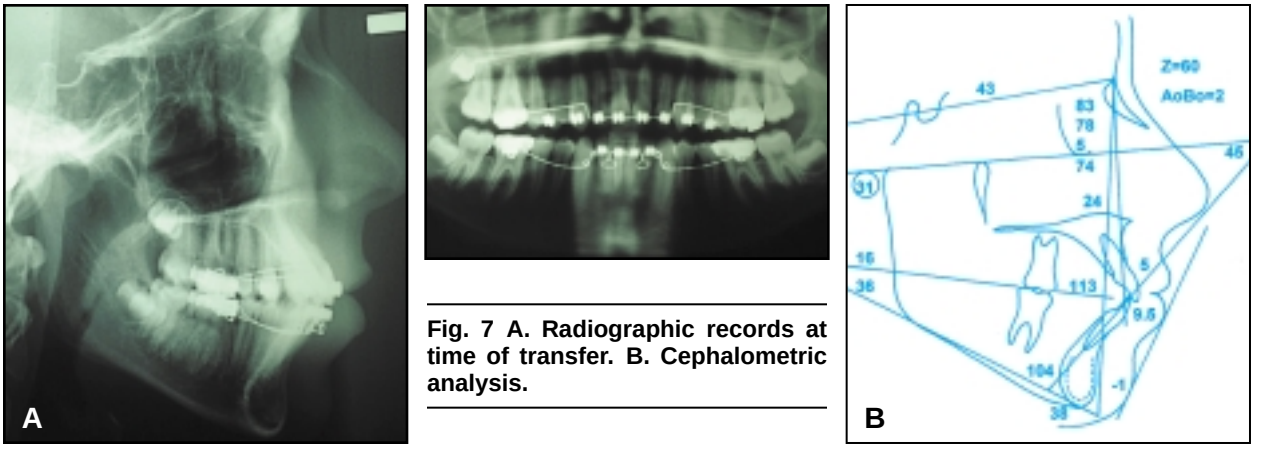


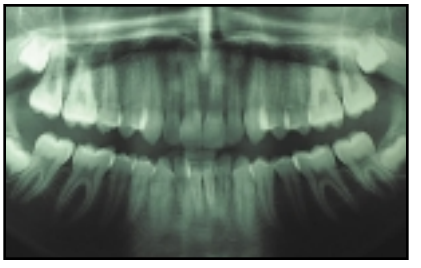
Fig. 7 A. Radiographic records at time of transfer. B. Cephalometric analysis.

Fig. 8 Patient after appliance removal to test stability.

Fig. 9 Nine months after appliance removal.

Fig. 10 Occlusal views and curve of Spee nine months after appliance removal.

Fig. 11 Comparison of mandibular casts. A. Before initial treatment. B. After transfer. C. Nine months after appliance removal.



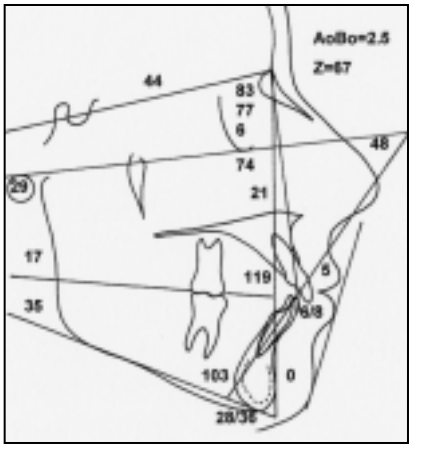


Fig. 12 Radiographic records and cephalometric analysis nine months after appliance removal.

We then removed the appliances for a nine-month period to test the stability of the "result" that had thus far been obtained, explaining to the patient that the intermediate equilibrium could serve as a basis for a new analysis to resume treatment (Fig. 8). The Class II molar (3mm) and canine (5.5mm) relationships did not change during this observation period (Fig. 9).

In Figure 10, we can see that the anterior dentomaxillary disharmony has returned and now actually exceeds its original value (4mm). The second molars have erupted, and the curve of Spee has increased to 2mm. The three occlusal views show the changes in the lower arch from the beginning of the initial treatment (Fig. 11A) to the conclusion of the pre-transfer phase, after the leveling had been accomplished at the cost of tipping the lower anteriors labially (Fig. 11B), and, finally, the relapse nine months after the removal of the appliance (Fig. 11C).

