A Simple Technique for Independent Torque Control with Miniscrew Anchorage

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Effective torque control is difficult to achieve with preadjusted appliances because of the play between the bracket slot and the wire.[1-5] In cases involving palatally blocked-out lateral incisors, inverting the brackets facilitates tooth movement without requiring 3rd-order bends.

Torque control is even more problematic in patients with extreme lingual tipping, severe alveolar bone resorption, or root dehiscence. This article shows how an orthodontic miniscrew with a bracket-shaped head can serve as anchorage for controlled root movement of the target teeth with minimal effects on adjacent teeth, using preadjusted appliances without 3rd-order bends.

Miniscrew-Assisted Root Movement

Because of the limited length of the lever arm in a bracket slot, increased force is needed to achieve an adequate moment for effective root movement, resulting in a heavy load on the anchor teeth and a concomitant risk of periodontal damage. Increasing the length of the lever arm is therefore preferable to increasing the force. This can be accomplished by applying pull-out forces to a miniscrew instead of the lateral forces generally used in tooth movement (Fig. 1).

For effective torque control, the miniscrew head must be designed to endure these pull-out

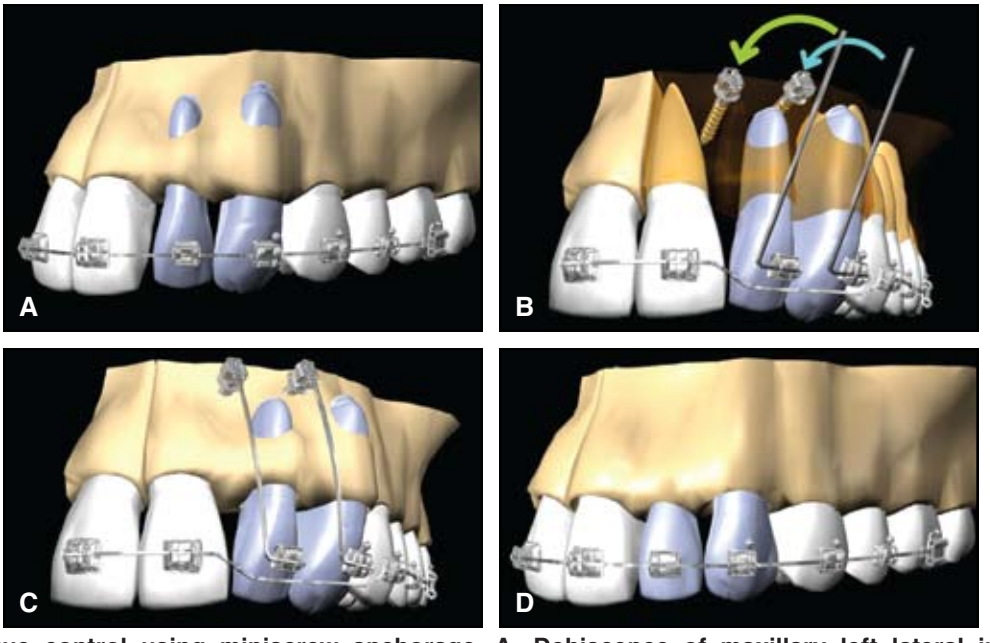

Fig. 1 Torque control using miniscrew anchorage. A. Dehiscence of maxillary left lateral incisor and canine. B. Pull-out forces applied to miniscrews. C. Engagement of TMA* archwire between miniscrews and brackets. D. After torque control.

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forces. The Dual-Top Anchor System, JD type** (1.6mm in diameter, 8mm long), has a bracket-shaped head to facilitate attachment of an archwire. The miniscrew is inserted into the interradicular space adjacent to the target tooth. A TMA* archwire is bent so that one end can be inserted into the bracket slot while the other end is connected to the miniscrew head, creating a lever arm (Fig. 1C). Placement of a miniscrew between two teeth enables independent control of their roots by changing the direction of the TMA lever arm.

Case Report

A 24-year-old female was referred for orthodontic treatment after undergoing oral surgery. She had been involved in an accident resulting in fracture of the mandible and right condylar head, the loss of both mandibular central incisors and the maxillary left second premolar, and multiple crown fractures. Four miniscrews had been placed for intermaxillary fixation during surgery. The roots of the maxillary left lateral incisor and canine were relatively prominent (Fig. 2).

Extraction of the maxillary right second premolar was planned, and a preadjusted appliance with .022" slots was bonded. During leveling and alignment, however, the roots of the maxillary left lateral incisor and canine became increasingly prominent. The canine root protruded into the mobile oral mucosa and showed some apical root resorption (Fig. 3). Cone-beam computed tomographic (CBCT) images showed dehiscence of the lateral incisor and canine roots, which were labially positioned (Fig. 4). The canine's apical root resorption was more apparent in these images.

