CASE REPORT

Micro-Implant Anchorage for Treatment of Skeletal Class I Bialveolar Protrusion

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Endosseous implants have been used to provide anchorage control in orthodontic treatment without the need for special patient cooperation.[1,2] These implants have limitations, however, including space requirements, cost, and the delay between implantation and orthodontic force application.

Recently, Kanomi[3] and Costa and colleagues[4] introduced the use of titanium microscrews and miniscrews for orthodontic anchorage. Microscrews are small enough to place in any area of the alveolar bone, easy to implant and remove, and inexpensive. In addition, orthodontic force application can begin almost immediately after implantation.[5]

In this article, we will introduce a new approach to treatment of skeletal Class I bialveolar protrusion, with micro-implant anchorage used for retracting the maxillary anterior teeth and uprighting the mandibular molars.

TABLE 1
CEPHALOMETRIC ANALYSIS

	Pretreatment	Post-Treatment
SNA	81.5°	81°
SNB	79.5°	80°
ANB	2°	1°
FMA	28.5°	28°
PFH/AFH	67% (57°/85°)	67% (57°/84°)
FH-OP	1°	–1.5°
FH-U1	132.5°	117.5°
IMPA	100.5°	79°
Z-angle	60°	73°
Upper lip to E	4.5mm	1mm
Lower lip to E	10mm	3mm

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Fig. 1 28-year-old female with Class I bialveolar protrusion before treatment.

Diagnosis and Treatment Planning

The patient, a 28-year-old female, had a convex profile and a Class I skeletal pattern with bialveolar protrusion (Fig. 1, Table 1). Cephalometric analysis showed an ANB angle of 2°, a mandibular plane angle (FMA) of 28.5°, and a flat occlusal plane (FH-OP 1°). The overjet and overbite were 1.5mm each, and there were arch-length discrep-

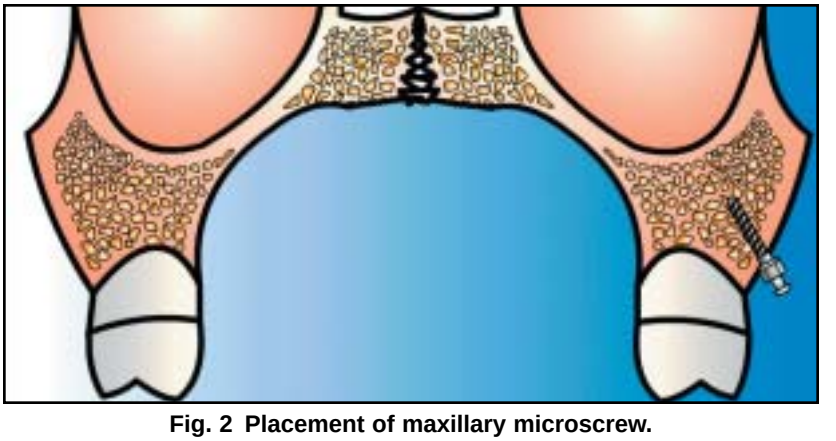

Fig. 2 Placement of maxillary microscrew.

Fig. 3 A. Initial maxillary canine retraction force applied with tieback between micro-implant and canine. B. Transpalatal arch used to maintain archform. C. After two months of treatment, maxillary anterior retraction force applied with nickel titanium coil spring.

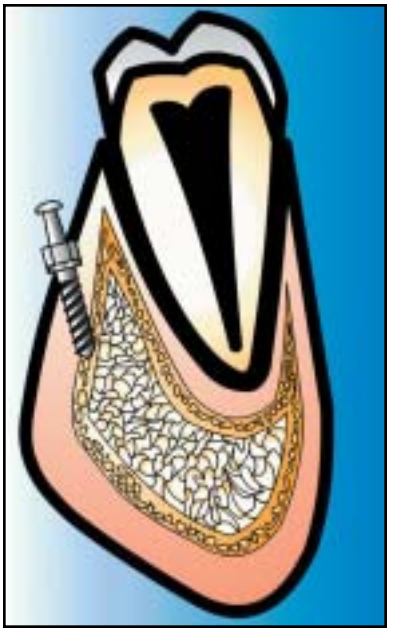

Fig. 4 Mandibular microscrew.

ancies of 1mm in both arches. The canine and molar relationships were Class I, but the maxillary incisors and mandibular incisors were proclined (FH-U1 132.5°, IMPA 100.5°).

The treatment plan called for extraction of both the maxillary and mandibular first premolars, followed by fixed appliance treatment using maxillary and mandibular micro-implants for anchorage control.

