

Nonextraction Treatment with Microscrew Implants

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Abstract: The maxillary and mandibular posterior teeth were retracted with microscrew implants (1.2 mm in diameter and six to 10 mm long) that were placed into the alveolar bone and used as anchorage. The retraction proceeded without adverse reciprocal effects on the reactive part of the conventional mechanics, such as premolar extrusion and flaring of the incisors. The anterior crowding was resolved without any deleterious effect on the facial profile. En masse movement of the posterior teeth and the whole dentition after anterior tooth alignment can reduce the treatment period and maximize the efficiency of the treatment. The microscrew implants were maintained firmly throughout the treatment and were able to provide an anchorage for retraction of whole dentitions. The efficacy and potency of the microscrew implants aid mechanics in the nonextraction treatment of both labial and lingual treatments. (*Angle Orthod* 2004;74:539–549.)

Key Words: Microscrew implants; Absolute anchorage; Nonextraction treatment; En masse movement

INTRODUCTION

The treatment of a Class II malocclusion without extraction requires posterior movement of the maxillary dentition, anterior movement of the mandibular dentition, or a combination of both. Many devices have been developed and used to distalize the maxillary molars and show positive clinical results. However, almost all the appliances need patient compliance¹ and show adverse reciprocal effects, such as mesial movement of the mandibular teeth, extrusion of the premolar, and flaring of the anterior teeth.² These adverse tooth movements or changes on the reactive part should be eliminated, if possible. In addition, the outcome of the molar distalization shows a limited amount of overall distal molar movement at the end of orthodontic treatment with these devices.³

Two decades ago,⁴ screws were introduced in clinical orthodontics for the purpose of orthodontic anchorage, and these presented the clinician with a versatile option.^{5–10} Microscrew implants can be placed in areas that would not

usually accept an endosseous implant. In addition, microscrew implants are less expensive, and the option for early loading after placement reduces treatment time compared with the endosseous choice.

Microscrew implants can provide special benefits to nonextraction treatment as an absolute anchorage. Their ability to retract whole dentitions can eliminate adverse reciprocal movement and maximize the efficiency of the treatment. Sliding mechanics with the aid of the microscrew implant anchorage (MIA) and its application for the treatment of skeletal Class I and Class II malocclusions have been described previously.^{7,8} Its application in nonextraction treatment, however, has not been widely discussed. The following case reports highlight the use of microscrew implants as an anchorage aid in labial and lingual orthodontics.

CASE 1

Patient CJ was a 28-year-old woman who presented for orthodontic treatment with the chief complaint of having “crooked front teeth.” Upon clinical examination, her temporomandibular joint function was within normal limits and without pathology. Her facial form was ovoid and symmetric, with a harmonious orthognathic profile. Dentally she had an Angle Class I malocclusion, a two-mm overjet, and a one-mm overbite, and the arch length discrepancies in the maxillary and mandibular arches were four and 5.5 mm, respectively (Figure 1). No pathology was noted on her intraoral radiographs.

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FIGURE 1. Pretreatment extraoral and intraoral photographs of case 1.

Treatment of case 1

Because of CJ's comparatively well-balanced soft tissue relationships, together with the moderate nature and location of her dental crowding, a nonextraction treatment was planned. The patient provided informed consent to undergo extraction of her right maxillary and mandibular third molars. She also submitted to the placement of microscrew implants (1.2 mm in diameter, eight and 10 mm long in the maxillary arch and six mm long in the mandibular arch; Osteomed Co, Dallas, Tex). The maxillary implants were placed in the palatal alveolar bone between the first and second molars, and the mandibular implants were placed in the alveolar bone distobuccally to the second molars (Figure 2). The detailed surgical procedure was described in previous reports.^{7,9}

After bonding lingual brackets, and two weeks after placement of the microscrew implants, elastomeric threads were used to apply orthodontic forces from the microscrew implants to the first premolars in the maxillary arch and to a lingual button on the second premolars in the mandibular

arch (Figure 3A,B). To prevent flaring of the anterior teeth, the archwires were ligated passively until space was created by moving the posterior teeth distally (Figure 3C). The alignment of the anterior teeth was carried out tooth by tooth after creating the required space. With the achievement of the orthodontic treatment goals, the microscrew implants were removed under local anesthesia by twisting them in the opposite direction of their placement. The patient had no complaint of discomfort or pain concerning the microscrew implants.

The treatment time was 10 months, and the case was finished with a well-aligned dentition, Class I canine and molar relationships, and no deterioration of the facial profile (Figure 4). A wrap-around maxillary retainer and lower lingual bonded retainer (four by four) were delivered. The cephalometric results are described in Table 1. The cephalometric superimposition of the before and after treatment tracings showed a three-mm posterior movement of the maxillary posterior teeth as well as a posterior movement of the anterior teeth and a distal uprighting of the mandib-



FIGURE 2. Placement of microcrew implants.

