Design Improvements in the Modified C-Palatal Plate for Molar Distalization

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Although early versions of the modified C-palatal plate (MCPP) were used successfully for molar distalization in both adolescents and adults, close contact between the plate and the palatal soft tissue made oral hygiene difficult and interfered with the engagement of elastic chains (Fig. 1). The addition of half-tubes to the screw holes helped prevent gingival overgrowth, and a jig used for placement of the appliance maintained more regular spacing between the plate's arms and the palatal slopes[1,2] (Fig. 2).

The MCPP has now been further modified by curving the lever arms distally and adding indentations to each arm for force attachment. We have also refined the jig-fabrication procedure, as illustrated in this article.

Design Changes

The third-generation plate incorporates three 2.5mm miniscrew tubes (two posterior and one anterior), each 2mm in diameter, to control soft-tissue inflammation and improve stability. The tubes become embedded in the palatal soft tissue, contacting or nearly contacting the palatal bone

Fig. 1 Inflammation from compromised oral hygiene due to close contact between original MCPP plate and palatal soft tissue.

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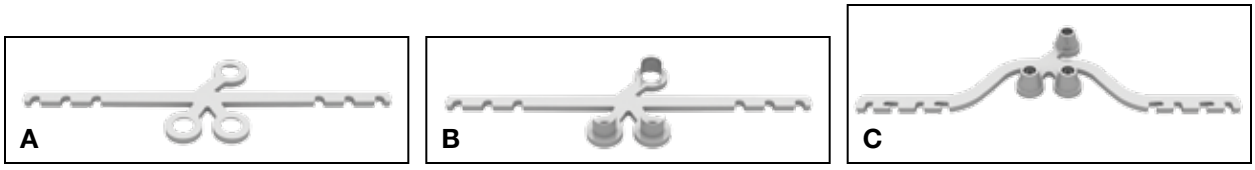

Fig. 2 A. First-generation palatal plate. B. Second-generation plate with half-tubes. C. Third-generation plate with full tubes, distally curved arms, and additional indentations on each arm.

Fig. 3 A. Consistent spacing of about 2mm between plate arms and palate. B. Sagittal and coronal cone-beam computed tomography (CBCT) images show screw tubes almost touching bone surface, reducing potential tilting range of plate.

(Fig. 3). The tight adaptation between tube and miniscrew* (2mm × 8mm) reduces the potential for plate tipping and resulting soft-tissue impingement when forces are applied. Placement of the miniscrews lateral to the midpalatal suture makes the appliance suitable for use in both adolescents and adults.

The two extended lever arms curve distally to increase the range of action of the distalizing springs or elastics and to avoid contact with the palatal archwire (Fig. 4). Each lever arm has four indentations for attachment of elastics or coils, two of them hook-shaped for more secure engagement during intrusion mechanics.

Silicone Jig Fabrication

To ensure that the plate's lever arms are a close and consistent distance from the palatal tissues, a silicone jig is used during placement. The procedure (shown with the second-generation MCPP) is as follows:

1. After determining the appropriate location for the appliance, stabilize the plate on the working cast by making shallow indentations for the screw tubes. Adapt the plate and arms to the contours of the cast, with the lever arms extending to the areas between the first molars and the second premolars or second deciduous molars (Fig. 5A). (The distally curved arms of the third-generation plate extend to the spaces between the first and second molars.) Maintain a consistent space of about 2mm between the arms and the palatal surface.
2. After removing the plate, apply a 3mm-thick

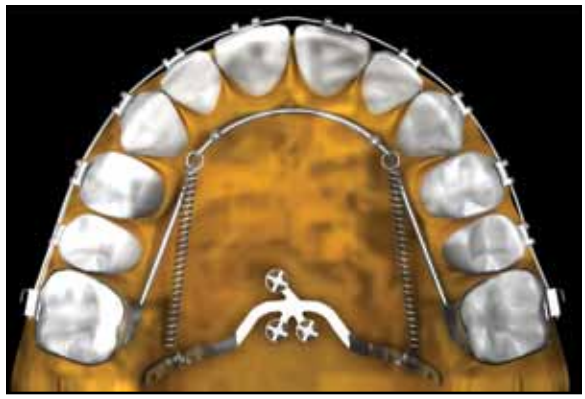

Fig. 4 Arms of palatal plate curve distally to increase range of action and facilitate application of elastic chain while avoiding contact with palatal archwire.

layer of silicone material** to the cast, crossing the palate and extending over the occlusal surfaces of the second premolars (or second deciduous molars) and first molars.
3. Press the plate gently into position on the silicone, guided by the screw-tube indentations in the cast (Fig. 5B).
4. Heat-cure the silicone and remove the jig-plate assembly from the cast.
5. Remove the silicone plugs from the screw tubes. Carefully slice diagonally through the silicone so that the jig can be easily removed after delivery of the plate (Fig. 5C).
6. Sterilize the jig-plate assembly in ethylene oxide gas for 24 hours before the placement appointment.

