The C-Orthodontic Micro-Implant

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Various skeletal implant systems have been proposed to reinforce orthodontic anchorage without the need for extraoral appliances.[1-7] Orthodontic miniscrews or microscrews are efficient, inexpensive, and simple to place and remove.[2,3,5] Since the primary means of retention of most micro-implants is a mechanical lock within the bone, however, and they require a tight fit to be effective, their stability depends almost entirely on the quality and quantity of available cortical and trabecular bone.[5] In addition, the heads of many designs of orthodontic miniscrews tend to cause gingival irritation.

To overcome these limitations and enable early osseointegrated skeletal fixation, we have developed a new skeletal anchorage system called the C-Implant.*[7]

Implant Design

The C-Implant is a unique titanium device that provides absolute orthodontic anchorage, mainly from osseointegration (Fig. 1). Each implant is packaged in an aseptic vial and blister pack (Fig. 2). It has two components:

1. A screw that measures 1.8mm in diameter and 8.5mm, 9.5mm, or 10.5mm in length. The entire surface, except for the upper 2mm, is sandblasted, large-grit, and acid-etched for optimal osseointegration (Fig. 3).
2. A head that measures 2.5mm in diameter and 5.35mm, 6.35mm, or 7.35mm in height. It con-

*Speedy Orthodontic Screw, Dentium, Inc., 6F Dahn-World B/D 154-11, Samsung-dong, Kangnam-gu, Seoul 135-897, Korea; www.implantium.com.

Fig. 1 C-Implant components and screwdriver (courtesy of Dentium, Inc.).

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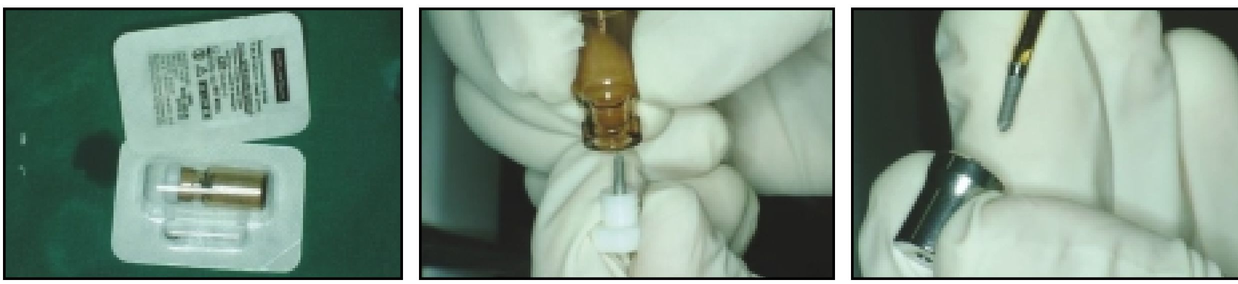

Fig. 2 C-Implant removed from vial with screwdriver.