The cephalometric analysis shows that the relapse has affected the interincisal angle as well as the relationship of the lower incisors to NB, and has decreased divergence at the angle formed by the mandibular plane with FMA as well as the angle with GoGn/SN (Fig. 12). Hence, the orthodontic mechanics employed did not control the vertical dimension.

I base my objectives on Steiner's standards[2,3] (Fig. 13), as modified by Root in his anchorage chart[4] (Table 1). Nine months after

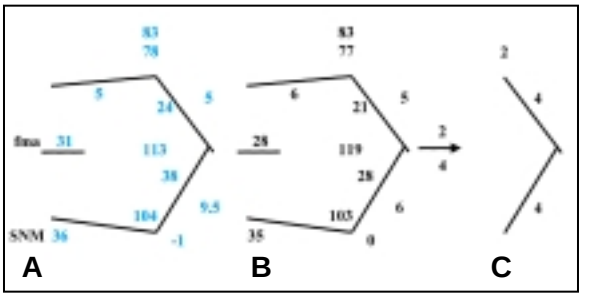


Fig. 13 Steiner Analysis. A. At time of transfer. B. Nine months after appliance removal. C. Treatment goal.

TABLE 1
ROOT SPACE ANALYSIS

		+	–
1.	Curve of Spee		2
2.	Crowding		4
3.	Incisal repositioning (ii/if × 2)		4
4.	Mesial molar movement (lines 2+3/6)		1
5.	Reduction of ANB	R	6
6.	Hyper/hypodivergent (± 8°)		
7.	Palatal bar	1	
8.	Delay of extractions		
9.	Space gained from extractions	15	3
10.	Total	16	20
11.	Net (severity factor)		4
12.	TIM Class III	2	
13.	EOE	2	

appliance removal, to insure that our treatment would attain them, I evaluated the maxillary and mandibular anchorage requirements and determined that extraction of the four first premolars would provide 12 anchorage units, which would fall short of the amount required. So the patient's active collaboration would have to be enlisted in these ways:

- She would wear Class III elastics for two months in the beginning of the second treatment stage (step 2).
- For the first year, she would wear high-pull headgear to help control the vertical dimension, as a supplement to the transpalatal anchorage bar.
- A space of 3mm would be preserved on each side so that the ANB angle could be reduced with Class II mechanics in the sixth stage (step 6).

The first stage (step 1) could begin; its goal was to level and stabilize the maxillary arch. All the maxillary teeth were bonded, but extraction of the upper first premolars was delayed during this stage to preserve anchorage. With an .018" × .018" nickel titanium wire (Fig. 14), we leveled the arch, established torque, and tipped the crowns of the upper second molars 15° distally (Fig. 15). We then successively placed preformed archwires of .017" × .025" nickel titanium and .018" × .025" stainless steel to work in brackets that already had 1st-, 2nd-, and 3rd-order bends incorporated in them, which, of course, required scrupulous care in their placement.

At the end of this stage (step 1), after the 2nd-order bends had worked out, we stabilized the maxillary arch with an .018" × .025" stainless steel archwire with tiebacks on the omega loops. Extractions of the four bicuspids could then be carried out as planned in our pretreatment anchorage chart (Fig. 16).

We cemented a transpalatal bar (Fig. 17A), and the patient began wearing high-pull headgear (Fig. 17B) as a means of controlling vertical alveolar and maxillary growth and of reinforcing anchorage preparation with Class III elastics, which we began after extractions of the lower bicuspids. In this stage (step 2), the crowded lower anterior teeth, which we did not bracket to be sure they didn't tip labially, began to realign spontaneously (Fig. 17C). The first .018" square

Fig. 14 Step 1: .018" × .018" nickel titanium maxillary appliance.

Fig. 15 Step 1: Four weeks later.

Fig. 16 .018" × .025" stainless steel archwire with tiebacks after first bicuspid extractions.

Fig. 17 A. Transpalatal bar. B. High-pull headgear. C. Spontaneous alignment of mandibular arch.

