

Spider Link: A Palatal Skeletal Anchorage System

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The Spider* Link is a new palatal skeletal anchorage system that integrates Spider self-ligating miniscrews and prefabricated stainless steel Power Plates.** This combination can be used to accomplish a number of tooth movements, including mesialization, distalization, intrusion, and constriction of the maxillary teeth.

The Power Plate consists of a central core and two or more lateral arms ending in hooks, allowing force to be applied with elastic chain (Fig. 1). The specific plate design is chosen based on the patient's clinical indications and palatal anatomy. Of the two primary configurations, the H-shaped plate has four lateral arms that can be used for intruding, mesializing, or contracting the upper teeth; the frog-shaped plate has two lateral arms that can be used for maxillary distalization.

The self-ligating miniscrew head has two parts: an external square with two .022" × .025" rectangular slots and an internal round, rotating portion with an .022" × .025" horizontal slot (Fig. 2A). After the archwire is inserted into the slot, it is locked into place by rotating the inner portion 45° (Fig. 2B). This allows immediate coupling of

the miniscrew with the plate, so that the appliance can be placed just after miniscrew insertion. No additional impressions are needed to customize the appliance. This one-visit procedure alleviates patient stress and is less time-consuming for both patient and clinician.

Precise miniscrew insertion is important to ensure easy coupling between the miniscrew slot and the core of the plate. We use the MAPA System,*** an insertion guide designed specifically for palatal applications.^{1,2} Cone-beam computed tomography (CBCT) or a lateral cephalogram is matched with digital models of the upper arch for precise coordination of the miniscrews, preformed plate, and surgical guide.

The anteroposterior position of the plate and, consequently, of the miniscrews is determined by the desired biomechanics. For direct anchorage during molar distalization, the plate should be placed with the hooks distal to the first molars, allowing the attached elastic chain to apply a distalizing force vector on the molars, premolars, and canines (Fig. 3A). For posterior intrusion, the plate is positioned with hooks at the molars and premolars, so that the elastic chain generates an intrusive force vector on those teeth (Fig. 3B). For mesialization, the plate is placed with its arms mesial to the molars and premolars, enabling the elastic chain to apply a mesializing force vector (Fig. 3C).

The miniscrew placement site and the amount of available bone should always be evaluated from CBCT or a lateral cephalogram. According to Kim and colleagues, palatal thicknesses measured from



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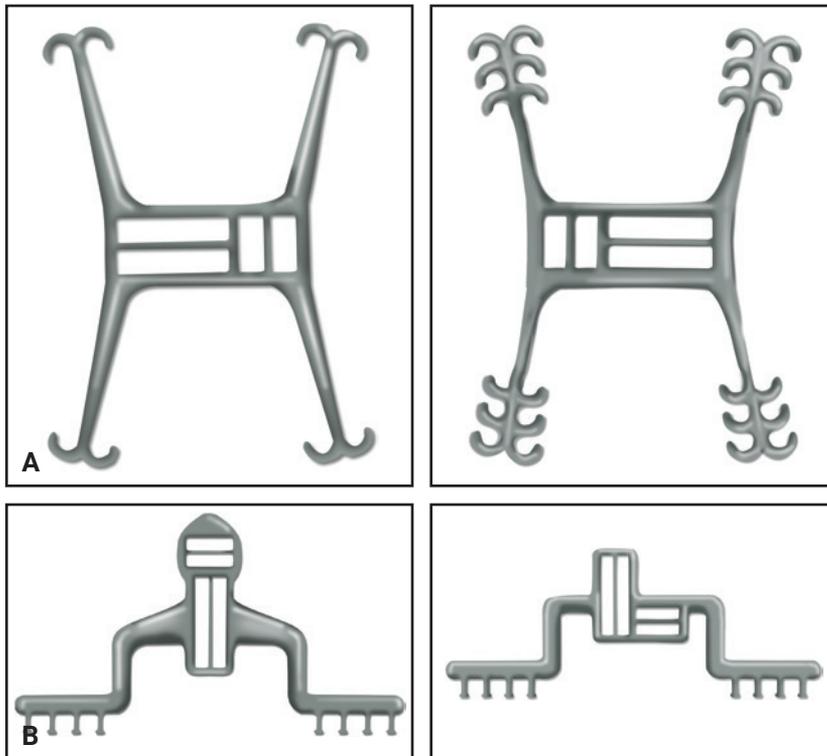


Fig. 1 Preformed Power Plates configured for various indications. A. H-shaped designs. B. Frog-shaped designs.**

lateral cephalograms are comparable to those measured from CBCT scans within 5mm of the mid-sagittal palatal line,³ provided that a magnification correction (usually 10%) is performed.^{4,5}

The preformed plate is adapted to a stereolithographic (STL) model of the maxilla (Fig. 4). Once the self-ligating miniscrews have been in-

serted using the MAPA System, the plate is placed in the palate and locked by rotating the internal part of the miniscrew head 45°.