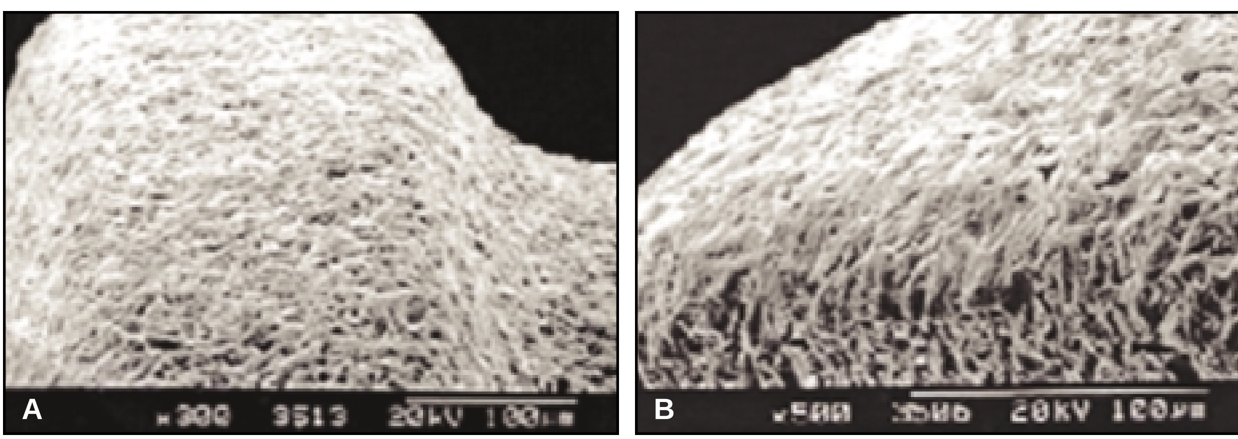

Fig. 3 Scanning electron micrographs of C-Implant screw surface (reprinted by permission[29]). A. 300×. B. 500×.

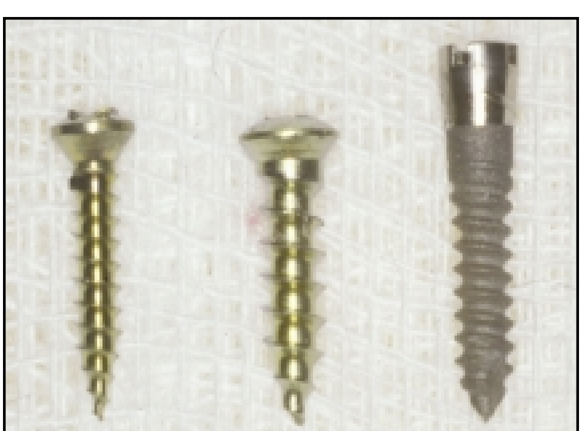

Fig. 4 Screw body of C-Implant (right) compared to self-tapping miniscrews.

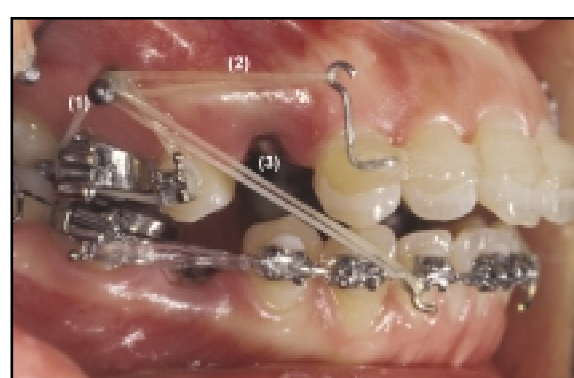

Fig. 5 Multidirectional elastic forces applied to C-Implant: (1) intrusion of upper first molar; (2) retraction of upper anterior teeth; (3) tipback of lower second molar.

