

Upper-Molar Intrusion Using Anterior Palatal Anchorage and the Mousetrap Appliance

BENEDICT WILMES, DDS, MSC, PHD
MANUEL NIENKEMPER, DDS, MSC
BJÖRN LUDWIG, DMD, MSD
RAVINDRA NANDA, BDS, MDS, PHD
DIETER DRESCHER, DDS, MSC, PHD

Overerupted upper molars due to missing lower antagonists are a common orthodontic problem, especially in adult patients. To facilitate prosthodontic restoration in the mandible, the overerupted molars have to be intruded, which tends to cause the adjacent teeth to extrude when conventional appliances are used. In recent years, temporary anchorage devices (TADs) have allowed orthodontists to overcome these drawbacks while avoiding unesthetic full-appliance therapy.¹⁻⁶

To avoid tipping the molars that are being intruded, either forces must be applied buccally and lingually or a transpalatal arch (TPA) may be placed. Miniplates inserted in the area of the zygomatic buttress can be employed to anchor a buccal intrusive force for upper molar intrusion,^{3,4,7-9} but their placement requires a surgical flap and full exposure of the bone. Insertion of larger mini-implants in the zygomatic buttress is a second but less advisable possibility, since coverage of the insertion site by movable mucosa increases the chances of screw failure and soft-tissue irritation.^{10,11} A third alternative is to insert two mini-implants in the alveolar process.^{1,2,5,12}

Disadvantages of miniscrew placement between the roots of the upper molars include the following:

- In many cases, there is insufficient space on the buccal side to insert a mini-implant safely between the roots, especially in the region of the upper molars.¹³⁻¹⁵ Narrower implants carry a higher risk of fracture¹⁶ and failure.^{11,17,18}
- The soft tissue is often thicker on the palatal side of the alveolar process,¹⁹ necessitating a longer

lever arm that increases the likelihood of mini-implant tipping and failure.¹⁷

- Contact between a mini-implant and a dental root may cause damage to periodontal structures and possibly lead to failure.^{20,21}
- A molar moved against a mini-implant during intrusion will cease to move, and the root surface may be damaged.^{22,23}
- When a mini-implant is inserted in the posterior area of the upper alveolar process, there is a risk of penetration of the maxillary sinus.²⁴

Considering these problems, it seems preferable to insert the mini-implants away from the roots and teeth to be moved. The anterior palate

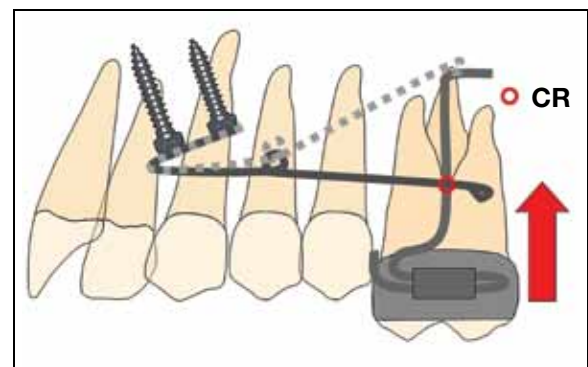


Fig. 1 Mousetrap appliance design and mechanics: one or two lever arms connect to palatal plate, anchored by two mini-implants in anterior palate. In passive state, distal ends of lever arms are located cranial to centers of resistance of molars. By pulling lever arms downward and connecting them to molars, constant intrusive force is produced.



Dr. Wilmes



Dr. Nienkemper



Dr. Ludwig



Dr. Nanda



Dr. Drescher

Dr. Wilmes is an Associate Professor, Dr. Nienkemper is an Instructor, and Dr. Drescher is Professor and Head, Department of Orthodontics, University of Düsseldorf, Moorenstrasse 5, 40225 Düsseldorf, Germany. Dr. Wilmes is also a Visiting Professor, Department of Orthodontics, University of Alabama at Birmingham School of Dentistry, and the developer of the Benefit system. Dr. Ludwig is a Contributing Editor of the *Journal of Clinical Orthodontics*; an Instructor, Department of Orthodontics, University of Homburg, Saar, Germany; and in the private practice of orthodontics in Traben-Trarbach, Germany. Dr. Nanda is an Associate Editor of the *Journal of Clinical Orthodontics*, UConn Orthodontic Alumni Endowed Chair, Division of Orthodontics, and Professor and Head, Department of Craniofacial Sciences, School of Dental Medicine, University of Connecticut, Farmington, CT. E-mail Dr. Wilmes at wilmes@med.uni-duesseldorf.de.

offers a location with high bone quality, thin soft tissues, and no risk of dental interference or root damage,¹⁹ allowing the insertion of larger mini-implants with greater stability.^{25,26}

This article describes the use of a palatally anchored appliance for upper-molar intrusion—named the “Mousetrap” because of its appearance, especially when used bilaterally (Fig. 1).

