The PIT and the Pendulum: Pendulum-Integrated TADs

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The Pendulum* family of appliances, including the Mini-Distalizing Appliance (MDA) and the Pendex, have proven effective in broadening the upper arch, distalizing upper molars (especially when the second and third molars are not fully erupted), and creating arch length. Depending on the facial muscular pattern and the appliance used, a clinician can reliably predict two-thirds distal molar movement vs. one-third anchorage loss in the rest of the arch.

Once the molars are distalized, the problem has always been how to employ effective anchorage for anterior retraction without round-tripping. Until the advent of temporary anchorage devices (TADs), the techniques available for molar stabilization required patient compliance and usually involved some forward movement of the lower arch. Now, the miniscrew has become a "silver bullet" for many Class II cases. Used properly, TADs can, for the first time, create predictable anchorage in the maxillary arch, approaching 100% effectiveness.

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Fig. 1 Wide interradicular space opened by Mini-Distalizing Appliance (MDA) for placement of buccal miniscrew.

An MDA facilitates TAD placement with little risk of impingement, even for novice clinicians (Fig. 1). Since the upper molars are not severely tipped while being moved into overcorrected Class I positions, they will settle and upright as the anterior segment is consolidated and retracted.

The four cases shown here illustrate en masse

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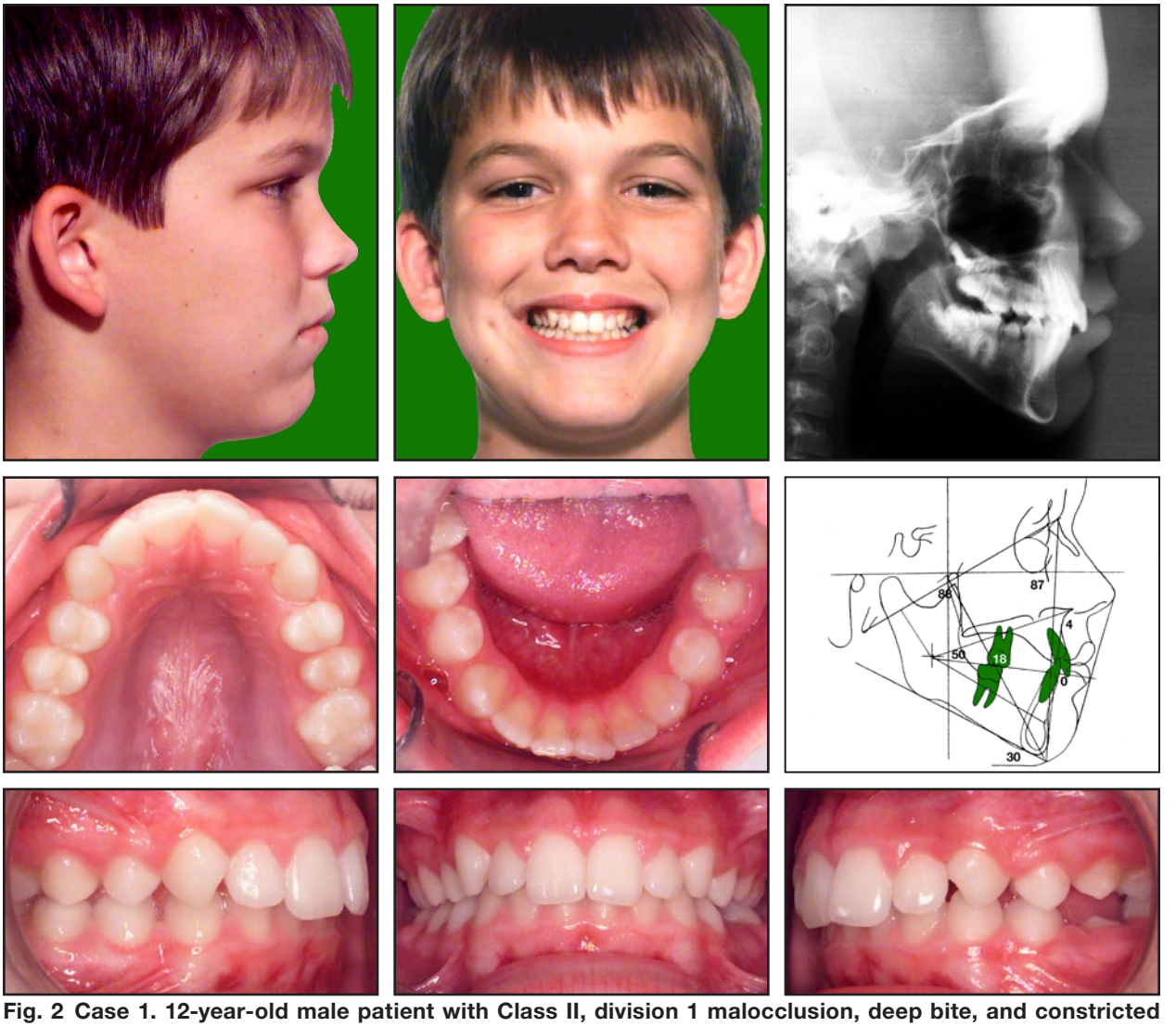

Fig. 2 Case 1. 12-year-old male patient with Class II, division 1 malocclusion, deep bite, and constricted upper arch before treatment.

retraction using direct and indirect skeletal anchorage following molar distalization with a Pendulum appliance for correction of Class II malocclusion and deep bite. We refer to this combination of appliances as PIT (Pendulum-Integrated TADs).

Case 1: Direct Anchorage from Buccal TADs

A 12-year-old male presented with a Class II, division 1 malocclusion and a deep bite (Fig. 2). Clinical examination revealed good facial symmetry, no crowding, ideally positioned lower incisors, and a constricted upper arch.

The treatment plan was to expand the upper arch and distalize the upper molars using an MDA (Fig. 3), maintain the lower-incisor angulation, and avoid the use of Class II elastics. Miniscrew anchorage would be used to intrude and retract the anterior segment (stabilized by the canines), allow molar uprighting during retraction, and permit the upper buccal segments to drift distally with little anchorage loss (Figs. 4-6).

Total treatment time was 15 months (Fig. 7).