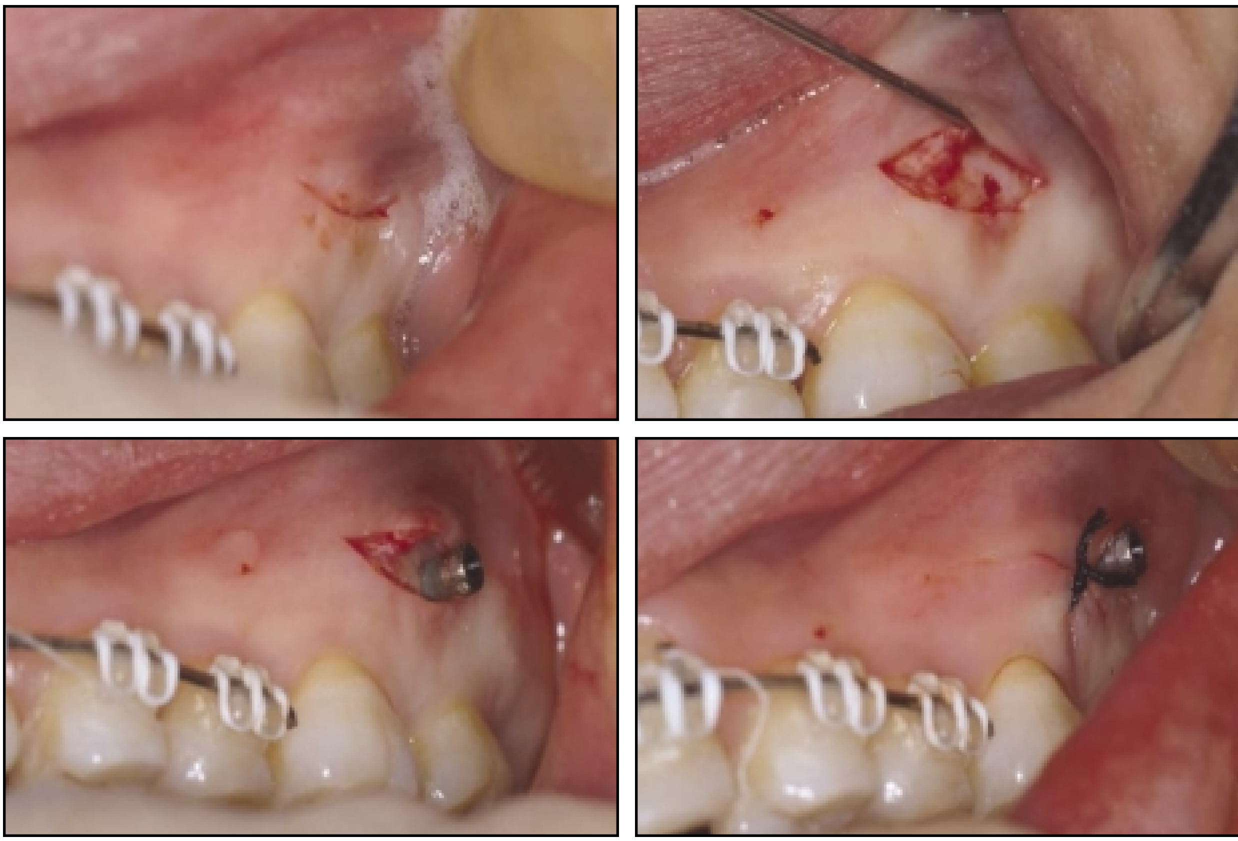

Fig. 6 Open technique for placing C-Implant.

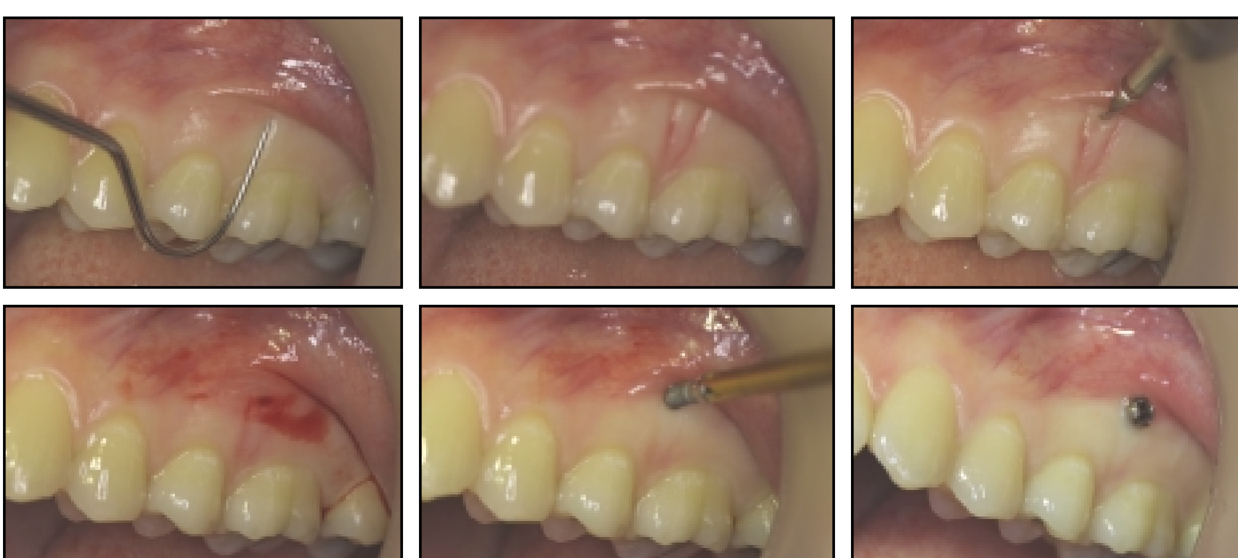

Fig. 7 Closed technique for placing C-Implant.

tains a .8mm-diameter hole located 1mm, 2mm, or 3mm from the top of the screw.