Treatment Progress

After the extractions, the maxillary microscrews* (1.2mm in diameter, 6mm in length) were implanted into the buccal alveolar bone between the maxillary second premolars and first molars (Fig. 2).

Two weeks after implantation, leveling was initiated with .022" × .028" preadjusted appliances. Force for partial canine retraction was applied with tiebacks between the microscrew implants and the maxillary canines (Fig. 3A). After two months of treatment, an .016" × .018" archwire with hooks was inserted, and 200g of force was

*No. 59-12106, Stryker Leibinger, 4100 E. Milham Ave., Kalamazoo, MI 49001.

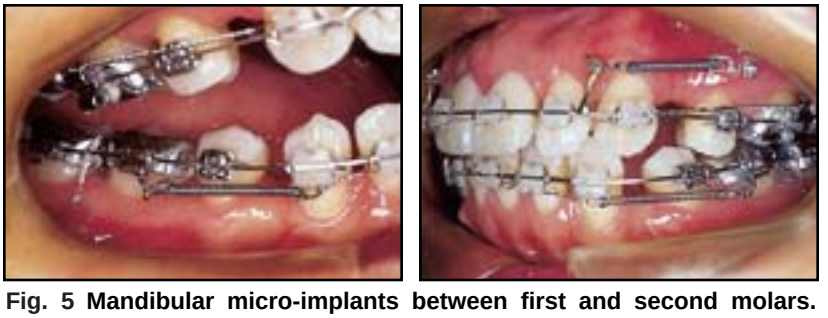

Fig. 5 Mandibular micro-implants between first and second molars. Force applied with elastic thread between microscrews and mandibular archwire.

Fig. 6 Profile improvement after 10 months of treatment.

Fig. 7 A. Patient after 18 months of treatment. B. Superimposition of pre- and post-treatment cephalometric tracings.

applied with nickel titanium coil springs to retract the maxillary anterior teeth (Fig. 3C).

Two months later, the mandibular micro-implants** (1.2mm in diameter, 6mm in length) were implanted into the buccal alveolar bone between the mandibular first and second molars (Fig. 4). Force application was begun two weeks after the implantation by ligating the microscrews to the mandibular archwire with elastic thread (Fig. 5).

Most of the profile improvement occurred during the first 11 months of treatment (Fig. 6).

Results

The patient showed good Class I skeletal and dental relationships after 18 months of total treatment time (Fig. 7). The facial profile was improved with the retraction of the upper and lower lips. The ANB angle was reduced from 2° to 1°, the mandibular plane angle decreased from 28.5° to 28° in conjunction with the decrease in anterior facial height, and the occlusal plane flattened from 1° to –1.5° (Table 1). The proclined mandibular incisors were uprighted by 21.5° (from 100.5° to 79°).

Cephalometric superimposition demonstrated a bodily retraction of the maxillary anterior teeth and an uprighting of the mandibular molars. The maxillary posterior teeth moved slightly distally and showed a small amount of extrusion. The mandibular molars were uprighted and slightly intruded, causing the mandible to be rotated upward and forward.

Discussion

The microscrews used in this case were small enough to be implanted in the interseptal alveolar bone. To avoid any damage to the roots, however, the screws were implanted at a 60° angle between teeth. Therefore, even though 5mm of the 6mm maxillary microscrews were embedded in the buccal alveolar bone, the depth of penetration into the bone perpendicular to the surface was only 2.5mm. And while 3mm of the 6mm mandibular microscrews were embedded in the bone, the average thickness of cortical bone in the mandibular molar area is 3.1-3.2mm,[6] so the screws could not penetrate into the bone marrow (Fig. 8). Costa and colleagues confirmed that the buccal aspect of the alveolar process in the mandibular premolar and molar region is safe for miniscrew implantation.[4] There is no risk of root damage during the surgical procedure or from subsequent tooth movement.

Biomechanically, the maxillary force is applied near the center of resistance of the six anterior teeth, making it possible to achieve bodily intrusion and retraction (Fig. 9A). In this patient, the maxillary posterior teeth—which are used for anchorage in conventional mechanics—actually showed a slight distal movement from the retraction force applied against the maxillary microscrews. In a previous report, Park showed a 1.5mm posterior movement of the entire maxillary dentition against the microimplant.[8]

To maintain or reduce the mandibular plane angle during treatment, mandibular microscrews are required. The mandibular micro-implants induce a forward and upward movement of the chin by intruding and uprighting the mandibular molars (Fig. 9B); in the case shown