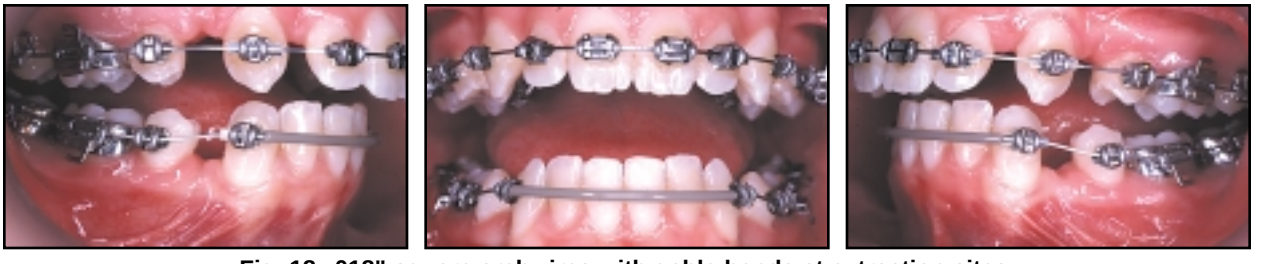


Fig. 18 .018" square archwires with gable bends at extraction sites.

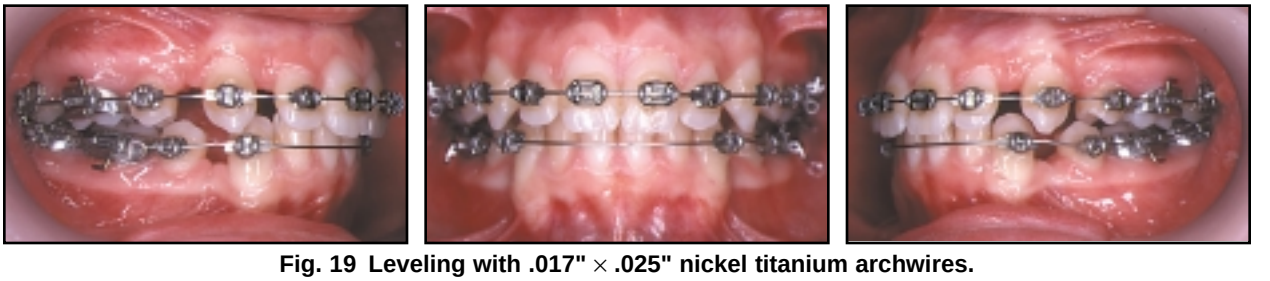


Fig. 19 Leveling with .017" × .025" nickel titanium archwires.

archwire had gable bends at the extraction sites (Fig. 18).

Next, we leveled the curve of Spee with an .017" × .025" nickel titanium archwire (Fig. 19). Then, for the planned two-month period, our patient wore Class III elastics to a stainless steel .018" × .025" mandibular archwire (Fig. 20).

In the third, lower cuspid retraction stage

Fig. 20 Class III elastics worn to stainless steel .018" × .025" mandibular archwire.

Fig. 21 .017" × .025" nickel titanium archwires with steeple-bend "V" loops at extraction sites; lower cuspid retraction with .010" × .040" reciprocal-action coil spring.

Fig. 22 After bonding of lower anterior teeth.

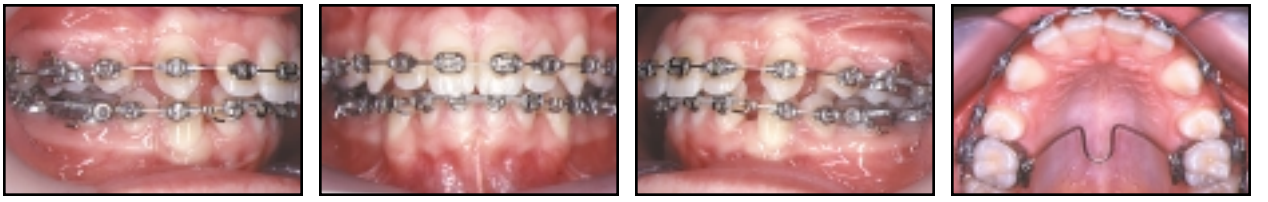


Fig. 23 Lower .018" square nickel titanium archwire and upper transpalatal arch (Class III mechanics).

(step 3), we leveled the buccal segments and stabilized them with figure-8 ligatures. We then placed an .017" × .025" nickel titanium archwire that had steeple-bend "V" loops at the extraction sites (Fig. 21). We began retracting the lower cuspids with an .010" × .040" reciprocal-action coil spring while conserving the maxillary anchorage that would later be required for proper distalization of the maxillary cuspids, as called for in the treatment plan. It should be pointed out that this retraction technique disposed of one-sixth of the dentomaxillary discrepancy, augmenting the incisal repositioning. At this time, after the spontaneous alignment of the lower

Fig. 24 Lower .018" × .025" stainless steel archwire with omega bends mesial to second molars.