Appliance Placement

1. Under local anesthesia, place the jig-plate assembly in the palate by fitting the jig to the occlusal surfaces of the molars and premolars (Fig. 6A).
2. Insert self-drilling miniscrews through the screw tubes with a torque driver* at 30rpm and less than 30Ncm of force (Fig. 6B).
3. Remove the jig by pulling gently and firmly from each side with a utility plier (Fig. 6C). Tighten the miniscrews if necessary, and make fine adjustments to the lever arms.
4. Place the palatal archwire or other appliances immediately to initiate distalization forces (Fig. 6D).

Case Report

A 12-year-old female presented with the chief complaint of a retruded chin (Fig. 7). She had Class I molar and Class II canine relationships and a skeletal Class II occlusion with a vertical growth pattern. All permanent teeth were present except for a missing upper right third molar. Clinical examination showed a convex facial profile, a protrusive upper lip, mild crowding in both arches, and a 5mm overjet.

*Jeil Medical Corporation, Seoul, Korea; www.jeilmed.co.kr.

**Positioner-Rohling, Forestadent Co., Pforzheim, Germany; www.forestadentusa.com.

Fig. 5 A. Plate contoured to working cast with 2mm space between palate and lever arms. B. Plate pressed gently into position on uncured silicone. C. Silicone sliced diagonally (dashed line) for easy removal after delivery of plate.

TABLE 1
CEPHALOMETRIC ANALYSIS

	Pretreatment	Post-Treatment
SNA	82.0°	81.0°
SNB	75.0°	75.0°
ANB	7.0°	6.0°
S-N/Go-Gn	38.0°	37.5°
FMA	32.0°	31.5°
P/A facial-height ratio	59%	60%
FH-U1	118.0°	105.0°
Overjet	5.0mm	3.5mm
Overbite	3.0mm	4.0mm
Nasolabial angle	112.0°	117.5°
TVL-UL	5.0mm	2.5mm
TVL-LL	0.0mm	–4.5mm

The recommended treatment plan involved extraction of the upper first premolars and retraction of the anterior segments to resolve the lip protrusion. Because the parents refused extraction treatment, however, a second-generation MCPP was used for full-arch distalization.

After leveling of the upper arch, the palatal plate was installed using a silicone jig as described above. An analgesic was prescribed to reduce discomfort following appliance placement.

A 1mm stainless steel palatal wire with hooks was inserted between the upper first molar bands, and about 250g of distalizing force was applied on each side with a power chain between the palatal-arch hook and the MCPP lever arm. Brackets were bonded in the upper arch to help restrict maxillary development. After 14 months of treatment, upper and lower .019" × .025" stainless steel archwires were placed (Fig. 8). Class III elastics were then used for retraction of the lower dentition.

No signs of inflammation of the palatal soft tissue were noted during active treatment. The mucosal tissue of the hard palate regenerated quickly after removal of the palatal plate, and healing by secondary intention[3] occurred within a few days.

After 33 months of treatment, the anterior protrusion had been resolved, with adequate overjet and overbite achieved (Fig. 9). The upper molars demonstrated more root than crown movement. The patient's three remaining third molars were extracted after debonding.

Post-treatment records 10 months after appliance removal showed a stable occlusion with good molar positions and a pleasant profile (Fig. 10).