The entire C-Implant is virtually the same size as a conventional miniscrew (Fig. 4). The two-component system keeps the neck area from fracturing during implantation and removal, and the long span between the head and the screw body prevents gingival irritation during orthodontic retraction (Fig. 5).

Implantation and Removal

For en masse retraction, C-Implants are usually placed in the interdental spaces between the second premolars and first molars or the first and second molars, using either an open (Fig. 6) or a closed technique (Fig. 7). The implantation procedure is as follows:

1. If the attached gingiva is insufficient and the implant site is surrounded by mucosa, make an incision.
2. Drill to the appropriate depth using a low-speed handpiece under copious irrigation with an isotonic saline solution. A drill speed of 1,000-1,500rpm and pressure of 10-15Ncm produce the best results. The 1.3mm- or 1.5mm-diameter guide drill* is especially helpful when drilling through cortical bone.
3. Screw the body of the implant clockwise into the prepared site under constant irrigation with sterile water or saline solution. Suture if needed.
4. Attach the head to the screw body using the supplied instrument, either immediately after insertion or six to eight weeks later (Fig. 8). Immediate loading is possible in areas of dense bone where stability is assured. In any case, however, the stability of the C-Implant should be confirmed four weeks after placement.

To remove the C-Implant, after disassembling the head from the screw, rotate the screw out counterclockwise with the screwdriver (Fig. 9). If the implant is too hard to remove with the screwdriver, an orthodontic heavy-wire plier can be used. The soft tissue will heal within a few days.

*Dentium, Inc., 6F Dahn-World B/D 154-11, Samsung-dong, Kangnam-gu, Seoul 135-897, Korea; www.implantium.com.

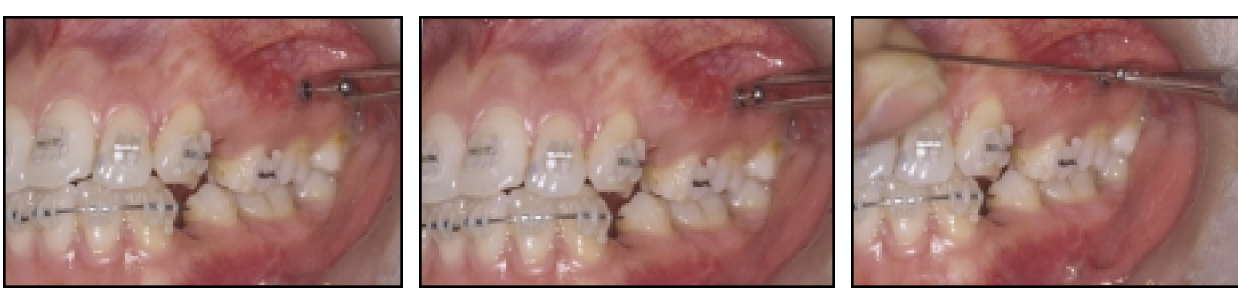

Fig. 8 Attachment of C-Implant head to screw body.

