Management of Partially Impacted Mandibular Molars Using Temporary Anchorage Devices

BRUNO DI LEONARDO, DDS, MS
RICCARDO RIATTI, DDS, MS
FABIO GIUNTOLI, DDS, MS
NICOLA DERTON, DDS, MS
ROSSANO MURA, DDS
GIUSEPPE PERINETTI, DDS, MS, PhD
LUCA CONTARDO, DDS, MS

Partially impacted mandibular second permanent molars are a common clinical condition, with an incidence of .06-.3%.[1] A number of uprighting techniques have been described, ranging from simple leveling archwires and open-coil springs[2,3] to more complex uprighting springs.[4,5]

Drs. Di Leonardo, Riatti, Giuntoli, and Derton are Clinical Instructors, Dr. Contardo is an Associate Professor, and Dr. Perinetti is a Research Fellow; Orthodontic Postgraduate Program; Department of Medical, Surgical and Health Sciences; University of Trieste; strada di Fiume 447, Trieste, 34100 Italy. Dr. Di Leonardo is also in the private practice of orthodontics in Arco, Italy; Dr. Riatti is in private practice in Reggio Emilia, Italy; Dr. Giuntoli is in private practice in Montecatini Terme, Italy; Dr. Derton is in private practice in Conegliano, Italy; and Dr. Mura is in private practice in Arco. E-mail Dr. Contardo at l.contardo@fmc.units.it.

Temporary anchorage devices (TADs) have simplified the handling of such difficult cases, minimizing adverse effects such as extrusion of the uprighted molar, intrusion of the anterior segment, and protraction of the teeth mesial to the tipped molar. Recent articles have proposed using miniscrew anchorage for correction of mesially tipped mandibular molars.[6-8] This case series demonstrates the versatility and usefulness of TADs in uprighting impacted molars using various biomechanical systems.

Case 1

A 16-year-old female, who had already undergone orthodontic treatment, presented with a partially impacted lower right second molar. Endodontic treatment of the first molar was needed initially because of a periapical lesion.

A tube was bonded to the buccal surface of the impacted second molar, and an 8mm-long self-drilling, self-tapping miniscrew* was placed buccally between the lower right first molar and

*OrthoEasy, registered trademark of Forestadent GmbH, Pforzheim, Germany; www.forestadent.com.

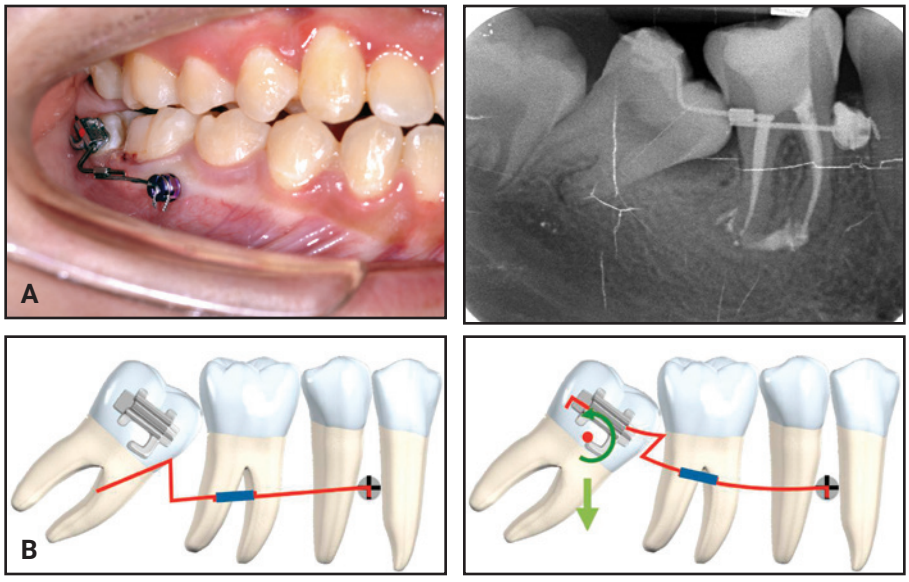

Fig. 1 Case 1. A. 16-year-old female patient with partially impacted lower right second molar. B. Biomechanical scheme, with .018" × 022" Memory Titanol cantilever attached between molar tube and buccal miniscrew.***

