# CASE REPORT

## Multipurpose Use of a Single Mini-Implant for Anchorage in an Adult Patient

MORTEN GODTFREDSEN LAURSEN, DDS
BIRTE MELSEN, DDS, DO

Many adults with extracted posterior teeth do not attach a high priority to prosthetic reconstruction. Failure to replace a missing tooth, however, can lead to changes in occlusal function and migration of adjacent teeth toward the extraction space. The result may be the development of a malocclusion or exacerbation of an existing deviation, necessitating bite rehabilitation. At this stage, optimal reconstruction using either implants or bridges may require preprosthetic orthodontic treatment.

In young patients, growth tends to neutralize vertical development, facilitating orthodontic anchorage. In adult patients with several missing teeth, however, an imbalance between the active and reactive tooth units can result in loss of anchorage, making it impossible to achieve the desired tooth movements. The use of skeletal anchorage with temporary anchorage devices (TADs) can help solve this problem, allowing optimal prosthodontic reconstruction.[1-7]

Careful biomechanical planning is needed to determine how, when, and where the skeletal anchorage should be incorporated into orthodontic treatment.[8] Anchorage problems should not be addressed simply by increasing the number of miniscrews, nor should TADs be used as a crutch to compensate for problems due to poor planning.[8-10] Rather, a strategy should be developed for attaining treatment goals using as few miniscrews as possible, thus minimizing risks, treatment time, and costs while maximizing patient comfort.

This article describes the efficient use of a single mini-implant for several purposes during preprosthetic orthodontic treatment of an adult patient with numerous missing teeth.

Dr. Godtfredsen Laursen is a Clinical Assistant Professor and Dr. Melsen is Professor and Head, Department of Orthodontics, School of Dentistry, Aarhus University, Vennelyst Boulevard 9, DK-8000 Aarhus C, Denmark. Dr. Melsen is also an Associate Editor of the *Journal of Clinical Orthodontics* and the developer of the Aarhus Anchorage System. E-mail Dr. Godtfredsen Laursen at mortengl@yahoo.com.

Dr. Laursen

Dr. Melsen

### Diagnosis and Treatment Planning

A 47-year-old female was referred by her general dentist for correction of an unfavorable position of the maxillary left second premolar and second molar before prosthetic reconstruction (Fig. 1). The patient wanted reconstruction for improved function and esthetics, as well as space closure and straightening of the anterior teeth.

Some 35 years earlier, both maxillary first premolars had been extracted in association with orthodontic treatment for crowding and excessive overjet. According to the patient, the treatment was interrupted and never completed. The mandibular second molars had been extracted due to caries. The previous extractions and a tooth-size discrepancy between the upper and lower premolars had left spaces distal to both maxillary canines, with the space on the left side measuring 4.5mm. Moreover, endodontic problems had resulted in loss of the maxillary left first molar, leaving 8mm of space between the left premolar and second molar. Therefore, the area of occlusal support on the left side consisted of only the canine, the premolar, and the marginal

**Fig. 1 47-year-old female patient with overjet, anterior spacing, and loss of posterior occlusal support due to numerous missing teeth.**

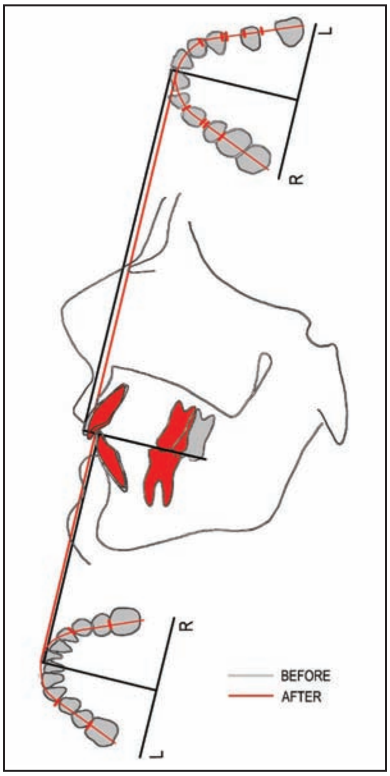


**Fig. 2 Visualized Treatment Objective showing projected movement of maxillary left second molar into neutral position of extracted first molar and planned positions of canines and remaining first molars.**

ridge of the extruded second molar. All four third molars were also missing. The maxillary dental midline was deviated to the left, and the mandibular anterior segment was crowded.