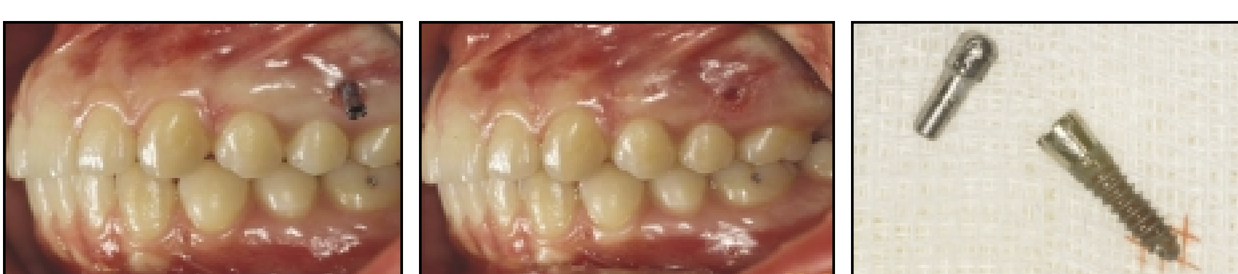

Fig. 9 Removal of C-Implant head with plier, followed by reverse turn of screw with screwdriver.

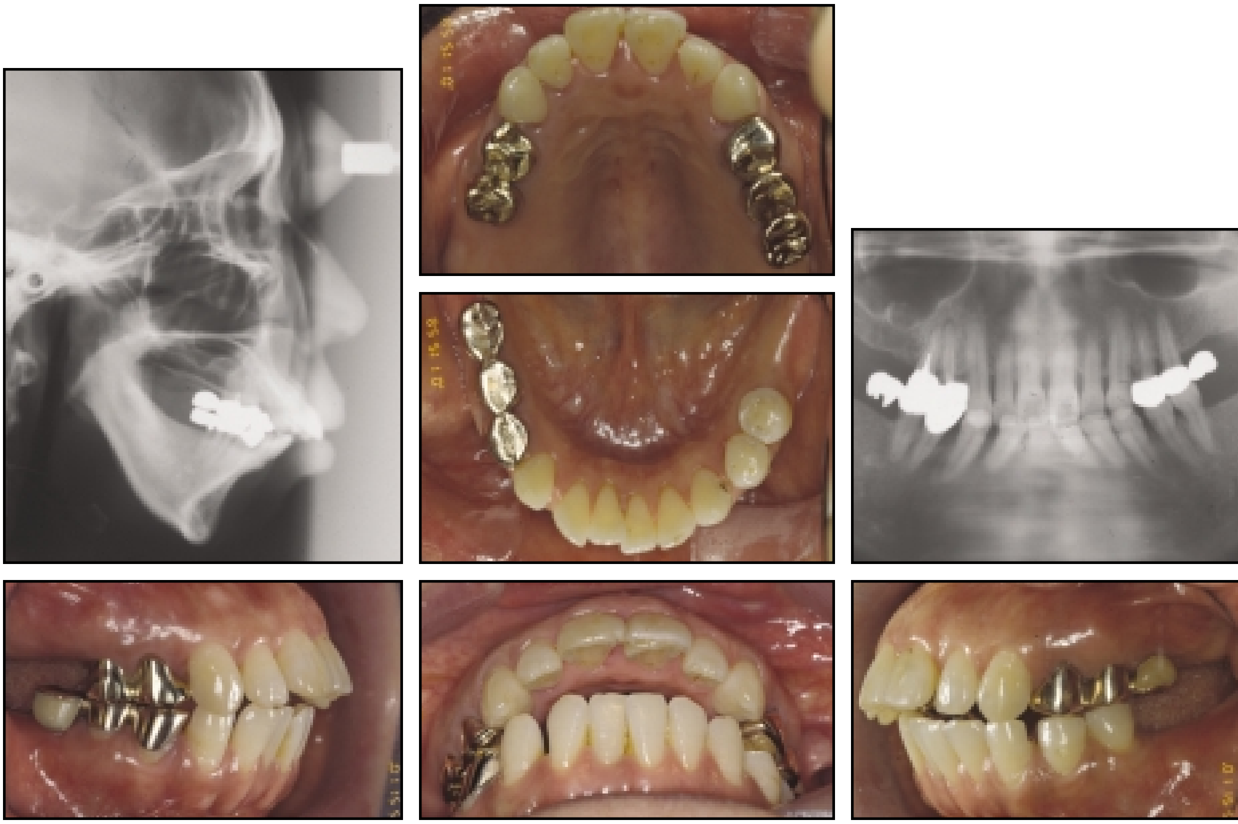

Fig. 10 Case 1. 51-year-old female patient with lip protrusion and missing molars before treatment.