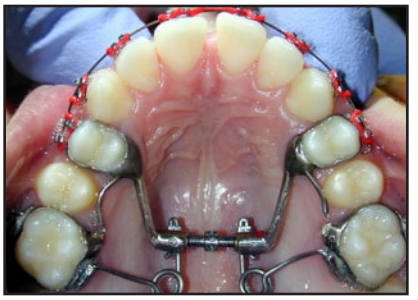

Fig. 3 Case 1. MDA activated once daily by patient for three weeks. After expansion, lingual stabilizing wire severed with crown-cutting bur to release preactivated TMA* Pendulum springs and begin distalization of upper first molars. Anterior spaces closed with elastic chain applied to segmented upper archwire.

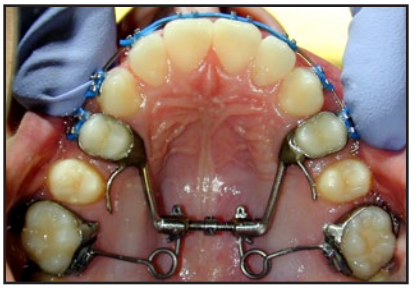

Fig. 4 Case 1. Expansion and distalization completed after three months of treatment. Although MDA is anchored by dentition rather than palatal acrylic button, any forward movement of buccal segments is limited by miniscrew anchorage.

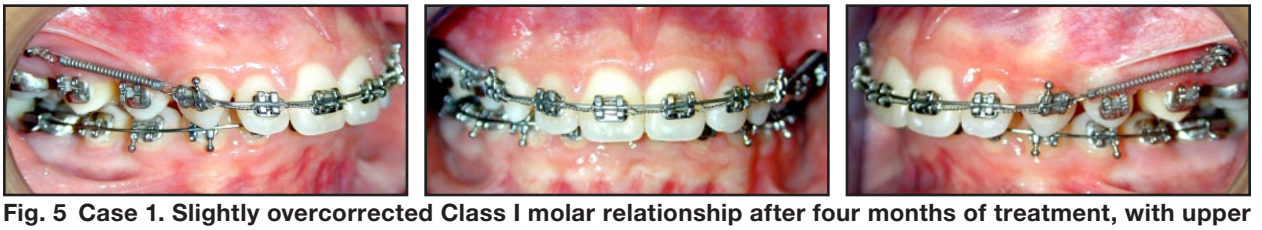

Fig. 5 Case 1. Slightly overcorrected Class I molar relationship after four months of treatment, with upper canines still in Class II relationship and deep overbite; brackets bonded to begin leveling in lower arch. Upper anterior retraction and intrusion carried out using 10mm closed-coil springs attached to upper canines and 8mm miniscrews in buccal interradicular spaces between upper left and right second premolars and first molars; .016" × .022" segmental wire securely ligated from upper canine to upper canine for torque control. With no friction from archwire in premolar region, buccal segments can drift into Class I positions. Four months later, with upper spaces closed, upper .016" × .016" nickel titanium leveling archwire was placed to enhance molar rotation, archform, and torque control. Miniscrews were removed at completion of intrusion and retraction, after 11 months of treatment (we typically remove miniscrews at this point if occlusion is solid Class I).

Fig. 6 Case 1. Further arch leveling and bite opening after 12 months of treatment, with ideal upper .016" × .022" stainless steel archwire in place (and no elastics worn to this point). Trauma from skateboarding accident had affected upper right lateral incisor, which was observed through remainder of treatment for possible root-canal therapy and whitening.