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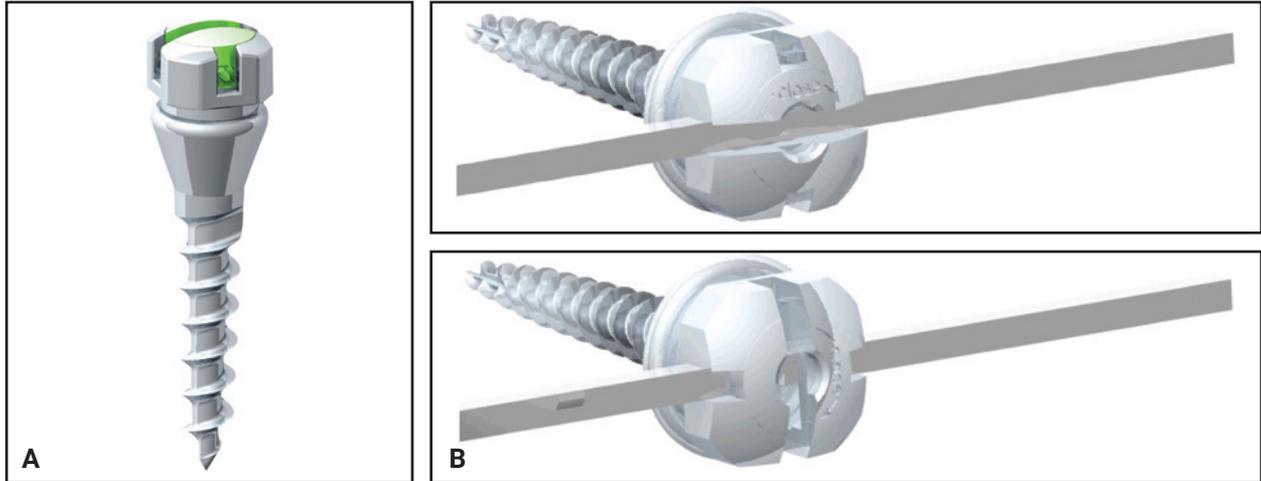


Fig. 2 A. Self-ligating Spider* miniscrew. B. Wire locked in by rotating internal portion 45°.

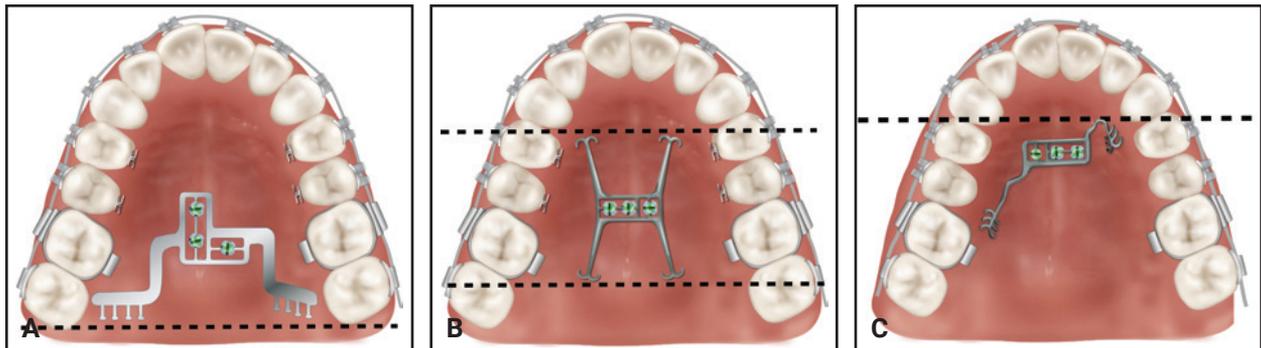


Fig. 3 A. For molar distalization, plate positioned with hooks distal to first molars. B. For posterior intrusion, plate positioned with hooks adjacent to molars and premolars. C. For mesialization, plate positioned with hooks mesial to molars and premolars.



Fig. 4 Plate adapted to stereolithographic (STL) model.

Case 1

A 15-year-old female presented with a Class II subdivision malocclusion, maxillary midline deviation to the left, and mild lower crowding (Fig. 5). The panoramic radiograph confirmed the presence of all permanent teeth. Cephalometric analysis indicated a Class I skeletal relationship ($ANB = 1^\circ$) with hypodivergence ($SN-GoGn = 22^\circ$).

The main objective of orthodontic treatment was to correct the Class II malocclusion. A non-compliance treatment plan was selected, involving distalization of the upper right molars, premolars,

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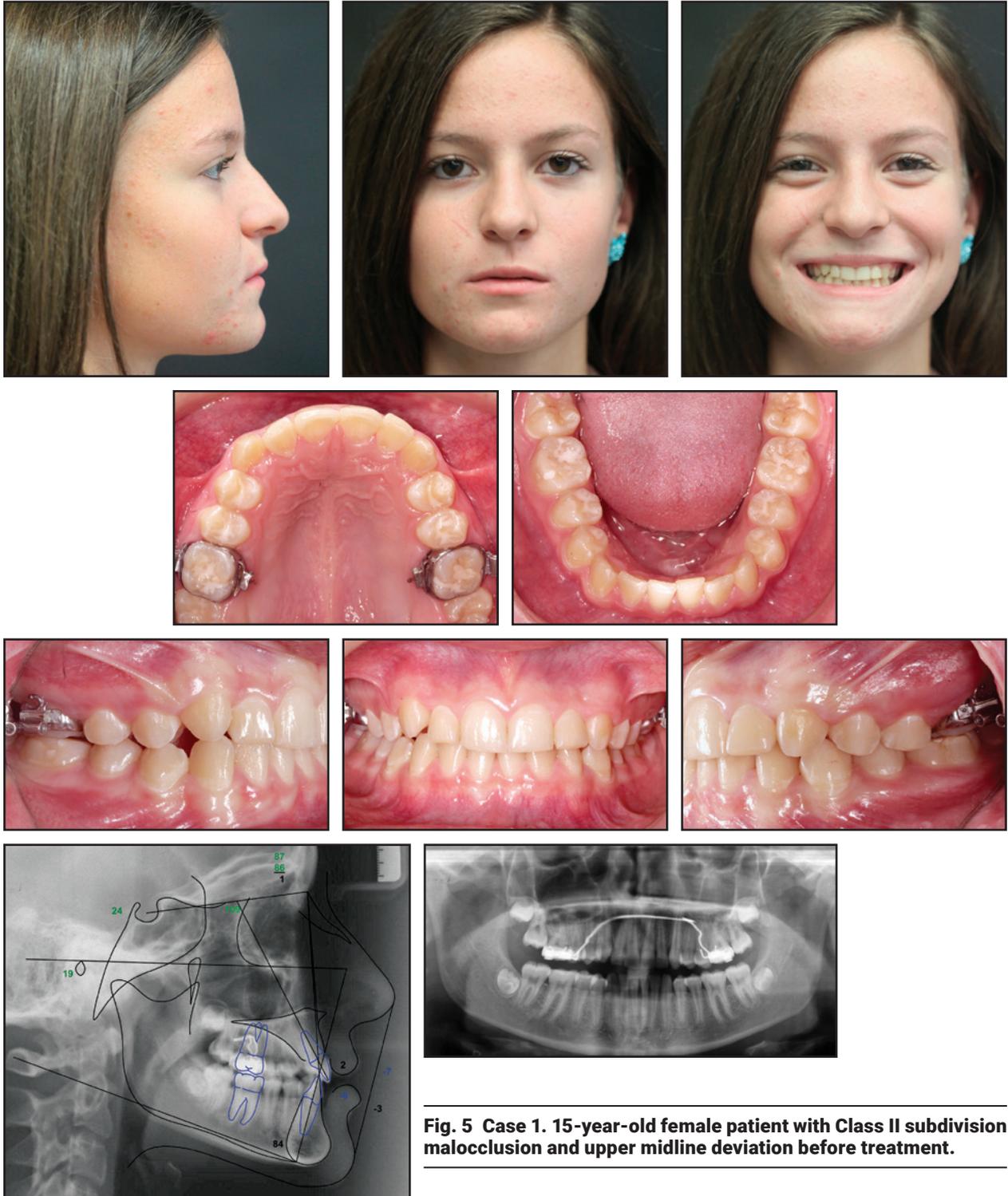