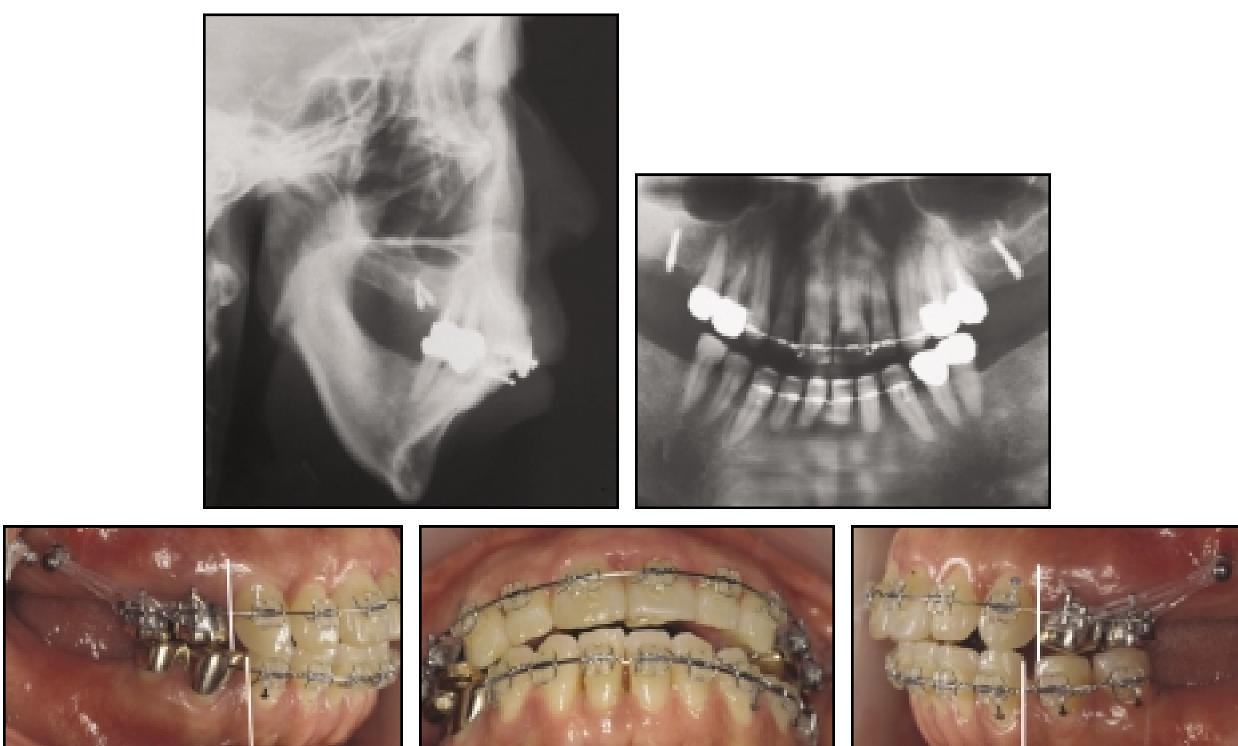

Fig. 11 Case 1. Patient after four months of en masse maxillary retraction using C-Implant anchorage.

Case 1

In this case, C-Implants were used for stationary anchorage during en masse retraction of the maxillary teeth. A 51-year-old female presented with the complaints of lip protrusion and missing upper and lower molars (Fig. 10). She requested orthodontic treatment followed by prosthetic replacements for a better esthetic appearance.

The treatment objectives were to reduce the overjet and overbite and improve interdigitation. En masse retraction of the upper dentition by conventional orthodontic means was impossible because of the lack of anchor teeth.

The patient also had an osteoporotic condition, which meant that a miniscrew or microscrew could loosen or even fall out during orthodontic treatment. Therefore, we decided to place two C-Implants (1.8mm in diameter, 8.5mm long) in the maxillary posterior regions. The implants were not loaded until eight weeks after placement.