The Mousetrap Appliance

The Mousetrap is anchored in the anterior palate by two mini-implants coupled with a Beneplate*²⁷ (Fig. 2A). One or two lever arms, as

needed, extend from the Beneplate to the molar region. There are two options for the palatal lever arms: a Beneplate with an incorporated bracket can be placed, and a lever arm from an .017" × .025" wire ligated to the bracket; or a Beneplate with an incorporated .032" stainless steel wire can be placed, with the wire adapted to the curvature of the palate and bent appropriately to function as the lever arm.

In the posterior region, the intrusive force can be applied either to a stainless steel ligature

*PSM Medical Solutions, Tuttlingen, Germany; www.psm.ms. PSM North America, Inc., Indio, CA; www.psm-na.us.

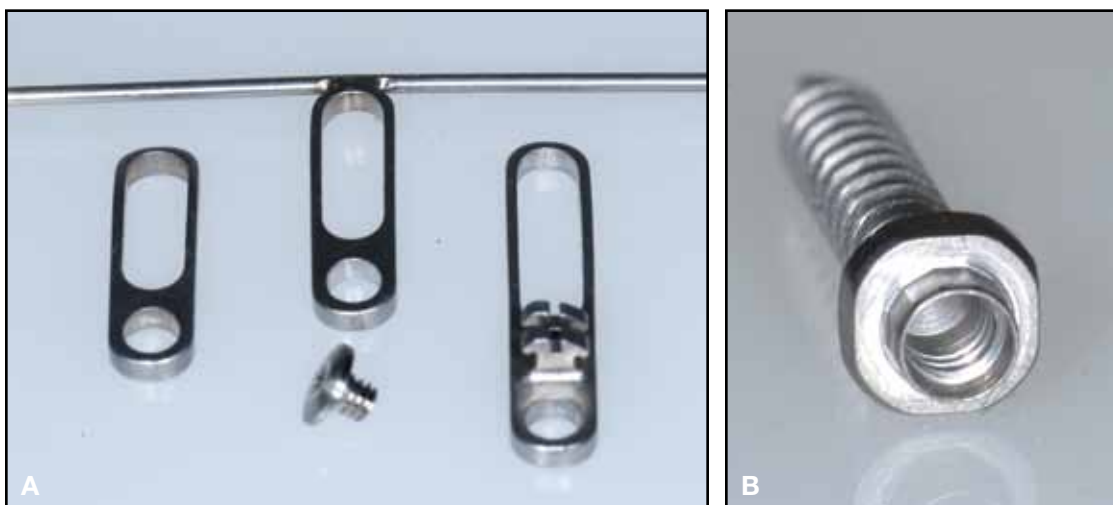


Fig. 2 A. Standard Beneplate, Beneplate with incorporated stainless steel wire (.032" or .045"), and Beneplate with incorporated bracket. B. Threaded Benefit mini-implant head.