To control the root positions, the bracket size was changed from .022" to .018", and Dual-Top Anchor System** miniscrews (JD type, 1.6mm in diameter, 8mm long) were placed between the central and lateral incisors and between the lateral incisor and canine (Fig. 5). A step-down bend was made in the maxillary archwire to create space for long lever arms made of .017" × .025" TMA wire (Fig. 6). The main archwire was kept in contact with the labial surfaces of the lateral incisor and canine to prevent labial movement of the crowns.

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Fig. 2 24-year-old female patient after jaw surgery due to mandibular fracture, with four miniscrews placed for intermaxillary fixation.

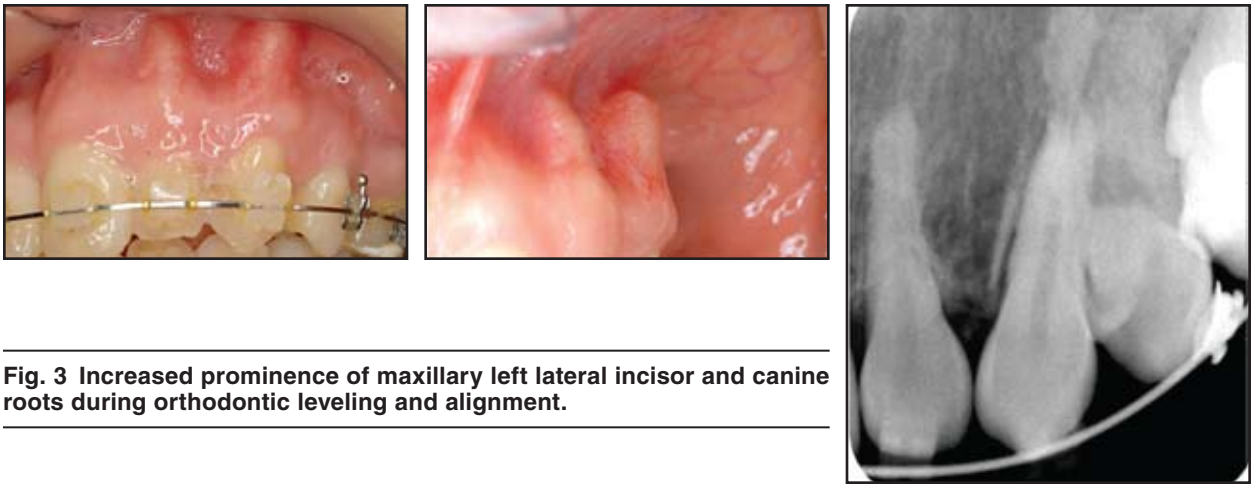

Fig. 3 Increased prominence of maxillary left lateral incisor and canine roots during orthodontic leveling and alignment.

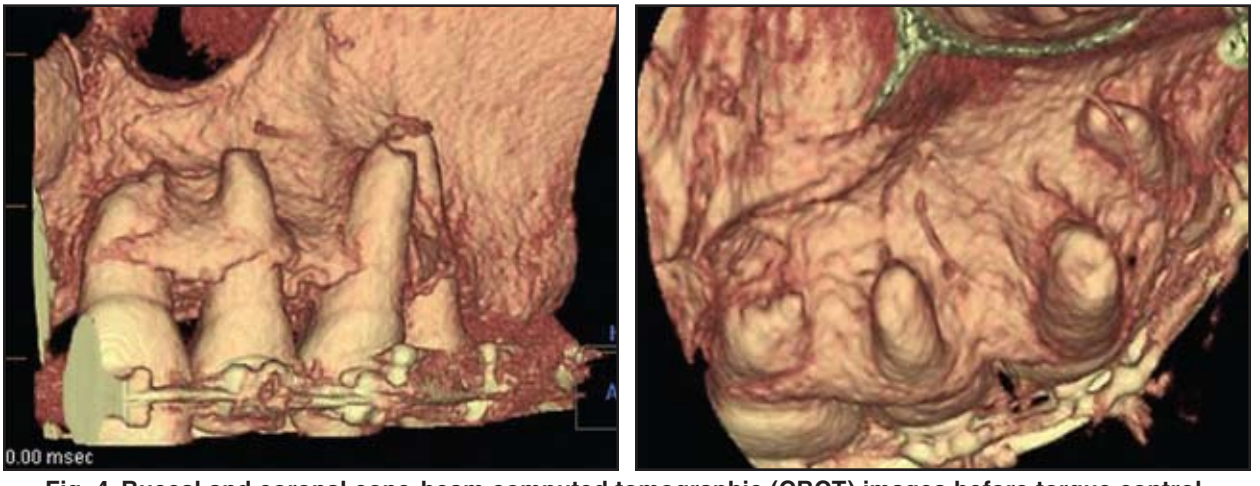

Fig. 4 Buccal and coronal cone-beam computed tomographic (CBCT) images before torque control.