After four months of en masse retraction, the patient showed an improved anterior overjet and interdigitation (Fig. 11).

Case 2

C-Implants can also be used for maxillary molar distalization. A 20-year-old female with a Class II malocclusion asked for correction of her dental midline (Fig. 12). The treatment objective was to distalize the upper dentition differentially while maintaining facial balance.

The upper right second molar and left third molar were extracted. The patient declined to use an extraoral appliance, so we decided to place C-Implants (1.8mm in diameter, 8.5mm long) in the interdental spaces between the upper right second premolars and first molars. The implants were not loaded until six weeks after placement.

An .017" × .022" sectional archwire and an .018" × .025" stainless steel sliding jig were used to distalize the upper right molars (Fig. 13). In 13 months of treatment, the patient showed a substantial improvement (Fig. 14).

Discussion

The application of prosthetic dental implants for orthodontic anchorage has expanded the biomechanical and clinical scope of orthodontic treatment.[8-14] Nevertheless, their size, cost, lengthy osseointegration period, limited availability of implant sites, and relatively invasive placement procedure have limited their usefulness.[1-7]

The C-Implant is based on the design of conventional osseointegrated implants, but like micro-implant systems, can be used in many orthodontic situations that require immediate loading. The threaded design has been found by Randow and colleagues to allow better mechanical retention and transfer of compressive forces.[15] It minimizes micromotion of the implant and improves initial stability—the prin-

Fig. 12 Case 2. 20-year-old female patient with Class II malocclusion before treatment.

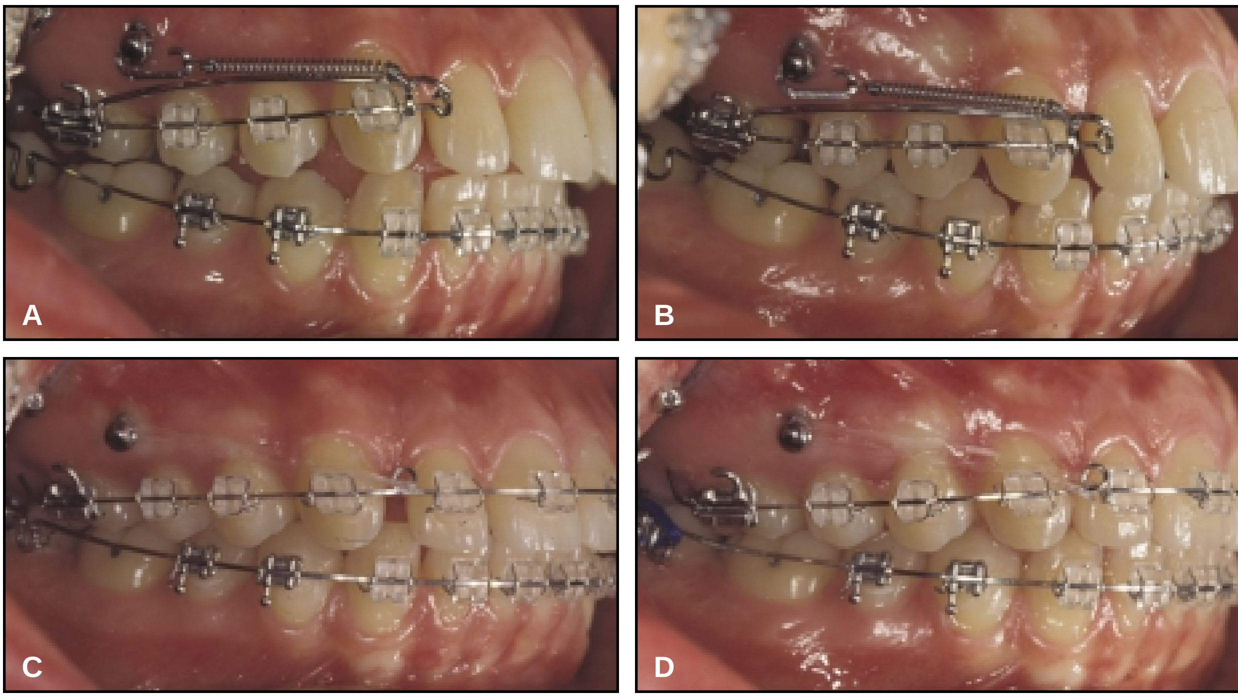

Fig. 13 Case 2. A. One month after placement of sliding jig for distalization of upper right molars. B. Two months after placement of sliding jig. C. En masse retraction of maxillary incisors. D. After retraction.

