

Palatal TADs with Exchangeable Abutments in Orthopaedic and Orthodontic Treatment Work

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Introduction

Temporary anchorage devices (TADs) have become a common treatment modality in orthodontics within the last two decades. Still, today the alveolar process is the most preferred insertion site^{1~5)}. However, orthodontists are still confronted with an average loss rate of 16.1%, as reported in recent literature^{6~9)}. Choosing the anterior palate as insertion site loss rates could be decreased to values as low as 2.1%¹⁰⁾. Distally from the rugae, an area with sufficient bone volume and a thin soft-tissue layer can be detected (Figure 1, T-zone)¹¹⁾. A new generation of mini-implants with interchangeable abutments (Benefit system, PSM, Germany¹²⁾) was developed that allow integration into the orthodontic mechanics (Figure 2). For high demands on the anchorage quality, two mini-implants are used and coupled with a miniplate (Beneplate¹³⁾, 1.1 mm or 0.8 mm, Figure 2H). These miniplates can be adapted to the mini-implants by bending of the miniplate body as well as the wire (Figure 3).

Implant Placement and Adaption of the Mechanics

If the patient is apprehensive about use of a needle syringe, the miniscrews can be placed using only topical anaesthetic (jelly). In adult patients, a pilot drilling (2-3 mm depth) should be performed due to very high bone densities nearby the suture. In children and adolescents with relatively low bone mineralization, pilot drilling is not needed. Mini-implants with diameter of 2 mm or 2.3 mm and lengths of 9 mm (anterior) and 7 mm (posterior) are inserted, which provides a high stability (Figures 4-6)^{14~17)}.

In many cases the appliance could be adapted intraorally,

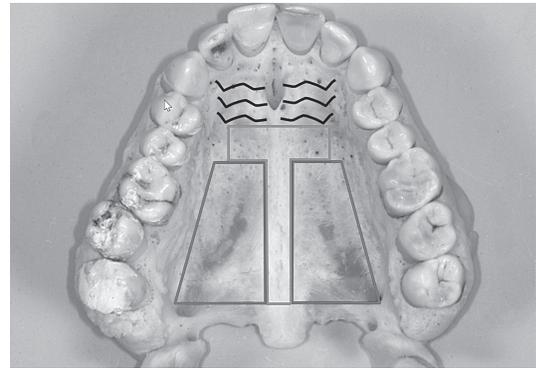


Figure 1 Picture of a maxilla of a cadaver

Recommended insertion site (T-Zone) posterior from the rugae. The bone is very thin in the posterior and lateral areas.

which, of course, implies some chair time (Figure 7 A, B). The alternative is to adapt the mechanics in the laboratory by taking a silicon impression and transferring the intraoral setup to a plaster cast using the impression cap and the laboratory analogue¹²⁾ (Figure 2 B, C).

Clinical Applications

1. Maxillary Molar Distalization (Beneslider and Pendulum B)

Due to esthetic drawbacks and the length of time to be worn, molar distalization with a headgear is unpleasant for many patients^{18,19)}. Unfortunately, most of the conventional devices for non-compliance maxillary molar distalization show some unwanted side effects, such as anchorage loss, especially, when distalization forces are applied buccally²⁰⁾. The amount of the anchorage loss of conventional intraoral devices ranges between 24 to 55%²¹⁾. To benefit from the advantages of *direct* anchorage mechanics and of the anterior

