Transitional Implants for Orthodontic Anchorage

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The efficacy of orthodontic anchorage provided by skeletal implants has been well demonstrated.[1-7] Conventional endosseous implants have substantial limitations, however, including their cost, the need for extensive surgical procedures, the time required for osseous integration, the difficulty in attaching orthodontic appliances, and the limited availability of implant sites.

While endosseous dental implants are intended to resist the heavy, intermittent forces of occlusion, orthodontic forces are considerably lower and more sustained. Therefore, the requirements of an orthodontic anchor implant may be quite different.[8-13] An ideal orthodontic anchor would be:

- Small
- Affordable
- Easy to place
- Routinely resistant to orthodontic forces
- Able to be immediately loaded
- Usable with familiar orthodontic mechanics
- Easy to remove

The titanium Modular Transitional Implant* possesses these characteristics (Fig. 1). The MTI, 1.8mm in diameter, is available in lengths of 14mm, 17mm, and 21mm. It was designed to support a temporary fixed prosthesis during the healing phase associated with placement of permanent implants, and to be removed when the permanent implants are restored.

This article describes the use of MTIs for orthodontic anchorage.

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Case Report

A 68-year-old female presented with missing posterior teeth and a periodontally compromised dentition (Fig. 2). Some of the posterior teeth were congenitally missing, while others had been extracted. The patient had undergone maxillary alveoloplasty and had removable partial dentures that had not been worn for several years and did not fit. Her chief complaint was the

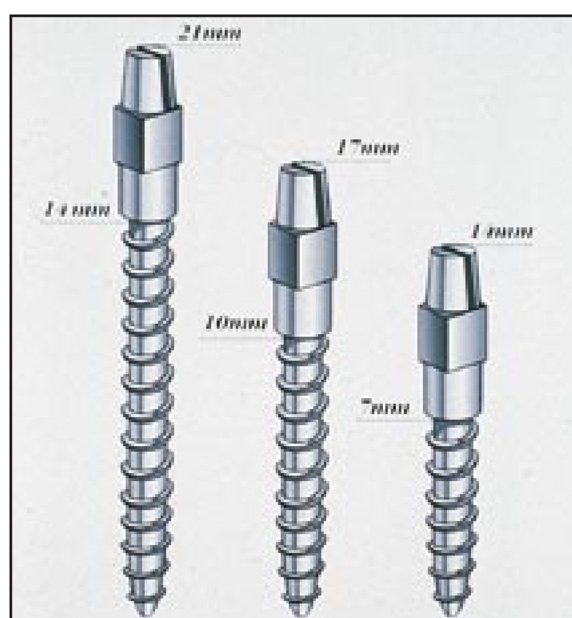

Fig. 1 Modular Transitional Implants.

Fig. 2 68-year-old female with missing posterior teeth and periodontally compromised dentition before treatment.

appearance of her maxillary anterior teeth.

The lack of posterior occlusal support and subsequent loss of vertical dimension had created an occlusion that was traumatizing the remaining teeth. All the teeth showed some mobility, especially the maxillary anterior segment, although bone support for the maxillary anterior teeth was generally good. These teeth were proclined, protrusive, and spaced, with excessive overbite and overjet. The maxillary sinus was generally in close proximity to the alveolar ridge, with little alveolar bone remaining in the posterior edentulous areas.

The mandibular anterior segment showed a greater degree of bone loss and moderate pathologic gingival recession. The mandibular incisors were proclined, spaced, and somewhat rotated. The mandibular posterior edentulous areas had lost alveolar height and width.

Prior to orthodontic consultation, the fractured maxillary right first bicuspid had been targeted for a crown. The tentative restoration plan was for a maxillary overdenture and a mandibular removable partial denture. Although the patient expressed a desire to save as many teeth as possible and avoid a complete denture, finan-

