The TopJet for Routine Bodily Molar Distalization

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The second generation of non-compliance molar-distalizing appliances has benefitted greatly from the development of temporary skeletal anchorage, first with osseointegrated implants and more recently with miniscrews that are easier to insert and capable of immediate loading.[1-11] Absolute anchorage allows bodily molar distalization from forces applied at the level of the center of resistance, avoiding many of the undesirable side effects—tipping and rotation of the molars and proclination of the anterior teeth—seen with conventional anchorage.

The introduction of palatal mini-implants has finally made skeletal anchorage realistic and convenient to use for molar distalization.[7,12-14] Unfortunately, many of the recently introduced palatal appliances, such as the Beneslider*[15] and the miniscrew-implant-supported distalization system (MISDS),[16] require costly and time-consuming laboratory work. The TopJet** was designed to avoid additional laboratory steps, allowing simple chairside placement at a single appointment.

Appliance Design

The TopJet molar distalizer is a compact, prefabricated appliance with welded twin tubes: a distalizing "power module" and an "adjustment module" (Fig. 1). It can be used unilaterally or bilaterally, with each unit anchored in the anterior

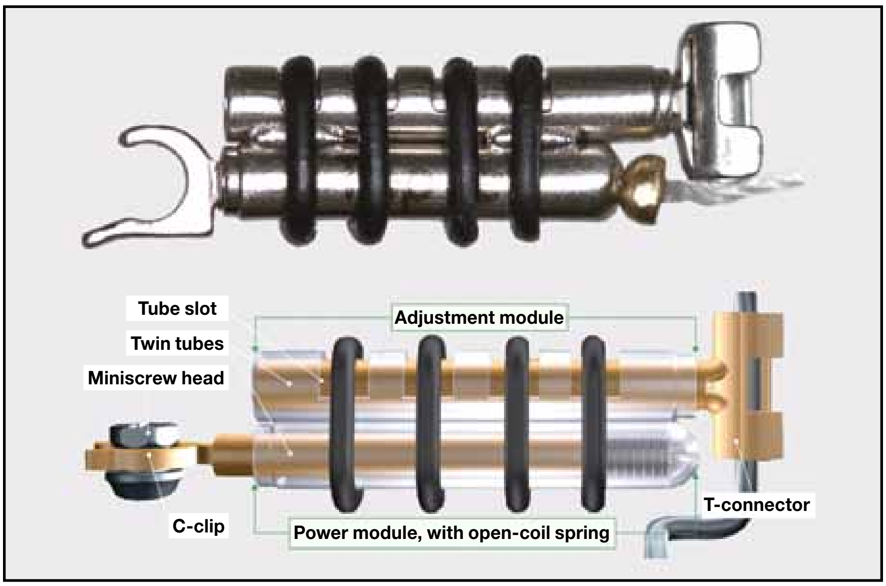

Fig. 1 Components of TopJet molar distalizer.

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palate by a single miniscrew lateral to the midpalatal suture.

The power module houses a Nitinol*** coil spring and has a C-clip at its anterior end for connection to the miniscrew head. The C-clip allows some directional and rotational freedom prior to activation in case the mini-implant is not ideally angulated. At the distal end, a securing thread with a crimped bead keeps the spring compressed during insertion. The thread is cut and removed to activate the distalizer.

The adjustment module houses a piston that extends distally for attachment to a transpalatal arch (TPA) using a T-shaped connector with crimpable wings. This connection forms a hinge along the axis of the TPA and provides some resistance against molar tipping in the vertical dimension. Four reactivation slots in the housing are used to stabilize the elastic rings that encircle both tubes. As the piston moves posteriorly to push the TPA distally, reactivation is accomplished by recompressing the Nitinol spring and allowing the next elastic ring to fall into its slot, providing a more posterior anchorage point for the piston.

A prefabricated TPA** is available with a U-shaped bend on either side, providing space between the screw heads and the TPA for easier placement of the TopJet (Fig. 2). A TPA can also be bent from .036" Blue Elgiloy† or stainless steel wire using the supplied template. The TPA prevents molar rotation while permitting friction-free distalization.

The TopJet is available in two working lengths (14mm and 22mm) and two loading forces (250cN and 360cN). Bilateral insertion generally takes less than 30 minutes.

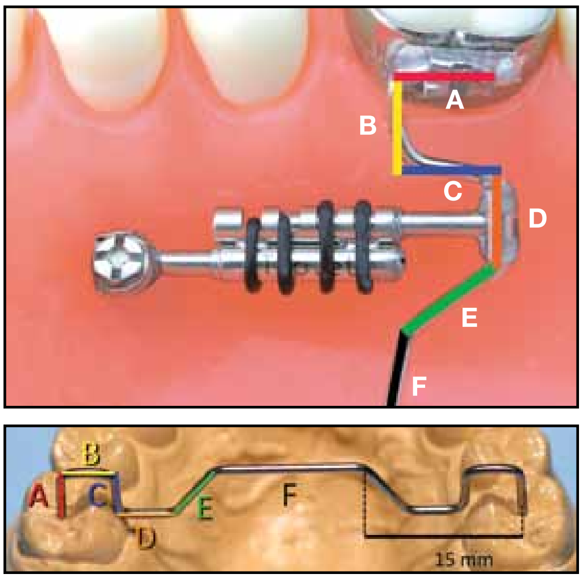

Fig. 2 Transpalatal arch used with TopJet distalizer. A. End section inserted in Goshgarian sheath from mesial. B. Descending section positioning TopJet at or near plane of resistance. C. Section extending distance between screw head and TPA. D. Attachment to T-connector, forming hinge-axis joint. E. Variable section, bent up or down as needed to customize TPA length. F. Final section, with length determined by width of palate.

*PSM Medical Solutions, Tuttlingen, Germany; www.psm.ms. Distributed in the U.S. by Mondeal North America, Inc., Indio, CA; www.mondeal-ortho.com.

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***3M Unitek, Monrovia, CA; www.3mUnitek.com.

†Registered trademark of Rocky Mountain Orthodontics, Denver, CO; www.rmortho.com.

