Biomechanical Considerations in Treatment with Miniscrew Anchorage

Part 3 Clinical Cases

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In two previous articles (JCO, February 2008 and March 2008), we described biomechanical variations that may occur during the retraction of anterior teeth using skeletal anchorage. The present article describes two clinical cases that would have been extremely difficult to treat without miniscrews.

Case 1

A 32-year-old female presented with the chief complaint of a protrusive profile (Fig. 1). Her mandibular first molars had been extracted when she was a teen-ager. She had a Class II, division 1 malocclusion with a severe overjet (13mm) due to the upper incisor protrusion, a deep overbite, and a retrognathic mandible (Table 1). Her lower dental midline was shifted 2mm to the right of the facial midline, and mild crowding was observed in both arches. Canting of the occlusal plane was noted in the upper left quadrant and the lower arch, and the left premolars were in buccal crossbite.

TABLE 1
CASE 1 CEPHALOMETRIC DATA

	Norm	Pre-treatment	Post-Treatment
Bjork sum	397.2°	403.3°	401.3°
FHt ratio	65.3%	61.5%	63.1%
ANB	3.5°	7.7°	6.5°
AN perp.	–0.5mm	0.9mm	0.3mm
PoN perp.	–2.4mm	–15.7mm	–12.9mm
U1-FH	113.8°	128.1°	104.1°
U1-SN	105.3°	117.8°	93.2°
L1-APo	3.8mm	0.7mm	2.9mm
IMPA	91.6°	86.6°	103.4°
Interincisal angle	125.4°	112.4°	123.1°
Nasolabial angle	98.0°	101.9°	114.5°
Upper lip-E line	–0.86mm	4.0mm	0.5mm
Lower lip-E line	0.06mm	2.9mm	–0.7mm

Although orthognathic surgery was recommended, the patient opted for orthodontic treatment alone, following extraction of the maxillary first premolars. To correct the dental midline position, we planned to regain the extraction space in the lower right quadrant and close the space in the lower left quadrant.

Miniscrew anchorage was used in the maxillary posterior regions to retract the maxillary anterior teeth and intrude the premolars. Another miniscrew was placed in the lower left premolar area for protraction and intrusion of the posterior teeth (Fig. 2). Initially, power chain was used in two directions (Fig. 3). With the retraction force rotating the maxillary arch and the intrusion force rotating the posterior segments in the opposite direction, the occlusal plane was quickly leveled.

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We attempted to place the line of retraction force near the center of resistance using long soldered hooks (Fig. 4), but the maxillary arch rotated slowly, so that a mild maxillary posterior open bite was observed when the extraction space was almost closed. To overcome this side effect, maxillary anterior miniscrews were used for anchorage to intrude the anterior teeth and rotate the occlusal plane (Figs. 5,6). (See Part 1, February 2008.)

In the lower arch, a reverse-curve TMA* wire was used to level the occlusal plane (Fig. 7). The mandibular molars were then protracted to close the left first molar space. During retraction,

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Fig. 1 Case 1. 32-year-old female patient with Class II, division 1 malocclusion, protrusive upper incisors, and retrusive mandible before treatment. Casts show severe overjet and canting of occlusal plane in both arches.

Fig. 2 Case 1. Miniscrew anchorage used to retract anterior teeth and correct occlusal plane canting.