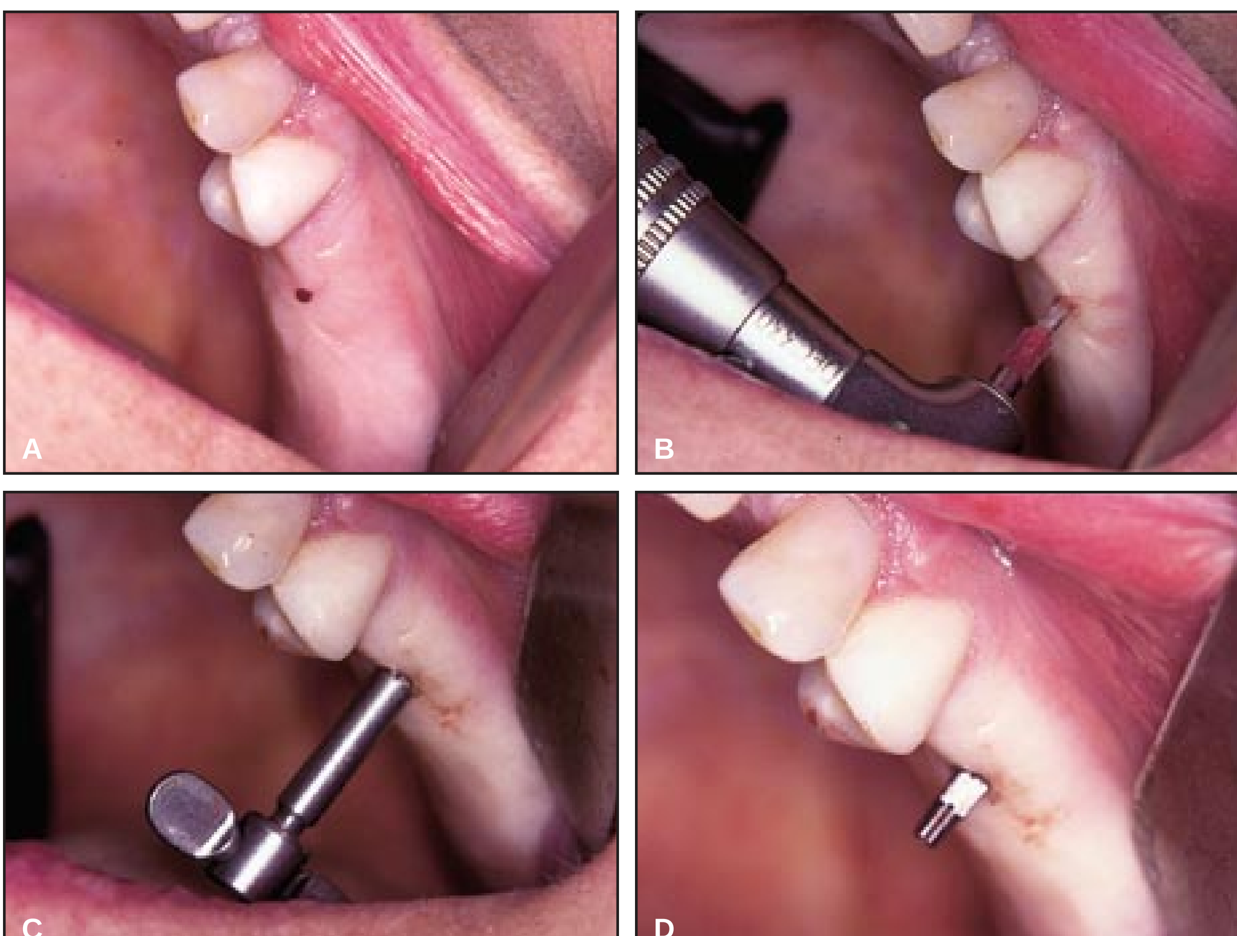

Fig. 3 A. Bleeding point for identification of implant site. B. Pilot channel prepared with needle-point drill. C. MTI placed with finger wrench. D. MTI in place.

Fig. 4 Nickel titanium wire bonded to slot of 21mm MTI and occlusal surface of acrylic crown on adjacent maxillary left first bicuspid for indirect orthodontic anchorage.