TABLE 1. Cephalometric Measurements (Case 1)

	Pretreatment	Posttreatment
SNA (°)	81.5	81
SNB (°)	78	78
ANB (°)	3.5	3
FMA (°)	33	34.5
PFH/AFH (%)	64 (49/77)	63 (48.5/77.5)
FH to Occ P (°)	11.5	13.5
Ui to FH (°)	111.5	107
IMPA (°)	96	97
Z angle (°)	67	68

ular posterior teeth (Figure 5). The 15-month retention photographs showed good facial profile and a well-retained dentition except for a breakage of the contact between the mandibular left premolars (Figure 6).

CASE 2

Patient DH was a 13-year-old adolescent boy who presented with crowding of the anterior teeth. He had a Class I canine and molar relationship, a two-mm overbite, and a one-mm overjet. The arch length discrepancies in the maxillary and mandibular arches were six and four mm, respectively (Figure 7). No pathology was noted on the panoramic radiographs.

Treatment of case 2

We decided to resolve the anterior crowding by distal movement of teeth with the aid of microcrew implants. In the maxillary arch, microcrew implants 1.2 mm in diameter and eight mm long (Absoanchor AX12-108, Dentos

Co, Taegu, South Korea) were placed bilaterally in the buccal interradicular bone between the maxillary second premolar and first molar. In the mandibular arch, implants 1.2 mm in diameter and six mm long (Osteomed Co) were placed bilaterally in the bone in the lower retromolar area (Figure 8). Two weeks after placement of the microcrew implants, NiTi coil springs and elastomeric forces were applied to the canines in both the maxillary and mandibular arches (Figure 9). After creating space by moving the posterior teeth distally, alignment of the anterior teeth was carried out by inserting an overlay round wire. After 17 months of treatment, the upper and lower dentitions were well aligned without having had a detrimental effect on the facial profile (Figure 10). The maxillary and mandibular posterior teeth were retracted by two and 2.5 mm, respectively (Figure 11). The microcrew implants were maintained firmly throughout the treatment, and the patient had no pain and inflammation related to the microcrew implants.

DISCUSSION

The effectiveness and clinical application of the microcrew implants has been discussed previously.⁵⁻⁸ The use of microcrew implants as part of a nonextraction treatment enabled en masse retraction of teeth against the device rather than individual molar/premolar distalization, which would be limited with routine orthodontic biomechanics. After distalization of the posterior teeth and creation of space to resolve anterior crowding and overjet, the alignment of the anterior teeth became a simple procedure, which could now be performed without discernable forward