Appliance Placement

1. Cement standard molar bands with fenestrated Goshgarian lingual sheaths to the upper first molars.
2. Adjust the prefabricated or custom-bent TPA to fit passively into the palatal sheaths with adequate clearance of the palatal mucosa, as with any Goshgarian arch. Add 3-4mm of transverse expansion before final insertion if molar expansion is desired during distalization. The fenestrated lingual sheaths facilitate the application of light-cured resin to secure the TPA. We have not found it necessary to engage the molar sheath with a conventional doubled-back wire, since the ends of the prefabricated TPA have strong retention grooves to ensure a secure fit.
3. The M4 area of the anterior palate (Fig. 3A) is relatively free of major nerves or blood vessels.[17] Because bone height is generally 6-8mm in this region, less than half of the screw shaft usually serves as osseous anchorage, while the rest of the shaft is embedded in the thick palatal gingiva or is partially visible. Our clinic has placed more than 1,000 mini-implants in this region without any clinical side effects. If desired, a cone-beam computed tomography (CBCT) scan can be used to assess the bone quality in this region (Fig. 3B). To penetrate the palatal mucosa under local anesthetic, we use a self-drilling miniscrew (10-, 12-, or 14mm long, 2mm in diameter‡), placed at an angle of about 10° lateral to the vertical and inserted slowly—no more than two turns per second—until the screw head reaches the plane of the molar's center of resistance.
4. After removing the TopJet from its package, unroll the securing thread, which both prevents accidental swallowing of the appliance and keeps the open-coil spring compressed during insertion.
5. While holding the TopJet securely with a self-locking forceps, use a Weingart plier to push the C-clip into position around the miniscrew head from the pharyngeal aspect. Extend the piston in the adjustment module toward the TPA with a fork probe and attach the T-connector to the short transverse section of the TPA (Fig. 2D). During this extension, one or two elastic rings will fall into the slots of the adjustment module tube, preventing the piston from sliding back into the tube. If the piston has been pulled out too far, it can easily be pushed back after lifting the appropriate elastic ring.
6. Use a modified-angle Tweed plier** to close the upper and lower flaps of the T-connector tightly around the TPA. Fill in the gaps around the T-connector and the middle of the C-clip with Triad Gel,††† avoiding any contact with the mucosa. This provides a stable connection in terms of

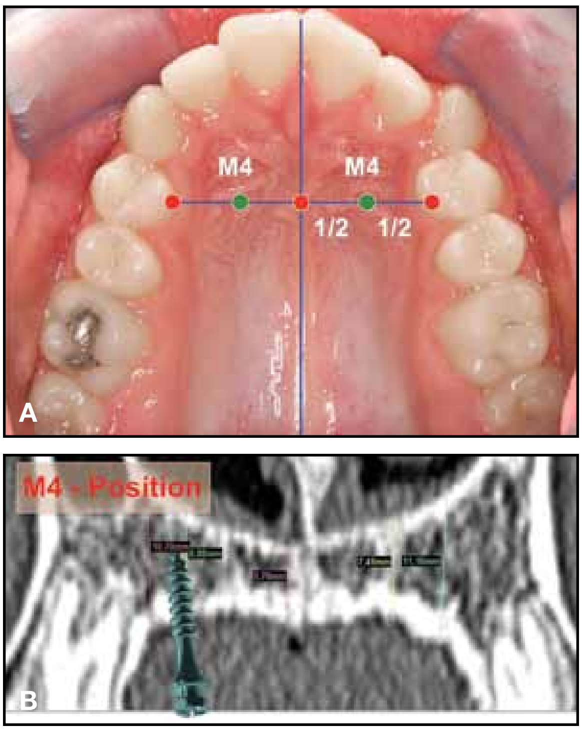

Fig. 3 A. M4 position is halfway across line connecting first-premolar palatal cusp to midpalatal suture line. B. Cone-beam computed tomography section between first premolars reveals bone heights of 8-10mm in 13-year-old male patient. Length of overlaid screw is 12mm.

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‡Dual-Top miniscrew, trademark of Jeil Medical Corporation, Seoul, Korea; www.jeilmed.co.kr. Distributed by Rocky Mountain Orthodontics, Denver, CO; www.rmortho.com.

†††Registered trademark of Dentsply Caulk, Milford, DE; www.caulk.com.

rotation and angulation at the C-clip and a hinge-axis-like joint at the T-connector, allowing bodily movement of the molars.

7. Once the appliance and the TPA have been secured, pull the thread slightly to the lateral and cut it between the crimped bead and the power module. This releases the Nitinol coil spring (Fig. 4A), so that the patient will notice a light pressure on the molars.

Reactivation

After initial molar distalization of as much as 5.6mm, the force of the open-coil spring will have decreased to about 50cN (Fig. 4B). Reactivation can be achieved in increments of 2mm—the distance between elastic rings. Using a fork probe, pull the twin tubes forward toward the miniscrew to compress the open-coil spring within the power module (Fig. 4C). The next elastic ring will fall into its groove, preventing the piston in the adjustment module from sliding back (Fig. 4D). If an elastic ring is lost, a stop can be created (irreversibly) by slightly compressing the appropriate segment of the adjustment tube at the end of the piston with a ligature cutter or the T-connector plier. Maximum molar distalization of 14mm is possible if all four reactivation slots are used.

Appliance Removal

To remove the TopJet, first remove the composite from the mini-implant head. Place the tip of a Weingart plier between the longer arm of the C-clip and the screw head; closing the plier will detach the clip. Lift the anterior end of the TopJet away from the palate to break the composite cover-