Fig. 5 Case 1. 15-year-old female patient with Class II subdivision malocclusion and upper midline deviation before treatment.

Fig. 6 Case 1. A. Frog-shaped Power Plate attached to three palatal self-ligating K2 miniscrews; Class I elastic chains attached from lingual buttons to plate hook for simultaneous retraction of upper right premolars and first molar. B. After three months of treatment.

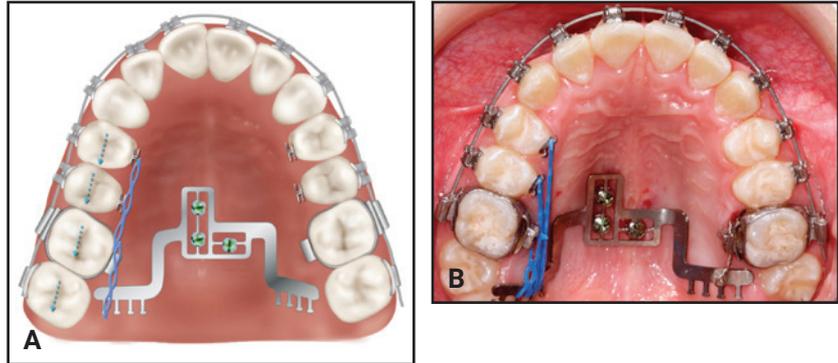
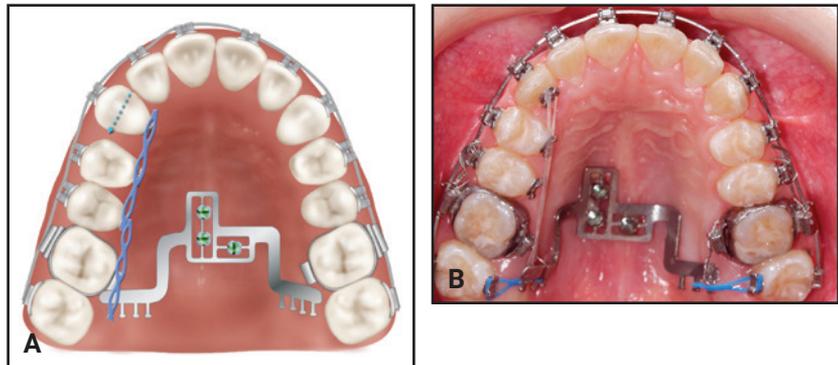


Fig. 7 Case 1. A. After distalization of upper right premolars and molars, lingual button bonded to upper right canine and attached to plate hook with elastic chain. B. After 10 months of treatment, elastic chain attached to overerupted upper second molars; twisted metal ligature placed to hold upper left first molar in Class I relationship.



and canines using the Spider Link system and subsequent en-masse retraction of the upper anterior teeth.

Three self-ligating Spider K2 miniscrews (7mm long, 1.9mm in diameter) were inserted in the paramedian palate using the MAPA System (Fig. 6). Self-ligating Bidimensional brackets (.018" x .025" anterior and .022" x .028" posterior) were bonded in the upper arch. Leveling and alignment were carried out on an .016" x .022" nickel titanium archwire. Wires were then changed to .016" x .022" stainless steel, and lingual buttons were bonded to the upper right first molar and premolars. Class I forces were delivered by attaching elastic chains between the plate and the palatal buttons. The lower arch was leveled and aligned using Bidimensional brackets.

After seven months of treatment, the upper right molars and premolars had reached a Class I relationship. A lingual button was then bonded to

the upper right canine and connected to the Power Plate with Class I elastic chain (Fig. 7). Four months later, the upper right canine was in a Class I relationship.

After 10 months of treatment, lingual buttons were bonded to the upper right and left second molars, which were overerupted. Power chain attached to the Power Plate was used to intrude both molars. A twisted metal ligature connected to the Power Plate held the upper left first molar in its Class I relationship while the asymmetrical mechanics moved the other teeth.