The primary goal of orthodontic treatment was to position the maxillary left premolar and molar for prosthetic reconstruction with one premolar implant behind the maxillary left canine. The patient would then have full occlusion on two pairs of premolars and one pair of molars on the left side. This plan involved mesial movement of the extruded maxillary left second molar into the neutral position of the extracted first molar, requiring extradental anchorage (Fig. 2). The tooth would be intruded, and space would be created for the implant in the left first premolar region through distal movement of the second premolar. The distal relation of the maxillary and mandibular right first molars and the neutral canine relations would be maintained. Minor spaces would be left distal to both maxillary canines because of the tooth-size discrepancy. The smile would be improved through closure of the anterior diastema, leveling and alignment, and coordination of the dental midlines.

The treatment plan was divided into four phases. Phase I would consist of mesial movement, intrusion, and uprighting of the maxillary left second molar, using a TAD in the maxillary left first premolar region; "hinge mechanics"[11] to guide the maxillary left second molar, with Triad* acrylic gel used to raise the bite

*Registered trademark of Dentsply Caulk, 38 W. Clarke Ave., P.O. Box 359, Milford, DE 19963; www.caulk.com.

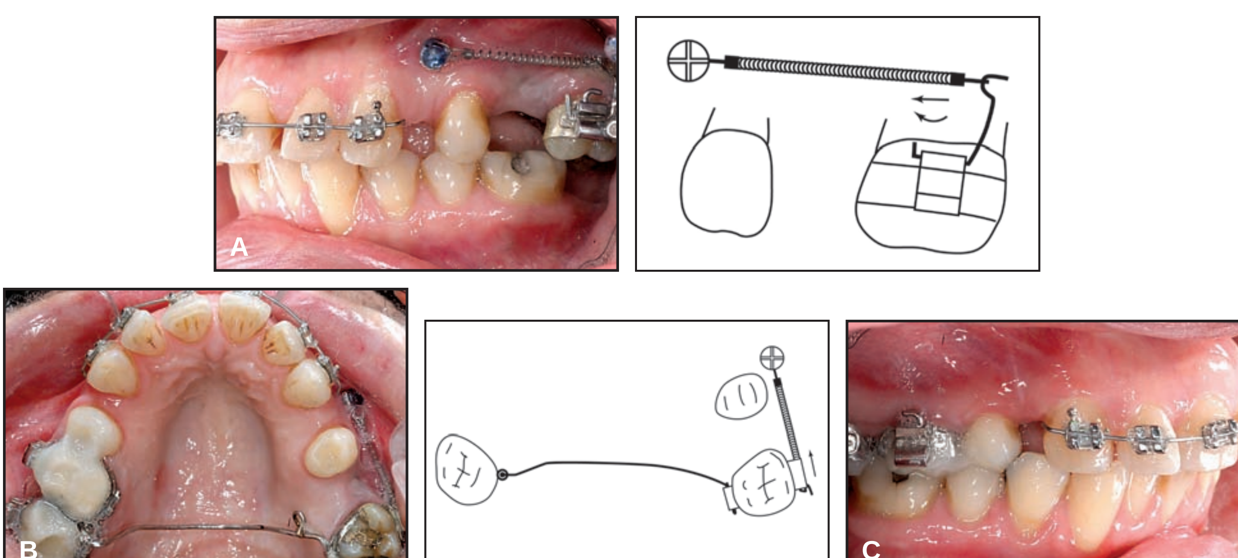


**Fig. 3 A. Mini-implant inserted as direct anchorage for mesial movement of maxillary left second molar. B. Transpalatal arch with vertical hinge on lingual of maxillary right second molar used to guide left second molar into planned position. C. Triad* acrylic gel used for temporary bite opening and reinforcement of occlusal anchorage.**