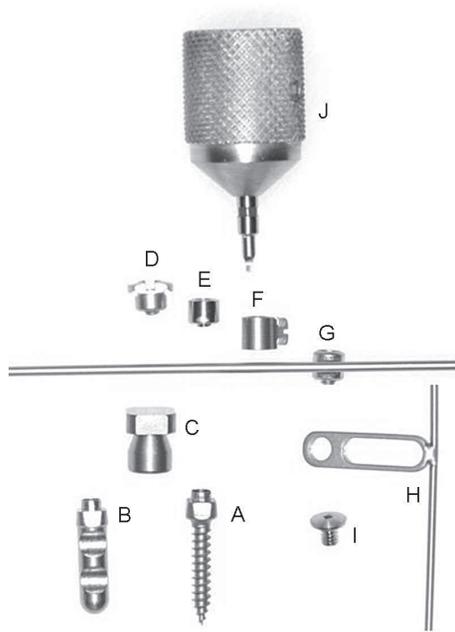


Figure 2 Benefit/Beneplate system
 A. Mini-implant. B. Laboratory analogue. C. Impression cap. D. Slot abutment. E. Standard abutment. F. Bracket abutment. G. Abutment with wire in place (0.8 or 1.1 mm). H. Beneplate with wire in place (0.8 or 1.1 mm). I. Fixation screw for Beneplate. J. Screwdriver for fixation of abutment or Beneplate on top of the mini-implant.



Figure 3 Bending of the Beneplate to fit on the mini-implants

palate as the most suitable mini-implant insertion site, the Beneslider^{5,12,13,22,23} device has been designed fixed on top of mini-implants with exchangeable abutments. The Beneslider utilizes sliding mechanics and has proved to be a reliable distalization device²³ (Figure 8). However, if frictionless mechanics is preferred and/or the molars are to be uprighted or derotated simultaneously during distalization, Pendulum



Figure 4 Manual insertion using a handpiece



Figure 5 Insertion of two mini-implants posterior from the rugae, the distance between the mini-implants should be 8-14 mm.

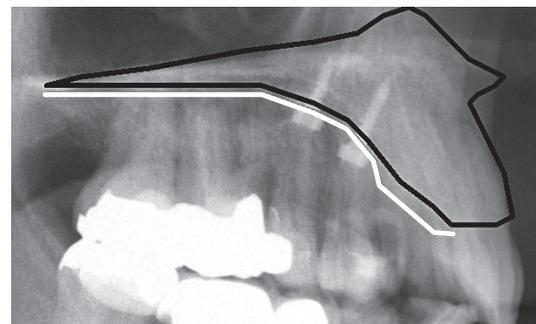


Figure 6 Angulation of the insertion is perpendicular to the bone: The soft tissue anterior is too thick.

mechanics can be employed²⁴. Several authors introduced skeletally-supported Pendulum mechanics to avoid anchorage loss^{25~28}. However, all described appliances require additional laboratory work. The Pendulum B²⁹ was designed to have the ability to adapt a skeletal borne Pendulum device chair side immediately after mini-implants insertion without a laboratory procedure (Figure 9).



Figure 7 Intraoral adaption of a Benetube for a Beneslider (A)
 Intraoral adaption of the Beneplate for the Mesialslider (B)

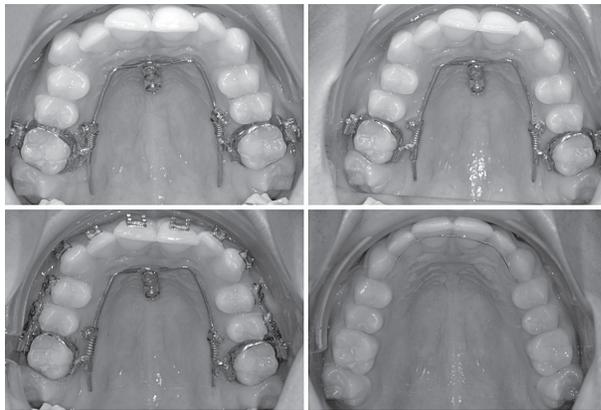


Figure 8 Clinical example
 Beneslider for upper molar distalization.