Fig. 14 Case 2. Patient after 13 months of treatment, before removal of C-Implants.

cipal requirement for immediate loading. In addition, the roughened screw surface has been associated by Trisi and colleagues with a significant increase in bone-implant contact.[16]

The small size, two-part design, efficiency, and low cost of the C-Implant make it applicable in various types of cases, as shown here. The groove in the screw head allows the patient to easily attach intermaxillary elastics, so that the clinician can control the direction of force without using soldered extensions or hooks.

Applied forces can range from 50-200g, depending on the quality of bone and the orthodontic movement desired.[1] Asikainen and colleagues showed in an animal experiment that titanium implants could resist lateral forces of 250-350g without losing osseointegration over a three-month loading period.[17] De Pauw and colleagues used titanium implants as anchorage for orthopedic force application.[18] Kyung and colleagues stated that even smaller 1.2mm and 1.3mm micro-implants could withstand as much as 450g of force.[5]

Osseointegration has been defined by

Brånemark as a direct structural and functional connection between living bone and the surface of a load-carrying implant.[19] Roberts and colleagues demonstrated that three to four months of healing is adequate for sufficient mature, lamellar bone to form adjacent to an implant.[20] It should be noted, however, that implants placed in different locations require different healing periods. Therefore, clinicians should use C-Implants mainly in areas of dense bone where mechanical stability can be expected.[21]

Histological animal data from Romanos and colleagues showed no adverse effects of immediate loading in either the osseointegration process or the bone morphology around the fixtures.[22] Although one could speculate that immediate loading of dental implants might accelerate bone formation, it is important to add that primary stability is essential for this process to occur.[23-28]

Lee and Chung investigated the effect of early loading on the osseointegration of a C-Implant prototype and on the healing of the impaired bone at the implant site after removal[29] (Fig. 15). They found no difference between immediately loaded implants and unloaded implants. After the four-week healing period, early loading did not slow the progress of osseointegration.

Gapski and colleagues strongly recommended following the standard two-stage protocol, perhaps allowing even longer healing periods, in patients with compromising systemic diseases such as diabetes, osteoporosis, osteopenia, and hyperparathyroidism, as well as in smokers and in patients undergoing radiation therapy in the oral cavity.[21] Because diseases that directly affect bone metabolism can significantly influence implant wound healing, C-Implants should not be loaded in these patients until osseointegration is complete.

Conclusion

C-Implants can produce skeletal anchorage in a wide range of clinical applications, even in patients with systemic diseases. Further research is needed to establish the optimal combination of osseointegration and mechanical retention for various orthodontic and orthopedic force applications and treatment mechanics.

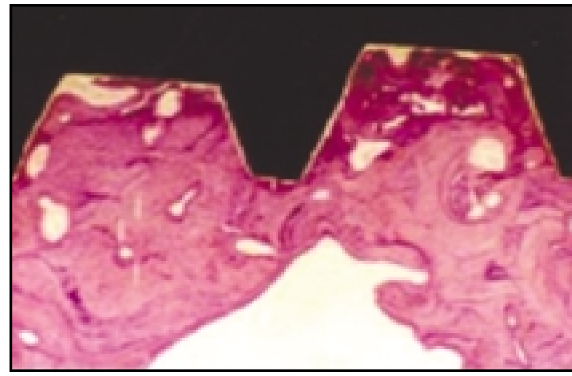

Fig. 15 Photomicrograph of tissue surrounding C-Implant in dog maxilla. Mature lamellar bone has covered most of screw thread (reprinted by permission[29]).

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