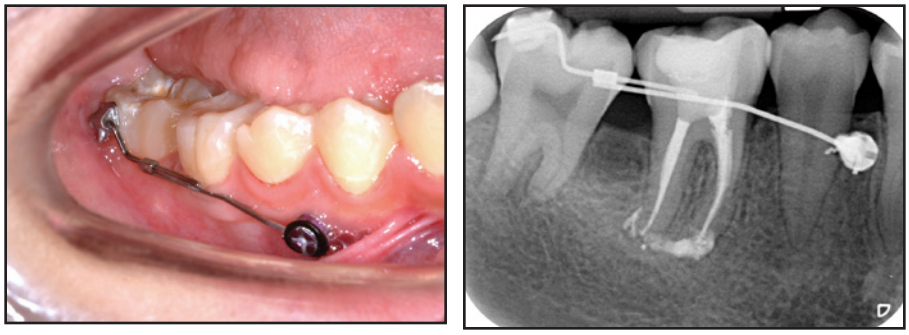

Fig. 2 Case 1. New miniscrew inserted after one month of treatment.

Fig. 3 Case 1. After five months of treatment (complete treatment required seven months).

second premolar (Fig. 1). An .018" × .022" superelastic Memory Titanol** cantilever, preactivated for both uprighting and intrusion, was attached between the miniscrew and the molar tube. After one month of loading, the miniscrew failed due to an incorrect angle of insertion, and a new one was placed between the lower right first and second premolars (Fig. 2). The cantilever was reactivated at each appointment for seven months, until complete uprighting of the second molar had been achieved (Fig. 3).

This biomechanical scheme can be used as long as a sufficient amount of crown is exposed to bond a molar tube to the impacted tooth.

Case 2

A 12-year-old male presented with an impacted lower left second molar. The technique employed in Case 1 could not be used in this patient because he had hypertrophic soft tissue and insufficient crown exposure of the tipped tooth.

Our alternative was to bond brackets to the lower left first and second premolars and a button to the impacted second molar (Fig. 4). The adjacent third molar was extracted, and two 8mm-long miniscrews* were inserted buccally between the first and second premolars and between the second premolar and the first molar. The miniscrews were used to obtain maximum anchorage of the first and second premolars, which were connected with a stainless steel ligature wire to avoid mesiodistal or extrusive movements. An .017" × .025" stainless steel sectional archwire was bent to form a loop distal to the impacted tooth, and the uprighting force was provided by a coil spring from the button to the loop (Fig. 5). After three months, the crown had been exposed enough to bond a tube and insert a nickel titanium leveling archwire. Treatment was completed in 12 months.

This approach is suggested when a tube cannot be bonded to the buccal surface of the tipped tooth. The miniscrews anchor the mesial dental unit and thus prevent mesiodistal and vertical side effects during the molar uprighting.

*OrthoEasy, registered trademark of Forestadent GmbH, Pforzheim, Germany; www.forestadent.com.
**Forestadent GmbH, Pforzheim, Germany; www.forestadent.com.

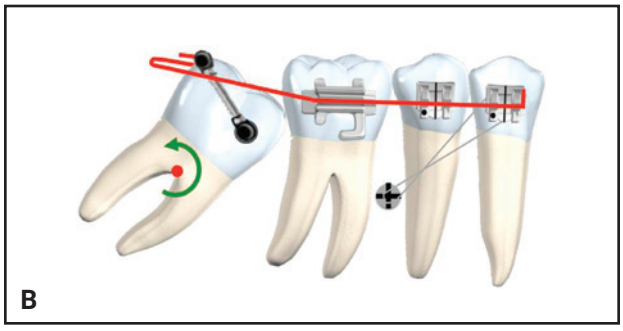

Fig. 4 Case 2. A. 12-year-old male patient with impacted lower left second molar and minimal exposed crown surface. B. Biomechanical scheme, with looped .017" × .025" stainless steel sectional archwire and elastomeric chain or nickel titanium coil spring.