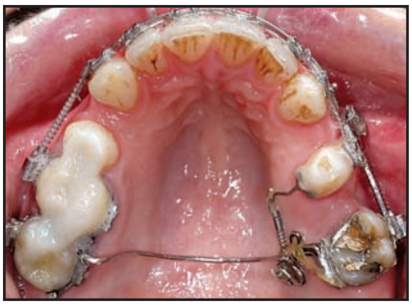

**Fig. 4 Mini-implant used as direct anchorage for mesial movement and indirect anchorage for intrusion of maxillary left second molar.**

and disocclude the tooth; and closure of the anterior diastema. Phase II would involve distal movement of the maxillary left second premolar by reciprocal anchorage between it and the second molar. Phase III would comprise arch coordination and finishing. Phase IV, the retention phase, would include bonding of fixed retainers in the maxillary arch from canine to canine and left second premolar to left second molar and in the mandibular arch from right canine to first premolar; a maxillary splint would also be delivered.

## Treatment Progress

An Aarhus Anchorage System** mini-implant (1.5mm in diameter, 11.6mm long) was inserted between the maxillary left canine and premolar to serve as direct anchorage for the mesial displacement of the extruded left second molar, with a Sentalloy*** closed-coil spring attached between the screw and a power arm on the second molar (Fig. 3A). The rotation of the second molar was controlled by hinge mechanics from a transpalatal bar inserted in the horizontal palatal slot of the second molar, with its center of rotation located in a contralateral palatal vertical cylinder on the right second molar (Fig. 3B). Triad was applied to the maxillary right second molar, right first molar, right second premolar, and left second premolar to reinforce the anchorage unit on the right side and to raise the bite slightly, allowing mesial movement of the left second molar (Fig. 3C).

When a primary contact at the left second molar prevented further mesial displacement, an intrusive force was added by means of an .018" × .025" stainless steel segment connecting the premolar bracket to the mini-implant and extending to a one-point contact on the buccal tube of the left second molar (Fig. 4). On the palatal side, a power arm was bonded to the left second premolar and attached to a soldered hook on the hinge with a Sentalloy closed-coil spring to help guide the left second molar mesially. The left second premolar was indirectly anchored to the mini-implant through a step bend in the buccal stainless steel segment.

Instead of undergoing the desired pure translation, however, the left second molar tipped mesially. This tipping was caused by the deep extension of the maxillary sinus into the alveolar process mesial to the second molar; the mini-implant could not be placed in a more apical position because of interference from the buccal ligaments and the power arm on the left second molar. Because of the slight play in both its vertical and horizontal insertions, the hinge could not prevent the tipping.

At this point, the mini-implant took on its third role. A cantilever uprighting spring made of .017" × .025" TMA† wire was inserted in the auxiliary tube of the molar band, activated for mesial root movement of the left second molar, and hooked onto the existing .018" × .025" stainless steel segment, which was anchored to the mini-implant (Fig. 5A). This stainless steel seg-

**MEDICON eG, Tuttlingen, Germany; www.medicon.de. Distributed by American Orthodontics, 1714 Cambridge Ave., Sheboygan, WI 53082; www.americanortho.com.

***Registered trademark of GAC International, Inc., 355 Knickerbocker Ave., Bohemia, NY 11716; www.gacintl.com.

†Registered trademark of Ormco/"A" Company, 1717 W. Collins Ave., Orange, CA 92867; www.ormco.com.

