

A Miniscrew System with Interchangeable Abutments

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Orthodontic miniscrews have become increasingly popular in recent years because of their versatility, minimal invasiveness, and low cost.¹⁻⁶ The effectiveness of conventional miniscrew systems is limited, however, by the lack of a stable connection to the orthodontic appliance. The Straumann Orthosystem* addresses this problem with a cap or abutment that can be fixed to the implant.⁷ The system can be used as anchorage for distalization of the maxillary molars or for mesial space closure, but is more costly than conventional miniscrews in terms of both direct expense and chairtime. Moreover, a three-month healing period is recommended after placement of an Orthosystem implant before force loading. As an alternative, we developed the Benefit** mini-implant system with interchangeable abutments (Fig. 1).

Implant Placement

The Benefit mini-implant is made from a titanium alloy (Grade 5: Ti-6Al-4V). Four different types of stainless steel abutments can be fixed to the top of the implant by means of tiny fixing screws integrated into the abutments. Mini-implants with diameters of 2mm and 1.5mm are available. The 2mm-diameter screws are used in the anterior palate, which provides the best stability.⁸⁻¹⁰ The 1.5mm-diameter screws should be used only in combination with connecting plates (Beneplates**). A variety of mini-implant lengths are available, but the 9mm and 11mm screws are most commonly used.

Depending on the anticipated anchorage load, one or two mini-implants are inserted in the line of force (Fig. 2). If the patient is apprehensive

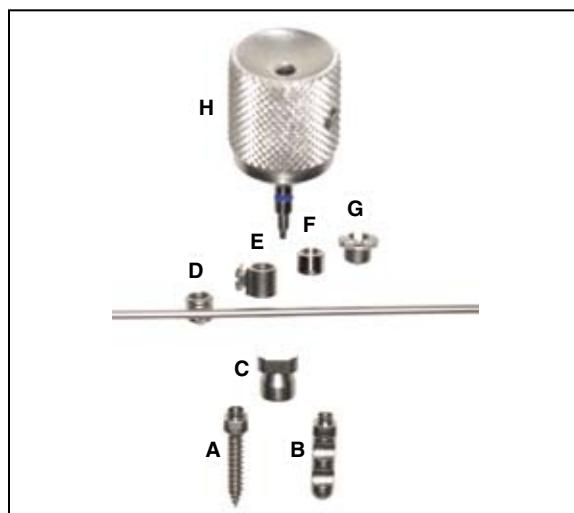


Fig. 1 Benefit system:** A. Mini-implant. B. Laboratory analog. C. Impression cap. D. Wire abutment with wire in place. E. Bracket abutment. F. Standard abutment. G. Slot abutment. H. Screwdriver for abutment fixation.



Fig. 2 Cephalogram showing preferred insertion region in anterior palate. Two Benefit mini-implants (anterior, 2mm x 11mm; posterior, 2mm x 9mm) are inserted in line of force.