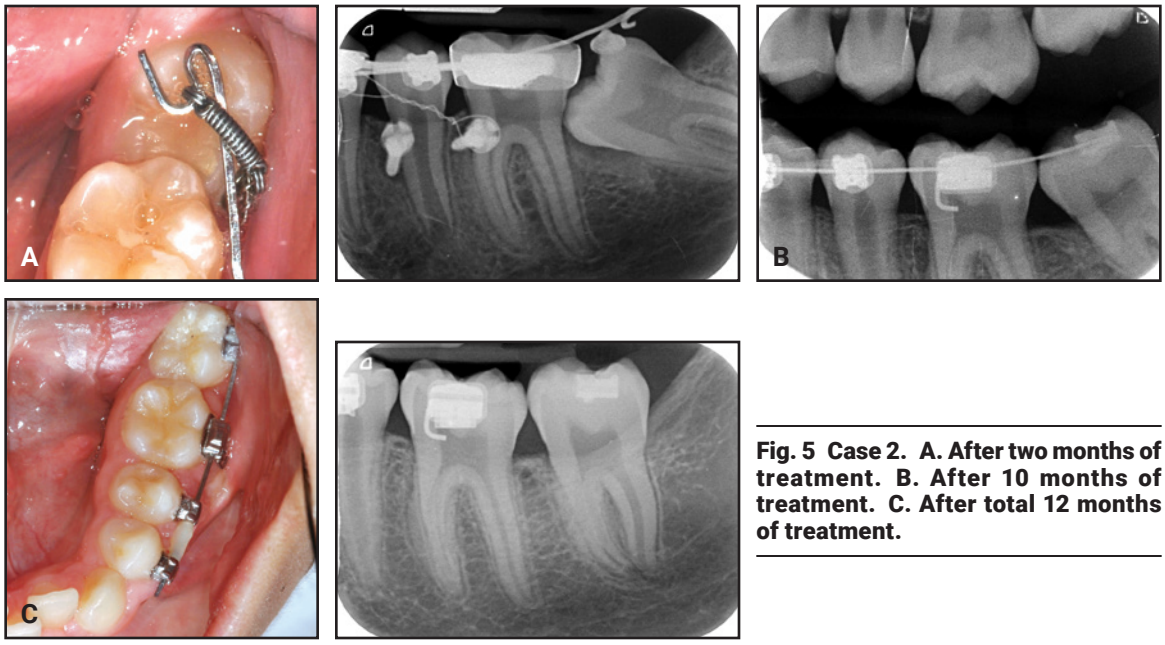

Fig. 5 Case 2. A. After two months of treatment. B. After 10 months of treatment. C. After total 12 months of treatment.

Case 3

A 33-year-old male presented with an impacted lower right third molar. The patient had previously undergone orthodontic treatment for which the upper right first molar and lower right first premolar had been extracted.

A miniscrew*** was inserted between the lower right first and second molars, and a tube was bonded horizontally to the distal surface of the third molar (Fig. 6). An .016" stainless steel sectional wire with a nickel titanium open-coil spring was inserted into the holes in the neck of the miniscrew and attached to the tube. Four months later, with the buccal surface of the third molar exposed, new tubes were bonded to this tooth and the second molar, and an .016" × .022" superelastic nickel titanium sectional wire was inserted (Fig. 7). Another three months later, an .019" × .025" beta titanium sectional wire with a V-bend was placed to complete the uprighting (Fig. 8). In this second phase, the miniscrew served as indirect anchorage to stabilize the lower first and second molars, using a stainless steel

Fig. 6 Case 3. A. 33-year-old male patient with impacted lower right third molar. B. Biomechanical scheme, with .016" stainless steel wire and nickel titanium open-coil spring between distal molar tube and miniscrew.***

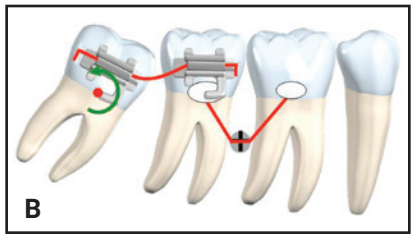

Fig. 7 Case 3. A. After four months, tubes bonded to second molar and newly exposed buccal surface of third molar. B. Biomechanical scheme, with .016" × .022" superelastic nickel titanium wire.