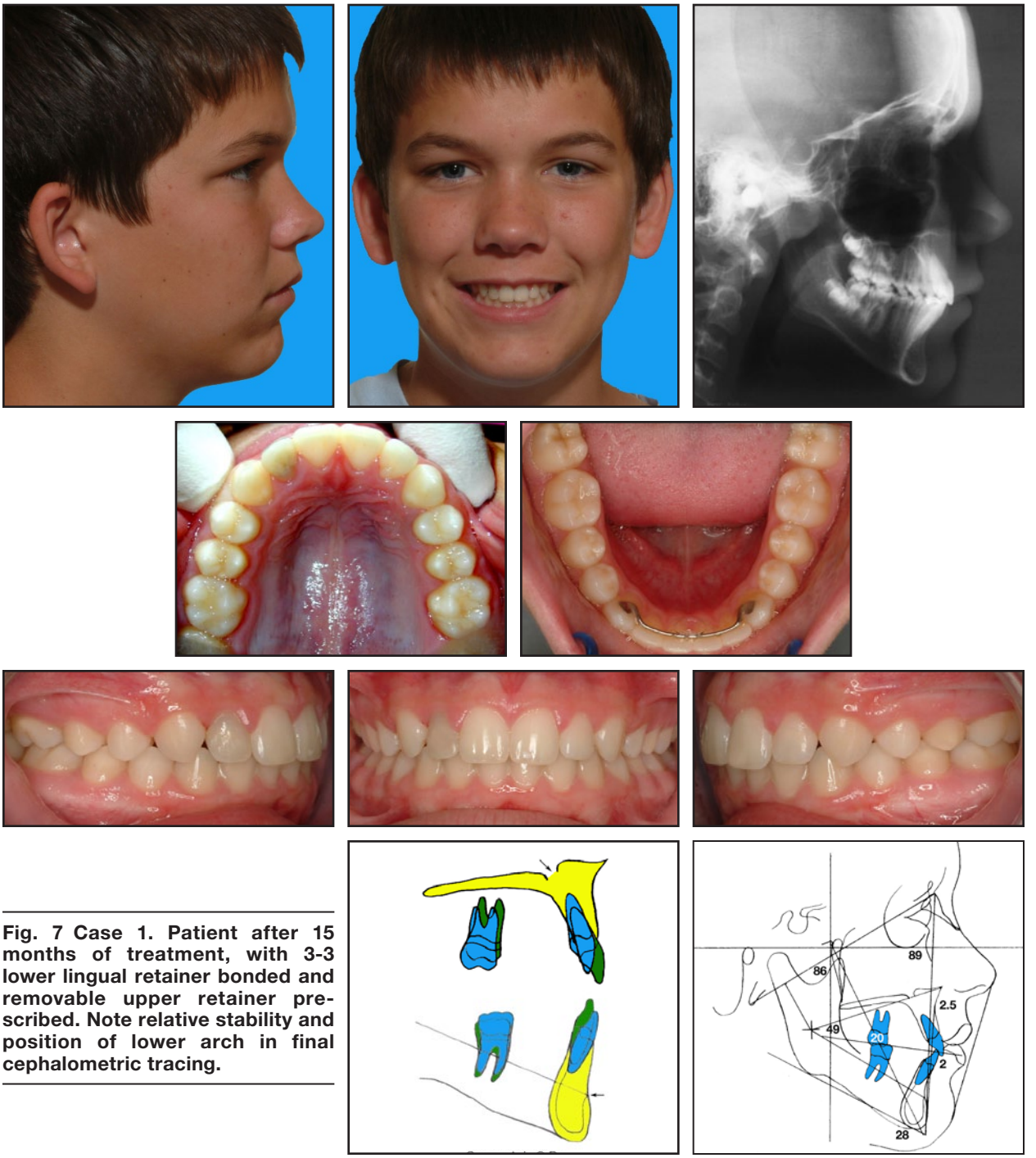

Fig. 7 Case 1. Patient after 15 months of treatment, with 3-3 lower lingual retainer bonded and removable upper retainer prescribed. Note relative stability and position of lower arch in final cephalometric tracing.

Case 2: Indirect Anchorage from Lingual TADs

A 13-year-old female presented with a brachyfacial skeletal pattern, a Class II, division 2 malocclusion, and a deep bite (Fig. 8). She showed moderate maxillary dental protrusion, a normally positioned lower arch, and moderate crowding.

The treatment plan involved distalization of the upper molars into a slightly overcorrected Class I position with a Pendulum appliance (Fig. 9). Lingual TADs would then be inserted distal to the upper first molars and ligated to lingual sheaths to apply indirect anchorage for en masse retraction of the anterior teeth (Figs. 10-11).

Total treatment time was 17 months (Fig. 12).

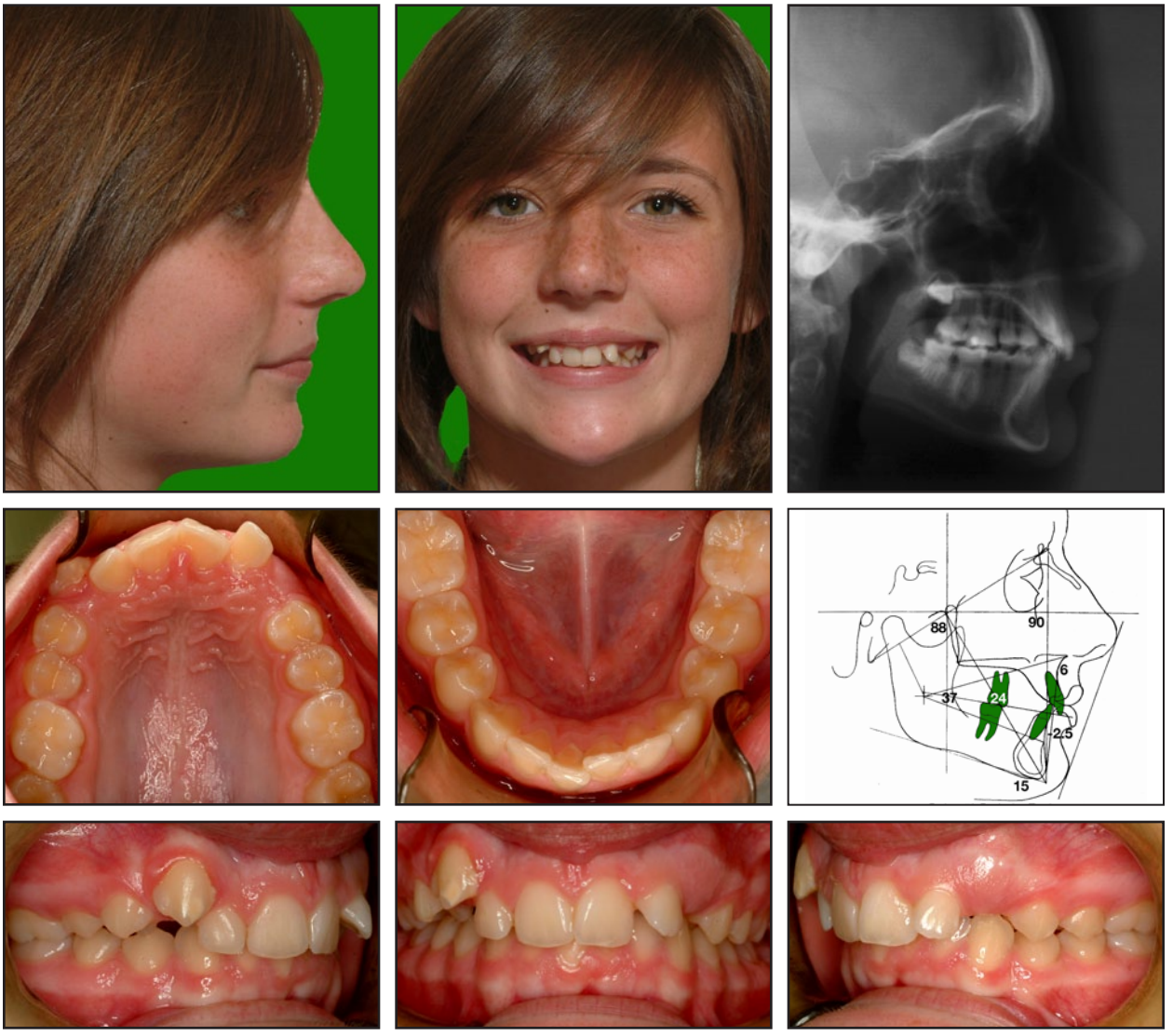

Fig. 8 Case 2. 13-year-old female patient with brachyfacial skeletal pattern, Class II, division 2 malocclusion, deep bite, and moderate maxillary dental protrusion before treatment.