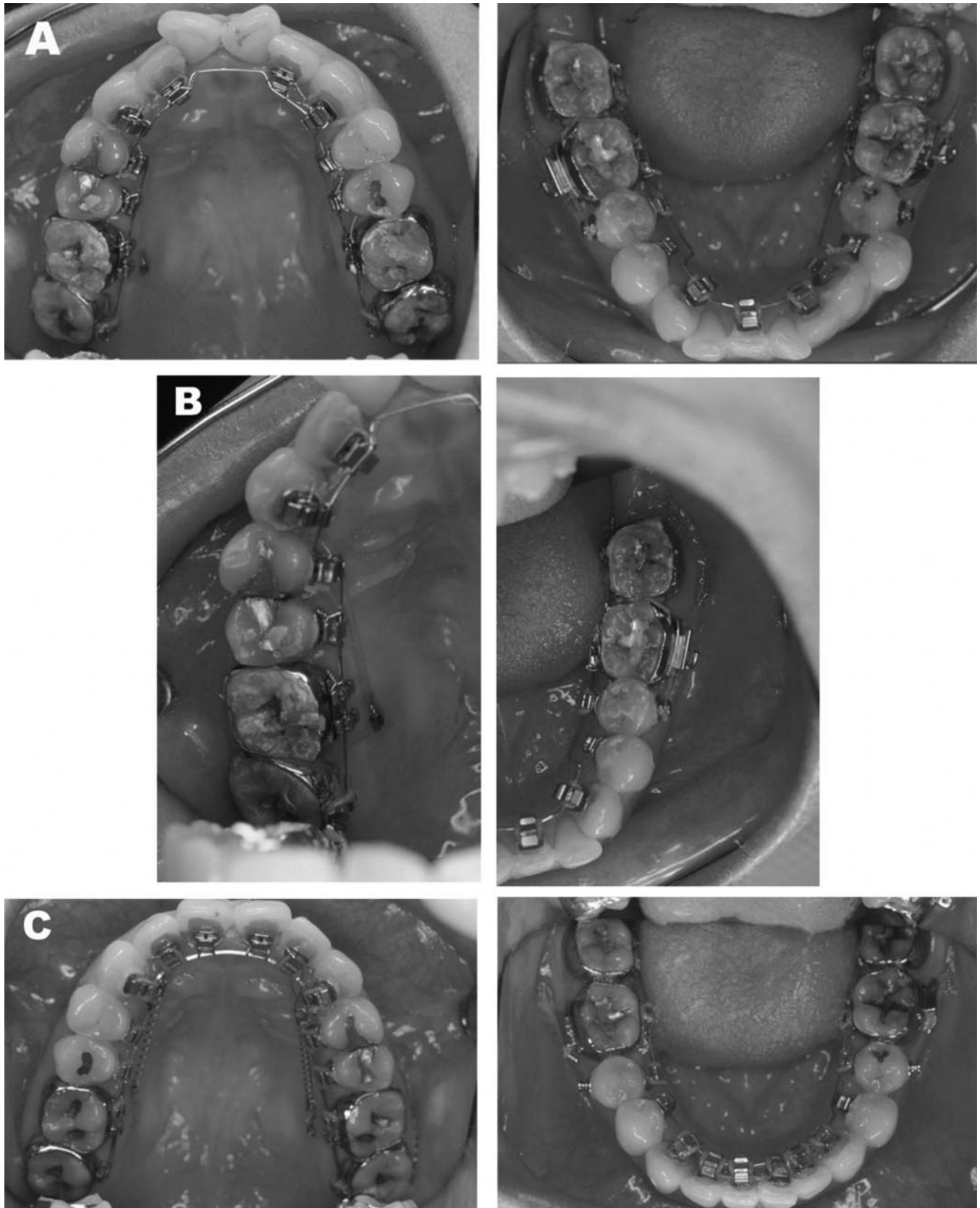


FIGURE 3. Activation of distalizing force by elastomeric threads between microcrew implants and first premolars in the maxillary arch and second premolars in the mandibular arch (A,B). After distalization of molars, the anterior teeth aligned (C).

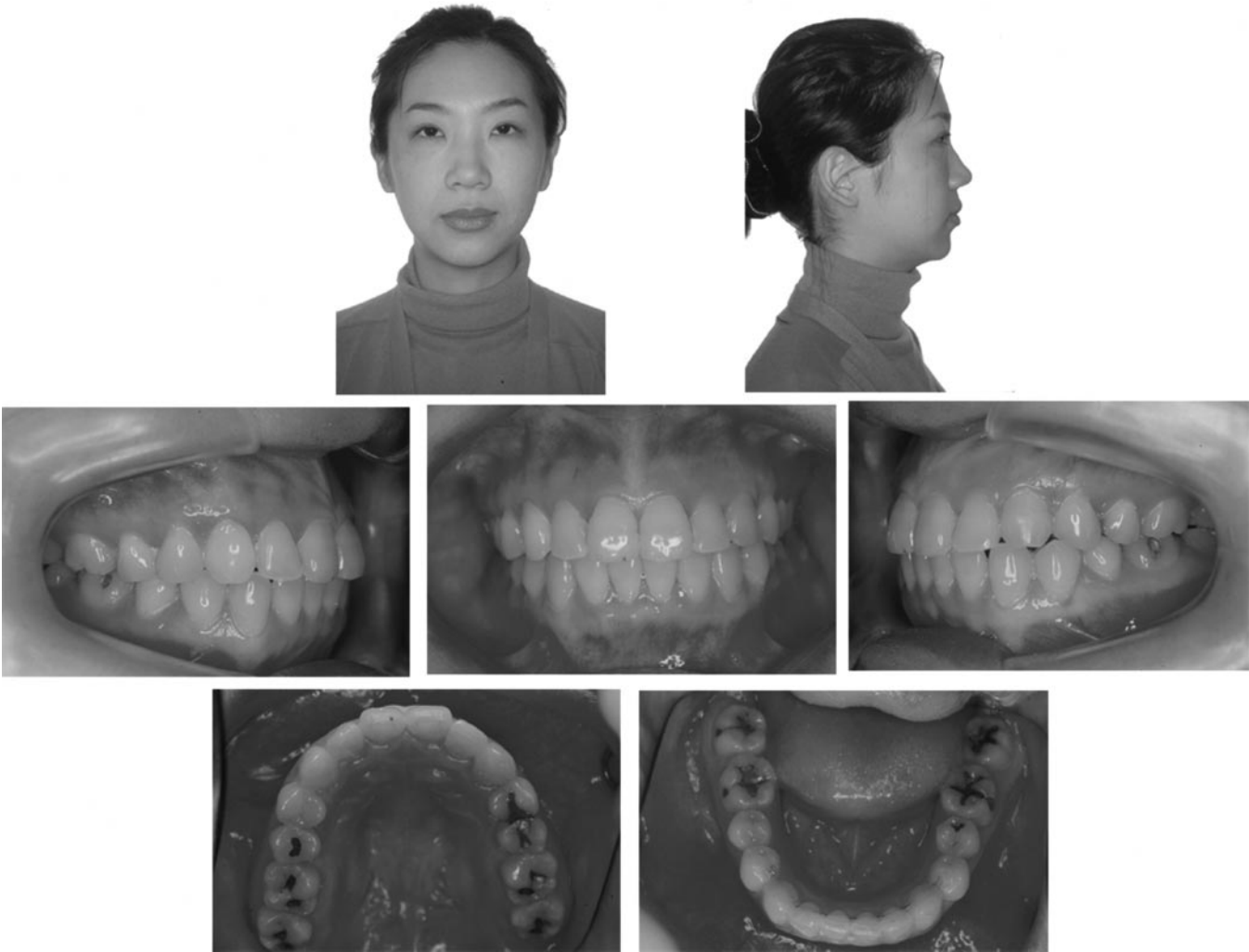


FIGURE 4. Posttreatment extraoral and intraoral photographs of case 1.