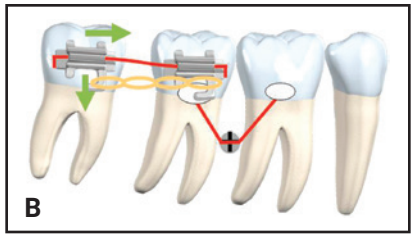

Fig. 8 Case 3. A. After three more months. B. Biomechanical scheme, with .019" × .025" beta titanium sectional wire. C. After total six months of treatment.

sectional wire bonded to the buccal surfaces with light-cured composite and connected directly to the miniscrew. Orthodontic treatment was completed in six months, and an Essix† removable retainer was delivered for nighttime wear to stabilize the molar position.

The biomechanics in this case illustrate an option when the molar is partially erupted, with only the distal portion of the crown available. The molar tube, sectional wire, and open-coil spring permit the crown to rotate around the molar's center of rotation, as in a single-force scheme. At the same time, the slot in the miniscrew head allows the sectional wire to slide. For final correction of the third-molar position, we connected the first and second molars to the miniscrew as an anchorage unit.

Case 4

A 35-year-old female was referred by her general dentist for uprighting of a mesially tipped lower right second molar.

An oral surgeon extracted the adjacent third molar and placed a 1.5mm-diameter, 8mm-long miniscrew‡ between the lower right first and second premolars (Fig. 9). After positioning the miniscrew, we bonded a tube to the buccal surface of the second molar. An .018" × .022" TMA†† cantilever was activated both vertically—using a small amount of force and thus exploiting the length of the cantilever to produce the moment required to upright the molar—and horizontally, as a spring for distalization of the molar. After

***3M, Monrovia, CA; www.3m.com.
†Registered trademark of Dentsply Raintree Essix Glenroe, Sarasota, FL; www.essix.com.
‡Leone S.p.A., Sesto Fiorentino, Firenze, Italy; www.leone.it.
††Registered trademark of Ormco Corporation, Orange, CA; www.ormco.com.

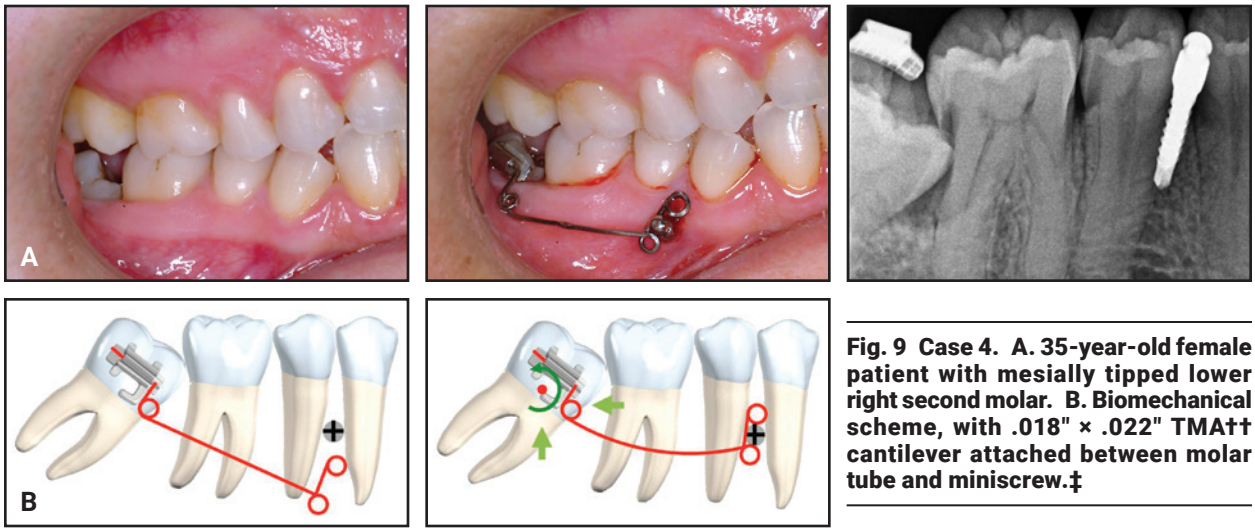

Fig. 9 Case 4. A. 35-year-old female patient with mesially tipped lower right second molar. B. Biomechanical scheme, with .018" × .022" TMA†† cantilever attached between molar tube and miniscrew.‡