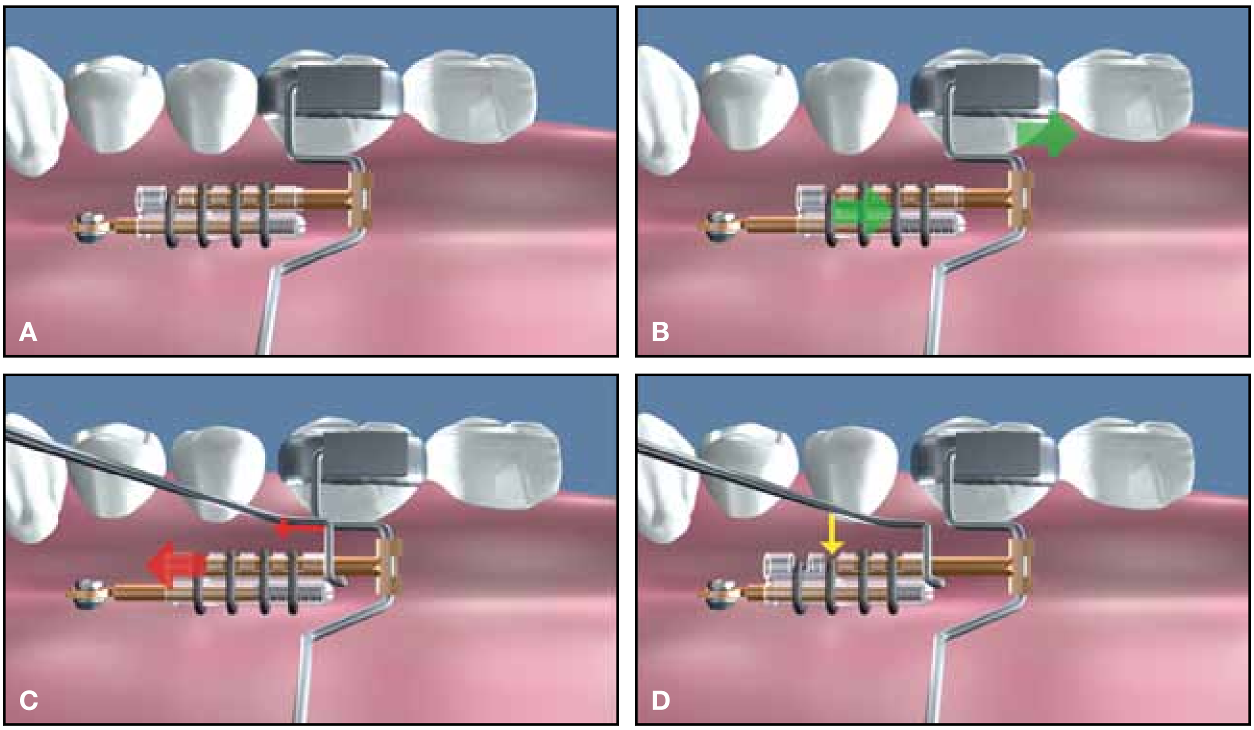
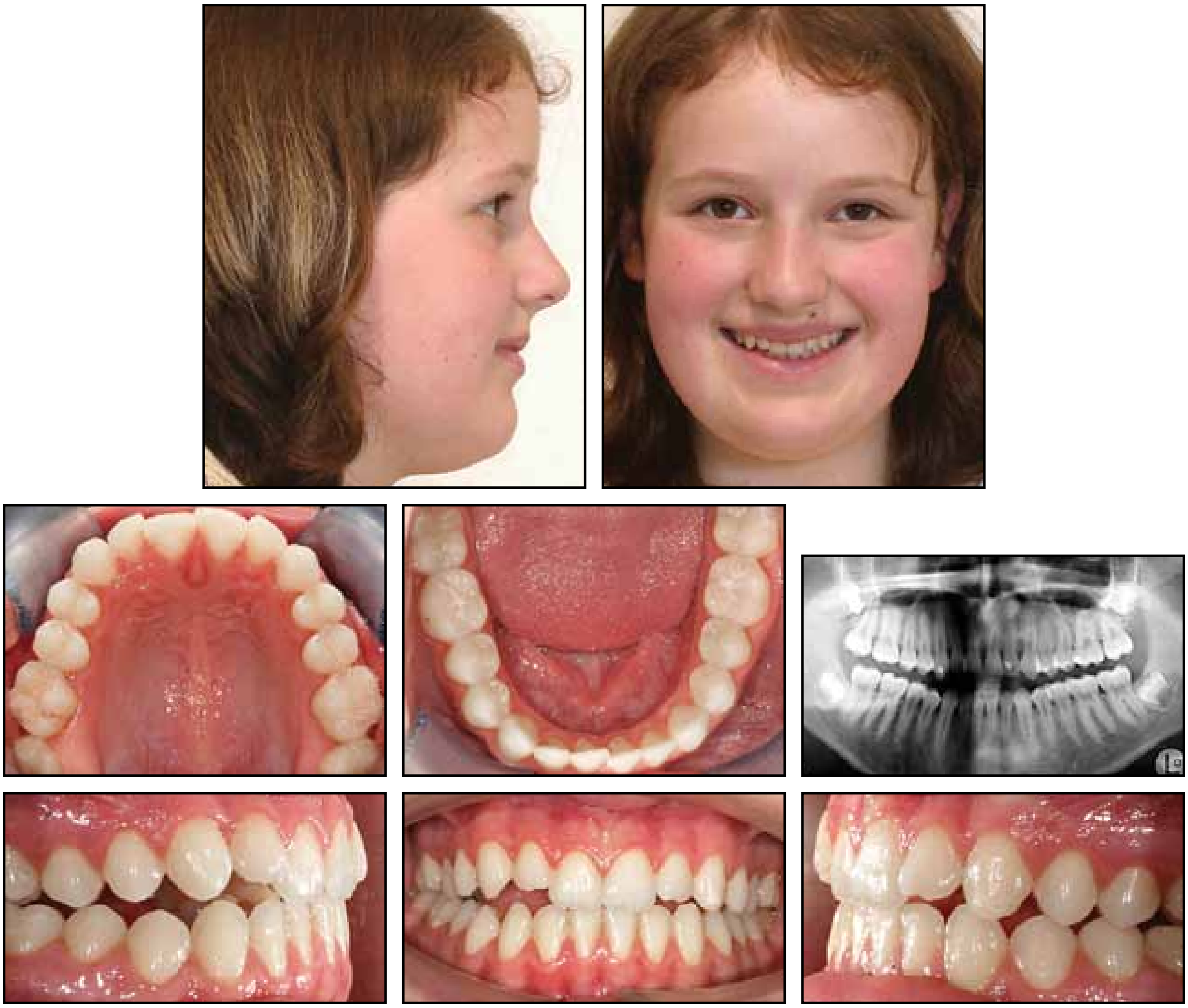


Fig. 4 Placement and reactivation of TopJet. A. Activation by release of compressed coil spring. B. As TPA moves teeth distally, coil spring decompresses. C,D. Pulling twin tube toward miniscrew with forked probe causes next elastic ring to fall into its slot, holding piston in extended position and recompressing coil spring for reactivation.