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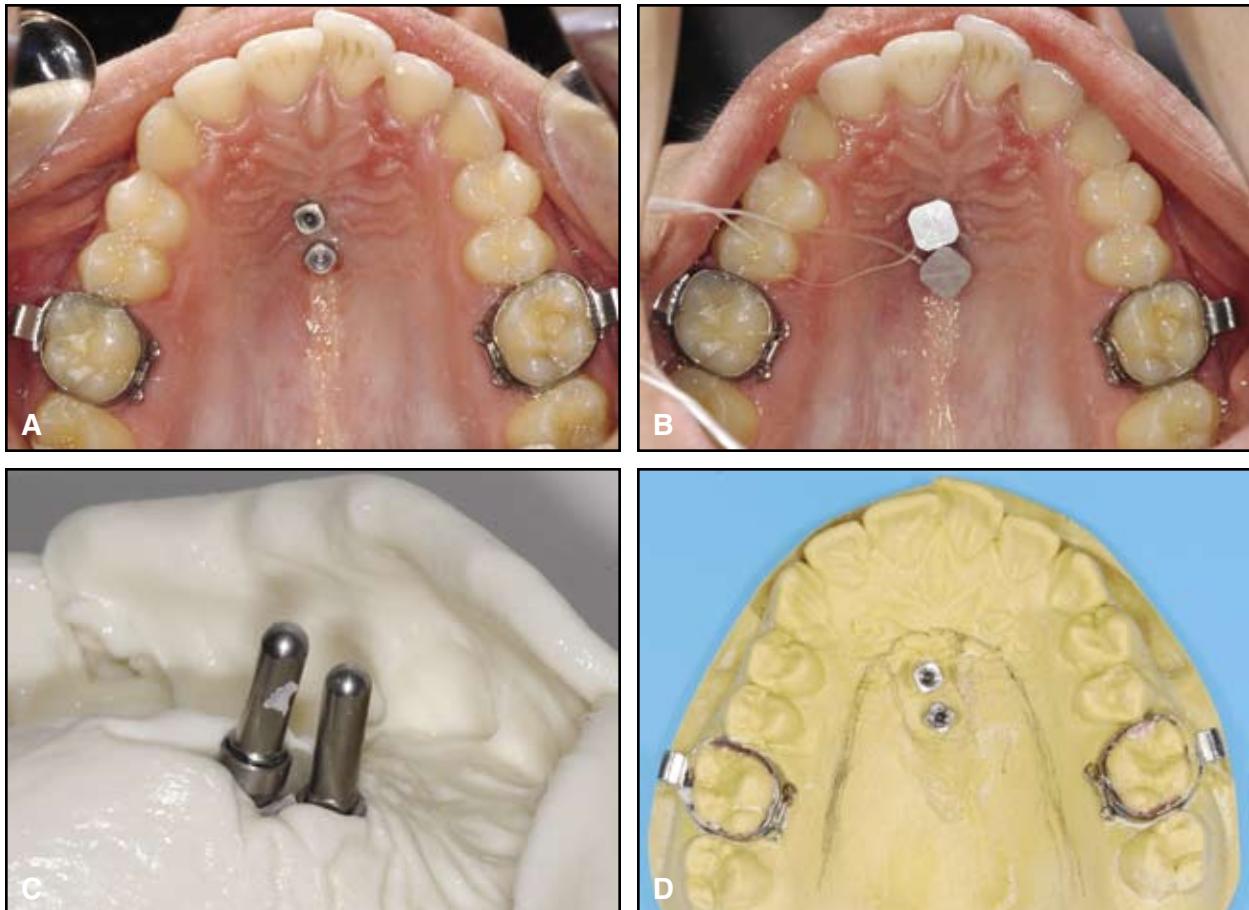


Fig. 3 Transfer of intraoral arrangement to plaster cast for laboratory fabrication of appliance. A. Mini-implants inserted. B. Impression caps placed on mini-implants. C. Laboratory analogs inserted into impression caps. D. Plaster cast.

about use of a needle syringe, the miniscrews can be placed using only topical anesthetic. In younger patients with relatively low bone mineralization, pilot drilling can usually be avoided.

The four removable abutments allow a variety of methods of connecting the mini-implant to the orthodontic appliance, especially in the max-

illa. The appliance can be fabricated in the laboratory by taking an impression and transferring the intraoral setup to a plaster cast (Fig. 3), using an impression cap and a laboratory analog (Fig. 1). If additional laboratory work is not required, the mini-implants can be loaded immediately after insertion.