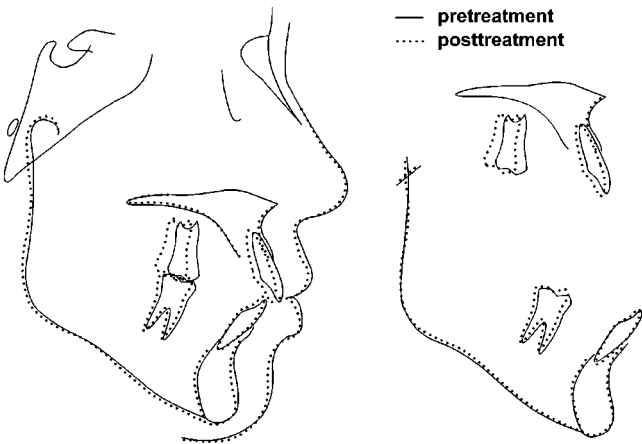


FIGURE 5. Cephalometric superimposition.

movement of the anterior teeth and without possible deleterious effect on the facial profile.

This MIA also simplified the biomechanics required to affect bodily movement of these teeth. The occlusal gingival height of the microscrew implants was one factor that determined the direction of the line of force relative to the center of resistance, thus facilitating the efficiency of the system. Power-arm extensions from the teeth to be distalized in nonextraction treatment and anterior hooks soldered on the archwire in extraction treatment were activated by attachment to the microscrew implants. This permitted predictable biomechanical control of the movements that these teeth would experience. When retracting anterior teeth in extraction treatment, an archwire with hooks between the lateral incisors and canines was used with MIA sliding mechanics.^{7,8} The force was applied to pass near the center of resistance of the anterior teeth segment so that bodily movement could be achieved. With MIA sliding mechanics the en masse retraction of the six anterior teeth could be



FIGURE 6. Fifteen-month retention extraoral and intraoral photographs.

performed without anchorage loss, ie, mesial movement of posterior teeth.^{7,8,10}

In nonextraction treatment, the biomechanics of anterior teeth retraction using microscrew implants as an orthodontic anchorage were different from that used in extraction treatment. The contact of the teeth on the crown acted as a resistance to movement, which created a counterclockwise moment on the anterior teeth, in other words, a root lingual movement. As a result, the crown of the upper anterior teeth showed distal movement, whereas the roots showed more distal movement (Figure 12A). These movements are acceptable or desirable in the case of retracting lingually tipped upper anterior teeth. When retracting the upper anterior teeth showing labial tipping or normal inclination in nonextraction treatment, the counterclockwise moment on the upper anterior teeth should be eliminated. By applying distal force to the crown of the teeth, the distal force was transmitted through the crown. After creating space by moving the posterior teeth distally against the microscrew implants, the anterior crowding could be resolved without flaring of the maxillary incisors (Figure 12B). Once anterior

alignment was achieved, the entire dentition could be moved distally by adding a figure-eight tie on the anterior teeth (Figure 12C).

The microscrew implants, placed deep to the vestibular sulcus, could not produce a sufficient horizontal component of force to retract the anterior teeth (Figure 12D). This was because the higher the microscrew implants were placed, the more vertical was the vector of the force. The occlusal gingival position of the microscrew implants, therefore, should be lower in nonextraction treatment than in extraction, which will contribute to the increased horizontal vector of the force. In these two cases, the microscrew implants were placed lower as compared with those in extraction treatments described in previous reports.^{7,8}

Because of the application of a distalizing force on the buccal side, the posterior teeth tended to tip lingually and the terminal molars were prone to rotate distally and tip lingually in our limited clinical experiences (Figure 12E), which was preventable by applying a buccal crown torque and a buccal flaring bend. With palatally placed microscrew implants, however, the terminal molars were prone to flare

