Clinical Application of Micro-Implant Anchorage

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Conventional methods of reinforcing orthodontic anchorage have several disadvantages, including complicated appliance design and the need for exceptional patient cooperation. Although standard dental implants have been used for orthodontic anchorage, they have drawbacks such as the difficulty of selecting proper implant sites in most orthodontic patients, the need to wait for osseointegration before force loading, the invasiveness of the surgical procedure, and the high cost.

For several years, we have controlled anchorage in orthodontic treatment using micro-implants designed to fix the bone fragments in oral and maxillofacial or plastic surgery. These inexpensive micro-implants,* which are small in diameter (1.2mm) and come in several lengths, can be inserted in any desired location, including interradicular space; can be loaded immediately; can withstand typical orthodontic forces of 200-300g for the entire length of treatment; do not need osseointegration, unlike restorative implants; and can easily be removed by the orthodontist.

The surgical procedure is as follows:

1. The patient is premedicated as necessary.
2. The insertion site is measured from a guide bar on the bite-wing x-ray (Fig. 1A).
3. Local anesthesia is administered with 2% lidocaine.
4. A stab incision is made, and a flap is reflected (Fig. 1B).
5. A 1mm-diameter pilot hole is drilled through the cortical bone only, using a coolant spray (Fig.

*Part No. 204-1210, OsteoMed Corp., 3750 Realty Road, Dallas TX 75001.

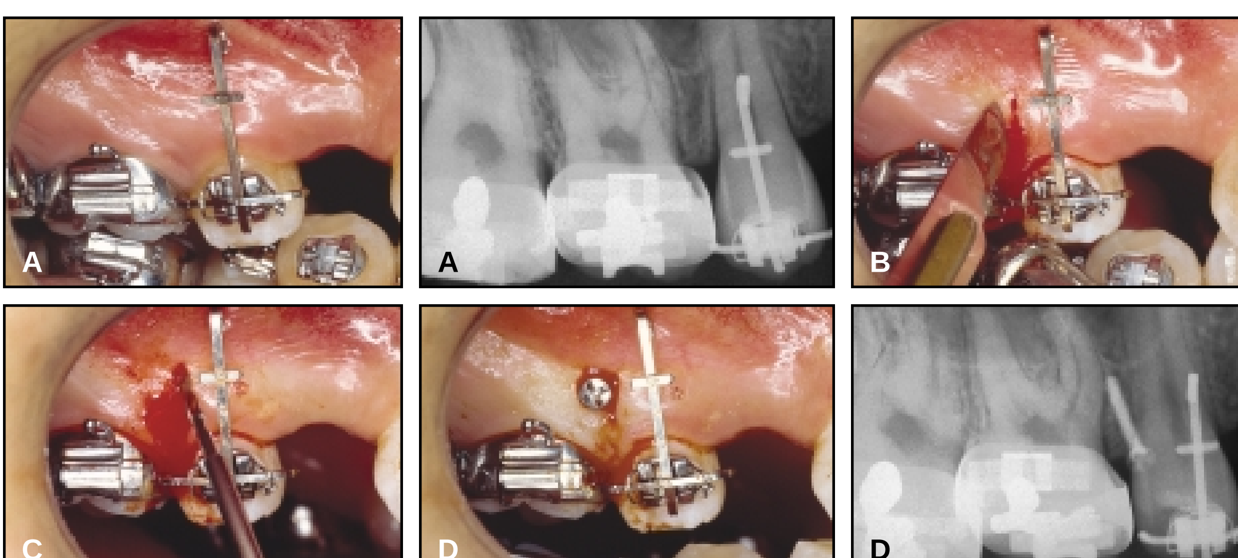
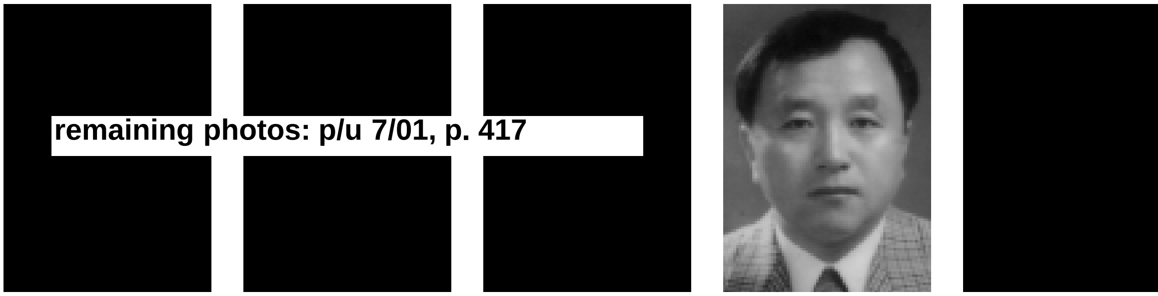


Fig. 1 Surgical procedure. A. Insertion site measured from guide bar on bite-wing x-ray. B. Stab incision for flap reflection. C. Drilling through cortical bone only. D. Micro-implant insertion.