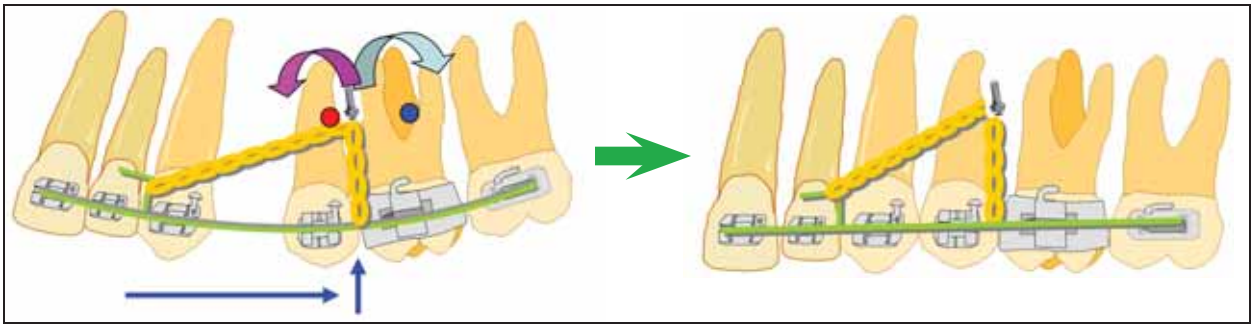


Fig. 3 Case 1. Retraction force causes slight rotation of occlusal plane (purple arrow), and intrusion force causes clockwise rotation of posterior segment (light blue arrow), resulting in intrusion of maxillary buccal segment (short, dark blue arrow) and leveling of occlusal plane.

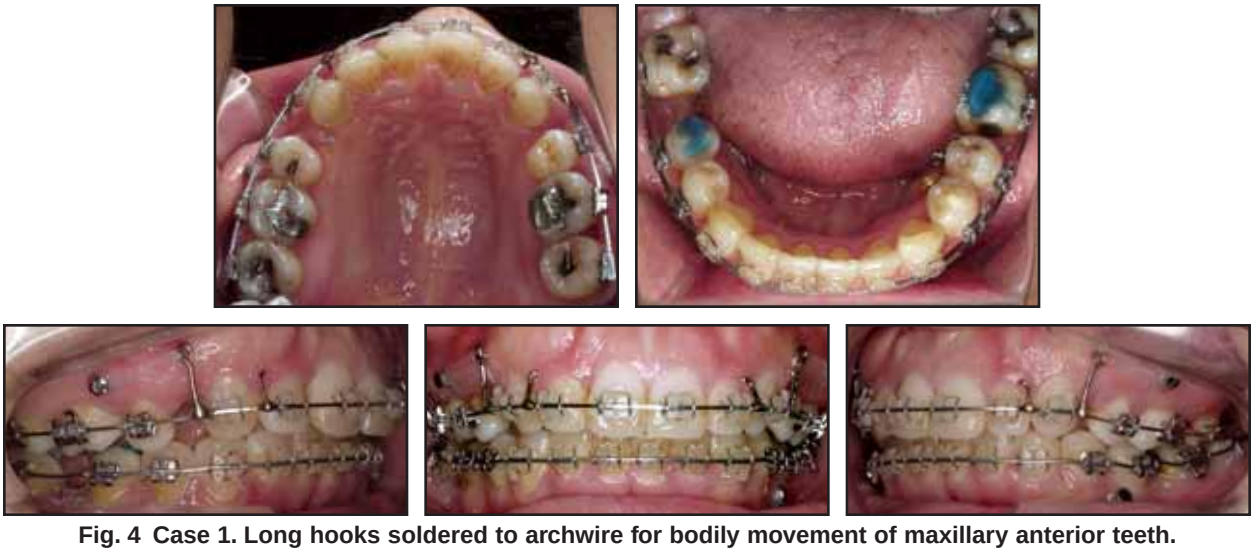


Fig. 4 Case 1. Long hooks soldered to archwire for bodily movement of maxillary anterior teeth.

Fig. 5 Case 1. Additional miniscrews placed in anterior alveolus to overcome side effects of retraction with miniscrew anchorage.

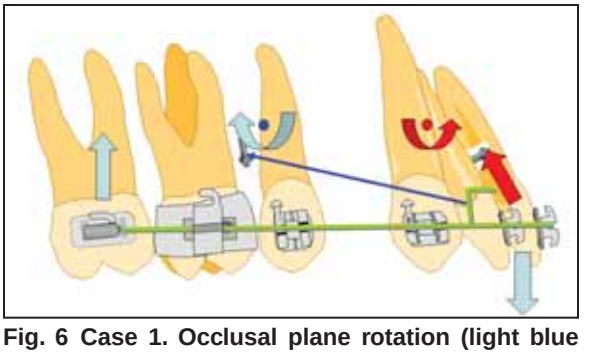


Fig. 6 Case 1. Occlusal plane rotation (light blue arrows) can be corrected or prevented with anchorage from additional miniscrews (red arrows), especially in patients with gummy smiles.

the mandibular left incisors were intruded, and the occlusal plane canting was completely corrected by the rotational effect. The midline was aligned by opening space in the mandibular right first molar area.