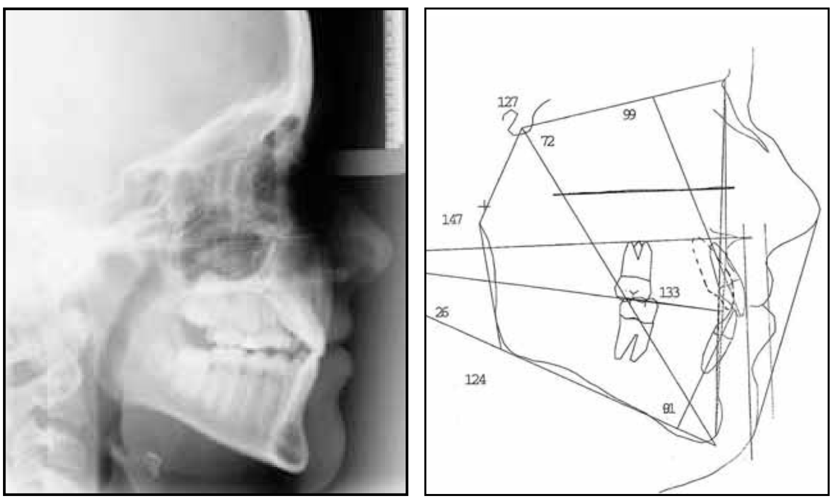


Fig. 5 Case 1. 15-year-old female patient with dental Class II occlusion on skeletal Class III base, mandibular prognathism, bilateral open bite, and mild crowding in anterior maxillary region before treatment (tongue spikes for open-bite treatment can be seen on panoramic radiograph).

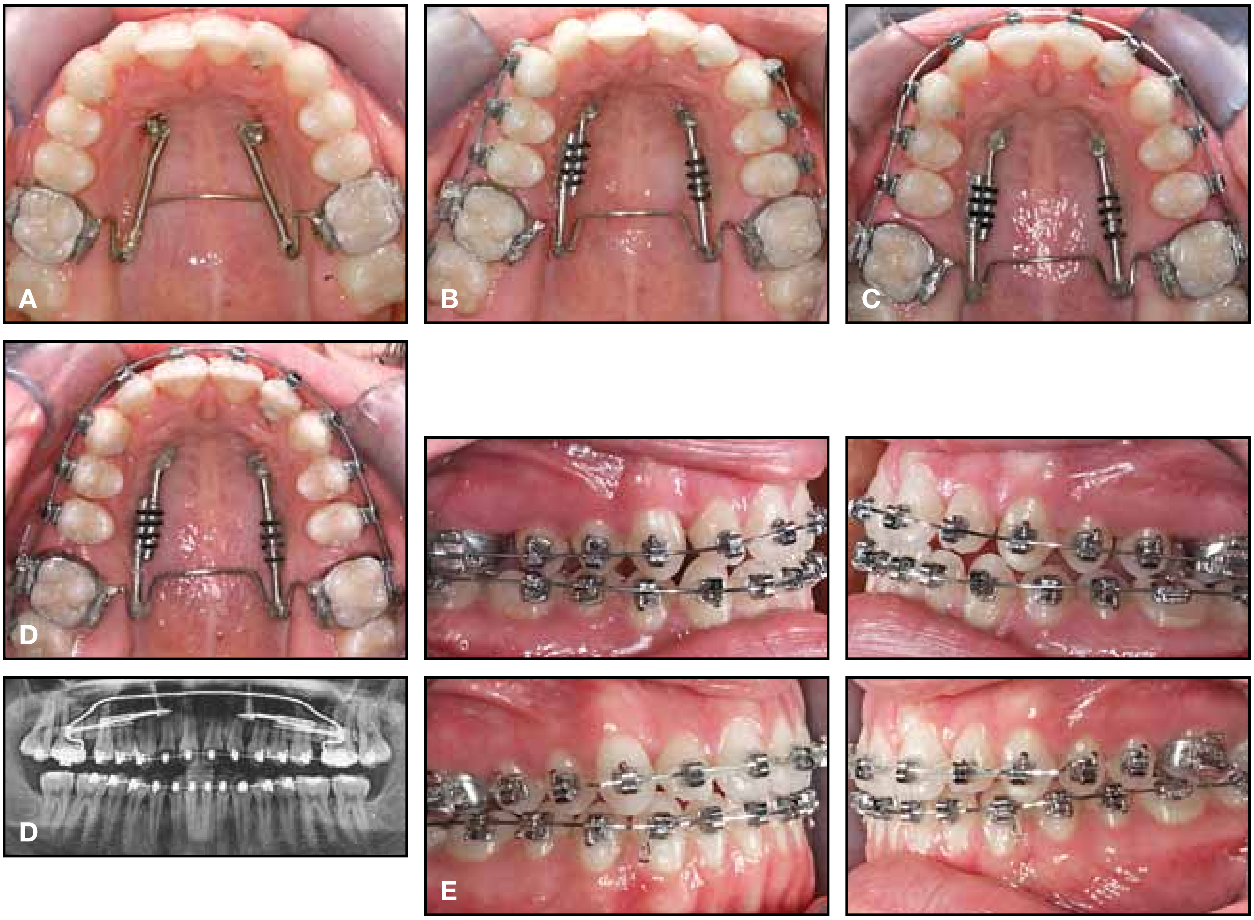


Fig. 6 Case 1. A. Placement of TopJet prototype (uncovered open-coil springs without reactivation mechanisms). B. After four months of treatment, with current TopJet in place. C. After seven months of treatment. D. After 10 months of distalization, showing overcorrected molar position. E. Occlusion after five months of settling.