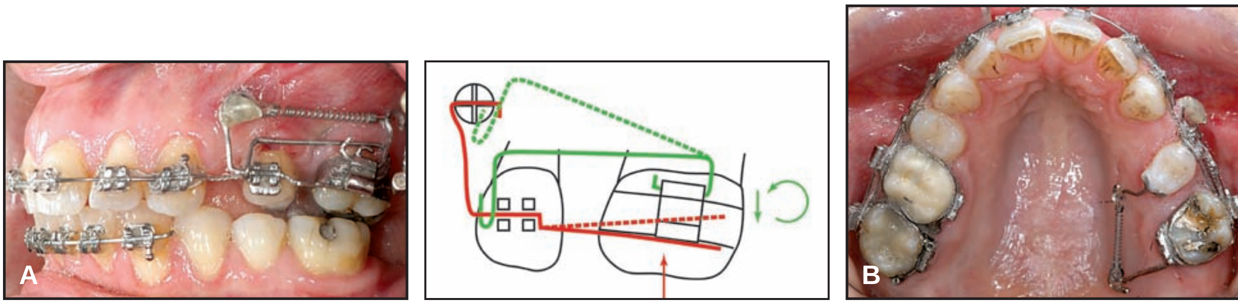


**Fig. 5 A. Simultaneous mesial movement, intrusion, and uprighting of maxillary left second molar. Uprighting spring is attached to indirect anchorage segment, which also counteracts extrusive force on left second molar generated by uprighting moment. B. Transpalatal arch removed, and power arm added to molar for mesial movement and rotational control.**

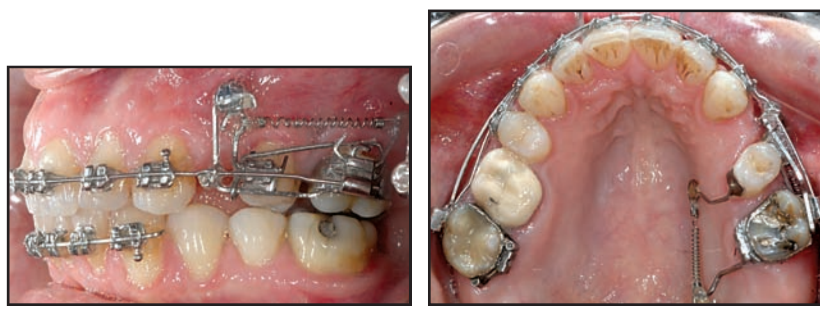

**Fig. 6 Final closure of space between left second premolar and second molar with reciprocal anchorage and continued uprighting against indirect anchorage segment, modified to bypass premolar.**

ment counteracted the vertical side effects of molar extrusion and premolar intrusion that were generated by the uprighting spring. The palatal hinge was removed to allow for the uprighting. In its place, power arms attached to the left second premolar and second molar were connected by a Sentalloy closed-coil spring for mesial movement and rotational control of the left second molar (Fig. 5B). The step bend in the buccal .018" × .025" stainless steel segment prevented distal movement of the left second premolar.

During the finishing phase, the left second premolar was moved distally with reciprocal anchorage against the left second molar, using Sentalloy closed-coil springs attached to power arms on the two teeth both buccally and lingually (Fig. 6). The .018" × .025" stainless steel segment was modified, bypassing the left second premolar to allow for the distal movement.

After 20 months of treatment, the orthodontic aims had been achieved. The mini-implant was removed, and a Brånemark implant‡ was placed in the left first premolar region during the finishing phase, three months before debonding. Six months later, the implant crown was cemented. In addition to bonded upper and lower lingual retainers, a fixed labial retainer wire was placed between the maxillary left second premolar and left second molar to prevent space reopening. A 2mm removable acrylic splint was also delivered, to be worn full-time for the first three months and at night only for the following 24 months.