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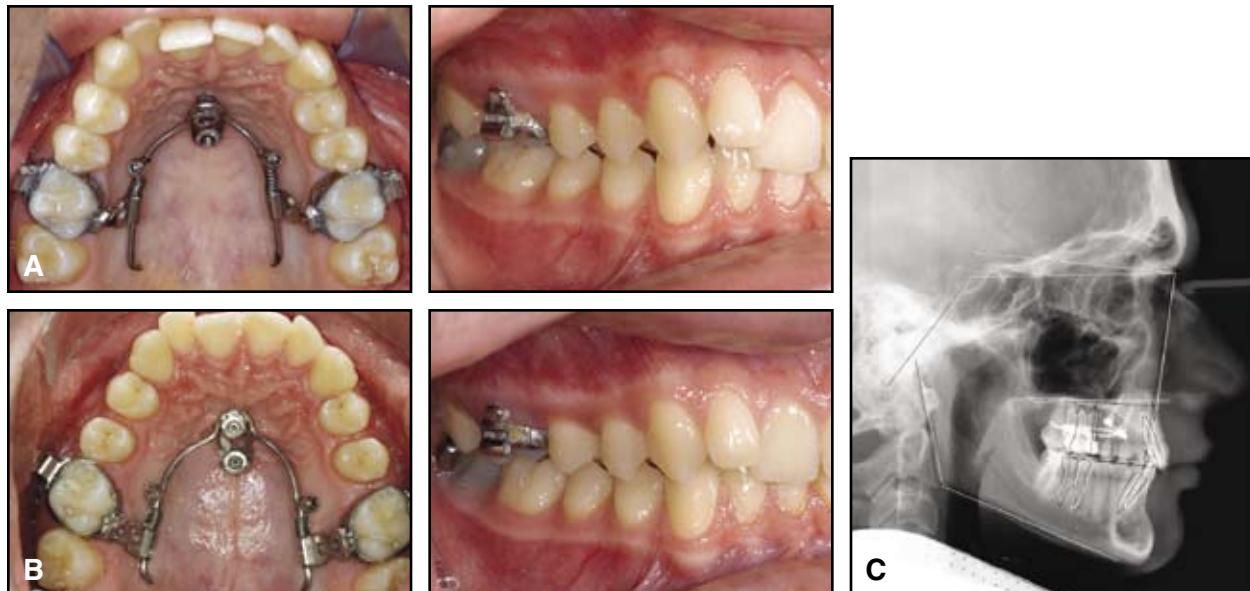


Fig. 4 Maxillary molar distalization with Beneslider. **A.** Patient before distalization. **B.** Class I molar relationship established after seven months of distalization (amount of distalization indicated by length of wire extending distal to molar tube). **C.** Superimposition of pre- and post-treatment cephalometric tracings shows bodily movement of first molars, due to direction of force through molar's center of resistance.

Clinical Applications

Maxillary Molar Distalization

Although indirect anchorage can be used to support the premolars during maxillary molar distalization, miniscrew tipping and wire deformation may result in anchorage loss and mesial premolar migration. Moreover, after molar distalization, the appliance must be refabricated for distalization of the premolars and anterior teeth. Therefore, direct anchorage is preferable.

We use the Beneslider^{**} molar-distalization appliance, which combines elements of the Distal Jet***^{11,12} and the Keles Slider¹³ (headgear tubes†) with the Benefit miniscrews (Fig. 4). The Benefit standard abutments are usually connected to an .045" stainless steel wire, but if welding or solder-

ing cannot be performed, the prefabricated abutment with a fixed wire can be used (Fig. 1). The active force is applied from two 240g nickel titanium springs.*** Because the premolars and canines will drift distally due to the pull of the transeptal fibers, significant spaces will not open.

Molar Uprighting

For pre-prosthetic molar uprightness,¹⁴ the Benefit mini-implant can be inserted parallel to the tooth axis in an edentulous area, as with a dental implant. After mini-implant placement, the bracket abutment (Fig. 1) is fixed in one of 12 possible angular positions. No laboratory procedure is needed, and conventional uprightness mechanics can be used (Fig. 5).

Maxillary Anterior Retraction

Benefit mini-implants can also serve as maxillary molar anchorage for retraction of the maxillary anterior teeth. An abutment with an .032" wire