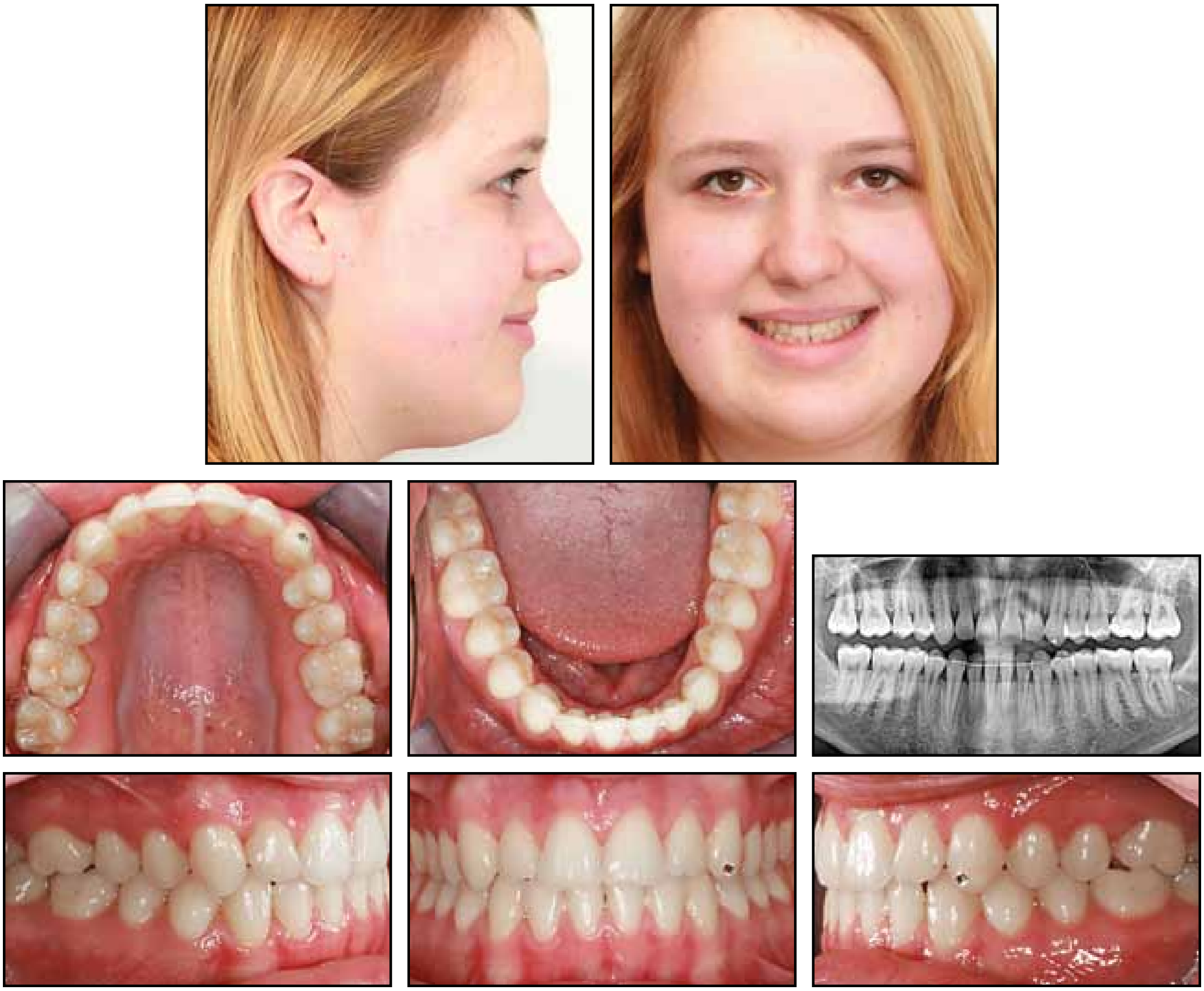
ing the T-connector, thus opening the flaps and releasing the TopJet.

To remove the TPA, clear the covering resin from the molar sheaths, then push the ends of the TPA mesially with a Weingart plier. If this is not possible, the TPA can be cut away with a water-cooled mini-diamond disc; the remaining segments are then pulled mesially while being rotated to break the bonds.

Case 1

A 15-year-old female presented with a Class II dental relationship, an open bite from first molar to first molar, and a maxillary anterior space deficiency of about 3mm (Fig. 5). She had recently been treated with a chin cup and rapid maxillary expander for a skeletal Class III malocclusion involving mandibular prognathism and an inadequate maxillary transverse dimension. Because Class II elastics would have exacerbated the open bite and headgear therapy could have worsened the skeletal Class III, we planned molar distalization with a TopJet prototype (uncovered open-coil springs with no reactivation mechanisms).[18]

Tongue spikes were bonded to the upper right canine and upper left lateral incisor in an attempt to improve the open bite. The four impacted third molars were extracted in preparation for upper-molar distalization. The TopJet prototype was placed and activated with 250cN of force per side (Fig. 6A). Three months later, it was replaced with the current TopJet. After 10 months of treatment, a slight molar overcorrection of about half a premolar width had been achieved, while the upper canines and premolars had drifted distally about the same distance (Fig. 6B-D). The anterior and buccal open bites were corrected as the anterior



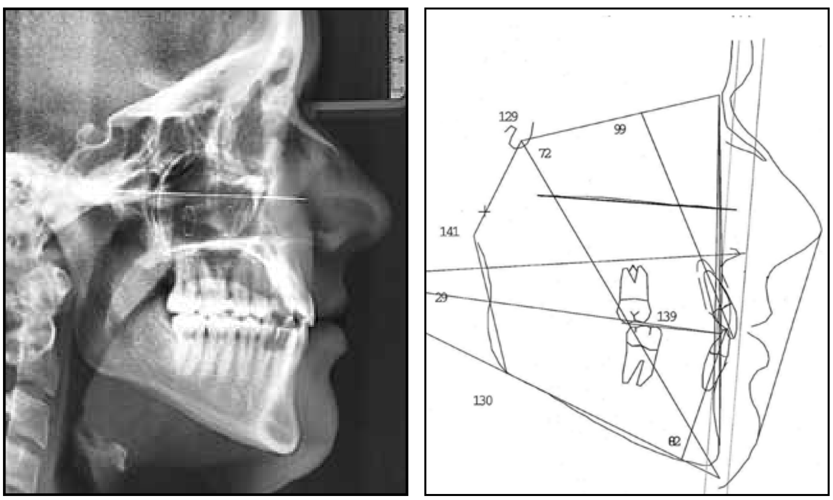


Fig. 7 Case 1. Patient after 18 months of treatment.

space problem was resolved. The TopJet, TPA, and buccal segments of the upper archwire were then removed, and the occlusion was allowed to settle for five months to normalize the molar relationship (Fig. 6E).

After 18 months of treatment, including finishing with a positioner, the patient showed a Class I occlusion, well-formed arches, and a normal overbite (Fig. 7).