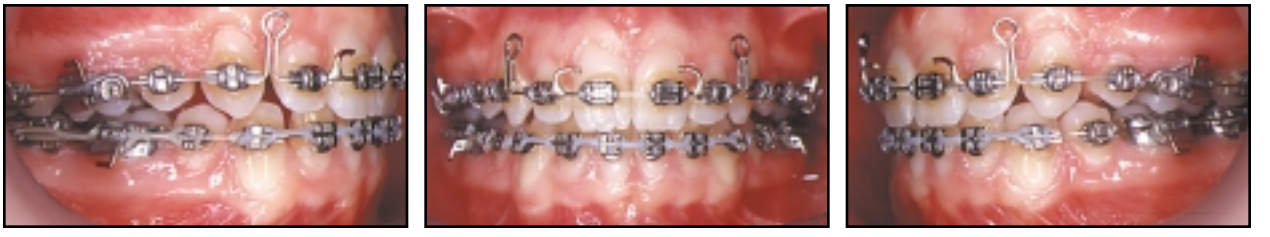


Fig. 25 Upper .018" × .024" stainless steel archwire with retraction loops between canines and incisors.

Fig. 26 Comparison of mandibular occlusal views. A. After removal of original appliance. B. Nine months later. C. After extraction of first premolars.

incisors, it was possible to bracket them and include them in the strapup for overall arch leveling (Fig. 22).

We continued the Class III mechanics, with an .018" square nickel titanium mandibular arch and an upper transpalatal arch in place (Fig. 23), to prevent labial tipping of the anterior teeth (modified step 4).

We then stabilized the lower arch with an .018" × .025" stainless steel archwire with omega bends mesial to the second molars (step 5, Fig. 24).

A full Class I molar relationship having been obtained, we could then begin retracting the upper anterior teeth using a minimum of Class II mechanics, because, as a cephalogram confirmed, the lower extraction spaces had largely been used up in the retraction of the mandibular incisors. High-pull headgear, affixed to J-hooks on an .018" × .024" stainless steel archwire with retraction loops between the canines and the incisors (Fig. 25), assured the maintenance of good torque control (step 6).

In comparing three occlusal views of the mandible, one taken when we removed the original appliance (Fig. 26A), another nine months later (Fig. 26B), and the third after the extraction of the lower first premolars (Fig. 26C), we can see that the musculature imposes stability upon the mandibular incisors.

After canine retraction (Fig. 27A), leveling (Fig. 27B), and incisor retraction (Fig. 27C), it

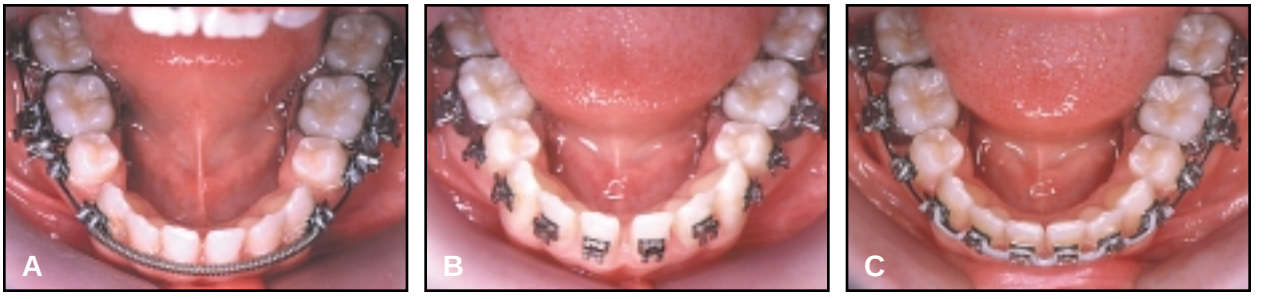


Fig. 27 Comparison of mandibular occlusal views. A. After canine retraction. B. After leveling. C. After incisor retraction.

Fig. 28 Progress facial photographs.