After debonding, the patient's profile was markedly improved, largely due to dental changes, and the overjet and lower midline position were corrected (Fig. 8, Table 1). The maxillary posterior teeth moved slightly backward and upward—an effect that would not have been seen in conventional extraction treatment.

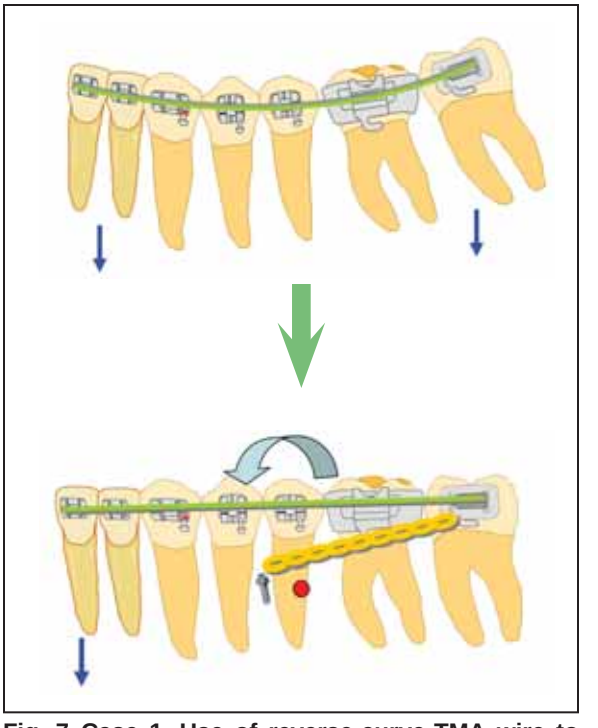


Fig. 7 Case 1. Use of reverse-curve TMA wire to flatten curve of Spee. Slight rotation of occlusal plane from retraction of posterior teeth with miniscrew anchorage helped correct occlusal plane canting.

Fig. 8 Case 1. A. Patient after 28 months of treatment. B. Pre- and post-treatment cephalometric tracings, showing distal movement of maxillary molars.

Case 2

A 26-year-old female presented with the chief complaints of right TMJ discomfort and mandibular anterior crowding (Fig. 9). She had a severe Class III molar relationship and anterior crossbite with moderate crowding, indicated by an upper arch-length discrepancy of 6mm and a lower discrepancy of 4.5mm. The lower dental midline was shifted 1.5mm left of the facial midline, and

Fig. 9 Case 2. 26-year-old female patient with Class III malocclusion and protrusive profile before treatment. Casts show anterior and left posterior crossbite and deviation of lower dental midline.

Fig. 10 Case 2. Progress records. A. During retraction. B. After correction of anterior crossbite.