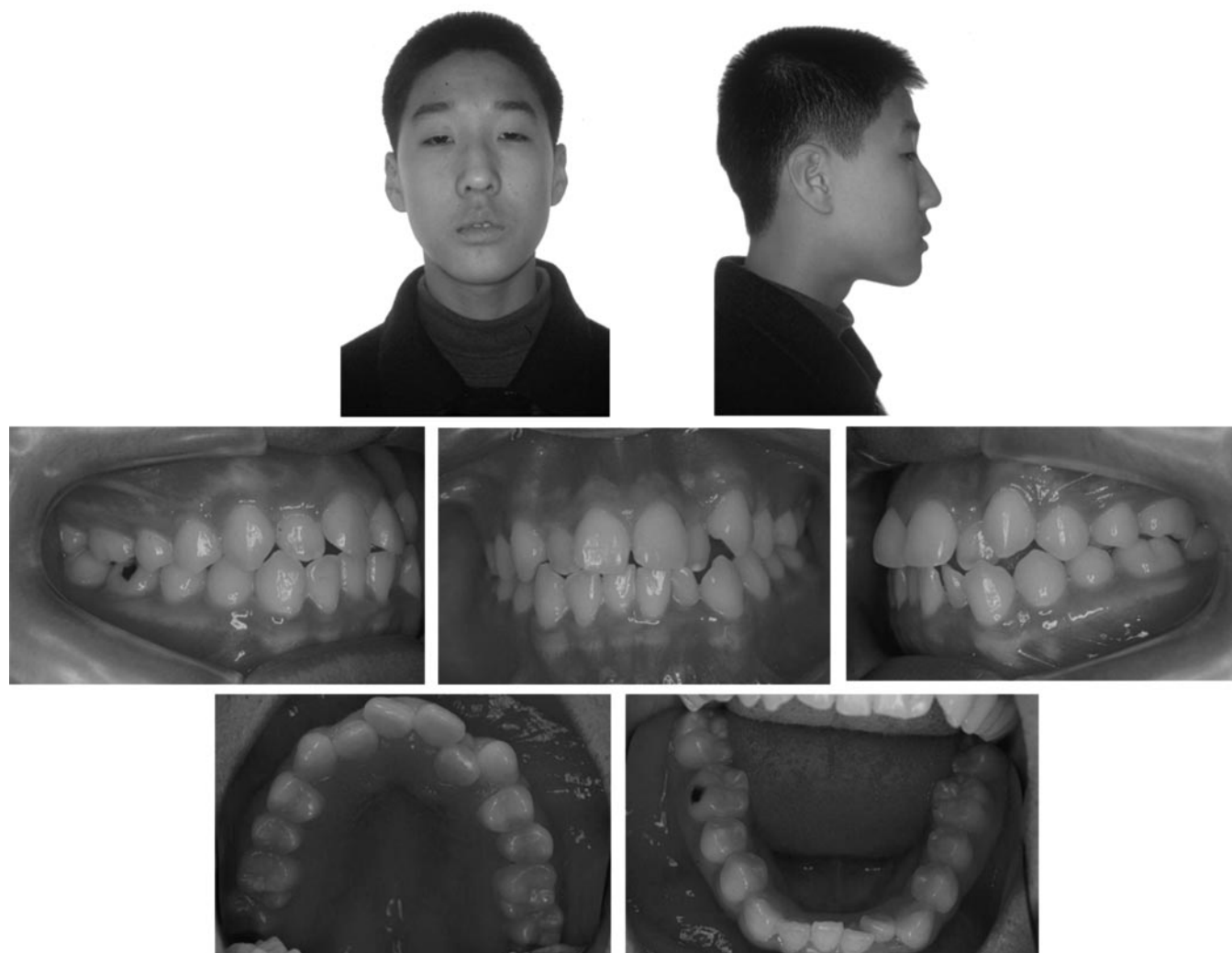


FIGURE 7. Pretreatment extraoral and intraoral photographs of case 2.



FIGURE 8. Placed micro screw implants and removed ones after treatment.

buccally during the application of a distalizing force on the lingual side.

This procedure could be adapted to nonextraction treatment by using labial or lingual fixed appliances. The ability to produce absolute anchorage against which posterior teeth could be retracted as a unit would necessarily shorten treatment time. The actual treatment time shown in these cases

was short compared with that of conventional treatment. This was not achieved by rapid tooth movement but by group movement of the teeth. Therefore, root resorption may not be a special issue.

The cephalometric superimposition of the case reports presented above indicated that the maxillary incisors and maxillary and mandibular molars did, in fact, move distally