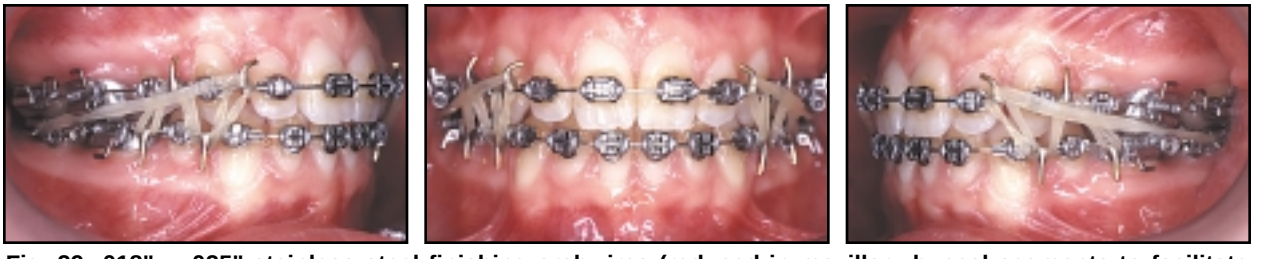
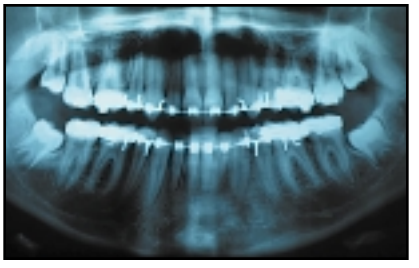


Fig. 29 .018" × .025" stainless steel finishing archwires (reduced in maxillary buccal segments to facilitate application of vertical elastic traction).

was important that none of the mechanics we employed should alter the intercanine distance.

Having determined by extraoral examination that the nose, lip, and chin had been placed in a harmonious relationship (Fig. 28), we began final alignment procedures using .018" × .025" stainless steel archwires, reduced in the maxillary buccal segments to facilitate the application of vertical elastic traction to finish intercuspation between the arches[5] (Fig. 29).

Radiographic examination at the close of treatment shows that good skeletal and dental Class I relationships had been achieved, that the mandibular incisors were correctly positioned, and that vertical dimension had been adequately controlled, which, in turn, had allowed for proper forward rotation of the mandible—an essential element in treatment of Class II cases (Fig. 30).



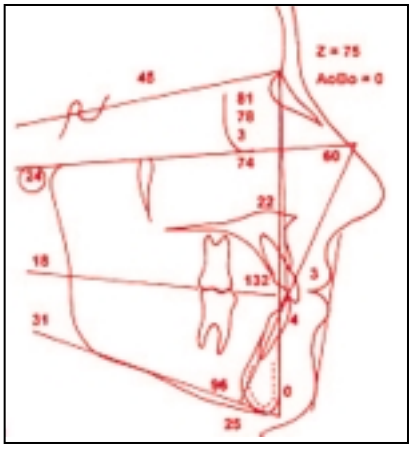


Fig. 30 Radiographic records and cephalometric analysis after 31 months of post-transfer treatment.

TABLE 2
CEPHALOMETRIC DATA

	Time of Transfer	After Relapse	After Treatment
SNA	83°	83°	81°
SNB	78°	77°	78°
ANB	5°	6°	3°
1-NA	5.0mm	5.0mm	3.0mm
1-NA	24°	21°	22°
1-NB	9.5mm	8.0mm	4.0mm
1-NB	38°	36°	25°
SL	43°	44°	45°
AoBo	2.0mm	2.5mm	0.0mm
1-1	113°	119°	132°
SN-M	36°	35°	31°
FMA	31°	29°	24°
FMIA	45°	48°	60°
IMPA	104°	103°	96°
Z	60°	67°	75°

Table 2, which gives basic cephalometric data, attests that the achieved skeletal and dental positions closely approximated those we anticipated. I have provided a resume of our treatment in Figure 31.

Figures 32 and 33 provide a comparison of the lateral headfilms and panoramic x-rays taken at the time of transfer (A), after the relapse (B),

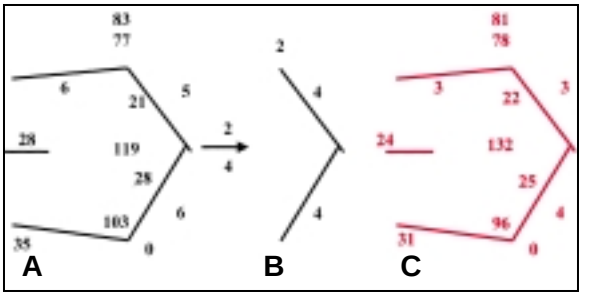


Fig. 31 Steiner Analysis. A. Beginning of second phase of treatment. B. Treatment goal. C. Final result.

and after the completion of the second treatment (C). It is interesting and instructive to superimpose the cephalometric tracings made after the first treatment (Fig. 7B), after the relapse (Fig. 12), and after the retention period of the second treatment (Fig. 34).