Case 2

A 10-year-old male in the late mixed dentition (Fig. 8) presented with a severe lack of space (−7mm) in the upper arch, buccally displaced upper canines, a mild mandibular prognathism (Wits appraisal = −3mm), and a dolichofacial growth pattern (jaw angle = 30°). We considered extraction of the upper first premolars, but preferred sagittal expansion of the upper arch because of the prognathic growth pattern. Again, headgear was contraindicated by the skeletal situation. To facilitate space gaining in the lower arch, both lower second molars were planned for extraction during treatment.

Treatment was initiated with TopJet distalizers (250cN on each side). Despite the presence of impacted third molars, sufficient space was created after seven months of treatment (Fig. 9A). Both TopJet springs were left passively in place for another three months, allowing rotation of the premolars and spontaneous settling of the canines (Fig. 9B). After removal of the TopJet springs, the miniscrews and the TPA were left in place for another two months (Fig. 9C).

After a total 23 months of treatment, the patient finished with a solid Class I occlusion (Fig. 10). Comparison of pre- and post-treatment cephalograms indicated no increase in the maxillomandibular angle, despite the 4mm molar distalization. To prevent overeruption of the upper second molars, the patient wears a splint positioner at night while awaiting eruption of the lower third molars.

Assuming that the form and size of the incipient third molars are favorable, extraction of the upper second molars makes molar distalization much easier. Distalization of all molars may complicate later removal of the third molars, but is feasible if required.

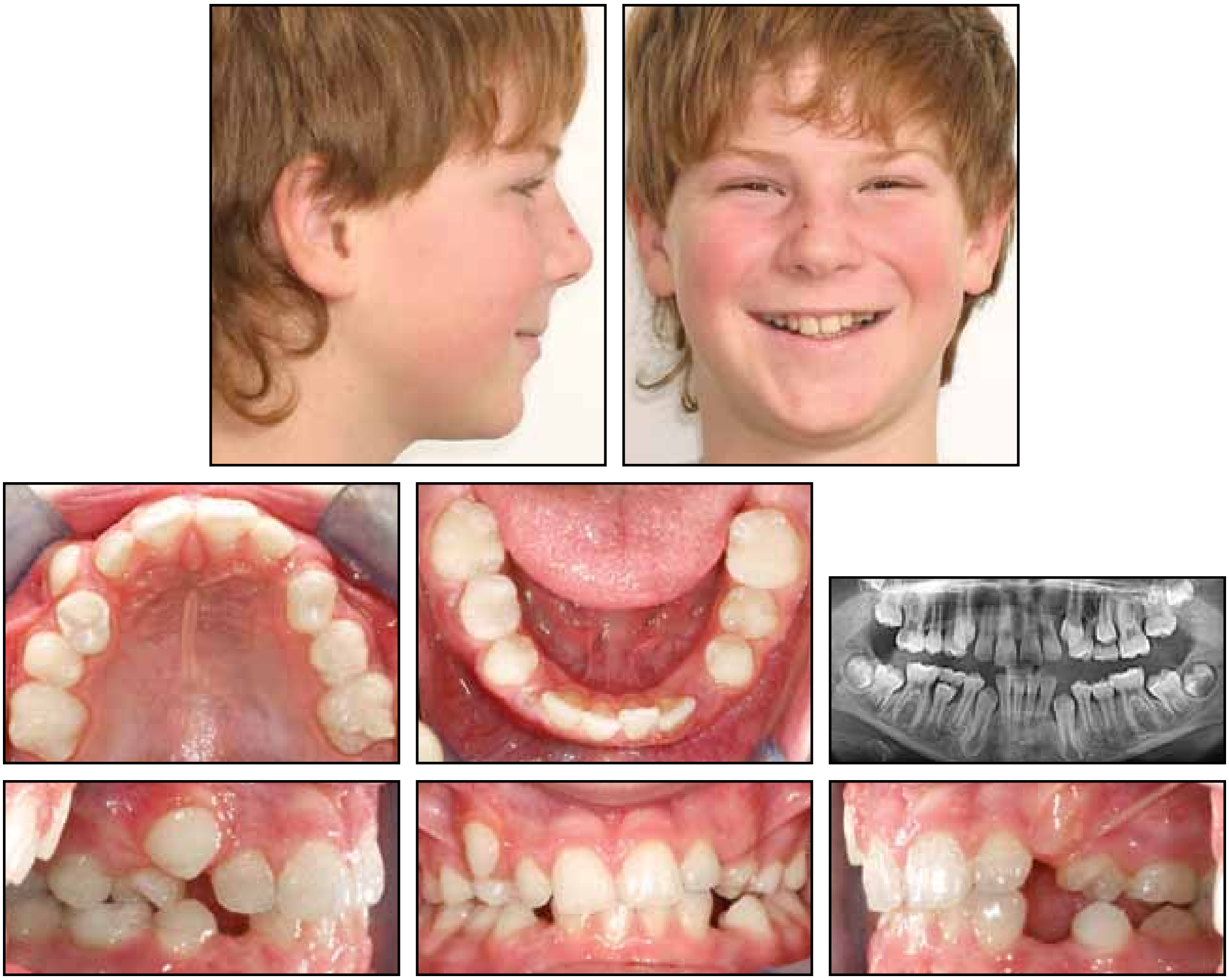
Discussion

The hard palate offers several suitable sites for miniscrew insertion. Computed tomography has shown that the densest bone in the entire palate is in the anterior portion, 3mm posterior to the incisive foramen and 1-5mm lateral to the median suture.[19,20] Using CBCT, a mean vertical bone thickness of 7.6-8.7mm has been measured in the M4 area of adults.[21,22] Also with CBCT, King and colleagues found mean bone heights of 5.1mm (S.D. = 3.4mm) and 4.5mm (S.D. = 2.8mm) in 10-to-19-year-old boys and girls, respectively.[23] Since Gracco and colleagues did not substantiate an age-related variation in bone thickness at the M4 position,[24] this finding requires further investigation. In any case, all studies indicate that M4 is a favorable site for insertion of paramedian anchorage screws.

The stability of mini-implants appears to improve with increased insertion depth and implant diameter.[25] Palatal miniscrews 8-9mm in length and 1.6mm in diameter did not provide reliable stationary anchorage for molar distalization in one study,[26] and screws less than 8mm in length and 1.2mm in diameter have been associated with high failure rates.[27-29] Therefore, to avoid any possibility of anchorage loss or screw fracture, a palatal miniscrew should be 12-14mm in length and 2mm in diameter.[7] In our experience with such screws, there is virtually no chance of anchorage loss due to screw movement; we agree with authors who have reported negligible anchorage failures[30,31] (compared to published success rates of 91%[32] and 92%[33] for the Orthosystem‡‡).