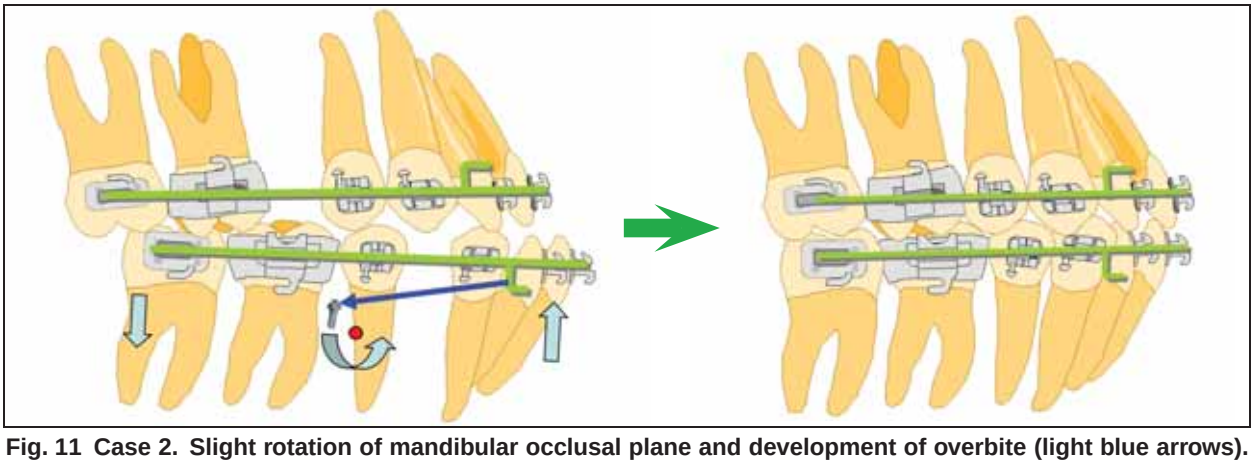
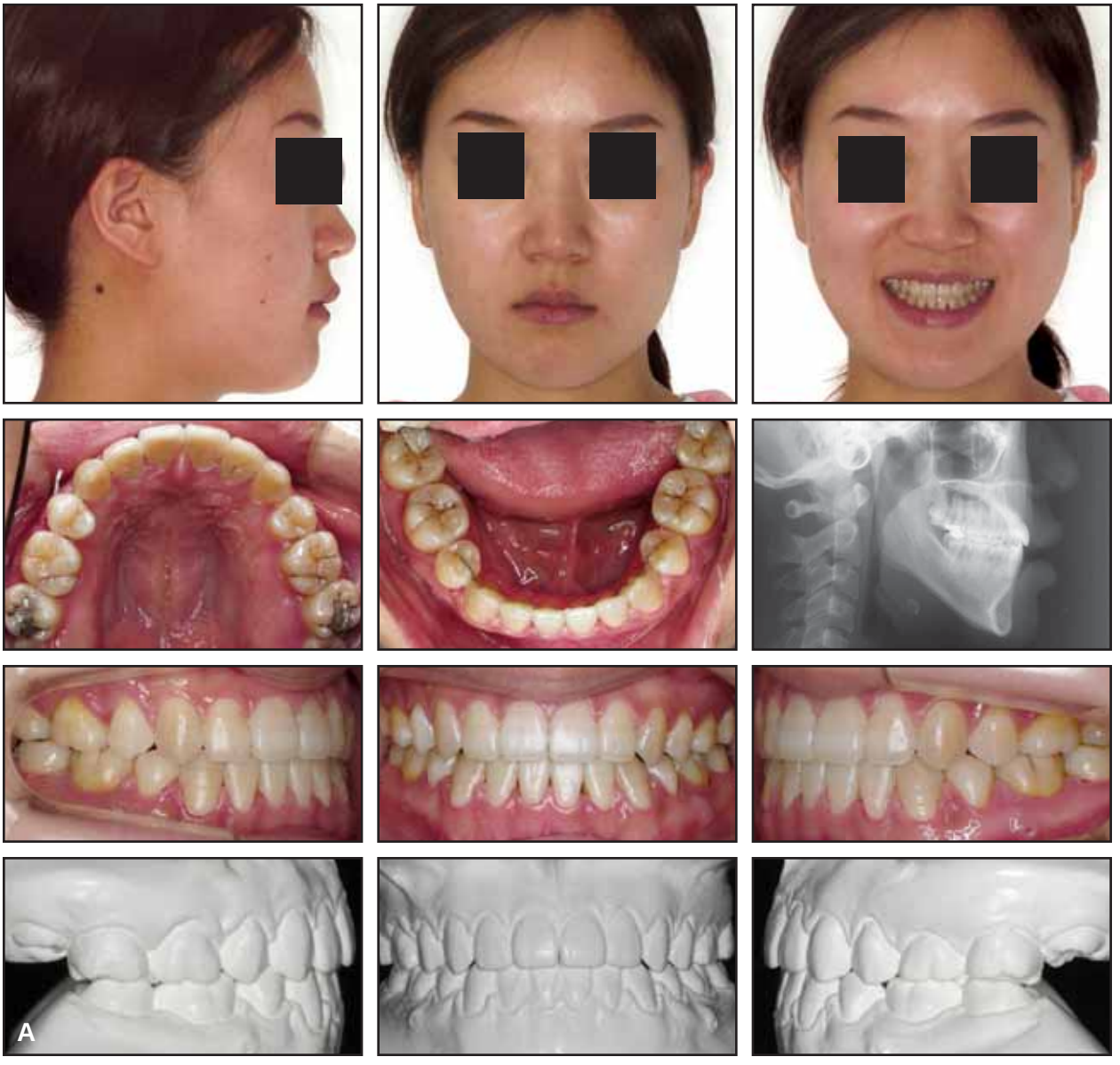