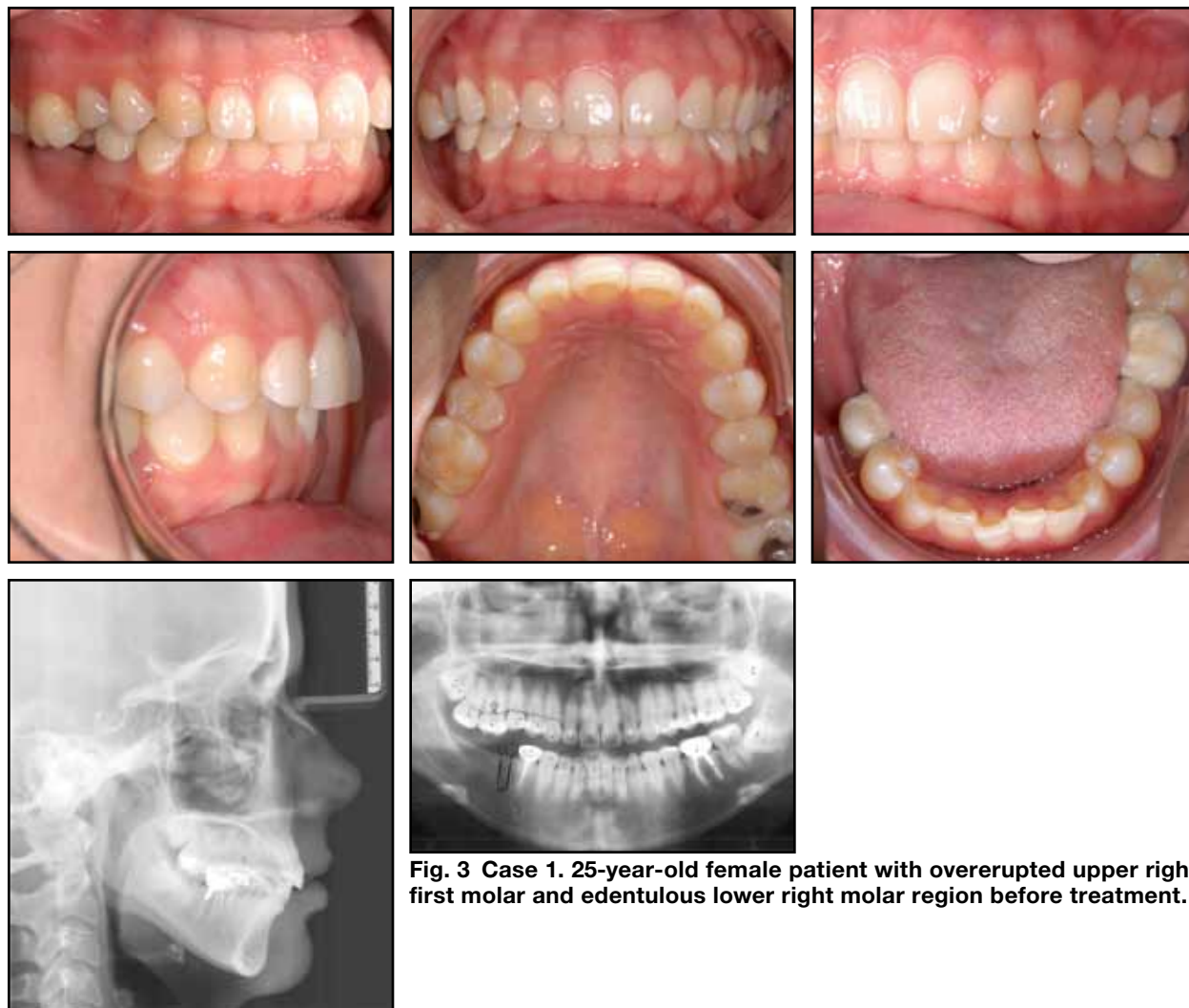


Fig. 3 Case 1. 25-year-old female patient with overerupted upper right first molar and edentulous lower right molar region before treatment.

wire tied to the molar band's lingual sheath or to a hook soldered to the TPA.

With the Mousetrap in a passive state, the distal ends of the lever arms are located cranial to the center of resistance of the molar. By pulling the lever arm downward and connecting it to the molar, a constant intrusive force is produced (Fig. 1).

Appliance Placement

After administering topical and/or local anesthesia and measuring the gingival thickness with a dental probe, predrill to a depth of about 3mm with a 1.4mm-diameter drill. Using a manual contra-angle or a motorized unit, insert two

Benefit* mini-implants (2mm × 11mm anterior, 2mm × 9mm posterior), oriented perpendicular to the palatal curvature (Fig. 1). The Benefit mini-implant head has an inner screw thread (Fig. 2B) for fixation of various abutments.²⁸

Since large tipping moments are produced by the Mousetrap mechanics, we recommend placing the mini-implants along the line of force. If the mini-implants are not inserted perfectly in parallel, the Beneplate body can easily be adapted with a three-prong plier. Activation applies a palatal intrusive force of approximately 100g to the molar,

*PSM Medical Solutions, Tuttlingen, Germany; www.psm.ms. PSM North America, Inc., Indio, CA; www.psm-na.us.



Fig. 4 Case 1. Mousetrap appliance in place, with .017" x .025" lever arm bent and tied to Beneplate bracket.