Because a miniscrew inserted at M4 with its head vertically positioned on or near the plane of molar resistance will have about 50% of its shaft embedded in bone, it is possible that the threaded section could be shorter (5-7mm) and the remaining shaft could be polished to reduce irritation.

‡‡Registered trademark of Institut Straumann, Waldenburg, Switzerland; www.straumann.com



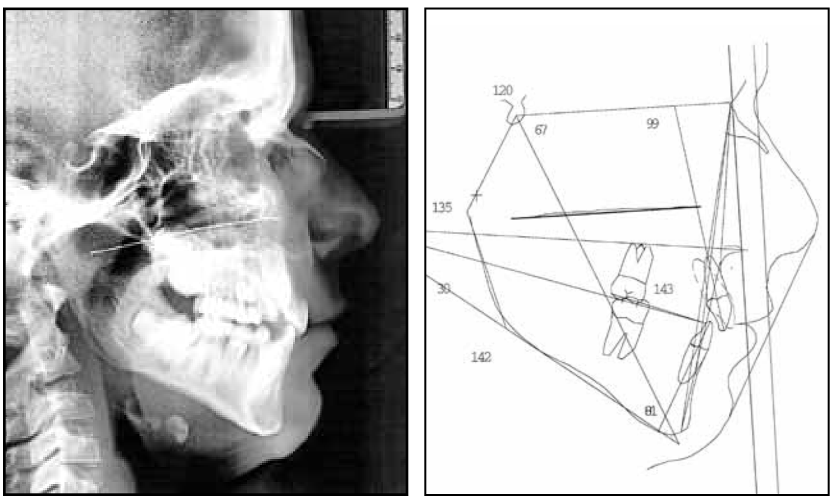


Fig. 8 Case 2. 10-year-old male patient with severe upper-arch crowding, buccally displaced upper canines, and four impacted third molars before treatment.

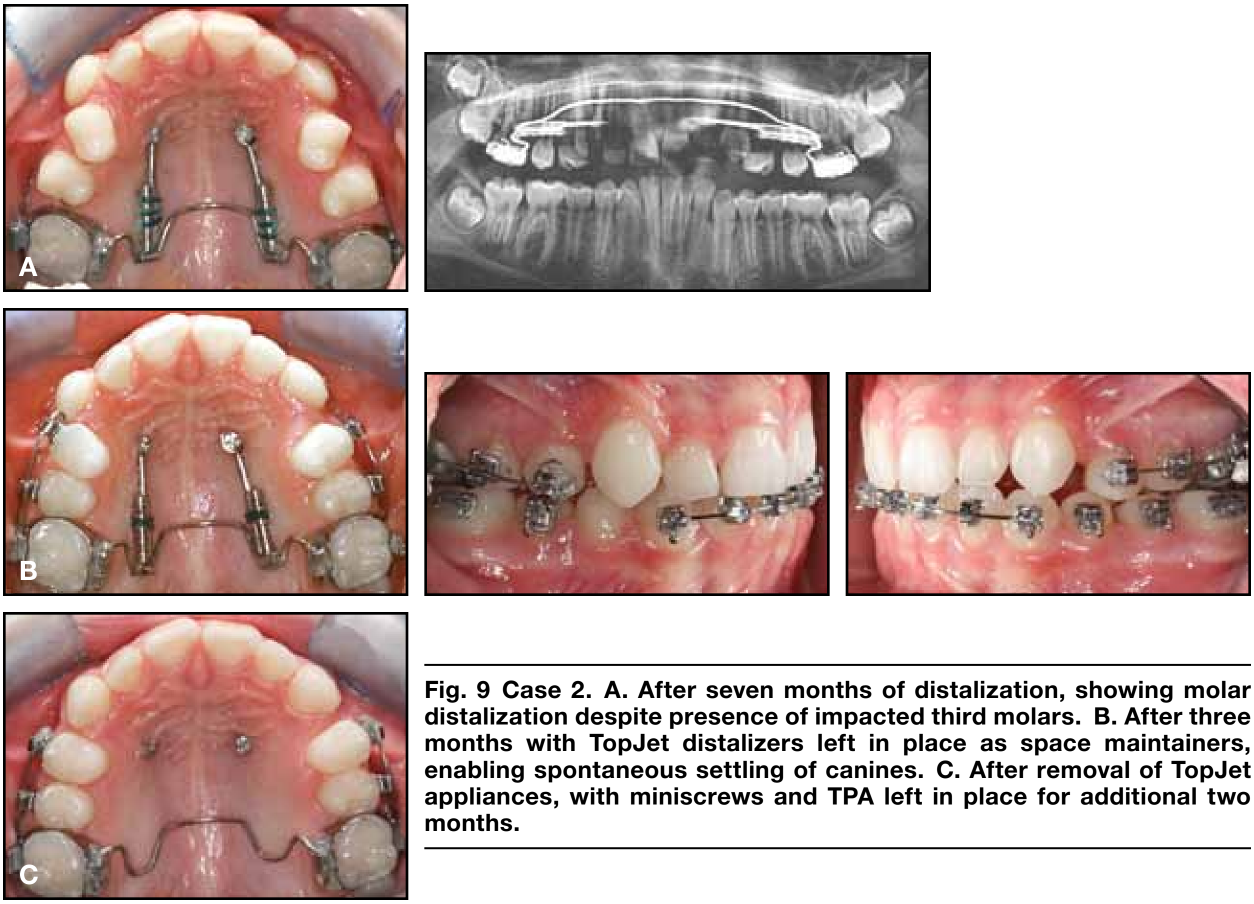
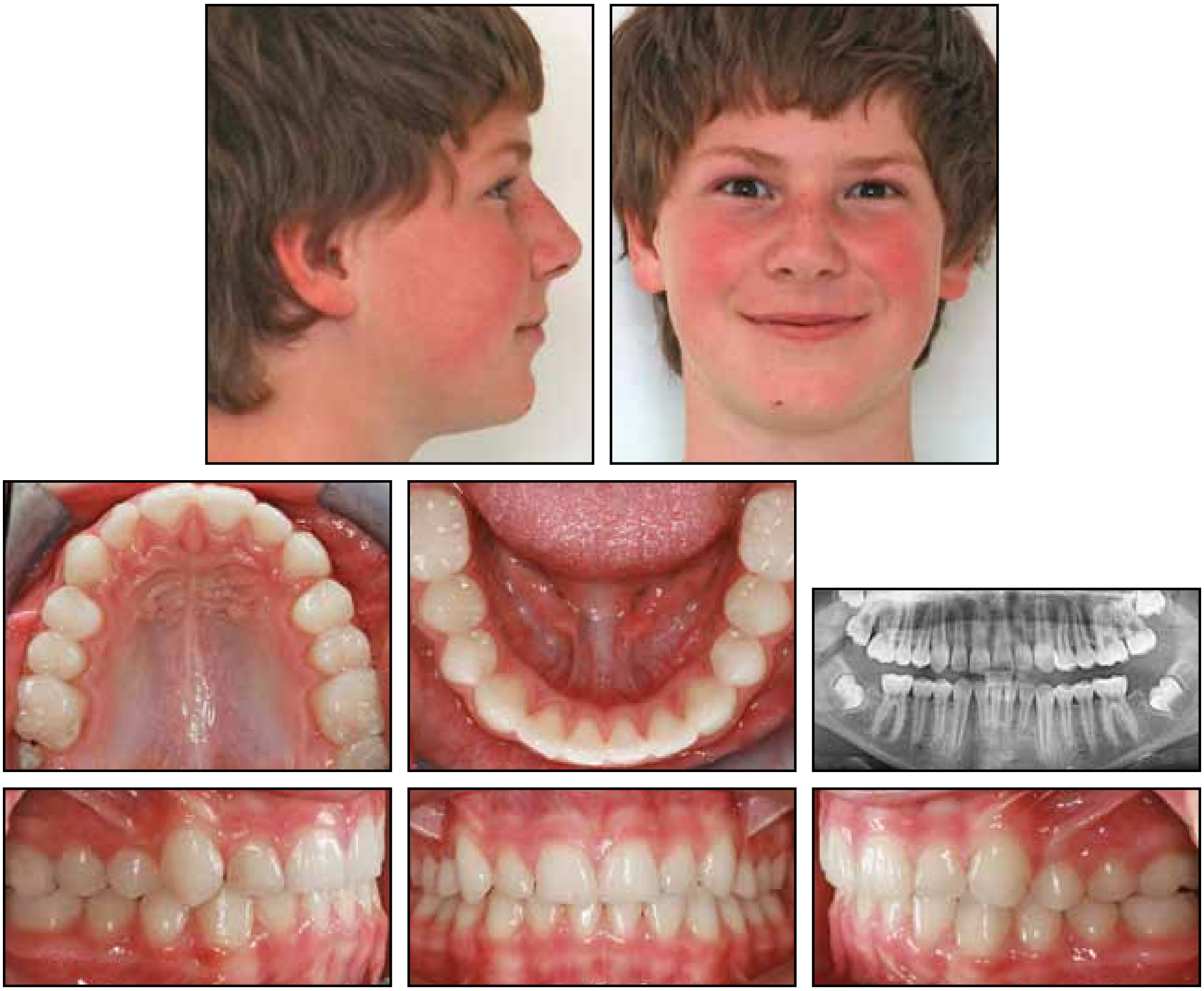