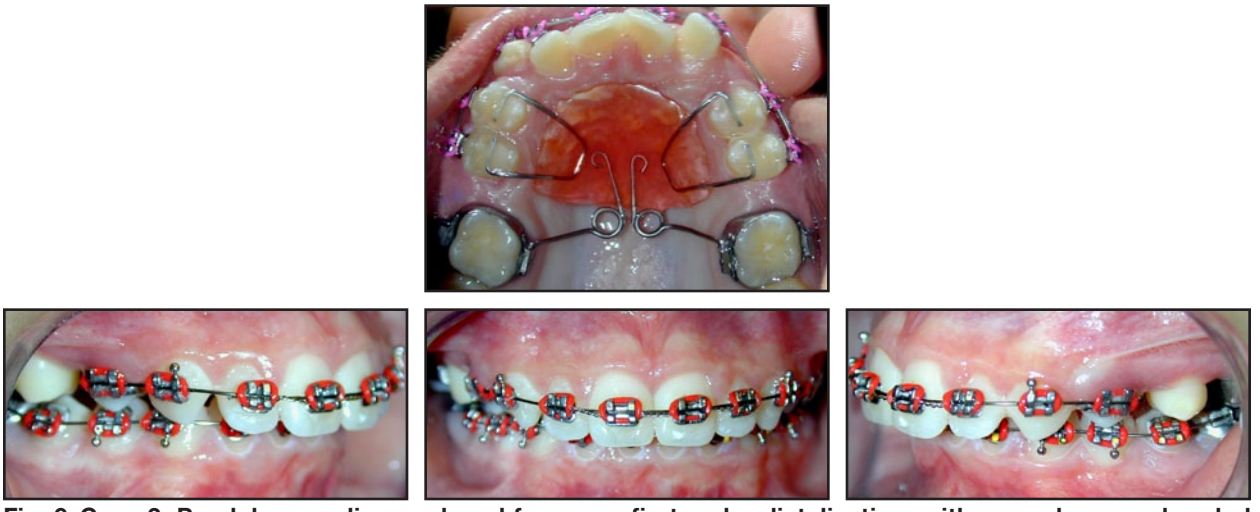

Fig. 9 Case 2. Pendulum appliance placed for upper first molar distalization, with premolar arms bonded to occlusal surfaces and palatal acrylic button used for anchorage.

Fig. 10 Case 2. A. Molar relationship slightly overcorrected after two months of treatment. Continuous archwire placed in upper arch, with stops crimped mesial to molars to maintain their positions, allowing removal of Pendulum appliance without risk of anchorage loss. B. Six weeks later, 6mm lingual miniscrews ligated to lingual sheaths on upper molars to provide indirect anchorage for upper-arch leveling and alignment. Another three months later, lower arch was bonded for alignment and bite opening, and en masse upper retraction was begun using elastomeric chain.

Fig. 11 Case 2. Ideal .016" × .022" stainless steel archwires placed to coordinate arches and detail occlusion after 15 months of treatment.

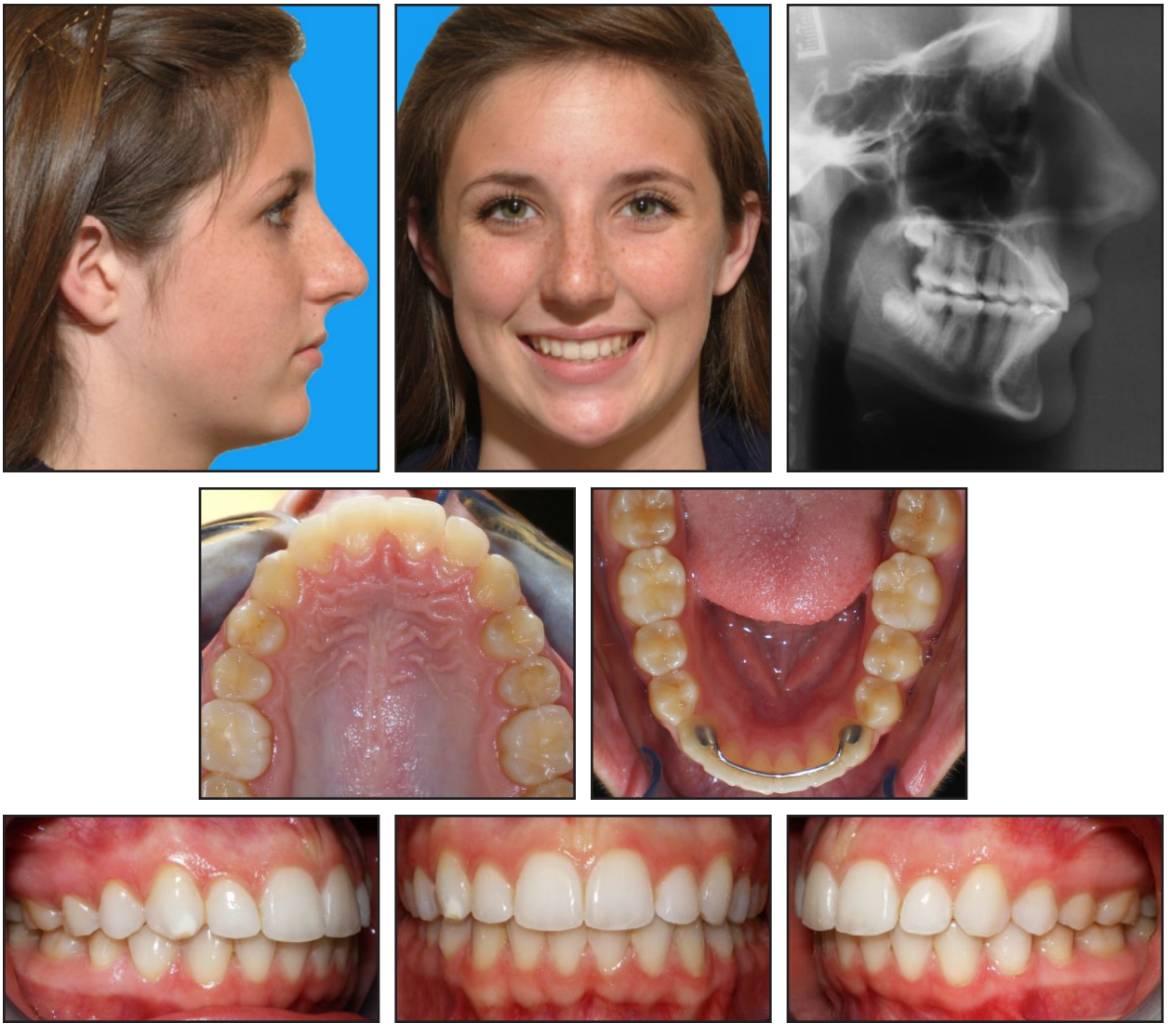

Fig. 12 Case 2. Patient after 17 months of treatment, including eight months of retraction using skeletal anchorage, with 3-3 lower lingual retainer wire bonded and upper removable retainer prescribed. Note balanced occlusion and arch positions when Class II malocclusion is corrected without long-term use of Class II elastics. Slight forward movement of lower arch occurred when crowding was resolved by expansion.