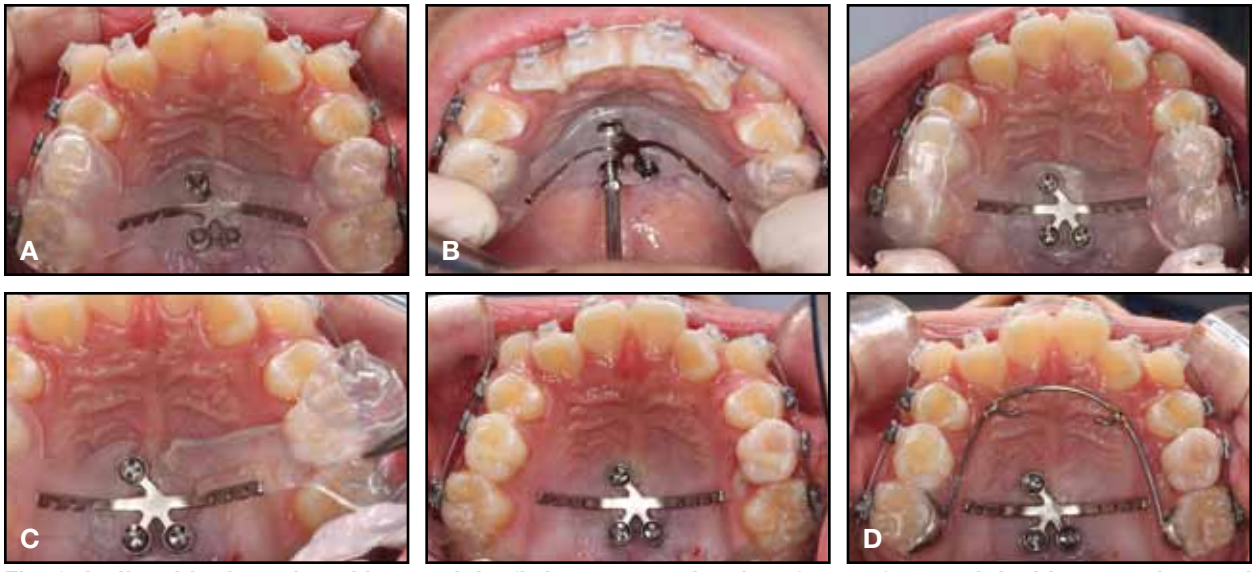

Fig. 6 A. Jig with plate placed in mouth by fitting onto occlusal surfaces of second deciduous molars and first molars. B. Self-drilling miniscrews inserted through screw tubes. C. Jig removed with utility plier. D. Palatal wire with hooks bonded to first molars to begin distalization.