After active treatment, as the third molars were erupting, the patient wore a bonded 3-3 lower lingual arch and upper and lower Hawley retainers (Fig. 35).

Post-treatment casts demonstrate that we reached our treatment objectives, respecting Andrews's keys to occlusion and the stability criteria described by Schudy[6] (Fig. 36). Archforms are symmetrical, the curve of Spee is level, and the intercanine distance, a critical element of treatment stability in all orthodontic treatment,

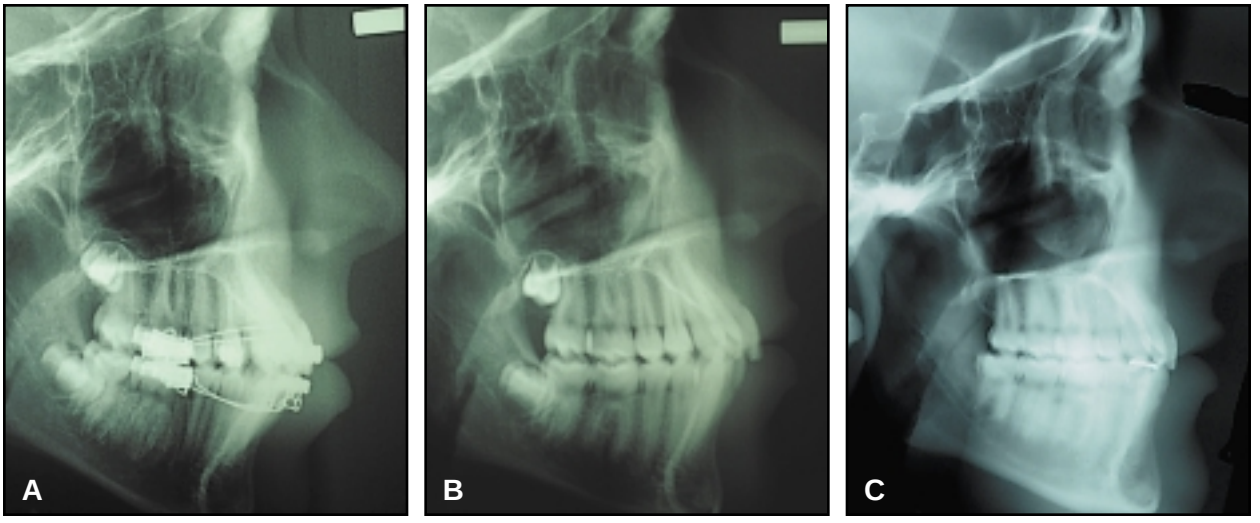


Fig. 32 Comparison of lateral headfilms. A. At time of transfer. B. Nine months after appliance removal. C. After second phase of treatment.

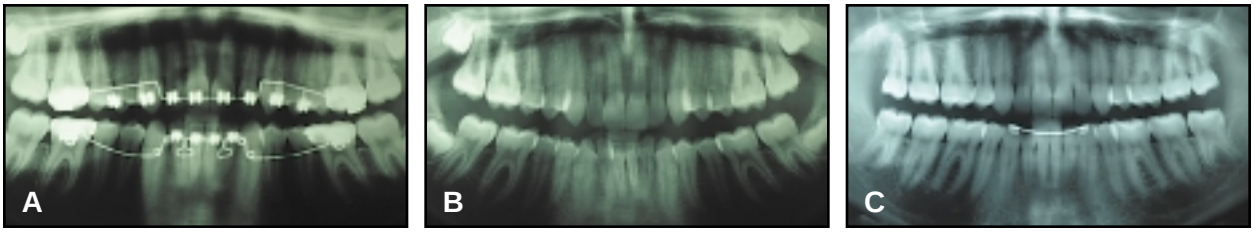


Fig. 33 Comparison of panoramic x-rays. A. At time of transfer. B. Nine months after appliance removal. C. After second phase of treatment.