Case 3: Division 2, Direct/Indirect Anchorage

A 14-year-old brachyfacial female presented with a Class II, division 2 malocclusion and a deep bite (Fig. 13). Clinical examination indicated moderate maxillary dental protrusion, a narrow upper arch, and mild crowding, but a normal lower-arch position.

The treatment plan was to begin with a Pendex appliance (Pendulum combined with expansion) to expand the upper arch slightly and distalize the upper molars into a slightly overcorrected Class I position (Fig. 14). The anterior teeth would be retracted with direct anchorage from buccal miniscrews inserted mesial to the upper molars, which would also provide indirect anchorage to stabilize the distalized molars (Figs. 15-18).

Total treatment time was 17 months (Fig. 19).

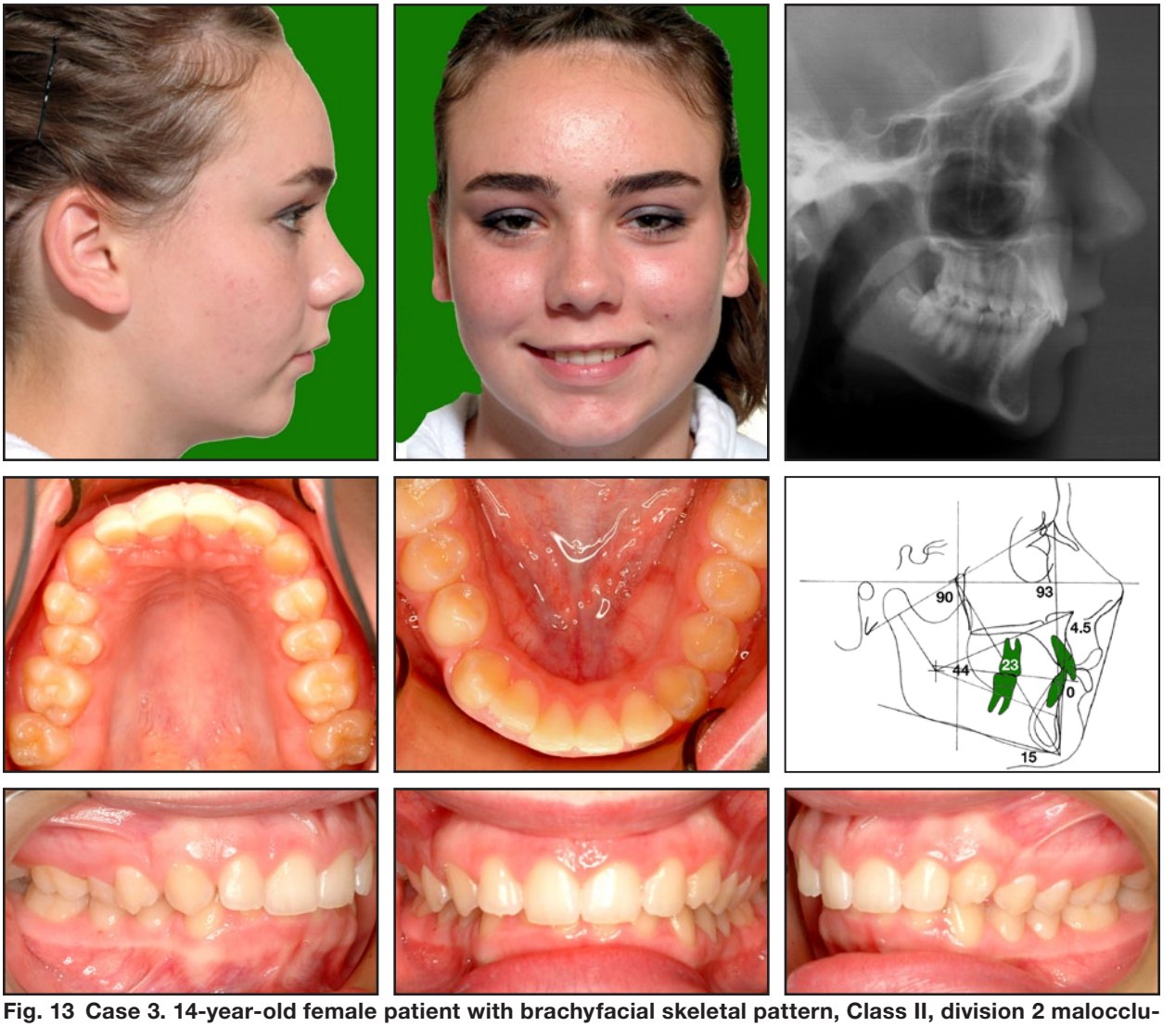

Fig. 13 Case 3. 14-year-old female patient with brachyfacial skeletal pattern, Class II, division 2 malocclusion, deep bite, and moderate maxillary dental protrusion before treatment.

Fig. 14 Case 3. After three months of expansion and distalization with Pendex appliance anchored by palatal acrylic button. Jackscrew was activated every other day for four weeks to provide slow palatal expansion in this older child.

Fig. 15 Case 3. After completion of Pendex treatment, upper utility archwire placed to maintain position of distalized molars; 8mm buccal miniscrews inserted between upper second premolars and first molars and loaded with 5mm closed-coil springs attached to hooks crimped mesial to first premolars for anterior retraction. Lower arch bonded for leveling.

Fig. 16 Case 3. Distal drifting of upper buccal segments after six months of treatment. Utility arch removed, and 10mm closed-coil springs attached from miniscrews to anterior segmental archwire to continue retraction and begin anterior bite opening by intrusion of upper anterior teeth.