Fig. 5 Case 1. Patient after six months of treatment (TPA remained passive, with loop adjusted only to move wire away from palatal mucosa).

but a passive TPA will prevent palatal tipping. We have found that 100g of force is sufficient for single-molar intrusion, although open-bite cases involving intrusion of multiple teeth will require greater force.

Case 1

A 25-year-old female was referred by her general dentist for intrusion of an overerupted upper right first molar, in preparation for placement of a dental implant in the edentulous lower right molar region (Fig. 3). The upper right second and third molars and the upper and lower left third molars were scheduled for extraction. The patient

declined additional treatment for her crowded lower incisors.

Two mini-implants were inserted in the anterior palate for attachment of the Beneplate with an incorporated bracket, and upper first-molar bands and a passive TPA were placed. An .017" x .025" lever arm was bent and tightly ligated to the bracket, and the bracket was coated with resin for patient comfort. A molar-intrusive force of about 100g was activated (Fig. 4).

Six months later, the molar had been intruded to the proper level (Fig. 5). A dental implant was inserted in the lower arch during orthodontic treatment, so that the patient was ready for prosthodontic restoration.

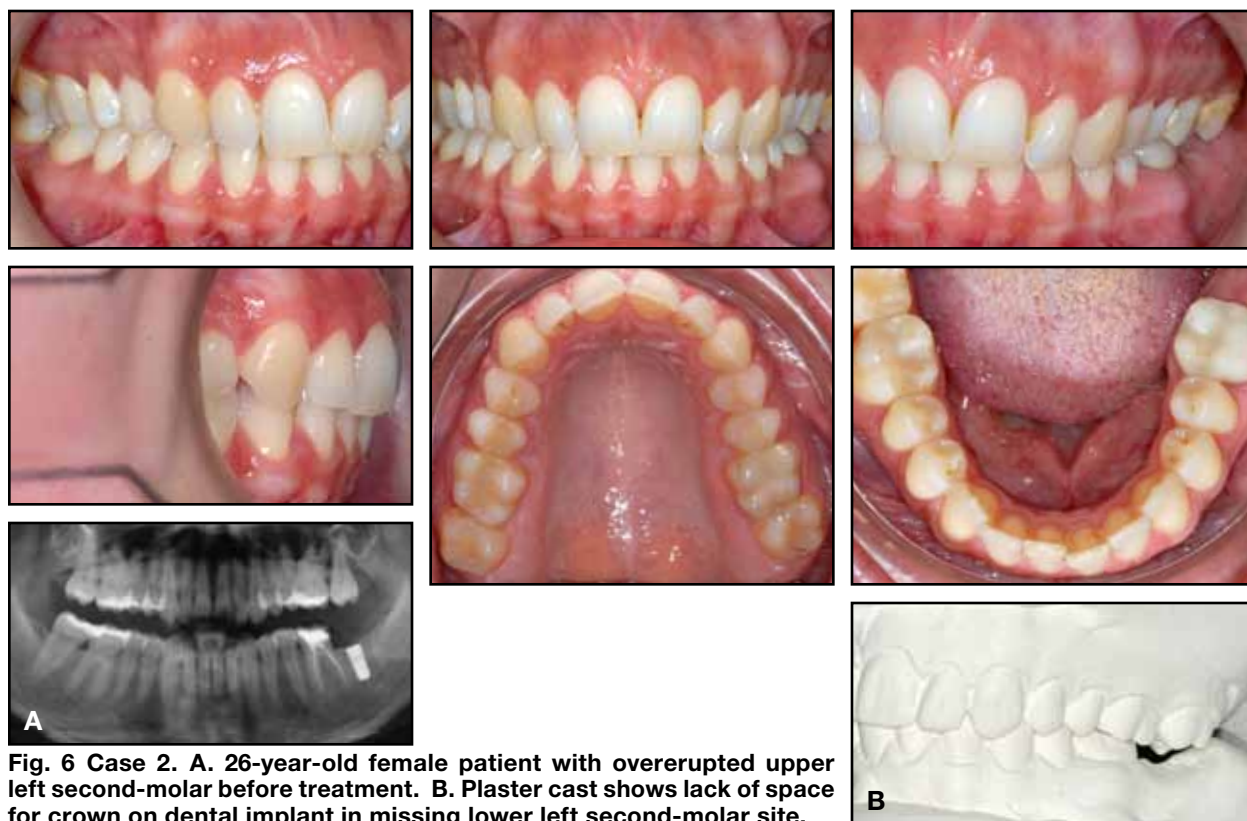


Fig. 6 Case 2. A. 26-year-old female patient with overerupted upper left second-molar before treatment. **B.** Plaster cast shows lack of space for crown on dental implant in missing lower left second-molar site.