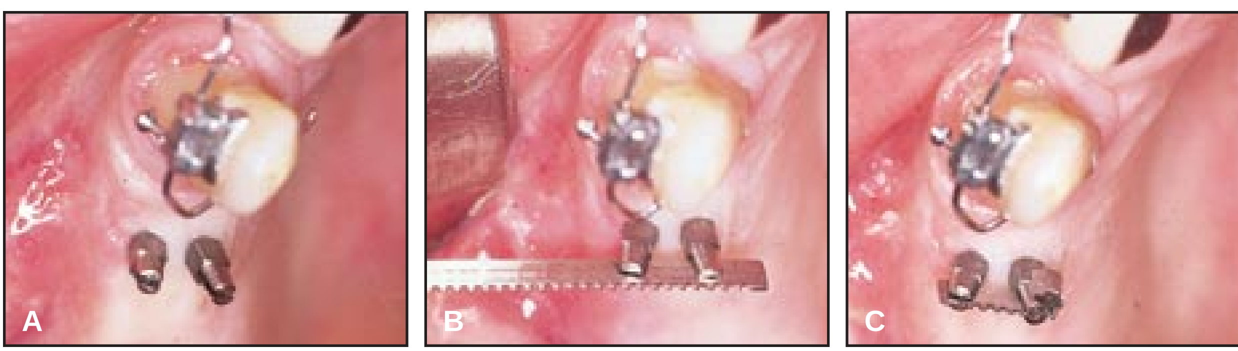

Fig. 5 A. Two 17mm MTIs placed distal to maxillary right cuspid for direct orthodontic anchorage. B. Measurement of titanium bar. C. MTIs connected with titanium bar for stabilization.

cial considerations initially precluded the replacement of missing teeth with dental implants.

Orthodontic treatment objectives were to improve the positions of the teeth, particularly the interincisal relationships, for eventual replacement of the posterior teeth with removable partial dentures. The general treatment plan was to open the bite, align the teeth in both arches, and retract and consolidate the maxillary anterior teeth.

After the vertical dimension had been increased with temporary partial dentures, MTIs were surgically placed under local anesthesia, using a needle-point drill. Pilot-hole channels were drilled in the bone directly through the mucosa to avoid the need for mucoperiosteal flaps (Fig. 3). The length of each implant was based on the depth of available bone.

A 21mm MTI was used for indirect orthodontic anchorage distal to the maxillary left first bicuspid, which had been restored with an acrylic crown (Fig. 4). An .016" × .022" nickel titanium wire in a ribbon configuration was bonded with light-cured composite to the slot of the MTI and the occlusal surface of the crown, using a dovetail occlusal preparation. The “flexible anchorage” of the nickel titanium wire allowed the bicuspid to function occlusally while dissipating these heavier forces at the implant. The bicuspid could then be used to anchor a fixed orthodontic appliance. Although the nickel

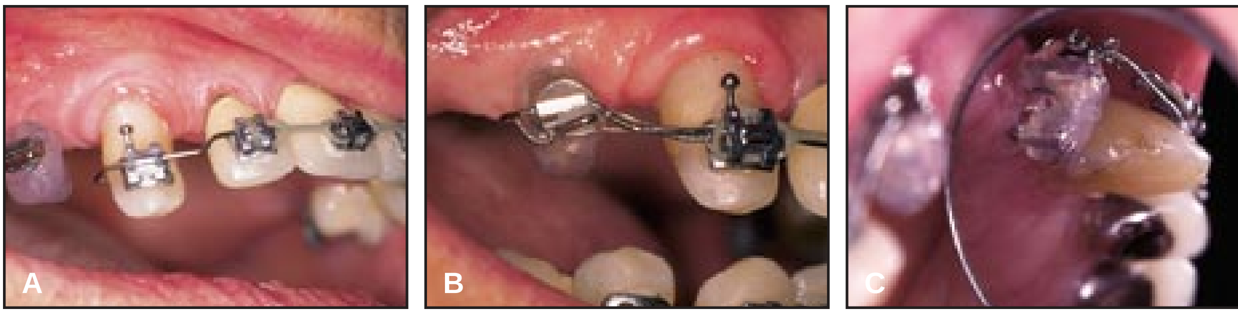

Fig. 6 A. MTIs and titanium bar covered with light-cured acrylic to simulate maxillary bicuspid; mandibular second molar tube with 25° torque placed upside down in acrylic. B. Molar tube on acrylic "bicuspid" ligated to adjacent cuspid. C. Cleanable furcation in acrylic between implants.

titanium wire broke after six months of attachment and again four months later, the MTI maintained its integrity.