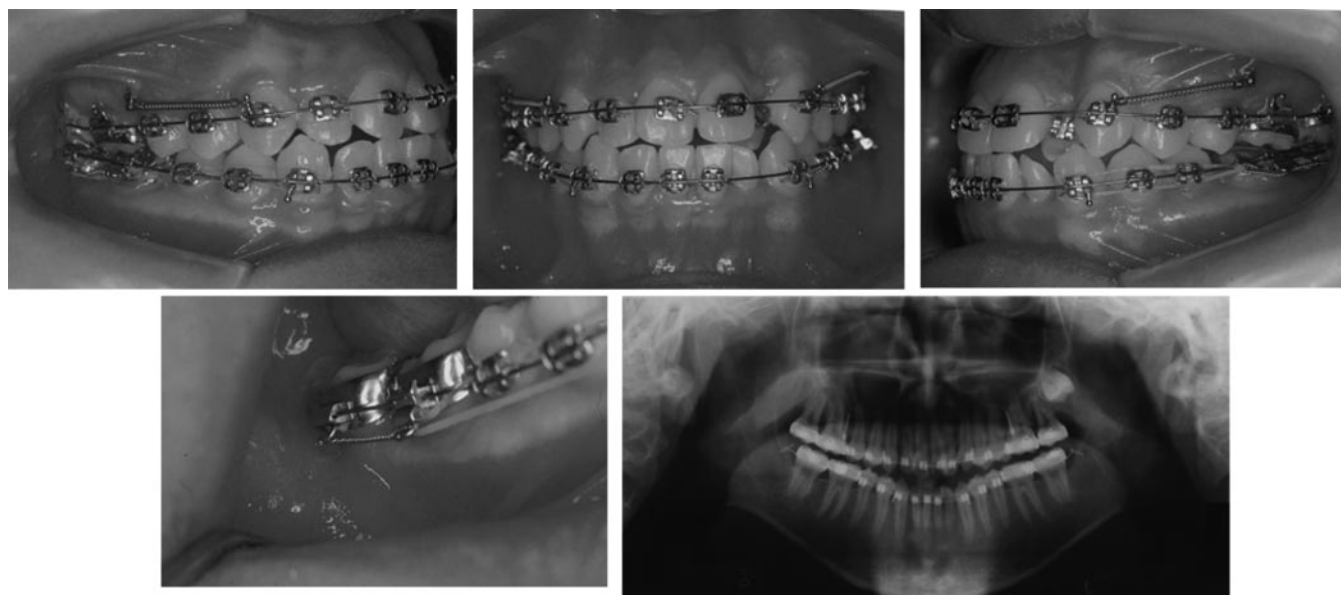


FIGURE 9. Application of distalizing force by connecting NiTi coil springs in the maxillary arch and elastic threads in the mandibular arch.

(Figures 5 and 11), meaning that the microscrew implants could provide an anchorage for retracting entire dentitions. Therefore, Class II or Class III canine and molar relationships can easily be treated by en masse movement of the posterior teeth with MIA. In addition, MIA eliminated the need for intermaxillary elastics to correct the Class II or Class III dental relationships. Therefore, there was no need to be concerned about reactive mechanics, such as loss of anchorage, canting of the occlusal plane, or loss of vertical control.

When less than three mm of distal movement of the posterior teeth was needed, the microscrew implants could be placed between the maxillary second premolars and first molars. In a previous article,¹¹ the distance between the roots of the maxillary second premolar and first molar was 3.18 mm at five to seven mm apical from the alveolar crest, and the apices of the microscrew implants were usually placed into the alveolar bone more apical than the five- to seven-mm level. By placing microscrew implants at 30–40° to the long axes of the crown, the apices of the microscrew implants can be kept apart from the roots. Therefore, the possibility of damage to the roots could be eliminated. When more than three mm of posterior movement of the posterior teeth was required, the palatal alveolar bone between the maxillary first and second molars was a good position for microscrew implant placement because there was much more space on the lingual side. During retraction of the teeth, there might be a small chance that the roots of the teeth might come in contact with microscrew implants, and if this should occur, after the removal of the microscrew implants the roots could be repaired by a normal repairing process.¹² Small periodontal damage during autotransplantation also could be repaired to normal configuration of the periodontal ligament. In a study with mon-

keys,¹³ less than two-mm² damage to the periodontal ligaments showed normal repair. The contact between microscrew implants and roots was less than 1.2 mm because of the small diameter (1.2 mm in diameter) of the microscrew implants.

There was an increase in the FMA angle with distal movement of the posterior teeth (Table 1), which made a fulcrum move backward and opened the mandible. The vertical component of force in each arch might be a factor that prevented extrusion of molars during retraction. The consequence of the opened mandibular plane could be prevented by adding an intrusive force from the microscrew implants. A transpalatal arch and a lingual arch should be placed to prevent buccal tipping of the teeth. The effect of the distal movement of posterior teeth on the opening of the mandible in a growing child in case 2 was not the same as that in adult patients (Table 2). This was because the growth of the mandible could dilute the effect.

In lingual orthodontic treatment, the best position for the placement of the microscrew implants in the maxillary arch was the palatal interradicular alveolar bone between the first and second molars.¹⁰ Their vertical positioning could be determined by the types of tooth movement required. As has been reported earlier, normally there was an acceptable amount of space between the palatal roots of the maxillary first and second molars. Therefore, this area should be the primary placement site for this device.