Retraction of the upper anterior teeth was performed over six months with sliding mechanics, using the Bidimensional edgewise technique and .018" x .022" stainless steel archwires. The molars and premolars were blocked during this phase with metal ligatures from the plate to the canines. At the same time, the midline deviation was corrected using an asymmetrical upper archwire that was

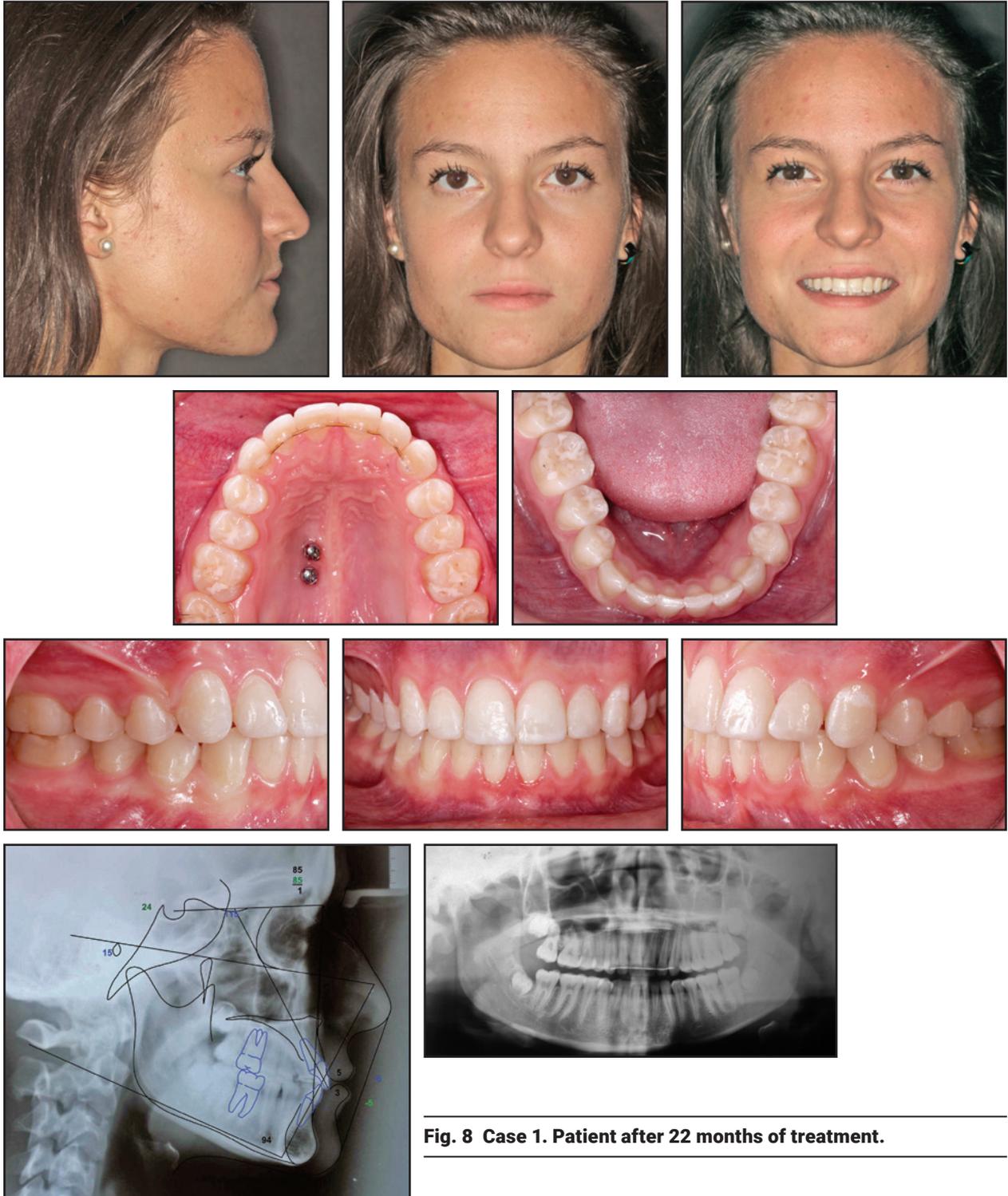


Fig. 8 Case 1. Patient after 22 months of treatment.