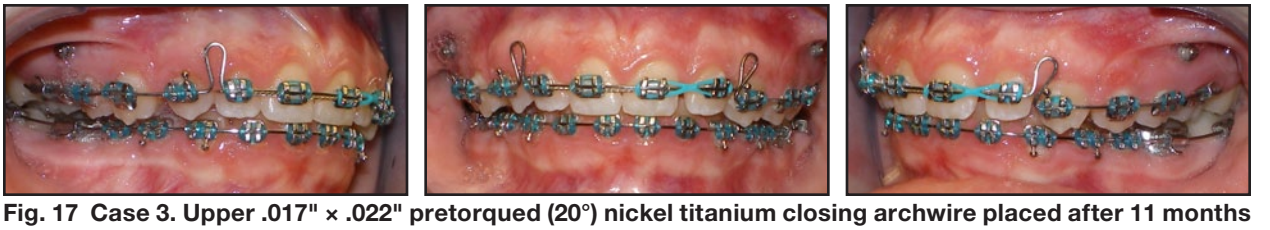

Fig. 17 Case 3. Upper .017" × .022" pretorqued (20°) nickel titanium closing archwire placed after 11 months of treatment. Posterior segment stabilized by ligating miniscrews to upper second premolars for indirect anchorage that allowed controlled anterior retraction without sacrificing buccal-segment positions or requiring Class II elastics.

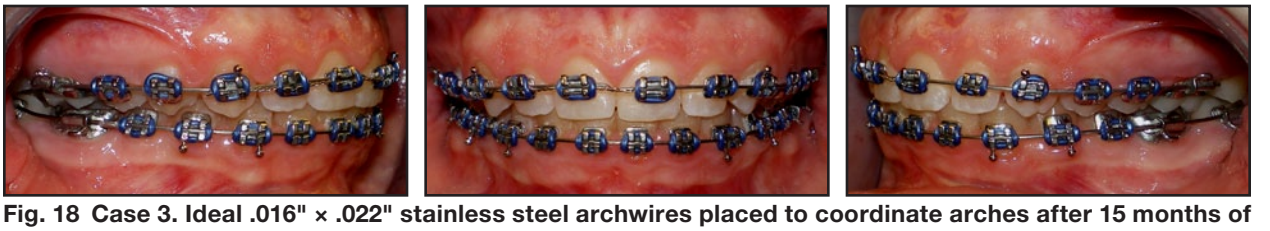

Fig. 18 Case 3. Ideal .016" × .022" stainless steel archwires placed to coordinate arches after 15 months of treatment.

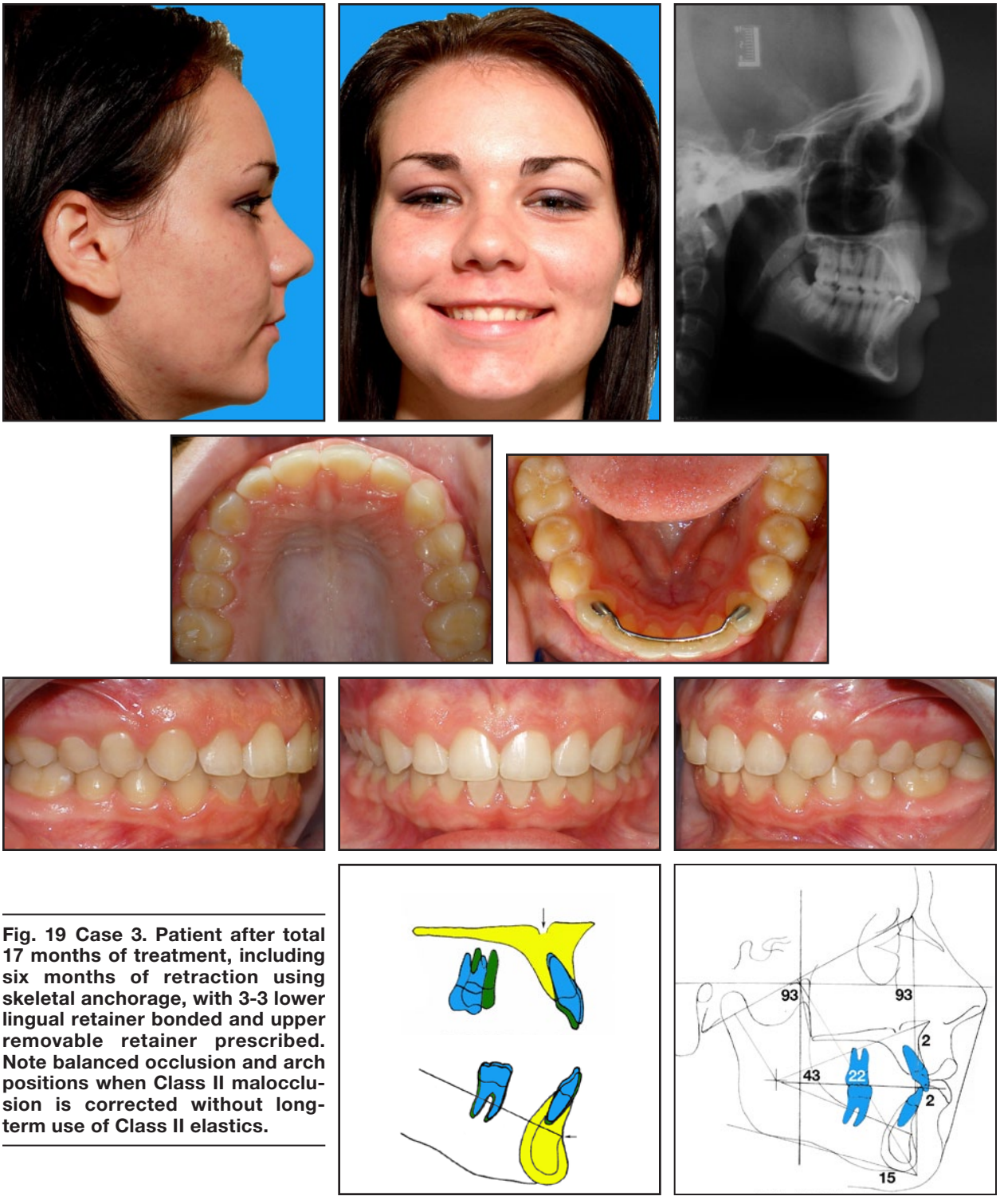

Fig. 19 Case 3. Patient after total 17 months of treatment, including six months of retraction using skeletal anchorage, with 3-3 lower lingual retainer bonded and upper removable retainer prescribed. Note balanced occlusion and arch positions when Class II malocclusion is corrected without long-term use of Class II elastics.