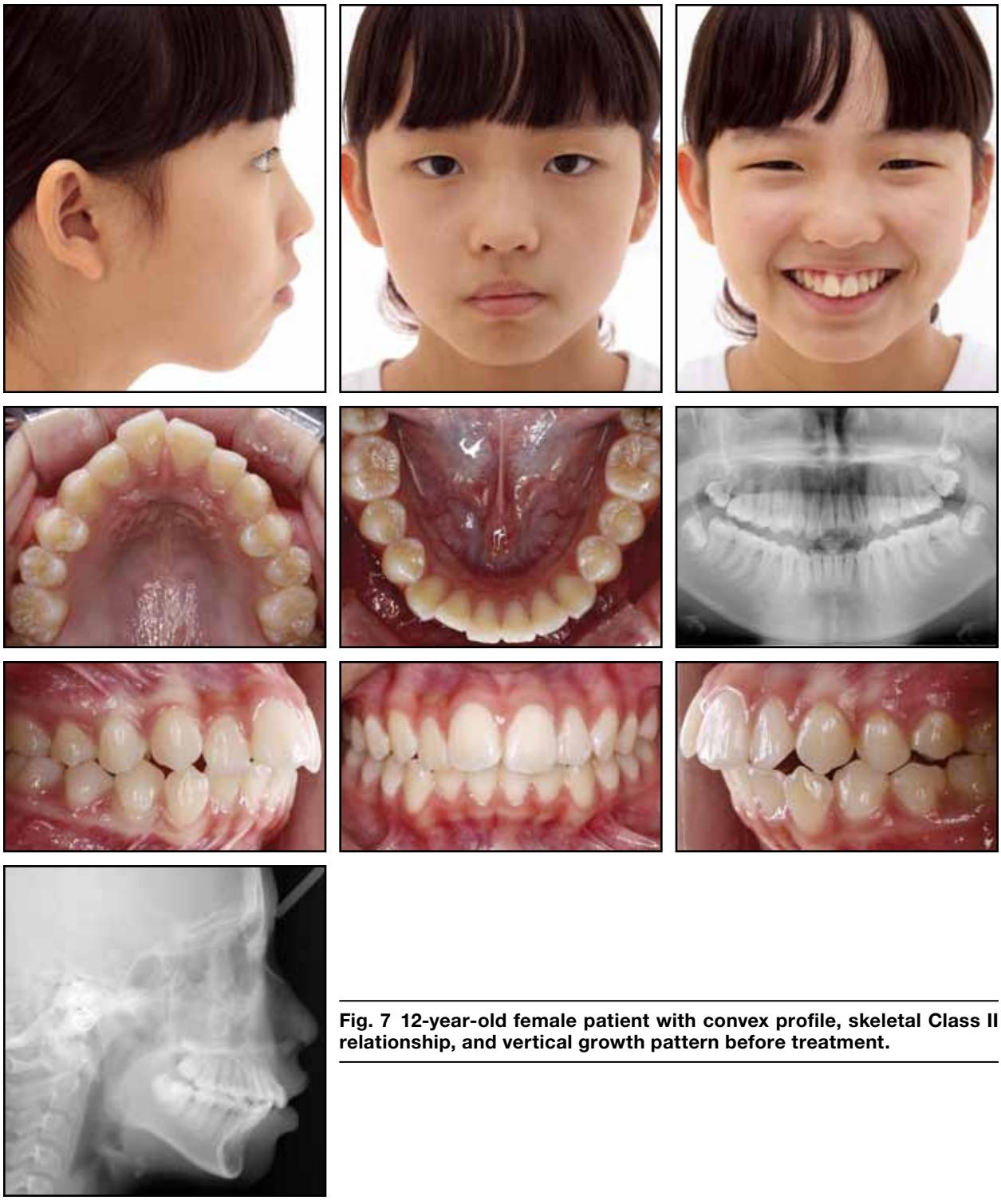

Fig. 7 12-year-old female patient with convex profile, skeletal Class II relationship, and vertical growth pattern before treatment.

Discussion

Although successful en masse distalization using buccally placed temporary anchorage devices (TADs) has been reported,[4,5] miniscrew placement in the interradicular spaces may limit the potential amount of distalization. In contrast, palatal TADs allow teeth to be moved farther without requiring midtreatment relocation of miniscrews.[6,7] In addition to enabling distalization of more than 3mm, palatal anchorage has the advantages of easy application, flapless insertion, and

Fig. 8 After 14 months of upper-arch distalization with MCPP, upper and lower .019" × .025" stainless steel archwires.

low risk of interference with growth.

Distalization of the entire maxillary dentition requires the application of 450-500g of force. Since a single miniscrew may not be able to withstand forces this heavy,[8] and since the bone quality is lower in adolescents than in adults,[9] our palatal plate is anchored with three miniscrews. Placing the screws about 2mm lateral to the midpalatal suture allows the appliance to be used in adolescents as well as adults. With 8mm-long miniscrews inserted in the 2.5mm screw tubes, about 5mm of the screw will be embedded in palatal bone. The palatal bone thickness in the late mixed dentition is reported to be 5.9mm in the midpalate and 6.5mm in the posterior palate,[10] making penetration of the nasal cavity unlikely.

An evaluation of several buccal and palatal approaches to upper-molar distalization found that force application 10mm above the palatal surface of the molar, measured from the level of the molar bracket slot (and corresponding to the MCPP arms' most medial indentations), resulted in bodily movement with mesial-in rotations.[2] To minimize this rotational effect, a heavy maxillary archwire is recommended, and additional force from buccal miniscrews may be required.

Third-generation modifications to the MCPP have added indentations in each lever arm, with two of them hook-shaped for better retention of elastic chains and closed-coil springs. These indentations provide a wider range of angles through which force vectors can be applied, especially in cases with high palatal vaults. The screw half-tubes (and later full tubes) have helped prevent impingement of the palatal soft tissues. The plate is offset enough from the palate by the screw tubes to accommodate slight individual variations in palatal soft-tissue thickness,[11] while remaining stable due to the tight contacts between the screw tubes and miniscrews and the palatal bone.

In our patient, cone-beam computed tomography (CBCT) superimposition over the cranial base confirmed bodily movement of the maxillary dentition with minimal tipping, probably due to the location of the force vectors at the molar centers of resistance. The MCPP served as direct anchorage for the upper-molar distalization and indirect anchorage for distalization of the full mandibular arch. This wouldn't ordinarily take as long as 33 months, but our patient's skeletal discrepancy required longer treatment. Furthermore, since she had declined extraction of her three remaining third molars before appliance placement, there was greater resistance to the molar distalization. The third molars were eventually extracted after post-treatment CBCT images indicated the possibility of relapse due to posterior space deficiency.

It is noteworthy that distal movement of the patient's upper-molar roots was greater than that of the crowns, since most distalization methods result in distal crown tipping, a possible contributor to relapse. Because conventional two-dimensional analysis of bodily movement is difficult, especially in adolescents, further research using three-dimensional superimposition is needed to evaluate the results of MCPP treatment.