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1C).
6. The 1.2mm micro-implant is inserted with a screwdriver (Fig. 1D).

Direct orthodontic forces may be applied after soft-tissue healing, which usually takes about two weeks.

Case Report

A 28-year-old female presented with a convex, retrognathic profile, a gummy smile, a Class II canine relationship, an overbite of 4mm, and an overjet of 6mm (Fig. 2). Both mandibular first molars had previously been extracted. Cephalometric analysis revealed a Class II skeletal relationship with maxillary excess, a normal mandible, and a steep mandibular plane angle (Table 1). The maxillary incisors were upright (FH/1 = 109°), and the mandibular incisors protrusive.

Treatment objectives were to correct the lip protrusion, reduce the gummy smile, and achieve good interdigitation. To retract the maxillary incisors bodily, mechanics were designed for maximum anchorage control.

Fig. 2 28-year-old female Class II patient with lip protrusion and gummy smile before treatment.

The maxillary first premolars were extracted, and .018" × .025" preadjusted appliances were placed. After three months of leveling and alignment, instead of prescribing headgear for anchorage, 10mm micro-implants were inserted between the maxillary first molars and second premolars.

An .017" × .025" stainless steel closing-loop archwire and an .016" × .016" stainless steel overlay intrusion archwire were placed in the maxillary arch to retract the maxillary anterior teeth upward and backward. The closing loops were activated by the micro-implants, which counteracted the extrusive force generated by the overlay wire on the maxillary posterior segment (Figs. 3,4A). An .016" × .022" stainless steel closing-loop archwire was used in the mandibular arch to protract the mandibular posterior teeth.

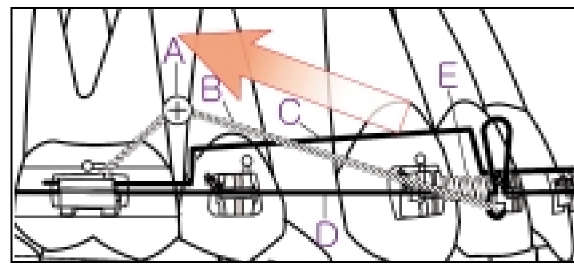

Fig. 3 Schematic of retraction archwire. A. Micro-implant. B. Ligature wire. C. .016" × .016" stainless steel overlay intrusion archwire. D. .017" × .025" stainless steel closing-loop archwire. E. Nickel titanium open-coil spring.