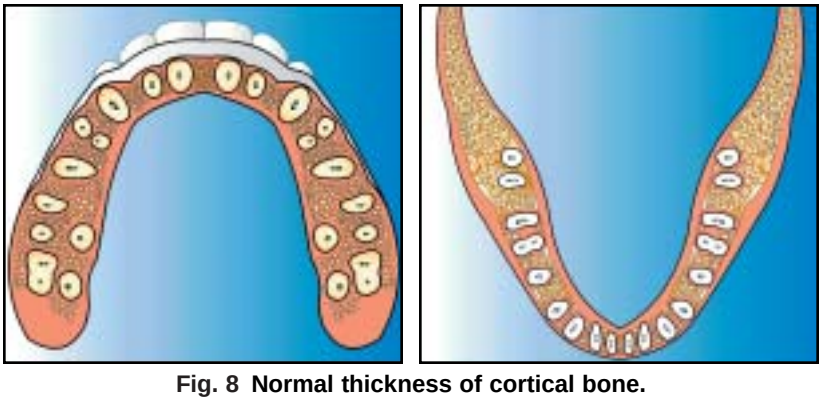

Fig. 8 Normal thickness of cortical bone.

**No. 204-1206, OsteoMed Corp., 3750 Realty Road, Dallas, TX 75001.

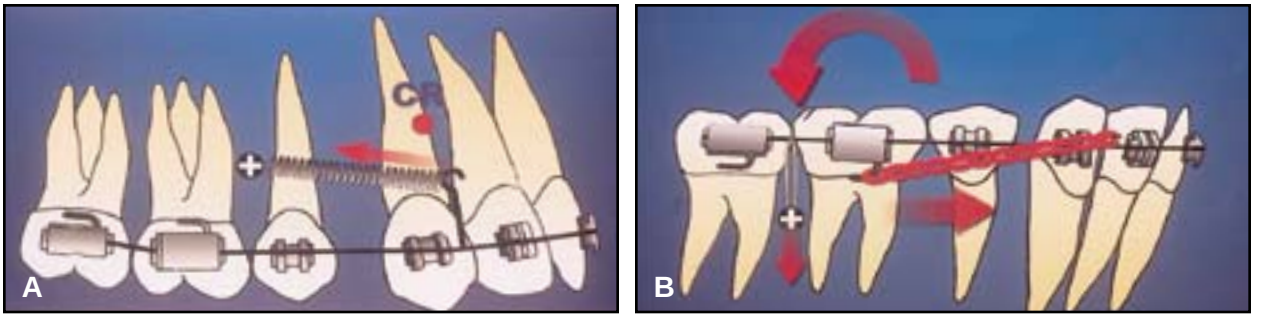

Fig. 9 A. Mechanics of bodily retraction of anterior segment, with force applied against micro-implant passing near center of resistance of six anterior teeth. B. Mandibular micro-implant uprights and intrudes molars, causing upward and forward movement of chin.

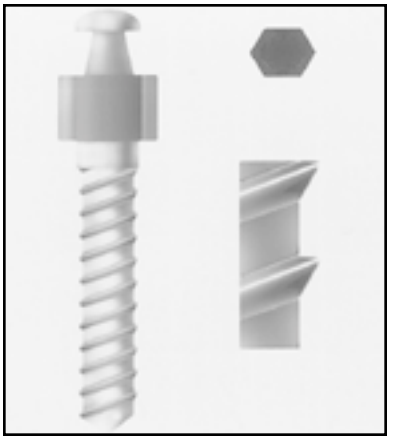

Fig. 10 New design of micro-implant with hook on head and smooth surface in contact with soft tissue.

here, FMA was reduced by .5°. These biomechanics are quite similar to Tweed-Merrifield directional force mechanics, but without the use of an extraoral appliance.[7]

Even though orthodontic force was applied just two weeks following implantation, none of the microscrews loosened during the treatment period. There is a possibility, however, of soft-tissue impingement and inflammation around micro-implants. Such problems can be avoided by using a new micro-implant we have designed, with a hook on its head for attaching elastics or a nickel titanium coil spring, and a smooth surface under the head where the screw contacts the soft tissue (Figs. 2,4,10).***

Conclusion

Micro-implant treatment has the following advantages:

- Does not depend on patient compliance with extraoral appliances.
- Produces an early profile improvement, giving the patient even more incentive to cooperate.
- Shortens treatment by retracting the six anterior teeth simultaneously.-
- Reduces chairtime.-
- Provides absolute anchorage-for orthodontic tooth movement.-

***Absoanchor, Dentos Co., Taegu City, Korea.

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