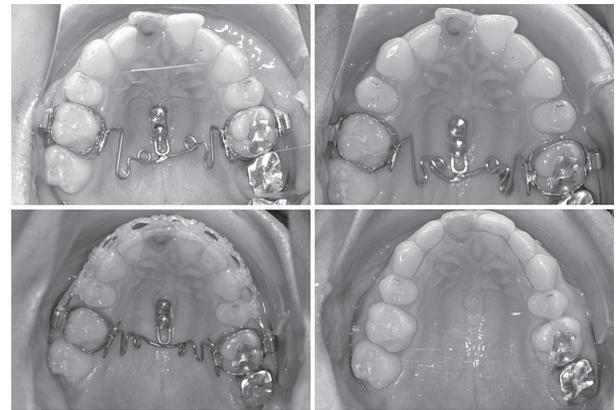


Figure 9 Clinical example
 Pendulum B for upper molar distalization.

2. Maxillary Space Closure (Mesialslider)

The two major treatment approaches are space closure or space opening to allow prosthodontic replacements either with a fixed prosthesis or single-tooth implant. In many cases, space closure to the mesial seems to be the favourable treatment goal, since treatment already can be completed as soon as the dentition is complete³⁰. As an alternative to the T-Bow (indirect anchorage) the Mesialslider^{12,13,31} as a *direct anchorage* device can be used. The Mesialslider enables clinicians to mesialize upper molars unilaterally or bilaterally. Since the incisors are not fixed, a midline deviation can be corrected at the same time. The Mesialslider can be used to close space in the upper arch from distal, e.g. for missing lateral incisors (Figure 10), canines (Figure 11), premolars (Figure 12) or molars. The Mesialslider can also be used for protrusion of the whole upper dentition to compensate a mild Class III occlusion.

3. Asymmetric molar distalization and space closure (Mesial-Distalslider)

In many cases with unilaterally missing teeth the midline is off. The favoured appliance to correct the midline, to close the space on one side and to distalize the contra lateral segment is a combination of the Mesialslider and a Beneslider, the Mesial-Distal-Slider³² (Figure 13).

4. Rapid palatal expansion (RPE) and early Class III treatment

For the treatment of patients with a Class III caused by a retrognathic maxilla, RPE is combined with a facemask for protraction of the maxilla. Since the forces are transmitted to the dentition, side-effects such as buccal tipping of the anchor teeth, fenestration of the buccal bone, root resorptions, and gingiva recessions were reported in some cases^{33,34}. To avoid these complications caused by the tooth-borne character of the conventional appliances, some authors reported about pure

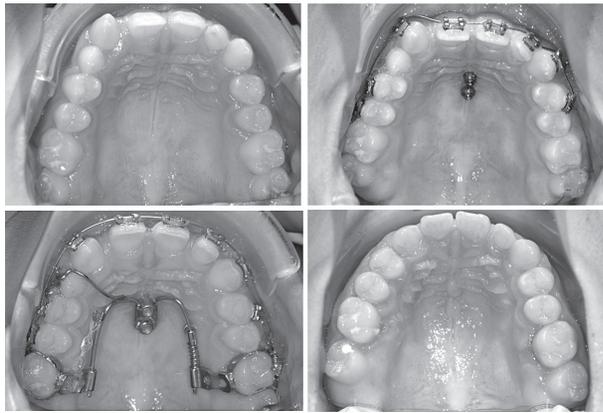


Figure 10 Clinical example with missing upper right lateral incisor
Mesialslider for unilateral upper mesialization.

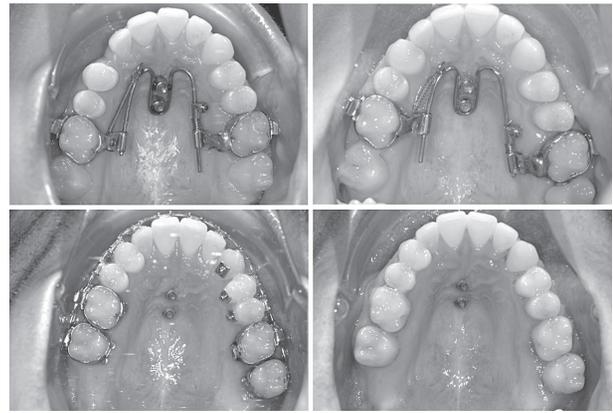


Figure 13 Clinical example with missing upper right canine and midline shift
Mesial-Distalslider for unilateral upper mesialization and contralateral distalization.