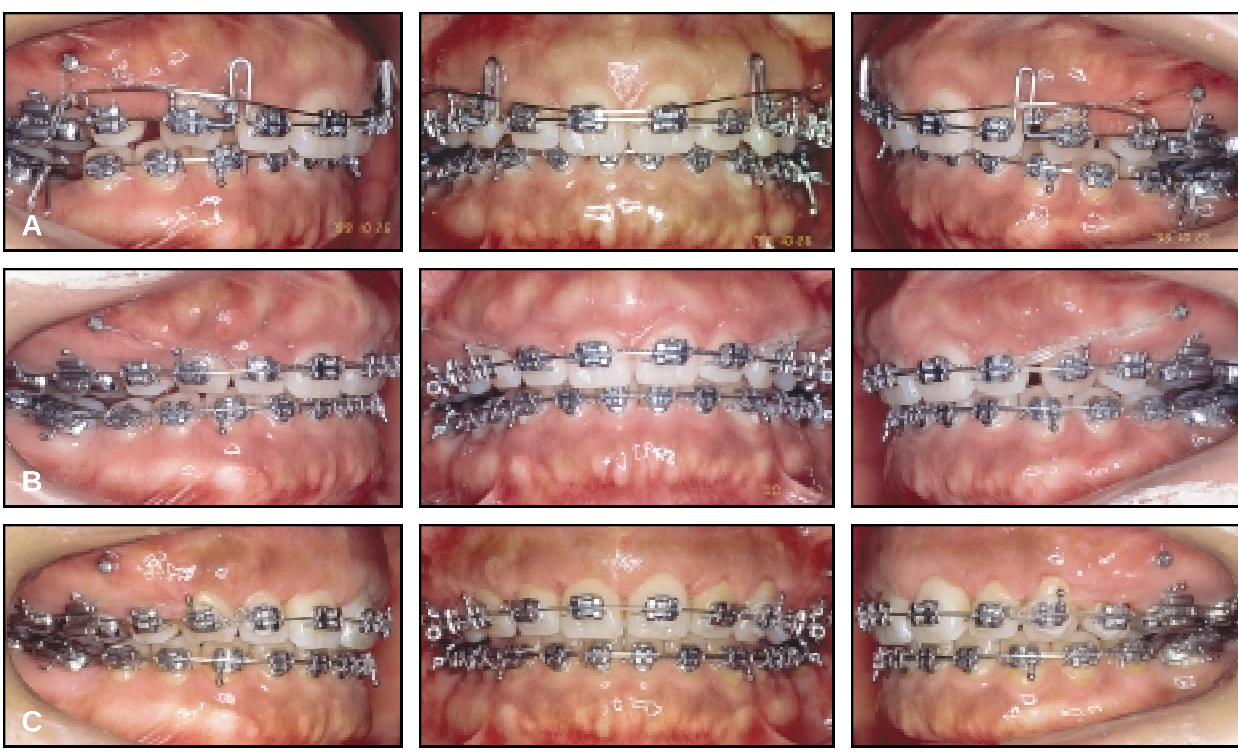

Fig. 4 A. Maxillary .017" × .025" stainless steel closing-loop archwire and .016" × .016" stainless steel overlay intrusion archwire used to retract anterior teeth upward and backward; .016" × .022" stainless steel closing-loop archwire used to protract mandibular posterior teeth. B. .017" × .025" reverse-curve nickel titanium archwires placed in both arches to control curve of Spee and inclination of maxillary anterior teeth. C. After alveoloplasty of maxillary anterior labial bone.

TABLE 1
CEPHALOMETRIC SUMMARY

	Pre-treatment	Post-Treatment
SNA	86.8°	84°
SNB	79.6°	77°
ANB	7.2°	7°
FMA	35°	36°
PFH/AFH	61%	59%
	(80°/131°)	(78°/132°)
FH/OP	9°	8°
U1-FH	109°	105°
IMPA	91°	85°
Z-angle	56.2°	62°

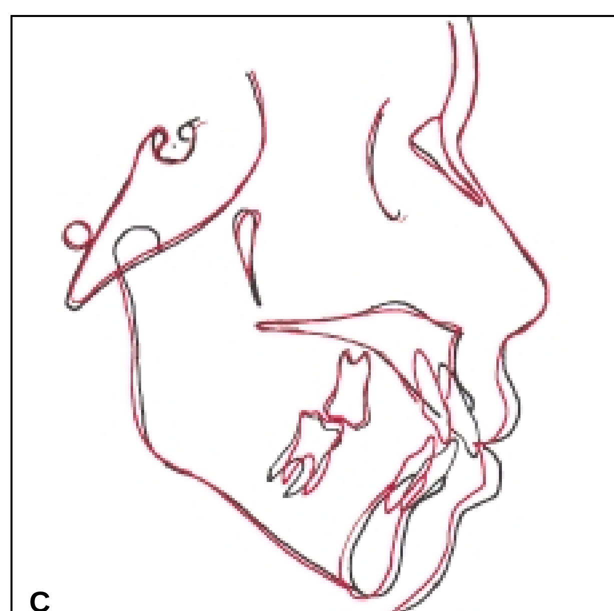

Fig. 5 A. Improvement in profile and gummy smile after treatment. B. Stability of micro-implants after treatment. C. Superimposition of cephalometric tracings before and after treatment, showing bodily retraction of maxillary anterior teeth without anchorage loss.

After about 11 months of space consolidation, .017" × .025" reverse-curve nickel titanium archwires were placed in both arches to control the curve of Spee and the inclination of the maxillary anterior teeth. During this process, crown tipping of the maxillary anterior teeth was prevented by the micro-implants (Fig. 4B).

Because the labial alveolar bone of the maxillary anterior teeth did not remodel to accommodate the lingual movement of the incisor roots, the remaining, non-tooth-supporting labial alveolar bone was surgically removed and reshaped to achieve a physiologic periodontal contour (Fig. 4C).

The micro-implants were stable for the entire length of treatment, and were easily removed with a screwdriver after debonding and debanding. Total treatment time was 26 months.

Dental changes resulted in a full-cusp Class II molar occlusion with a Class I canine relationship (Fig. 5). The maxillary anterior teeth were retracted bodily (FH/1 = 105°) without any loss of anchorage in the maxillary posterior dentition (Table 1). The posterior movement of the mandible could be explained by the patient's change to a habitual centric relation occlusion.

Discussion

Methods of bone anchorage such as retromolar implants,[1] onplants,[2] zygomatic wires,[3] ankylosed teeth,[4] palatal implants,[5] miniplates,[6] miniscrews,[7] and mini-implants[8] make it possible to overcome previous limitations of orthodontic tooth movement and, for example, move an entire dentition in the same direction or correct an open bite with molar intrusion.[6] These procedures may eventually change the way orthodontic treatment is planned and carried out.

As shown in this case, micro-implants can provide absolute anchorage for orthodontic tooth movement. Single micro-implants are still unable to withstand rotational forces,[7] however. Further development may make them even more useful in simplifying biomechanics.

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