Case 4: Division 1, Direct Anchorage

A 13-year-old female presented with a brachyfacial growth pattern, a severe Class II, division 1 malocclusion, and a deep bite (Fig. 20). She had a constricted upper arch, no crowding, and ideal lower-incisor positions.

The treatment plan involved the use of a Pendex appliance to expand the upper arch and distalize the molars (Fig. 21), maintain the lower-incisor angulation, and avoid the need for Class II elastics. TADs would be then placed in the wide interradicular spaces opened mesial to the upper first molars (Fig. 22). En masse retraction would be accomplished by allowing the upper buccal segments to drift distally while applying nickel titanium springs to the buccal arms of a utility archwire (Figs. 23-24).

Total treatment time was 26 months (Fig. 25).

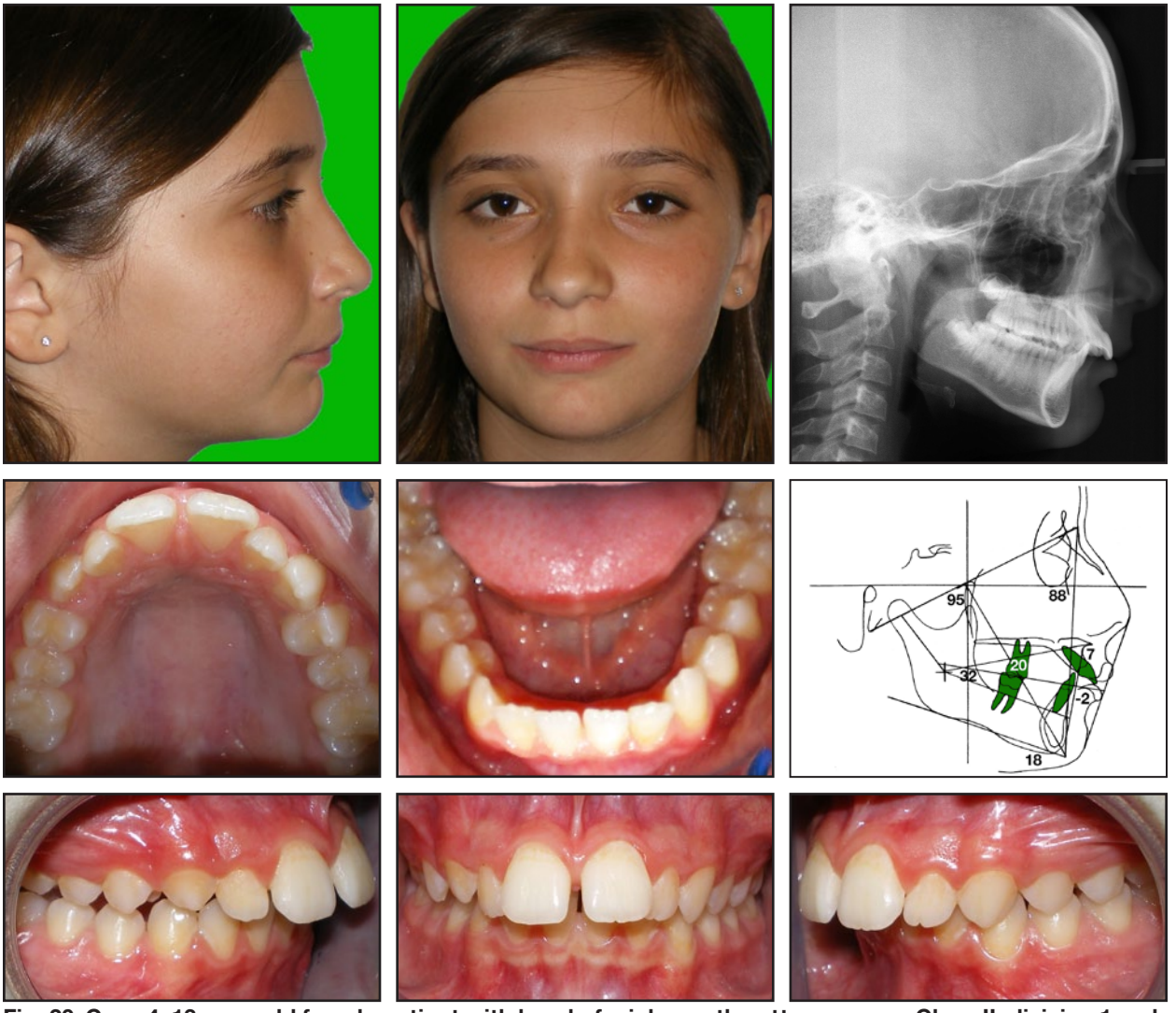

Fig. 20 Case 4. 13-year-old female patient with brachyfacial growth pattern, severe Class II, division 1 malocclusion, deep bite, and constricted upper arch before treatment.

Discussion

After more than 20 years of experience with the Pendulum family of appliances, we have found that effective molar distalization depends on appropriate case selection; otherwise, the negative side effects can be significant. Several key considerations have been gleaned from both clinical experience and published research:

1. Facial type and muscular pattern. Distal movement of the upper molars into the wedge of a fragile, dolichofacial muscular pattern can create or exacerbate an anterior open bite. The open bite and attendant tongue thrust often lead to a clockwise rotation of the mandible and weak chin esthetics, which can be difficult if not impossible to reverse. We highly recommend that the Pen-

Fig. 21 Case 4. A. After five months of expansion and distalization with Pendex appliance (activated once daily over three-week period). B. Upper utility arch placed to begin anterior space closure with elastic chain; lower arch bonded to begin leveling.

Fig. 22 Case 4. A. Five weeks later, buccal segments have drifted distally while molars are maintained in slightly overcorrected Class I relationship using 8mm buccal TADs for anchorage; canines are still Class II with deep overbite. Retraction of upper incisors and slight further distalization of molars achieved by attaching TADs to utility arch with horizontal springs. B. Upper canines and premolars allowed to drift distally over next five months.

Fig. 23 Case 4. A. All upper spaces closed after 11 months of treatment. B. After removal of TADs, upper .016" × .016" nickel titanium leveling archwire placed to enhance molar rotation, archform, and torque control.