Case 2

A 26-year-old female patient was referred by her general dentist for intrusion of an overerupted upper left second molar. A dental implant had already been placed in the missing lower left second-molar site, but there was inadequate space for placement of a molar crown (Fig. 6). The patient declined treatment for her Class II malocclusion.

Two mini-implants were inserted in the anterior palate, and molar bands were placed on the upper right first molar and upper left second molar. A Beneplate with an incorporated .032" stainless steel wire was adapted to the palate and affixed to the mini-implants. A TPA was placed, with a small hook soldered near the left second molar for attachment of the lever arm, and an intrusive force of about 100g was activated (Fig. 7).

After five months, the second molar had been intruded by about 2mm (Fig. 8). The dentist asked for slightly more intrusion; two months later, the



Fig. 7 Case 2. Mousetrap appliance in place, with Beneplate's .032" stainless steel wire bent and fixed to hook soldered to TPA.

tooth was overcorrected, and a prosthodontic crown was placed on the dental implant (Fig. 9). At a follow-up appointment four months later, spontaneous relapse of the overcorrection had resulted in proper contact with the lower molar crown (Fig. 10).



Fig. 8 Case 2. Molar intruded about 2mm after five months of treatment.



Fig. 9 Case 2. After two more months, upper left second molar intruded with noticeable overcorrection; restoration placed on dental implant.



Fig. 10 Case 2. Follow-up records four months after end of treatment, showing spontaneous relapse of overintrusion.

Conclusion

The Mousetrapp is a reliable device for intrusion of overerupted molars. Although its design may appear to be somewhat complex and bulky compared to other TAD-based appliances, it pro-

vides a constant force delivery that is easy to measure and adjust intraorally. Its anchorage in the anterior palate ensures a low risk of failure or screw fracture.