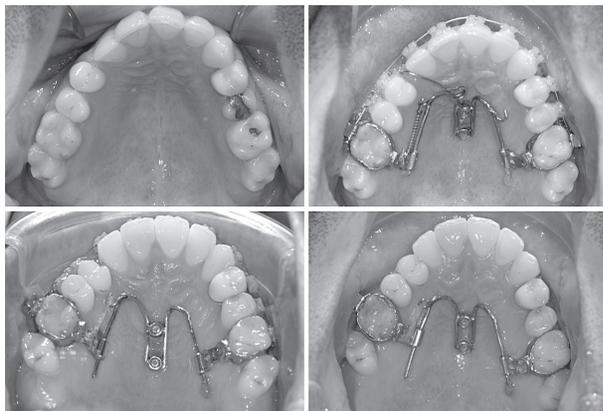


Figure 11 Clinical example with missing upper right canine
Mesialslider for unilateral upper mesialization.

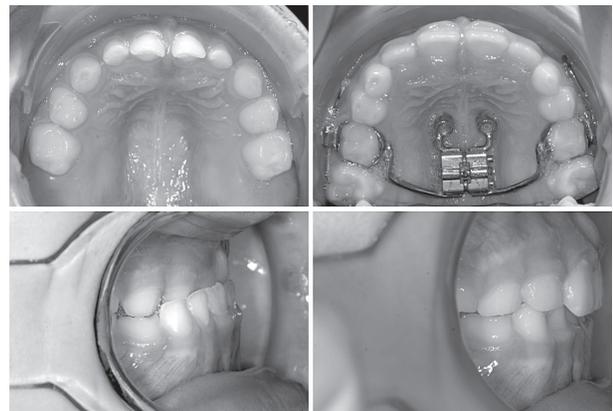


Figure 14 Hybrid Hyrax
Anterior anchorage is provided by two 2 mm × 9 mm Benefit mini-implants, placed about 5 mm apart. Before and after rapid maxillary expansion and Class III treatment using a facemask.



Figure 12 Clinical example with missing upper second bicuspid
Mesialslider for bilateral upper mesialization.

bone-borne RPE devices. Several palatal distractors have been presented over the last decade^{35,36}. However, insertion and removal of these miniplate-borne distractors are invasive surgical procedures with the need of a flap preparation, risk of root lesions and infections^{35,37}. As a consequence distractors

of this type could not establish themselves as standard devices for RPE. Due to the risk of a root lesion at insertion of implants in the lateral posterior alveolar process and lack of available bone in the posterior palate, we used the 1st molars as posterior anchorage unit. In the anterior median palate there is more bone available for mini-implants³⁸ and the resulting appliance is a half tooth-borne half bone-borne RPE-device called Hybrid Hyrax^{5,12,39~41} (Figure 14).

The application of the Hybrid Hyrax is minimally surgical invasive^{35,36}. To employ the 1st molars or 2nd deciduous molars as posterior anchorage unit and mini-implants as skeletal anterior anchorage unit provides several advantages^{39~41}:

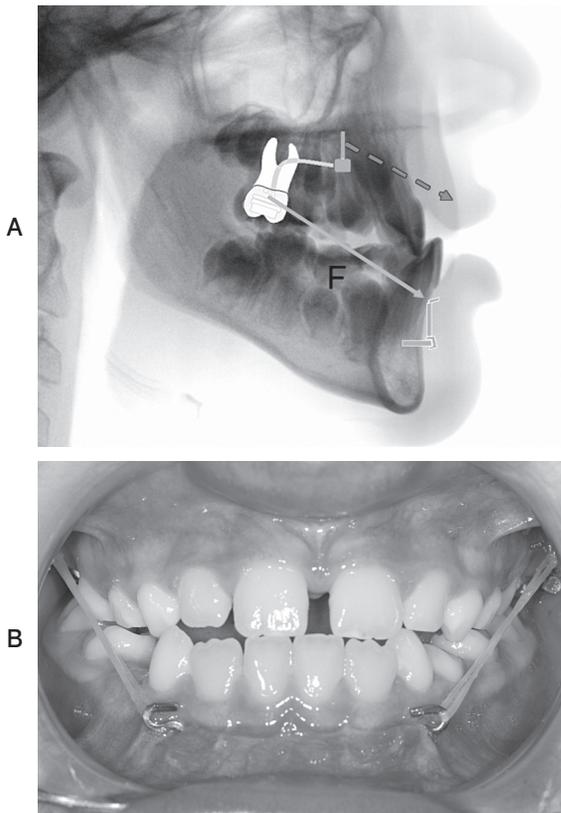


Figure 15 Skeletal borne early Class III treatment using the Hybrid Hyrax and the Mentoplate

- Applicable in cases with low anterior dental anchorage quality due to missing deciduous molars or deciduous molar with short roots.
- Applicable in cases with immature root development of the premolars.
- No risk of impairment of root development (curved roots).
- Reduction of the dental side effects, i.e. premolar tipping⁴⁰⁾.
- Anterior dentition is not bonded during the retention phase and thus regular orthodontic treatment could be started earlier.
- Advantageous in cases with need for early Class III treatment, where the RPE supports maxillary advancement by weakening the midface sutures.
- Avoidance of mesial migration of the upper dentition during application of a facemask or the Mentoplate³⁹⁾, thus enhancing the skeletal effects⁴⁰⁾.

Treatment of growing Class III patients with maxillary deficiency is mostly conducted with a facemask. Since the force is applied to the teeth, mesial migration of the dentition

is inevitable and may result in severe anterior crowding⁴²⁾. On the other hand, the desired skeletal effect of this commonly used approach often turns out to be less than expected⁴²⁾. To overcome these drawbacks and to minimize mesial migration of the molars, sagittal skeletal support by the Hybrid Hyrax is very useful. Secondly, to facilitate the advancement of the maxilla, opening of the midface sutures by rapid palatal expansion (RPE) is recommended⁴³⁾. With the goal to avoid an extraoral device (facemask) and to apply the forces directly to the skeletal structures, De Clerck introduced the use of four miniplates (two anterior in the lower jaw and two posterior in the upper jaw) in combination with Class III elastics⁴⁴⁾. This represents a new purely skeletal approach to correct the skeletal discrepancy. In order to enhance the skeletal effect by opening the midface sutures, we employ the Hybrid Hyrax appliance in the upper jaw allowing simultaneous rapid maxillary expansion and skeletally borne maxillary protraction. In the lower jaw the Bollard mini-plates by De Clerck are usually inserted after eruption of the canines. To allow earlier insertion of the mini-plate in the mandible, we developed the Mentoplate (Figure 15)³⁹⁾. Since the Mentoplate is inserted subapically to the lower incisors, it typically can be used already at the age of 8-9 years. By means of the Hybrid Hyrax in combination with a facemask or a Mentoplate forces are applied to skeletal structures only with the goal to achieve an optimum skeletal effect (Figure 15).

Conclusion

To summarize, the use of palatal TADs with abutments is expanding the options in orthodontic and orthopedic treatment significantly. Insertion and removal are minimally invasive procedures: orthodontists can place the screws by themselves and load them immediately. Usually, the screws can be removed without anaesthesia. The anterior palate is our preferred insertion region because of its superior bone quality and relatively low rates of miniscrew instability and failure. The attached mucosa has a better prognosis than other areas, and there is no risk of tooth damage. In the mandible, miniplates such as Bollard plates or the Mentoplate are recommendable for orthopedic and orthodontic purposes.

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