In the mandibular arch, buccally placed microscrew implants were preferable because of easy access. In this instance, it was recommended that the devices be placed in the interradicular bone between the mandibular first and second molars, distobuccal to the second molars, or in the retromolar area. Again, the choice is dependent on the type and amount of tooth movement required as well as on the

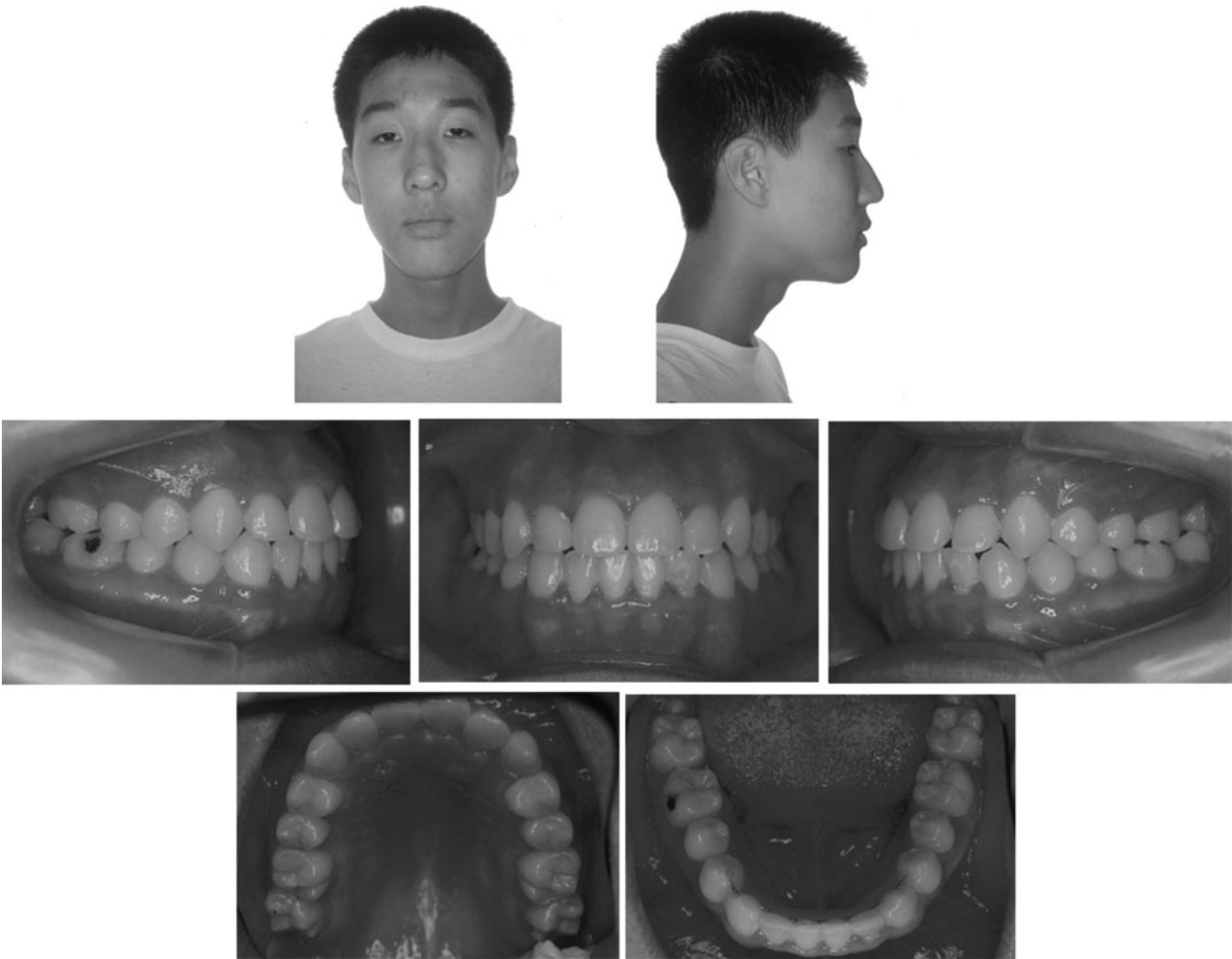


FIGURE 10. Posttreatment extraoral and intraoral photographs of case 2.

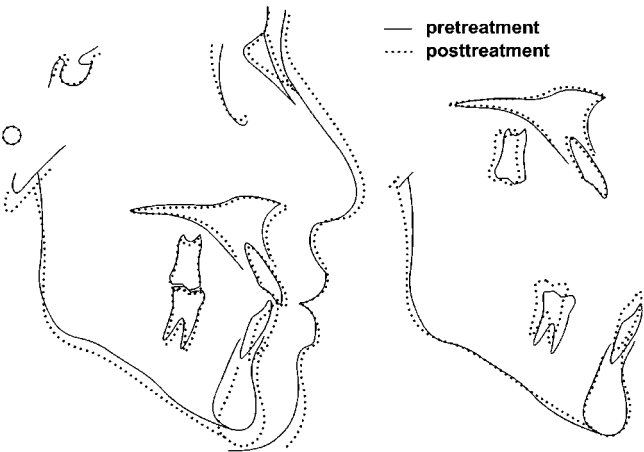


FIGURE 11. Cephalometric superimposition between pre- and post-treatment.

TABLE 2. Cephalometric Measurements (Case 2)

	Pretreatment	Posttreatment
SNA (°)	78	78
SNB (°)	75.5	75.5
ANB (°)	2.5	2.5
FMA (°)	29.5	29.5
PFH/AFH (%)	56 (47/84)	51 (45/88)
FH to Occ P (°)	9.5	8.5
Ui to FH (°)	120.5	121
IMPA (°)	86.5	86
Z angle (°)	77.5	80

availability of a healthy osseous implant site. This usually indicated that the former location was preferable. It should also be noted that these sites were valid choices for either labial or lingual appliance treatment.