Using the available alveolar bone in the maxillary right posterior segment to best advantage, two 17mm MTIs were placed distal to the cuspid (the terminal tooth) for direct orthodontic anchorage (Fig. 5). The MTIs were connected with a titanium bar, which stabilized the implants and prevented their rotation. This apparatus was then covered with light-cured acrylic to simulate a maxillary bicuspid in normal archform. Prior to curing, a mandibular second molar tube with 25° torque was placed upside down in the acrylic (Fig. 6).

After six months of treatment, the progress of space closure and incisor retraction stopped due to the difficulty of maintaining the bite opening (Fig. 7). The temporary partial dentures had little retention and were so uncomfortable that the patient did not wear them full-time. In addition, they tended to seat deeper and deeper, requiring occlusal build-ups to maintain the vertical dimension.

This problem was not resolved until the patient allowed us to revise the treatment plan to include permanent mandibular implants. Fixed bilateral posterior acrylic bridges were then placed, using the MTI system during stage-one healing of the permanent implants. These transitional bridges improved the stability of the posterior occlusion and helped preserve the bite opening.

Active orthodontic treatment was completed in another eight months (Fig. 8). The patient awaits restoration with bilateral mandibular implants and a maxillary removable partial denture. The anterior teeth in both arches will be splinted from the lingual for orthodontic retention and periodontal stabilization. The MTIs will be removed when the maxillary partial denture is delivered.

Implant Failures

With no natural posterior occlusal support, the forces generated on the anterior teeth in this case were surprisingly strong. The MTIs shown here maintained their integrity, but 10 other implants failed in attempts to retain the temporary partial dentures. Although a number of techniques were used, these MTIs were all freestanding and unprotected from rotational forces, which are especially problematic because of the threading on the implants. After causing soreness for the patient, these implants became mobile and were easily removed without anesthesia.

Experience gained from the failures was critical to the success of the MTIs used for orthodontic anchorage. The successful implants were loaded soon after placement, protected from direct occlusal forces, and stabilized to prevent rotation. No soreness was experienced by the patient after initial healing of the successful implant sites.

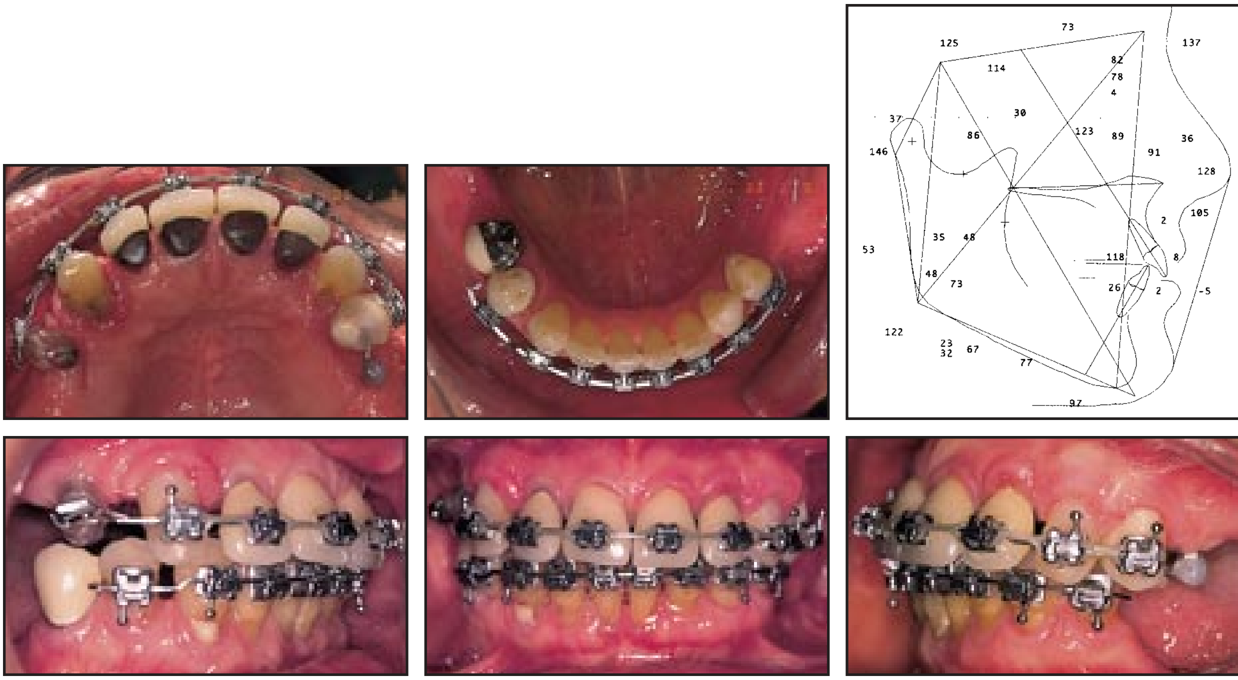

Fig. 7 Patient after six months of orthodontic treatment.