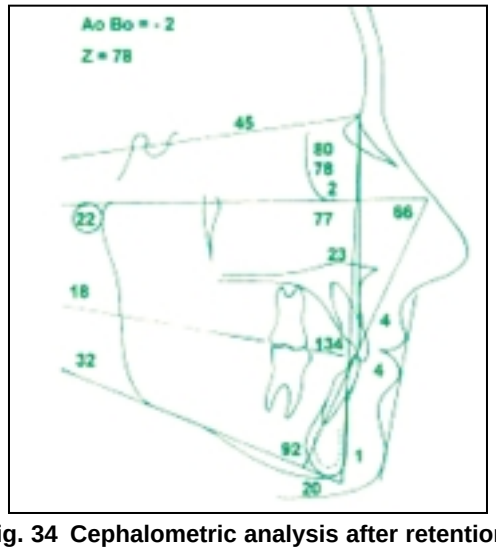


Fig. 34 Cephalometric analysis after retention.

has been fully respected (Fig. 37).

A strict observance of the rules of occlusion, guaranteed both by canine protection and by the absence of interference on the non-working side during all three excursive movements, constitutes the attainment of another of our treatment objectives (Fig. 38).

An examination a year later revealed that the occlusion had remained stable (Fig. 39). After another year, the upper third molars had erupted (Fig. 40).

Two and a half years after removal of the appliances, the third molars were functioning in good, healthy positions (Fig. 41). The arches had remained stable, and the curve of Spee remained flat (Fig. 42).

The esthetic results, as well as the cephalo-

Fig. 35 Bonded 3-3 lower lingual retainer and upper and lower Hawley retainers.