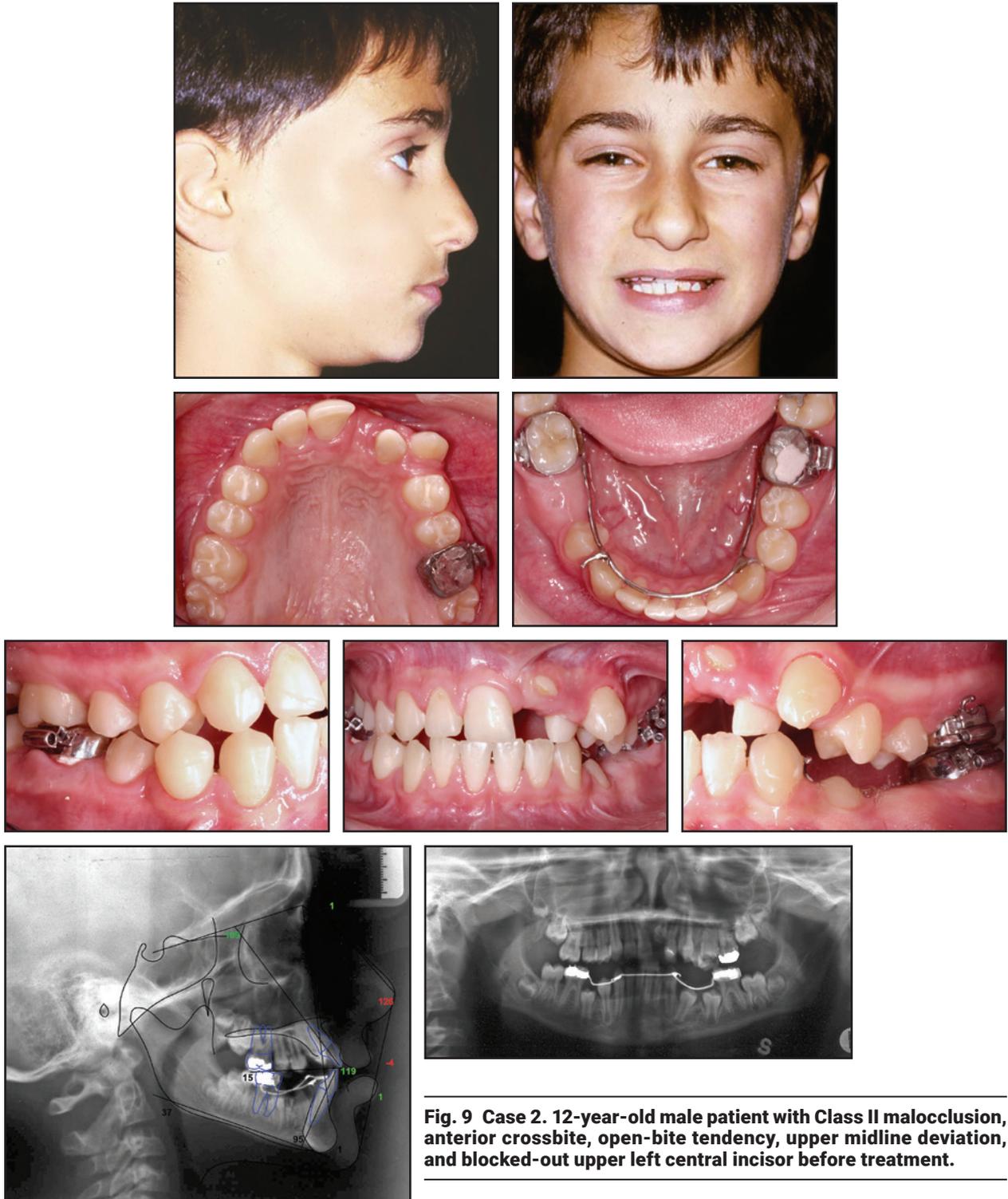


Fig. 9 Case 2. 12-year-old male patient with Class II malocclusion, anterior crossbite, open-bite tendency, upper midline deviation, and blocked-out upper left central incisor before treatment.

expanded near the right canine and constricted on the left side.

Treatment was completed in 22 months (Fig. 8). Class I molar and canine relationships were achieved, and ideal overjet and overbite were established. The upper incisors were built up with composite to reestablish their correct length. An upper 3-3 lingual retainer was bonded, and upper wraparound and lower modified Hawley retainers were delivered for nighttime wear.

Case 2

A 12-year-old male presented with a Class II malocclusion, anterior crossbite, open-bite tendency, upper midline deviated to the left, and blocked-out upper left central incisor (Fig. 9). After early loss of the deciduous molars, a lingual arch had been placed to maintain the leeway space. Panoramic examination confirmed the anomalous condition of the upper left central incisor. Cephalometric analysis showed a Class I skeletal relationship (ANB = 1°) with a steep mandibular plane (GoGn-SN = 37°).

The treatment plan involved extracting the anomalous upper left central incisor, mesializing the entire upper left quadrant, and distalizing the upper right quadrant. Asymmetrical mechanics were planned with the Spider Link system, using a modified H-shaped plate with two of the four arms removed (Fig. 10).

Two months after the upper left central incisor was extracted, the upper arch was bonded with Bidimensional brackets (.018" × .025" anterior and .022" × .028" posterior). Following 12 months of leveling and alignment, two self-ligating K2 miniscrews (7mm long, 1.9mm in diameter) were inserted in the paramedian palate using the MAPA System, and the modified H-shaped plate was attached to the miniscrews (Fig. 11). Lingual buttons were bonded to the upper left second premolar and first and second molars and to the upper right first premolar. To mesialize the upper left quadrant, Class I forces were applied with elastic chains from the anterior hook of the Power Plate. At the same time, distalization of the upper right quadrant was initiated with a Class I elastic chain from the

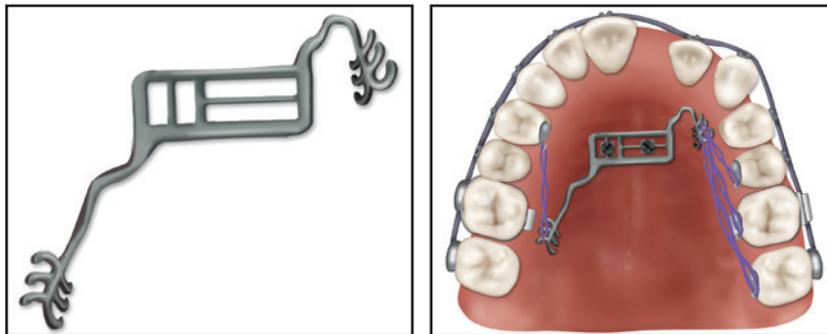


Fig. 10 Case 2. H-shaped Power Plate modified by removing two arms to create asymmetrical mechanics for simultaneous mesialization of upper left quadrant and distalization of upper right quadrant.

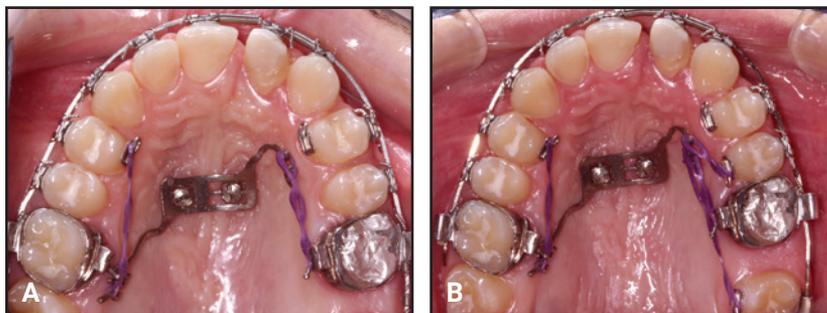


Fig. 11 Case 2. A. After 12 months of leveling and alignment, elastic chain attached between plate hooks and bonded lingual buttons to mesialize upper left quadrant and distalize upper right quadrant. B. After 16 months of treatment.