Discussion

Conventional wisdom derived from the use of permanent implants for tooth replacement has also guided the use of implants for orthodontic anchorage. This conventional wisdom is currently being challenged, however, in the areas of axial loading and two-stage implantation.[14] Because orthodontic forces are so different from other intraoral forces, it is equally reasonable to re-examine the requirements for orthodontic implants.

Our experience and other investigations[1,2,15-18] raise several questions: Is osseous integration necessary before loading an implant with orthodontic forces? If not, as in the present case, how does the tissue-implant interface develop and mature? What intraoral locations can be used for orthodontic anchorage implants, and how small can these implants be made?

Further consideration should be given to the concept of flexible anchorage. The nickel titanium wire in this patient's maxillary left buccal segment relieved the stress of occlusion and thus allowed placement of a smaller implant. The smaller the implant, the more suitable sites can be found, and the less invasive the surgical placement and removal become. Smaller implants can be combined over wide edentulous spaces to serve both as orthodontic anchors and in their original role as retention for temporary fixed prosthetic restorations. Specific orthodontic attachments for such MTIs are now being developed.

Conclusion

Many more opportunities exist for the orthodontist and restorative dentist to use implant-supported orthodontic anchorage in treatment of preprosthetic patients. MTIs' small size, relatively low cost, ease of placement, ability to be loaded immediately, and adaptability to routine orthodontic mechanics make them suitable for further investigation in the provision of stable anchorage.

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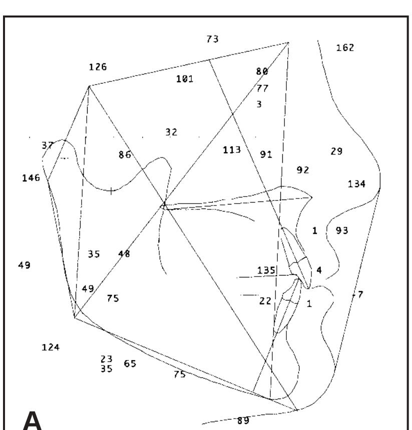

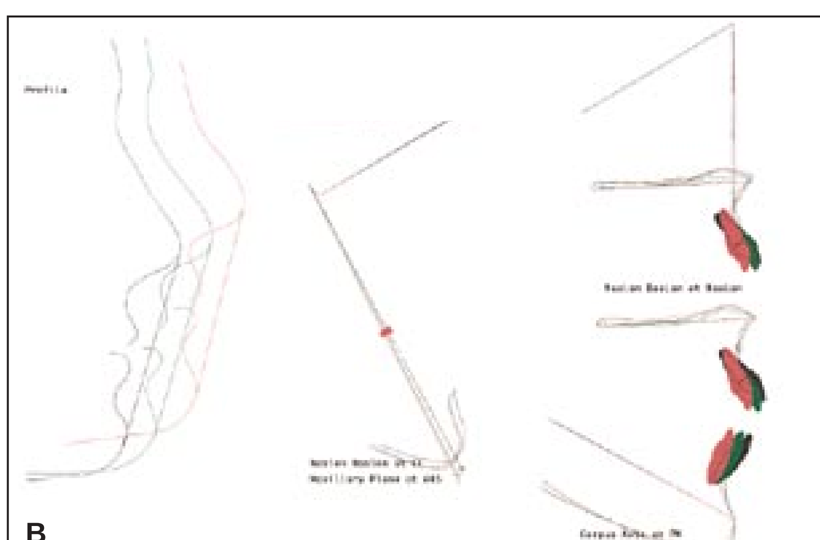

Fig. 8 A. Patient after 14 months of orthodontic treatment. B. Superimposition of initial (black), progress (green), and final (red) cephalometric tracings.

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