Fig. 9 Case 2. A. After seven months of distalization, showing molar distalization despite presence of impacted third molars. B. After three months with TopJet distalizers left in place as space maintainers, enabling spontaneous settling of canines. C. After removal of TopJet appliances, with miniscrews and TPA left in place for additional two months.

Still, the rare cases of inflammation or infection around miniscrews can be conservatively managed and will not necessarily lead to loss of the implants.[34]

The TopJet appliance fulfills the desired criteria of a third-generation non-compliance device for maxillary molar distalization. With reliable palatal anchorage, it provides bodily molar distalization from a force application close to the center of resistance. It is preferable to headgear in Class I or mild skeletal Class III cases because it avoids unfavorable maxillary orthopedic effects. The design allows some flexibility in vertical positioning of the screw head at insertion, so that molar intrusion or extrusion can be carried out during distalization. Reactivation is simple, quick, and safe; unwanted side effects are minimized, while desirable effects can include spontaneous distal movement of the premolars and canines. The TopJet can also be used to create space for anterior tooth alignment or to facilitate dentoalveolar compensation and allow incisor retrusion in Class II, division 1 cases.

Patient cooperation is required only in performing adequate oral hygiene. Costs are lower compared to many first- and second-generation appliances due to the ease of fabrication with no laboratory work, reduction in chairtime, appliance reliability, and low incidence of undesirable tooth movements. Since the standard-length prefabricated TopJet fits most patients, and since regular molar bands with Goshgarian sheaths can be used instead of special bands with soldered attachments, inventory requirements are minor.



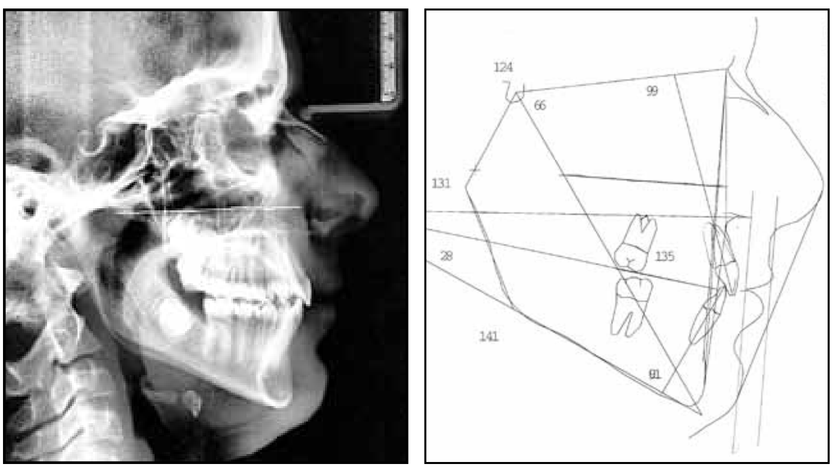


Fig. 10 Case 2. Patient after 23 months of treatment, showing solid Class I occlusion due to slight mandibular prognathism and dolichofacial growth pattern.

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