Fig. 11 Case 2. Slight rotation of mandibular occlusal plane and development of overbite (light blue arrows).



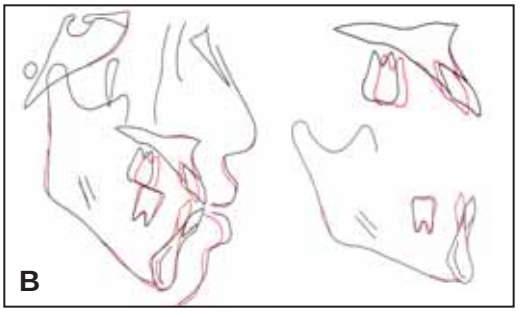


Fig. 12 Case 2. A. Patient after 23 months of treatment. B. Pre- and post-treatment cephalometric tracings, showing distal movement of mandibular molars.

mild protrusion was observed. The maxillomandibular skeletal relationship was within the normal range (AN perpendicular = .5mm, PoN perpendicular = –1.6mm, Table 2).

The maxillary second and mandibular first premolars were extracted so that the mandibular anterior teeth could be moved extensively to correct the overjet. Miniscrew anchorage in the mandibular posterior regions was used to retract the mandibular anterior teeth and correct the lower midline (Fig. 10). During retraction, the mandibular occlusal plane was rotated counterclockwise, and the anterior open bite was easily corrected without the use of anterior vertical elastics (Fig. 11). A mild posterior open bite developed after closure of the extraction spaces, but was controlled with two months' wear of posterior vertical intermaxillary elastics.

After debonding, the patient's profile and facial appearance were improved, primarily with dental changes, and the overjet and midline were corrected (Fig. 12, Table 2). The mandibular occlusal plane was rotated counterclockwise, and a normal overbite was achieved with mandibular anterior extrusion. The mandibular posterior teeth moved slightly backward, which would not have occurred in conventional extraction treatment.

TABLE 2
CASE 2 CEPHALOMETRIC DATA

	Norm	Pre-treatment	Post-Treatment
Bjork sum	397.2°	397.8°	400.0°
FHt ratio	65.3%	65.4%	63.2%
ANB	3.5°	0.2°	0.5°
AN perp.	–0.5mm	0.5mm	–0.2mm
PoN perp.	–2.4mm	–1.6mm	–1.8mm
U1-FH	113.8°	120.3°	119.8°
U1-SN	105.3°	113.9°	112.6°
L1-APo	3.8mm	7.9mm	3.7mm
IMPA	91.6°	90.0°	71.3°
Interincisal angle	125.4°	118.3°	135.4°
Nasolabial angle	98.0°	82.3°	93.2°
Upper lip-E line	–0.86mm	0.9mm	0.1mm
Lower lip-E line	0.06mm	5.4mm	–1.0mm

Discussion

If we had seen the dental casts of these cases 10 years ago, we might have assumed either that the patients had received combined surgical-orthodontic treatment or that they were unusually compliant with headgear wear. Today, an increasing number of adult and adolescent patients are unwilling to use extraoral appliances, making miniscrews a valuable adjunct. Skeletal anchorage can be successfully incorporated into the orthodontist's daily practice if the biomechanical factors described in this series of articles are properly considered. ❑