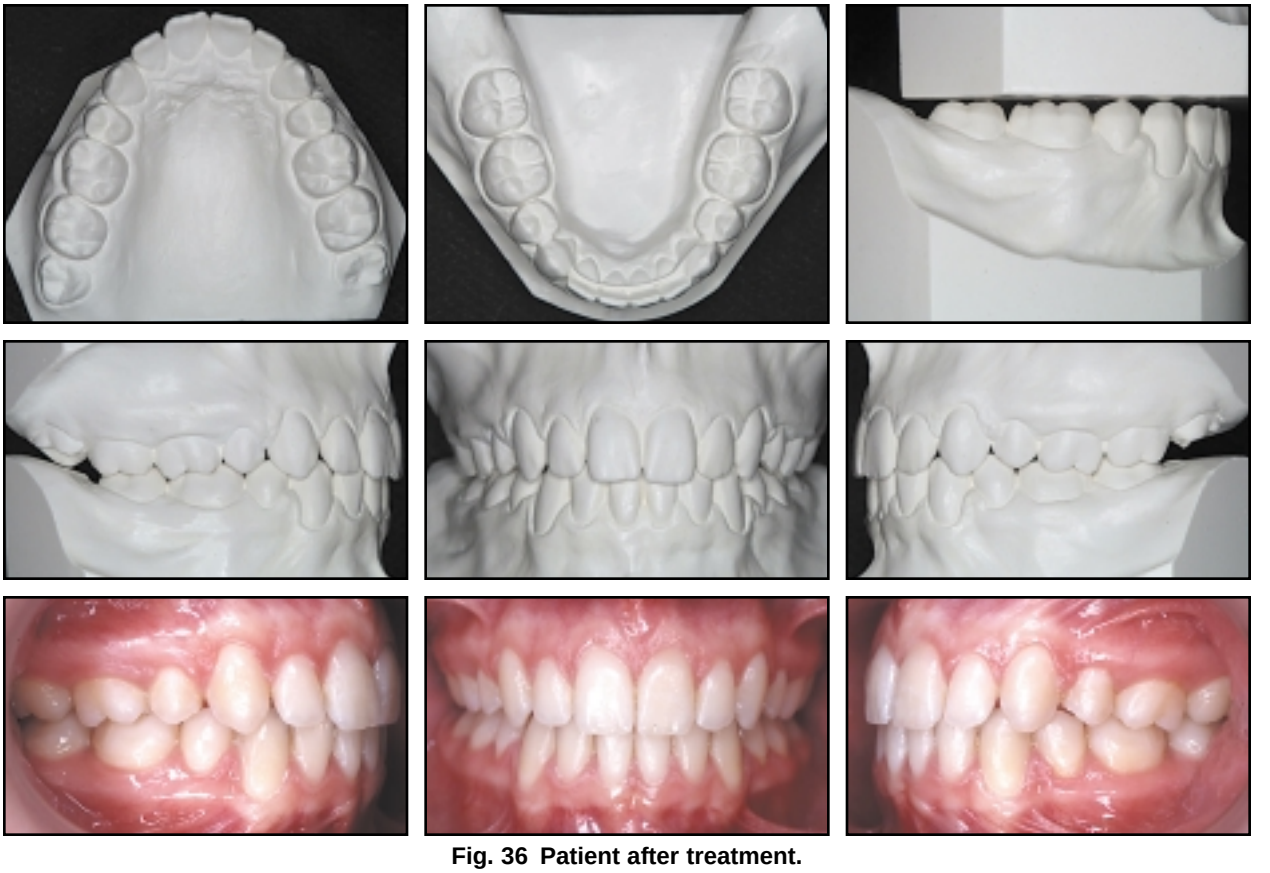


Fig. 36 Patient after treatment.

Fig. 37 Intercanine distance. A. Before treatment. B. Progress. C. After treatment.

Fig. 38 Absence of interference on non-working side during all three excursive movements. A. Right, working side. B. Right, non-working side. C. Left, non-working side. D. Left, working side. E. Protrusive.

Fig. 39 Patient one year after treatment.

Fig. 40 Patient two years after treatment.

Fig. 41 Patient two and a half years after treatment.

metric findings at the close of the retention period,[5] would, without doubt, have pleased Charles Tweed and Terrell Root, who set themselves the goal of treating their cases to a lower incisor-to-Frankfort-horizontal (FMIA) angle of 67° (Figs. 34,43).

Conclusion

Now, as we finish this case analysis, I think we can construct a useful answer to the question posed at the beginning in the title, "To extract or not to extract", by affirming that it is definitely not the right question.

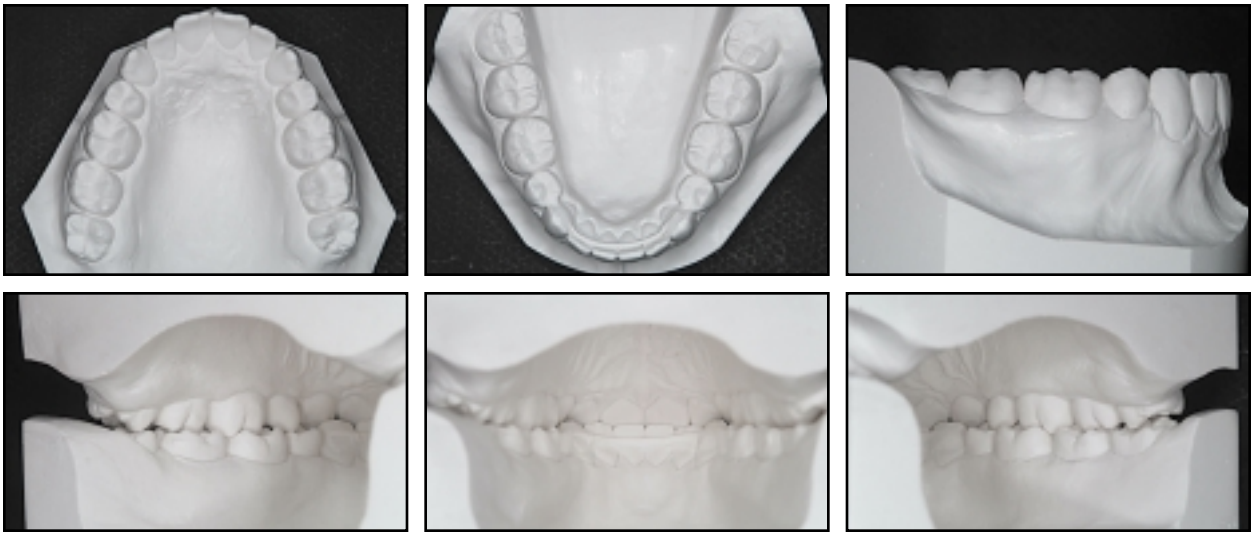


Fig. 42 Cast analysis two and a half years after treatment.

Fig. 43 Facial photographs two and a half years after treatment.

If the objectives of orthodontic treatment are to obtain perfect function, an agreeable facial appearance, and a stable result, it is essential that orthodontists establish careful treatment plans and formulate objectives that incorporate each patient's individual anchorage requirements. Using these anchorage needs as criteria, orthodontists can make case-by-case decisions about whether extractions should be a part of the individual treatment plan.

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