Patients did not have any discomfort or pain related to the microscrew implants, and the microscrew implants did not show any mobility throughout the treatment and were removed easily. The ease of the placement and removal of

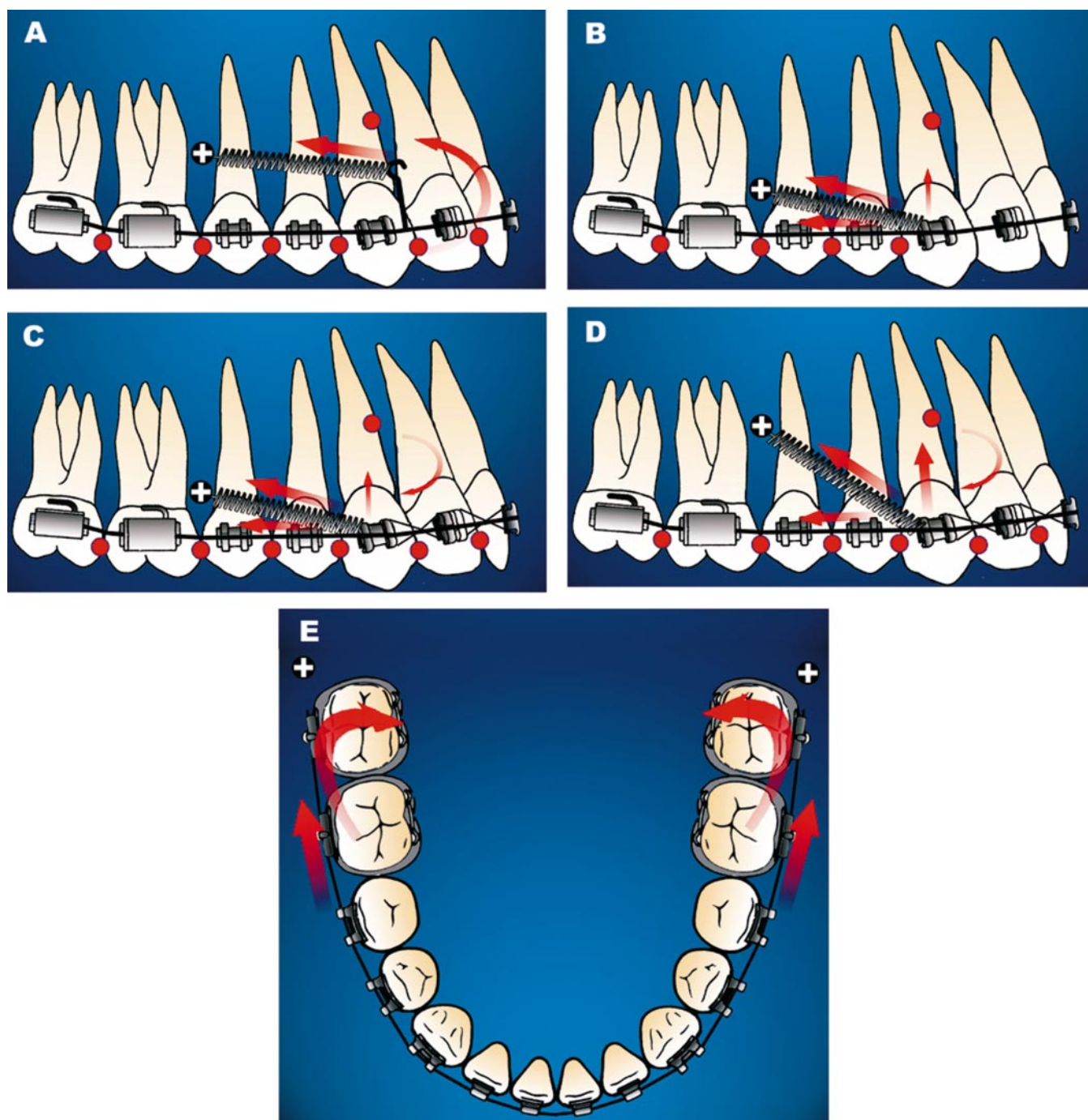


FIGURE 12. Biomechanics of the retraction of the dentition with MIA (A) using an archwire with anterior hooks; (B) without a figure-eight tie on anterior teeth; (C) with a figure-eight tie on anterior teeth; (D) with highly positioned microscREW implants; and (E) biomechanics on horizontal plane when applying the distalizing force on the buccal side in nonextraction treatment.

the microscREW implants and the efficiency and potency regarding the anchorage control may extend its application.

SUMMARY

The microscREW implant system can provide absolute anchorage for the en masse distal movement of posterior teeth. By moving posterior teeth in this manner, the treat-

ment time can be shortened. The microscREW implants can be adapted for labial treatment as well as lingual treatment.

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