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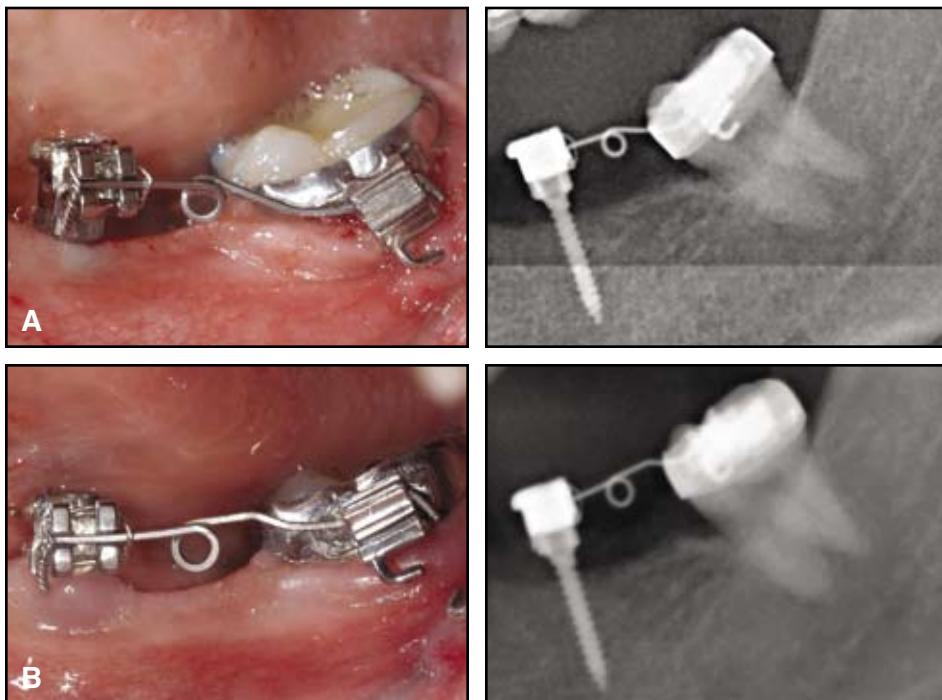


Fig. 5 Uprighting of mandibular left second molar with 2mm × 11mm Benefit mini-implant and bracket abutment. **A.** Patient before molar uprightness. **B.** After four months of uprightness with .016" × .022" TMA†† segmental wires.

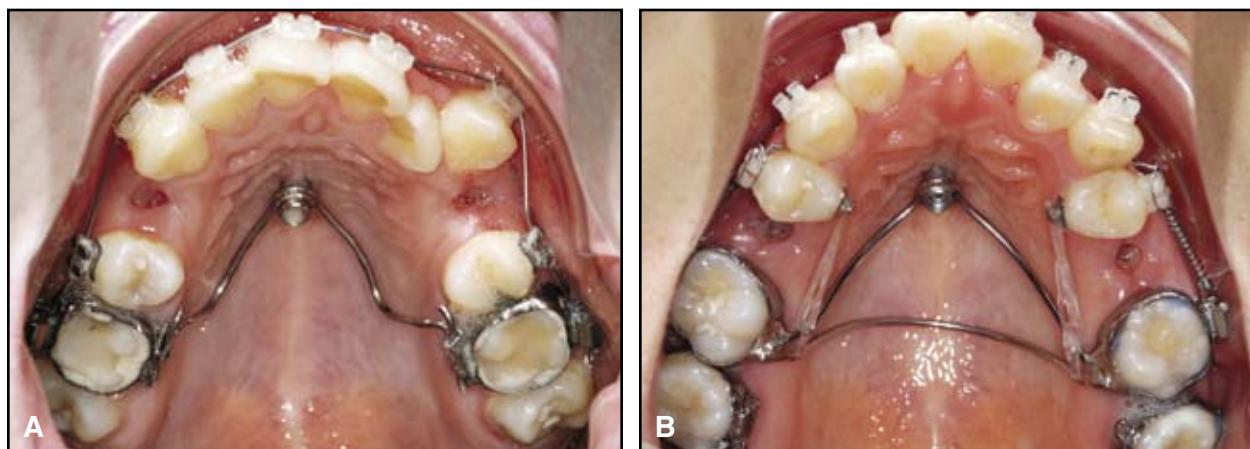


Fig. 6 Skeletal anchorage of maxillary molars for retraction of anterior teeth. **A.** Abutment with .032" wire used with Mobile Intraoral Arch system. **B.** Additional transverse posterior wire welded to prevent arch expansion.

should be selected if the Mobile Intraoral Arch (MIA‡) system is used (Fig. 6A). These mechanics tend to cause arch expansion, probably because of the bilateral buccal load and the midpalatal one-point anchorage. The amount of expansion will vary depending on the archwire diameter and the

load, but can be minimized by welding an additional transverse posterior wire (Fig. 6B).

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Fig. 7 Mesial space closure in patients with missing maxillary anterior teeth. **A.** Stainless steel wire bonded to lingual surfaces of maxillary central incisors and welded to Benefit abutment for indirect anchorage in bilateral space closure. **B,C.** Mesial Slider used for unilateral space closure and midline correction.