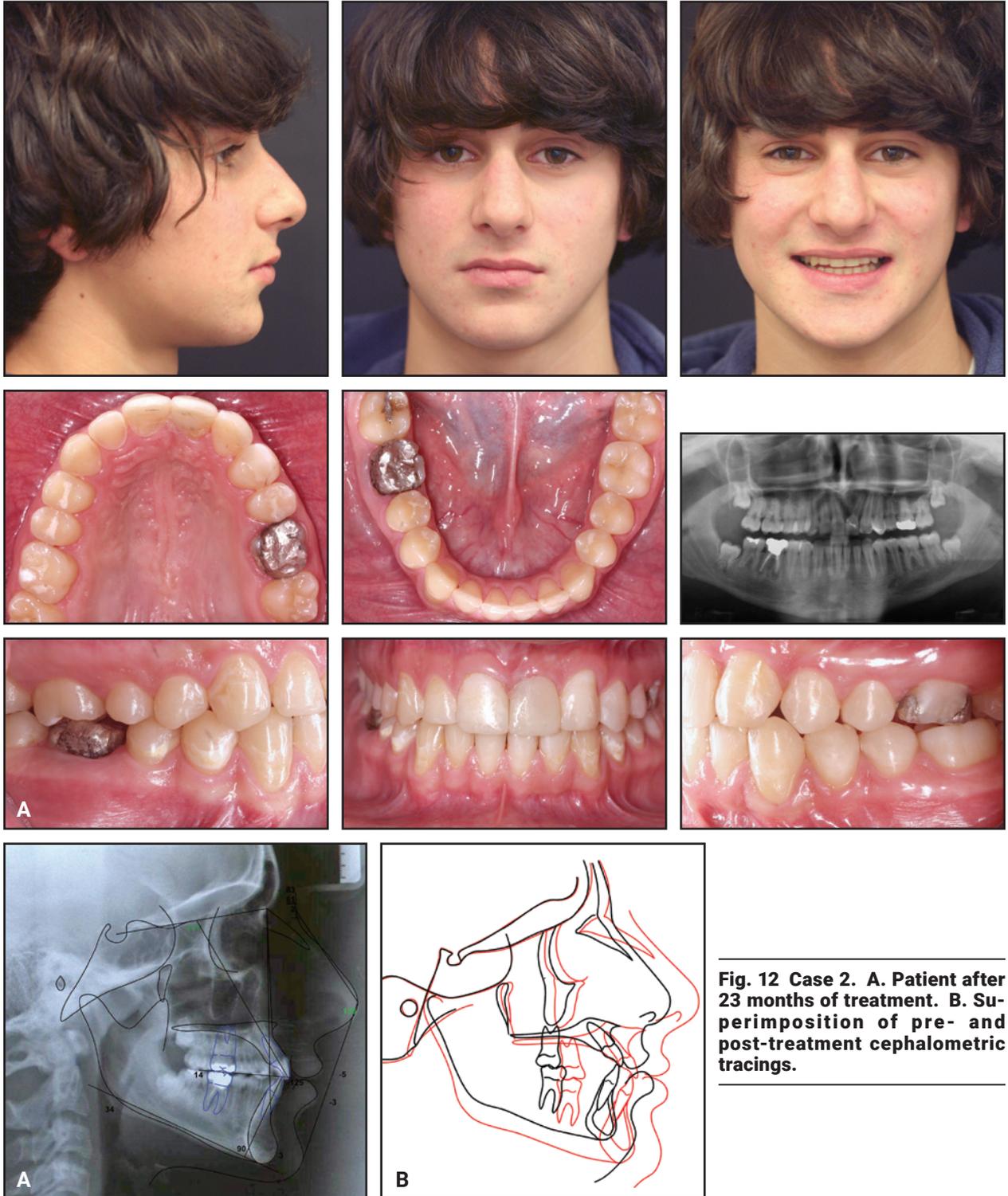


Fig. 12 Case 2. A. Patient after 23 months of treatment. B. Superimposition of pre- and post-treatment cephalometric tracings.

posterior plate hook. The lower arch was leveled and aligned using Bidimensional brackets. Archwires were .018" × .022" stainless steel.

Distalization of the upper right quadrant was completed in six months; mesialization of the upper left quadrant required 13 months. Enough space was left to accommodate direct composite reconstruction of the upper left lateral incisor and left canine, which would become the central and lateral incisors.

After 23 months of treatment, a Class I canine and molar relationship was achieved on the right side and a Class II molar and canine relationship on the left, with ideal overjet and overbite (Fig. 12). Upper 3-3 and lower 4-4 lingual retainers were bonded.

Case 3

A 13-year-old female presented with a Class II malocclusion, open-bite tendency, and upper midline deviation to the left (Fig. 13). The panoramic radiograph confirmed the presence of all permanent teeth. Cephalometric analysis indicated a Class II relationship (ANB = 7°) with proclined lower incisors (IMPA = 101°). The patient had previously been treated with high-pull headgear and a transpalatal arch with a palatal acrylic button to take advantage of tongue pressure during swallowing.

The treatment plan involved extraction of the two upper first premolars and use of the Spider Link system with an intruder-type Power Plate and mini-implant anchorage.

Bidimensional .018" × .025" anterior and .022" × .028" posterior brackets were bonded, and .016" × .022" nickel titanium archwires were placed. One month later, the upper first premolars were extracted. After eight months of leveling and alignment, the archwires were changed to .016" × .022" stainless steel, and two self-ligating K2 miniscrews (7mm long, 1.9mm in diameter) were inserted in the paramedian palate using the MAPA System (Fig. 14). An intruder Power Plate was attached, and elastic chain was connected to lingual buttons and hooks for posterior intrusion and anchorage control in the sagittal plane. A twisted .012" ligature wire was placed between the Power

Plate and the upper left first premolar to maintain its position after intrusion and constriction.