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REFERENCES

1. Kravitz, N.D.; Kusnoto, B.; Tsay, P.T.; and Hohlt, W.F.: Intrusion of overerupted upper first molar using two orthodontic miniscrews: A case report, *Angle Orthod.* 77:915-922, 2007.
2. Kravitz, N.D.; Kusnoto, B.; Tsay, T.P.; and Hohlt, W.F.: The use of temporary anchorage devices for molar intrusion, *J. Am. Dent. Assoc.* 138:56-64, 2007.
3. Yao, C.C.; Lee, J.J.; Chen, H.Y.; Chang, Z.C.; Chang, H.F.; and Chen, Y.J.: Maxillary molar intrusion with fixed appliances and mini-implant anchorage studied in three dimensions, *Angle Orthod.* 75:754-760, 2005.
4. Sherwood, K.H.; Burch, J.G.; and Thompson, W.J.: Closing anterior open bites by intruding molars with titanium miniplate anchorage, *Am. J. Orthod.* 122:593-600, 2002.
5. Lin, J.C.; Liou, E.J.; and Yeh, C.L.: Intrusion of overerupted maxillary molars with miniscrew anchorage, *J. Clin. Orthod.* 40:378-383, 2006.
6. Wilmes, B.: Fields of application of mini-implants, in *Mini-Implants in Orthodontics: Innovative Anchorage Concepts*, ed. B. Ludwig, S. Baumgaertel, and S.J. Bowman, Quintessenz, Berlin, 2008, pp. 91-122.
7. Erverdi, N.; Keles, A.; and Nanda, R.: The use of skeletal anchorage in open bite treatment: A cephalometric evaluation, *Angle Orthod.* 74:381-390, 2004.
8. Umemori, M.; Sugawara, J.; Mitani, H.; Nagasaka, H.; and Kawamura, H.: Skeletal anchorage system for open-bite correction, *Am. J. Orthod.* 115:166-174, 1999.
9. Moon, C.H.; Wee, J.U.; and Lee, H.S.: Intrusion of overerupted molars by corticotomy and orthodontic skeletal anchorage, *Angle Orthod.* 77:1119-1125, 2007.
10. Cheng, S.J.; Tseng, I.Y.; Lee, J.J.; and Kok, S.H.: A prospective study of the risk factors associated with failure of mini-implants used for orthodontic anchorage, *Int. J. Oral Maxillofac. Impl.* 19:100-106, 2004.
11. Tsaousidis, G. and Bauss, O.: Influence of insertion site on the failure rates of orthodontic miniscrews, *J. Orofac. Orthop.* 69:349-356, 2008.
12. Lee, M. and Shuman, J.: Maxillary molar intrusion with a single miniscrew and a transpalatal arch, *J. Clin. Orthod.* 46:48-51, 2012.
13. Ludwig, B.; Glasl, B.; Kinzinger, G.S.; Lietz, T.; and Lisson, J.A.: Anatomical guidelines for miniscrew insertion: Vestibular interradicular sites, *J. Clin. Orthod.* 45:165-173, 2011.
14. Poggio, P.M.; Incorvati, C.; Velo, S.; and Carano, A.: "Safe zones": A guide for miniscrew positioning in the maxillary and mandibular arch, *Angle Orthod.* 76:191-197, 2006.
15. Kim, S.H.; Yoon, H.G.; Choi, Y.S.; Hwang, E.H.; Kook, Y.A.; and Nelson, G.: Evaluation of interdental space of the maxillary posterior area for orthodontic mini-implants with cone-beam computed tomography, *Am. J. Orthod.* 135:635-641, 2009.
16. Wilmes, B.; Panayotidis, A.; and Drescher, D.: Fracture resistance of orthodontic mini-implants: A biomechanical in vitro study, *Eur. J. Orthod.* 33:396-401, 2011.
17. Wiechmann, D.; Meyer, U.; and Büchter, A.: Success rate of mini- and micro-implants used for orthodontic anchorage: A prospective clinical study, *Clin. Oral Impl. Res.* 18:263-267, 2007.
18. Fritz, U.; Ehmer, A.; and Diedrich, P.: Clinical suitability of titanium microscrews for orthodontic anchorage—preliminary experiences, *J. Orofac. Orthop.* 65:410-418, 2004.
19. Ludwig, B.; Glasl, B.; Bowman, S.J.; Wilmes, B.; Kinzinger, G.S.; and Lisson, J.A.: Anatomical guidelines for miniscrew insertion: Palatal sites, *J. Clin. Orthod.* 45:433-441, 2011.
20. Miyawaki, S.; Koyama, I.; Inoue, M.; Mishima, K.; Sugahara, T.; and Takano-Yamamoto, T.: Factors associated with the stability of titanium screws placed in the posterior region for orthodontic anchorage, *Am. J. Orthod.* 124:373-378, 2003.
21. Chen, Y.H.; Chang, H.H.; Chen, Y.J.; Lee, D.; Chiang, H.H.; and Yao, C.C.: Root contact during insertion of miniscrews for orthodontic anchorage increases the failure rate: An animal study, *Clin. Oral Impl. Res.* 19:99-106, 2008.
22. Kadioglu, O.; Buyukyilmaz, T.; Zachrisson, B.U.; and Maino, B.G.: Contact damage to root surfaces of premolars touching miniscrews during orthodontic treatment, *Am. J. Orthod.* 134:353-360, 2008.
23. Maino, B.G.; Weiland, F.; Attanasi, A.; Zachrisson, B.U.; and Buyukyilmaz, T.: Root damage and repair after contact with miniscrews, *J. Clin. Orthod.* 41:762-766, 2007.
24. Gracco, A.; Tracey, S.; and Baciliero, U.: Miniscrew insertion and the maxillary sinus: An endoscopic evaluation, *J. Clin. Orthod.* 44:439-443, 2010.
25. Wilmes, B.; Ottenstreuer, S.; Su, Y.Y.; and Drescher, D.: Impact of implant design on primary stability of orthodontic mini-implants, *J. Orofac. Orthop.* 69:42-50, 2008.
26. Wilmes, B. and Drescher, D.: Impact of bone quality, implant type, and implantation site preparation on insertion torques of mini-implants used for orthodontic anchorage, *Int. J. Oral Maxillofac. Surg.* 40:697-703, 2011.
27. Wilmes, B.; Drescher, D.; and Nienkemper, M.: A miniplate system for improved stability of skeletal anchorage, *J. Clin. Orthod.* 43:494-501, 2009.
28. Wilmes, B. and Drescher, D.: A miniscrew system with interchangeable abutments, *J. Clin. Orthod.* 42:574-580, 2008.