Fig. 8 Rapid maxillary expansion with hybrid Hyrax appliance, using anterior anchorage from two 2mm × 7mm Benefit mini-implants. Segmental buccal wires are added for simultaneous maxillary protraction with facemask.

Maxillary Space Closure

In patients with missing maxillary lateral incisors requiring bilateral space closure, a stainless steel wire can be bonded to the lingual surfaces of the maxillary central incisors and welded to the Benefit abutment for indirect anchorage. The main goal is to obtain appropriate overjet during space closure (Fig. 7A). Again, the prefabricated wire abutment can be used if laser welding is not possible.

In cases where unilateral mesialization is planned to correct a midline shift, direct anchorage should be used. A unilateral Mesial Slider can be fabricated (Fig. 7B), with the forces applied palatally by a 200g nickel titanium spring and buccally by an elastic chain (approximately 200g) connected to a lever arm. Because of friction, the

midline shift is corrected as the spaces are closed (Fig. 7C).

Rapid Maxillary Expansion and Maxillary Protraction

Anterior dental anchorage is often inadequate for rapid maxillary expansion because of missing deciduous teeth or premolars with undeveloped roots. In addition, if the premolars have just erupted, heavy forces may result in root damage or curvature. In these cases, we use a tooth- and bone-borne rapid maxillary expansion appliance, the hybrid Hyrax^{†4} (Fig. 8). Anterior anchorage is provided by two 2mm × 7mm Benefit mini-implants, placed about 5mm apart. The skeletal

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Fig. 9 Alignment of impacted maxillary left central and lateral incisors with anchorage from bracket abutment on 2mm × 11mm Benefit mini-implant. Additional bracket was welded to bracket abutment to allow ligation of two segmental .016" × .022" TMA wires.



Fig. 10 Uprighting and distalization of maxillary right first molar with 2mm × 11mm Benefit mini-implant and bracket abutment. A. Segmental .017" × .025" stainless steel wire, ligated to bracket abutment, acts as lever arm; power chain provides uprighting and distalizing force. B. Sufficient space gained after three months for eruption of maxillary right second premolar.

anchorage of the hybrid Hyrax appliance seems to minimize the mesial migration of maxillary teeth, especially when simultaneous maxillary protraction with a facemask is planned.

Impacted or Displaced Teeth

Full fixed appliances can sometimes be avoided if skeletal anchorage is used for alignment of impacted teeth. For eruption of impacted maxillary canines, segmental arches can be ligated to the Benefit bracket abutment after being bent into the desired shapes (Fig. 9), or can be adjusted intraorally. Displaced molars can also be uprighted and distalized using the bracket abutment (Fig. 10).

Temporary Tooth Replacement

The Benefit system can be used for temporary tooth replacement prior to placement of a dental implant. An artificial tooth is modeled over the standard Benefit abutment with composite resin, leaving the screwdriver hole open for access (Fig. 11). This procedure can simultaneously provide anchorage—for example, for extrusion of adjacent teeth. Whether it can reduce the risk of bone atrophy should be investigated in future studies.

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Fig. 11 Temporary tooth modeled around standard abutment of Benefit mini-implant with composite resin.

Discussion

The Benefit mini-implant system expands skeletal anchorage options in orthodontic treatment. Insertion and removal are minimally invasive procedures: orthodontists can place the screws themselves and load forces immediately, and the screws can be removed without anesthesia. We have observed no cases of infection after screw removal. The fixing screw is securely incorporated into the abutment, so that it cannot be lost or aspirated during placement.

The anterior palate is our preferred insertion region because of its bone quality and relatively low rates of miniscrew instability and failure. The attached mucosa has a better prognosis than other areas,¹⁵ and there is no risk of tooth damage.

The Benefit system does have several disadvantages. Some parts must be fabricated in the laboratory, which involves greater expense and a transfer process that may result in a poor intraoral fit, especially if more than one abutment is used. If an appliance with two mini-implants does not fit, one abutment can be disconnected and rebonded intraorally with a light-cured composite (such as Transbond[‡]), thereby avoiding a second laboratory procedure.

[‡]Trademark of 3M Unitek, 2724 S. Peck Road, Monrovia, CA 91016; www.3Munitek.com.

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