In addition, a Spider pin (10mm long, 1.3mm in diameter) was inserted in the interproximal space between the upper first and second molars on each side to control palatal tipping of the molars and to serve as anchorage for anterior retraction. Once the upper canines reached a Class I relationship, a twisted metal ligature was placed between the Spider pin and the canines to maintain their position and prevent anchorage loss during retraction of the upper incisors. Retraction of upper anterior teeth was accomplished with sliding mechanics using .018" × .025" stainless steel archwires with hooks crimped between the lateral incisors and canines and elastic chain from the Spider pin to the hooks. The vertical position of the upper molars was controlled by elastic chain attached from the miniscrews to the molars.

A Spider K1 miniscrew (10mm long, 1.5mm in diameter) was inserted in the interproximal space between the lower first and second molars on each side to anchor correction of the vertical discrepancy and bite closure, with simultaneous posterior intrusion and anterior retraction. The lower molars were intruded using elastic chain from the miniscrews to the molars. A lingual arch soldered to the lower first-molar bands helped prevent buccal tipping of the lower molars during the intrusion. After interproximal reduction of both lower premolars, elastic chain was extended from the premolars and canines on both sides to the miniscrews for retraction. An .018" × .025" stainless steel archwire with loops was then placed for retraction of the lower incisors. A twisted metal ligature was tied from the K1 miniscrew to the canines on both sides to prevent any loss of anchorage. Stretched metal ligatures between the miniscrews and the molars were used on both sides to stabilize the vertical position of the molars after intrusion.

After six months, the upper anterior teeth were sufficiently retracted. Although the lower anterior retraction was nearly complete, the elastic chain was continued between the plate and the lower molars and premolars during the final part of treatment to control the vertical position of the palatal cusps and improve intercuspation.

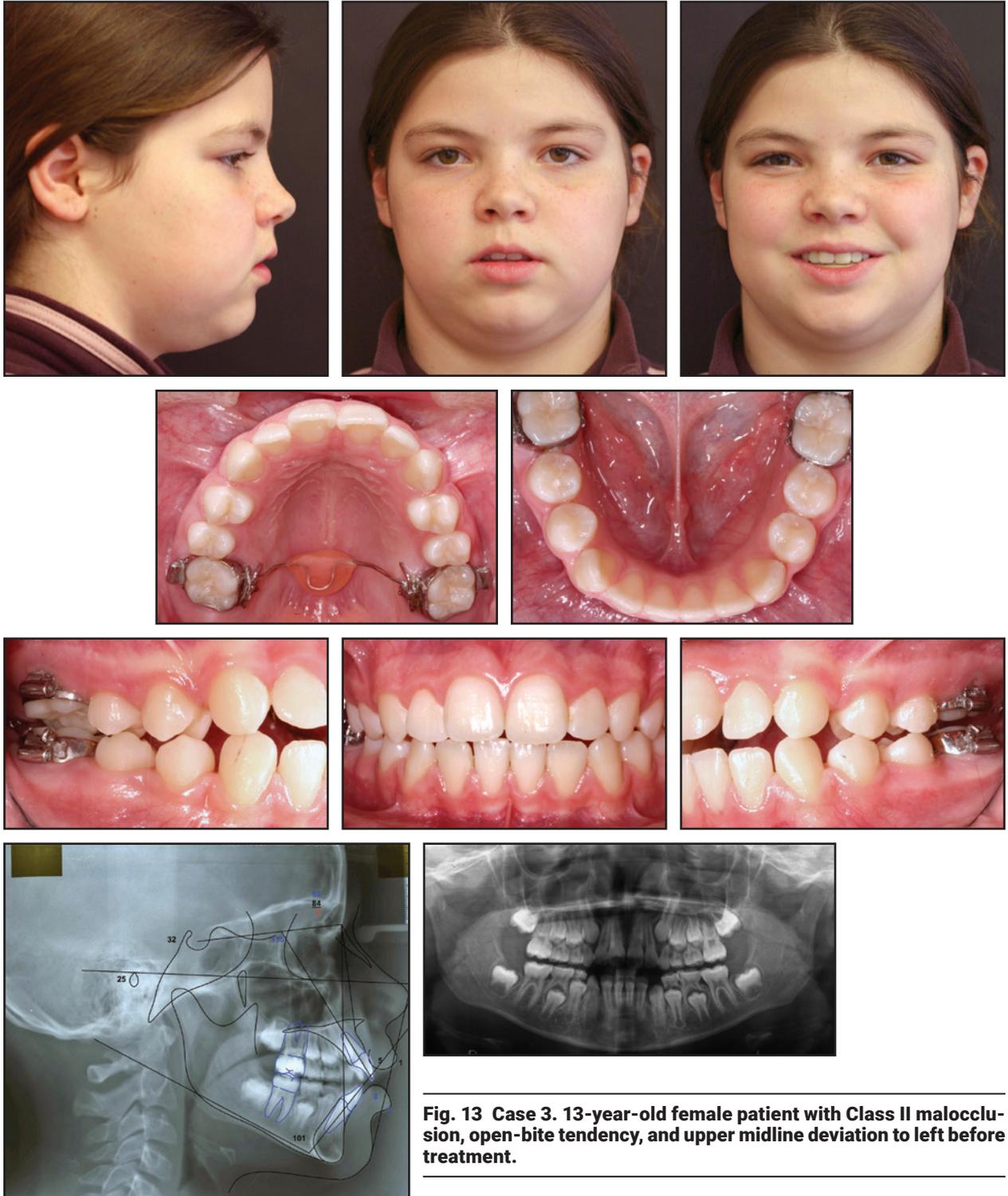




Fig. 14 Case 3. After eight months of leveling and alignment, intruder-type Power Plate placed with two self-ligating K2 miniscrews to intrude upper posterior segment using elastic chain. Spider pins inserted between upper first and second molars for anchorage and control of molar tipping. Spider K1 miniscrews inserted between lower first and second molars for retraction and intrusion. A. Four months later, upper canine retraction and posterior intrusion in progress. B. Five months later, upper incisor retraction in progress.