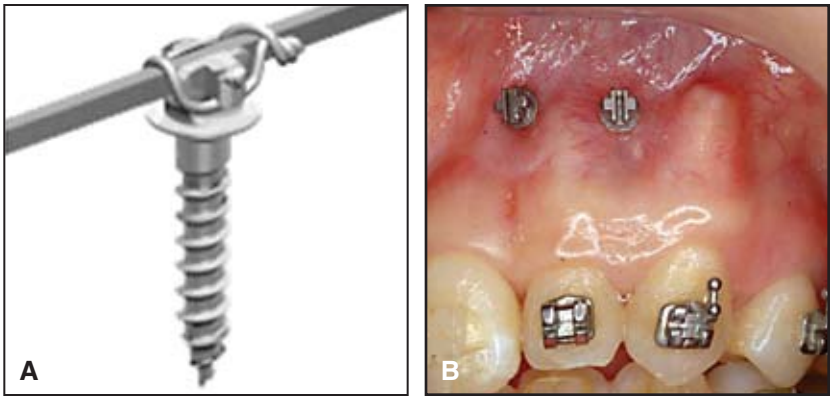

Fig. 5 Miniscrew anchorage used for torque control. A. Long lever arm engaged in slot of Dual-Top Anchor System miniscrew. B. Patient after miniscrew placement.

After one week, the miniscrew between the central and lateral incisors became loose because of inflammation. A new miniscrew was placed between the canine and first premolar (Fig. 7).

The miniscrew-assisted torque control improved the canine and lateral incisor root positions (Fig. 8). Three-dimensional CBCT images showed better root positions after six weeks of treatment (Fig. 9). Total treatment time was 26 months. Final post-treatment records showed com-

Fig. 6 Engagement of long lever arms made of .017" × .025" TMA wire.

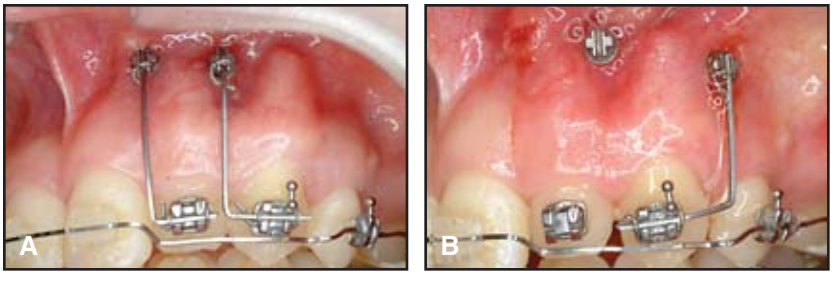

Fig. 7 A. Loose miniscrew between central and lateral incisors. B. New miniscrew placed between canine and first premolar.

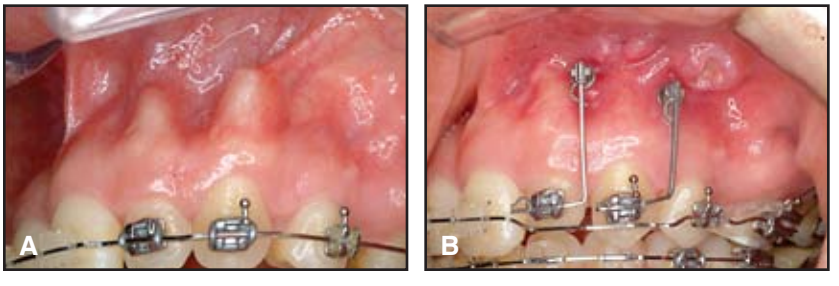

Fig. 8 Progress records showing improvement in canine and lateral incisor root positions. A. Before miniscrew placement. B. After miniscrew replacement.

plete closure of the spaces left by the lost teeth, a good occlusal relationship, and torque control of the target teeth, with no further root resorption or prominence of the adjacent teeth (Fig. 10).

Discussion

Using conventional mechanics, a force of as much as 2,000g per side (about 1,250gmm of moment) is needed to induce central incisor root movement,[6-9] a level of force that may result in damage to the periodontium. By increasing the length of the lever arm by about 10mm) the miniscrew-assisted technique for torque control described here can reduce the required force to about 125g (Fig. 1B).

Huja and colleagues reported that the pull-out strength of miniscrews was sufficient to support tooth-moving forces,[10] but the associated moment may result in flaring or extrusion of the teeth. To minimize these undesirable side effects, the archwire should be kept in contact with the incisal third of the labial crown surfaces (Fig. 1C).