Fig. 24 Case 4. Further leveling and bite opening after 18 months of treatment, with ideal upper .016" × .022" stainless steel in place. Vertical seating elastics were prescribed (no intermaxillary elastics used to this point).

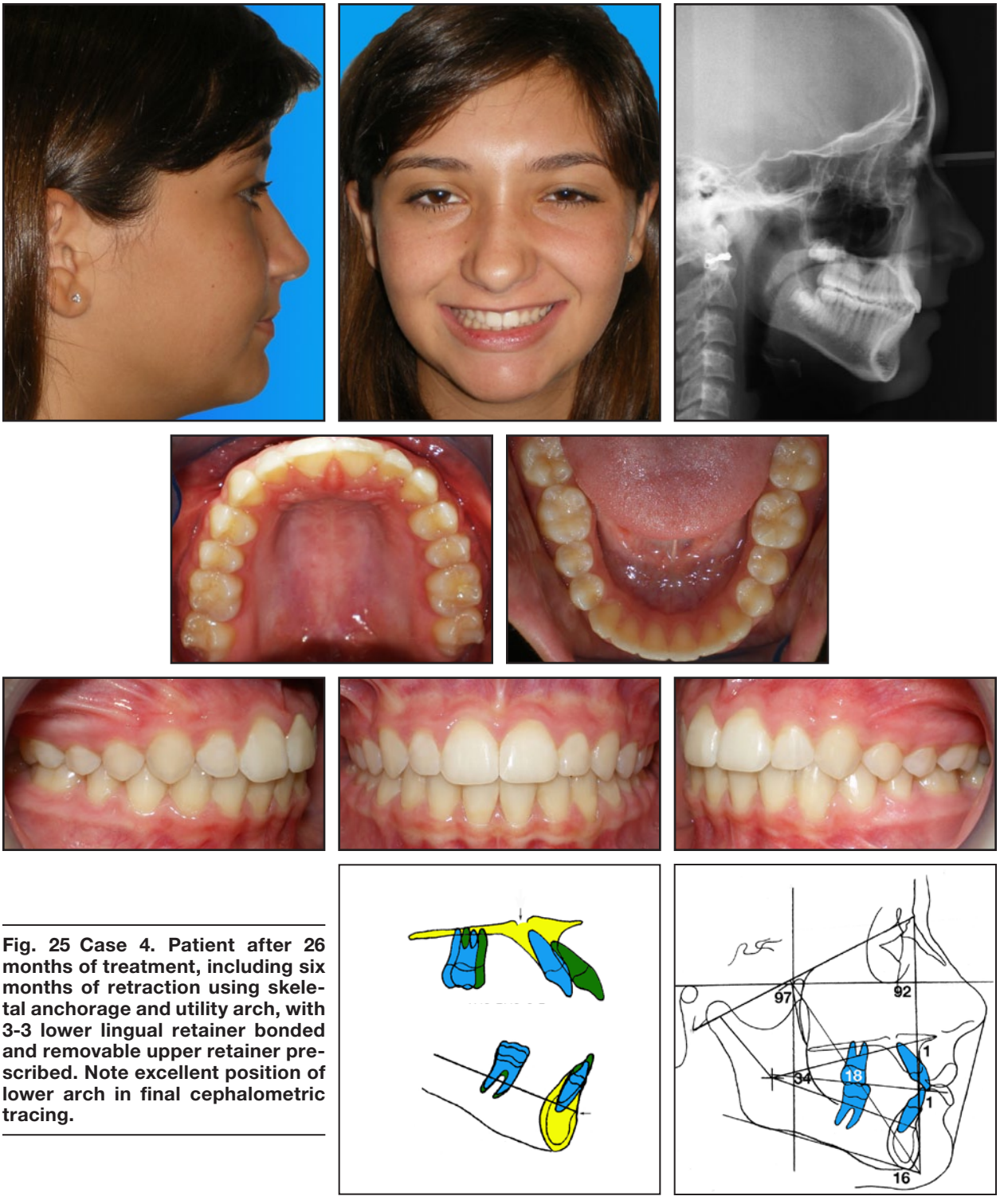

Fig. 25 Case 4. Patient after 26 months of treatment, including six months of retraction using skeletal anchorage and utility arch, with 3-3 lower lingual retainer bonded and removable upper retainer prescribed. Note excellent position of lower arch in final cephalometric tracing.

dulum family of appliances be used only in strong mesofacial and brachyfacial muscular patterns, as shown in this article.

2. Depth of overbite. Cases that respond best to molar distalization are Class II, division 2 deep bites, where the Pendulum can help open the bite and create substantial arch length, and where reciprocal anterior movement of the upper incisors is a desirable response to the distalization.

3. Age and eruption pattern. After the second molars have completely erupted, first-molar distalization becomes more problematic. The buttressing effect of the second and third molars often results in undesirable forward movement of the buccal anchorage units. Ideally, the ratio of molar distalization to forward movement of the remaining dentition should be 2:1. Extraction of upper second molars to create space for distally moved first molars (if the third molars are good replacements) is one way of treating older patients when the dentition is fully erupted and little growth is expected.

4. Bodily movement vs. molar tipping. Bodily distal movement of the upper molars can be difficult to achieve because the upper molars erupt in a fan-shaped pattern and are most easily moved back in that same pattern. Distal tipping of these teeth can be avoided if the anchorage employed to hold them in distal positions is secure and dependable.

5. Anchorage concepts. The adage that "it's easy to move the upper molars distally but tough to keep them there" is absolutely true. We have found that when the upper molars are moved distally and securely anchored, the upper buccal segments will drift back by means of the tension of interseptal periodontal fibers, with little additional anchorage loss. This is why miniscrews provide absolutely secure anchorage. TADs should be left in place as long as they are secure, but their major utility occurs during the first six months of treatment. Indirect anchorage is often desirable because the force is dispersed through the attached teeth, thus allowing the clinician to use standard closing mechanics without overloading the TADs. Direct anchorage is preferable when a secondary effect (intrusion) is desired.

6. TAD placement. Fully 80% of our PIT cases call for miniscrew placement between the upper second premolars and first molars. Opening wide interradicular spaces with the Pendulum greatly simplifies TAD placement, and we have not experienced any impingement of the distalized premolar roots, since the spaces typically remain until the TADs are removed during the final stage of treatment. We believe the future of miniscrew-based anchorage depends on such simple, clean, efficient, and predictable techniques.

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