The final post-treatment radiographic records clearly show the molar displacement, because amalgam had been left in the extraction space to serve as a reference (Fig. 7). Small spaces remained distal to the maxillary canines because of the tooth-size discrepancy between the upper and lower premolars. The total treatment time was 23 months, including 15 months of mesial movement, intrusion, and uprighting of the left second molar. After debonding, excess gingival tissue mesial to the left second molar was excised, and the amalgam

‡Registered trademark of Nobel Biocare, P.O. Box CH-8058, Zürich-Flughafen, Switzerland; www.nobelbiocare.com.

**Fig. 7 Significantly improved smile esthetics and occlusal support after 23 months of orthodontic treatment and placement of prosthodontic implant in left first premolar region.**

molar filling was replaced to achieve optimal morphology and occlusion.

## Discussion

A mini-implant with a bracket-like head, as used in this patient, can provide both direct and indirect anchorage. The required movement of the maxillary left second molar could not be achieved with a single force acting directly on the mini-implant. First, the screw was used as direct anchorage, assisted by a palatal hinge to guide the left second molar. Later, the connection of the mini-implant to the premolar provided indirect anchorage for an intrusive force on the buccal side of the molar and a mesially directed force on the lingual aspect. Finally, the wire connecting the premolar to the mini-implant was used as anchorage for an uprighting spring, while its extension served to neutralize the extrusive force generated by the spring.

The case shown here demonstrates that a single skeletal anchorage unit can generate a variety of different force systems. Achieving the desired treatment goals, however, requires precise definition of the forces required. Thus, the use of skeletal anchorage actually increases, rather than reduces, the need for careful biomechanical planning.

ACKNOWLEDGMENTS: Emanuele Basciu, dental technician, performed the implant crown laboratory work. Drs. Elisa Velling and Eline Øland Andreasen performed the dental implant reconstruction. Dr. Nina Agerbæk performed the mucogingival surgery.

**REFERENCES**

1. Leung, M.T.; Lee, T.C.; Rabie, A.B.; and Wong, R.W.: Use of miniscrews and miniplates in orthodontics, J. Oral Maxillofac. Surg. 66:1461-1466, 2008.
2. Melsen, B.: Mini-implants: Where are we? J. Clin. Orthod. 39:539-547, 2005.
3. Wehrbein, H. and Göllner, P.: Skeletal anchorage in orthodontics: Basics and clinical application, J. Orofac. Orthop. 68:443-461, 2007.
4. Diedrich, P.: Preprosthetic orthodontics, J. Orofac. Orthop. 57:102-116, 1996.
5. Janssen, K.I.; Raghoebar, G.M.; Vissink, A.; and Sandham, A.: Skeletal anchorage in orthodontics: A review of various systems in animal and human studies, Int. J. Oral Maxillofac. Implants 23:75-88, 2008.
6. Kokich, V.G.: Esthetics: The orthodontic-periodontic restorative connection, Semin. Orthod. 2:21-30, 1996.
7. Papadopoulos, M.A. and Tarawneh, F.: The use of miniscrew implants for temporary skeletal anchorage in orthodontics: A comprehensive review, Oral Surg. Oral Med. Oral Pathol. Oral Radiol. Endod. 103:e6-e15, 2007.
8. Melsen, B.: The Aarhus Anchorage System, in *OrthoTADS: The Clinical Guide and Atlas*, ed. J.B. Cope, Under Dog Media, Dallas, TX, 2006, pp. 179-190.
9. Melsen, B.: Is the intraoral-extradental anchorage changing the spectrum of orthodontics? in *Implants, Microimplants, Onplants and Transplants: New Answers to Old Questions in Orthodontics*, ed. J.A. McNamara, Jr., Center for Human Growth and Development, University of Michigan, Ann Arbor, 2005, pp. 41-68.
10. Melsen, B. and Verna, C.: Miniscrew implants: The Aarhus Anchorage System, Semin. Orthod. 11:24-31, 2005.
11. Fontenelle, A.: Lingual orthodontics in adults, in *Current Controversies in Orthodontics*, ed. B. Melsen, Quintessence, Chicago, 1991, pp. 219-268.