Two or three miniscrews are usually needed to control the positions of several roots. If one miniscrew becomes loose, however, two adjacent roots can be controlled by changing the direction of the TMA lever arm, using one miniscrew placed between the two teeth.

In the case shown here, the treatment time was 26 months because of the difficulty of completing torque control with only the L-shaped TMA wires. A newer technique involving a U-shaped TMA wire attached to two miniscrews, placed mesial and distal to the target tooth, may control torque more efficiently, thus shortening treatment time (Fig. 11).

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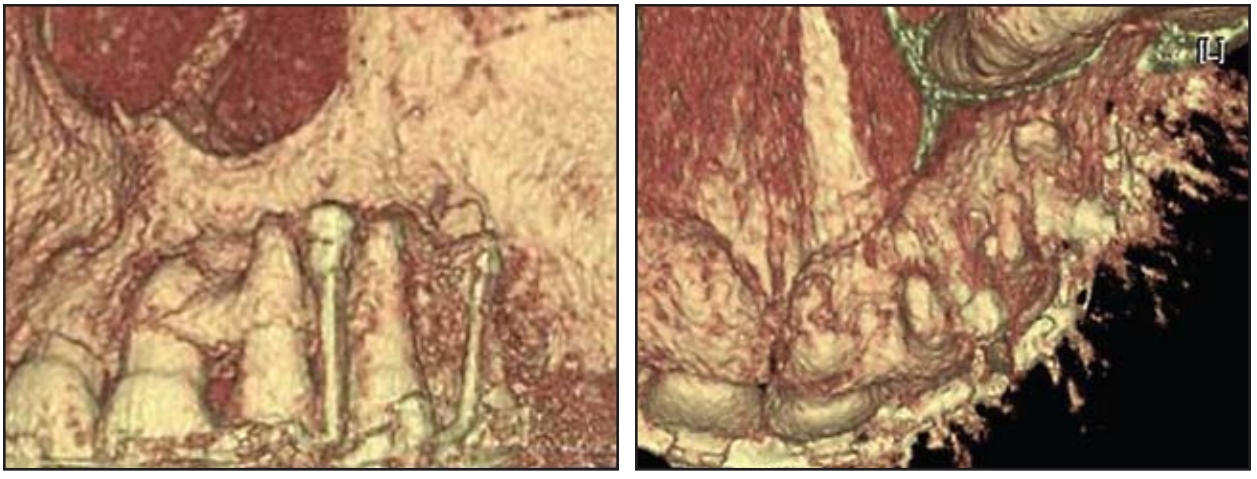

Fig. 9 Buccal and coronal CBCT images after six weeks of torque control.

Fig. 10 Patient after 26 months of treatment.

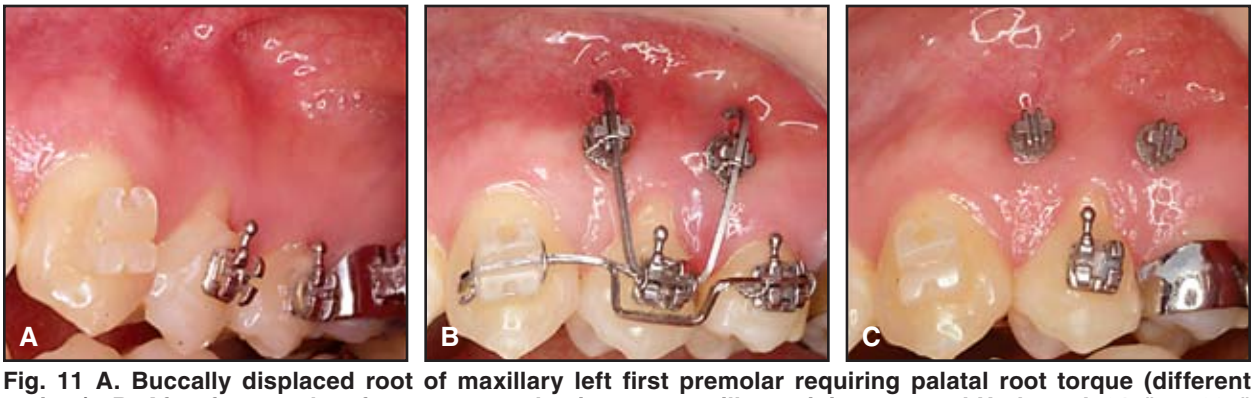

Fig. 11 A. Buccally displaced root of maxillary left first premolar requiring palatal root torque (different patient). B. After four weeks of torque control using two maxillary miniscrews and U-shaped .017" × .025" TMA wire. C. After 10 weeks of torque control, with no increase in premolar gingival recession.