Fig. 15 Case 3. After 26 months of treatment, sectional stainless steel wires placed on upper and lower posterior teeth and connected to miniscrews with .014" stainless steel ligatures.

After 26 months of treatment, Class II molar and Class I canine relationships with ideal overjet and overbite had been obtained. The mandibular incisor inclination was improved (IMPA reduced from 101° to 94°), and counterclockwise mandibular rotation was achieved by the posterior intrusion (GoGn-SN reduced from 32° to 26°). Myofunctional therapy was recommended to control tongue thrusting.⁶

To reduce the risk of open-bite relapse,⁷⁻⁹ sectional stainless steel wires were placed on the lower molars and upper premolars and molars and connected to the buccal miniscrews with .014" stainless steel ligatures (Fig. 15). These appliances were removed 10 months later (Fig. 16). Upper and lower 4-4 lingual retainers were bonded to counteract the remaining mild tongue thrust.

Discussion

The Spider Link system is useful in numerous clinical situations because of the variety of biomechanical designs that can be created with the

preformed Power Plates. In Class II cases, because the molars and premolars can be distalized simultaneously and predictably, treatment is shorter than with other noncompliance systems. In patients requiring molar and premolar intrusion, the intruder Power Plate enables the intrusion of different teeth at the same time, while forces are applied in different directions. An additional benefit is that the use of self-ligating miniscrews with a precise, guided insertion method allows the miniscrews and fixed appliances to be placed in a single visit, thus reducing chairtime and laboratory costs.

In all three cases presented here, the miniscrews were inserted in the paramedian region of the palate—the preferred location in growing patients.¹⁰ For simple distalization, however, the miniscrews should be inserted in the posterior region of the palate. Even though the palate is thin in this area, the bone is a double cortical plate with sufficient tissue quality to ensure excellent stability for the miniscrews.¹¹ One disadvantage is that the application of distalization forces from the palatal side tends to cause mesial rotation of the molars.

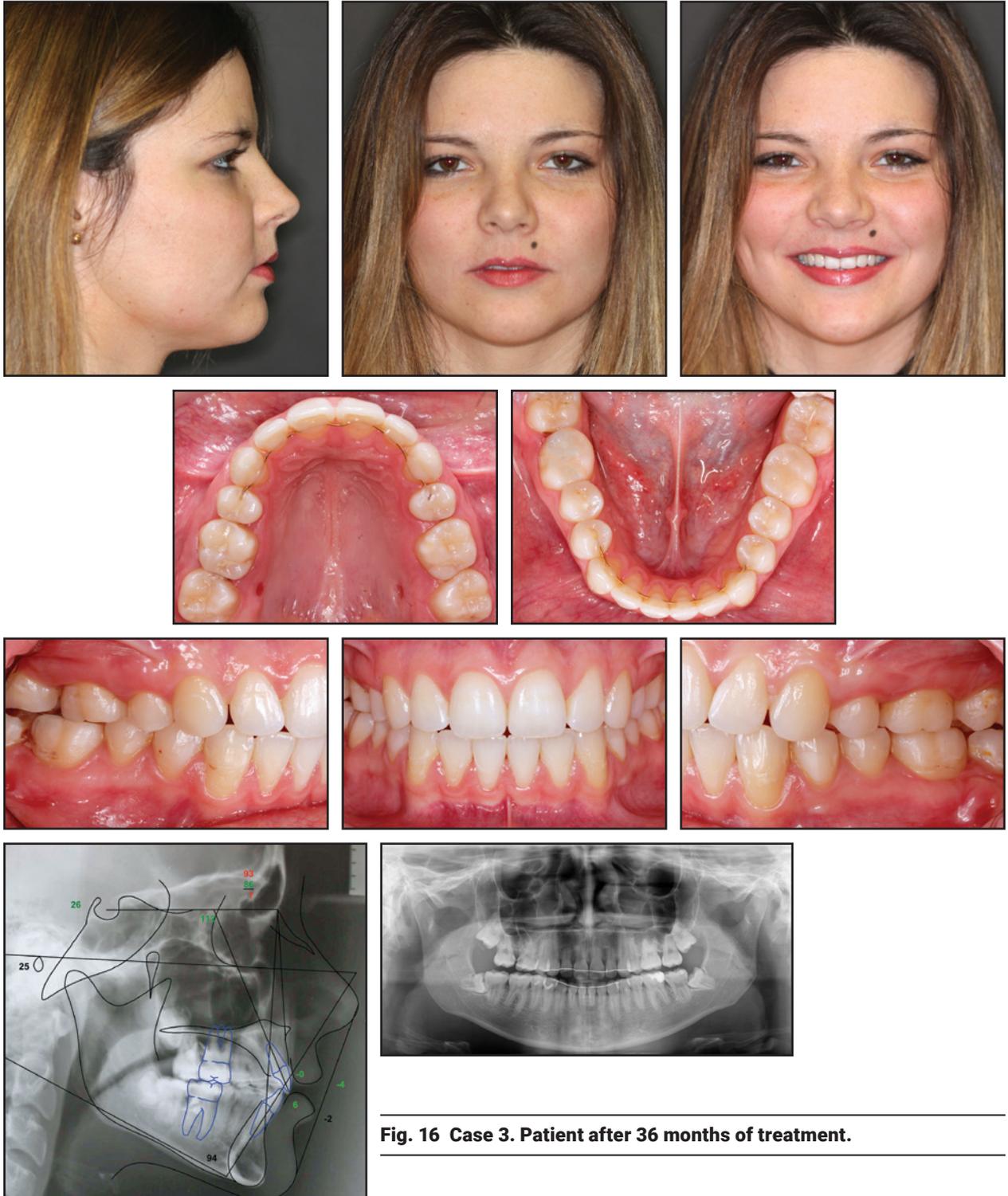


Fig. 16 Case 3. Patient after 36 months of treatment.

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