Conclusion

The MCPP offers a simple and effective nonextraction approach for distalization of the maxil-

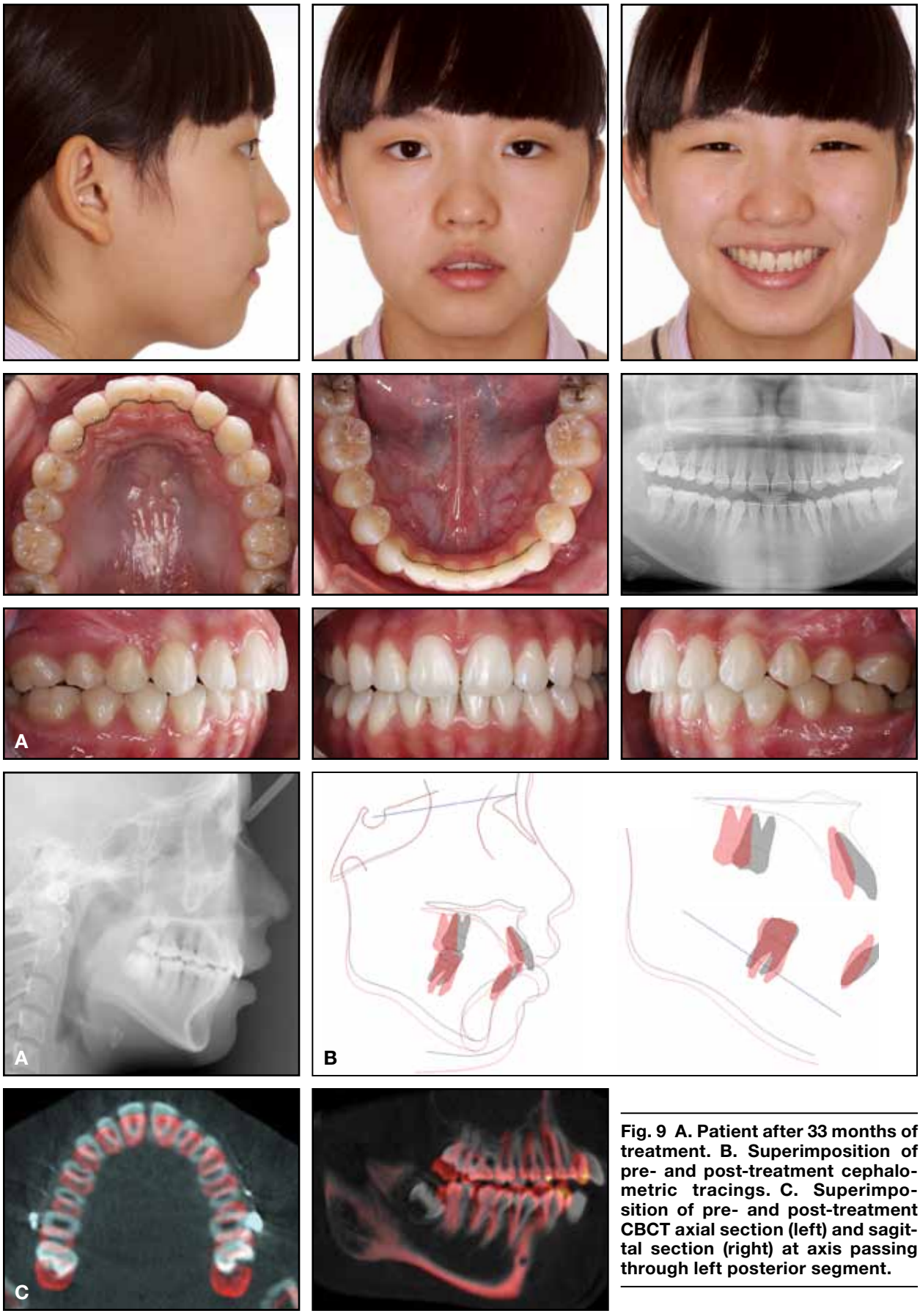

Fig. 9 A. Patient after 33 months of treatment. B. Superimposition of pre- and post-treatment cephalometric tracings. C. Superimposition of pre- and post-treatment CBCT axial section (left) and sagittal section (right) at axis passing through left posterior segment.

Fig. 10 Patient 10 months after debonding.

lary dentition. New features of the third-generation plate and the jig-fabrication procedure make the system more comfortable and versatile. It is our appliance of choice for chin retrusion and for moderate skeletal discrepancies requiring more than 3mm of distalization, in both adolescents and adults.

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