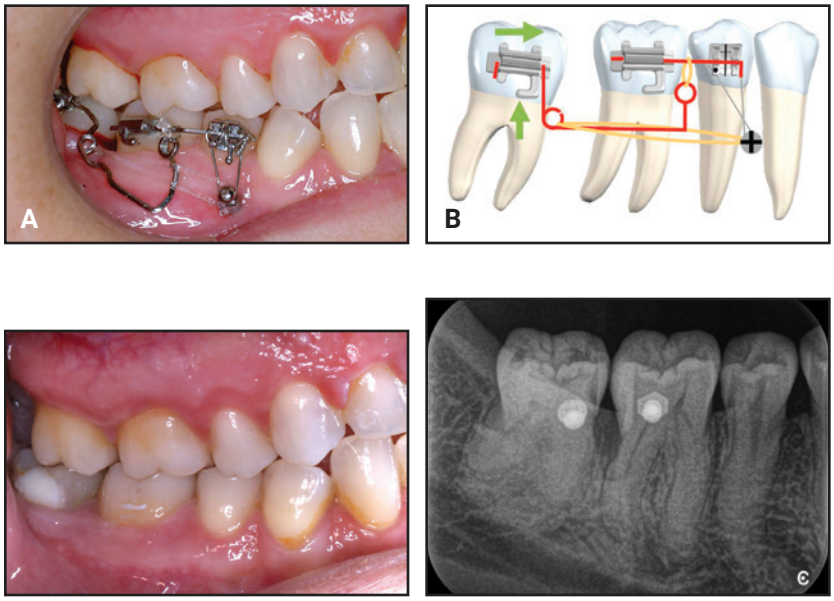

Fig. 10 Case 4. A. After five months, first-molar tube and premolar brackets bonded. B. Biomechanical scheme, with .016" × .022" nickel titanium wire and elastomeric chain.

Fig. 11 Case 4. After total eight months of treatment, lingual buttons and stainless steel ligature wire‡‡ added for retention.

five months of treatment, the molar had been uprighted (Fig. 10). Treatment was finished by bonding a tube to the buccal surface of the first molar and brackets to the first and second premolars, with an .016" × .022" superelastic nickel titanium sectional wire used for leveling and alignment. Orthodontic treatment was completed in eight months. For retention, we bonded lingual buttons to the lower right first and second molars and attached them with .012" stainless steel ligature wire‡‡ (Fig. 11).

This biomechanical system simultaneously applies a distal force, a counterclockwise moment, and a light extrusive force, without requiring brackets on any other teeth until almost the end of treatment.

Case 5

A 51-year-old female presented with mesial tipping of the lower right second and third molars due to earlier extraction of the first molar (Fig. 12). The treatment plan was to extract the third molar, upright the second molar with miniscrew anchorage, and insert an implant in place of the first molar.

Five months after the third-molar extraction, a 1.5mm × 9mm miniscrew§ was placed in the retromolar area on the crestal ridge (Fig. 13). A stainless steel button was bonded to the mesial surface of the second molar crown, and an elastomeric chain was attached to the miniscrew over the molar's occlusal surface. This is a simplified version of the mechanics proposed by Greco and colleagues to obtain distal movement around the center of rotation of the tooth and simultaneous intrusion from the vertical force of the elastomeric chain.[9] The chain was replaced and the miniscrew stability and occlusal contact points were checked every two weeks, with selective abrasion if necessary. After four months, the second molar had been uprighted enough for placement of a first-molar implant, while extrusion of the lower right second molar had been controlled (Fig. 14). A stainless steel ligature wire was added to maintain the vertical and distal positions. In another two months, the implant was inserted; four months later, the first molar was replaced with a prosthetic crown.

This approach avoids the unwanted distal rotation, lingual tipping, and extrusion that may occur when conventional fixed appliances are used. The biomechanical system is a simple alternative for molar uprighting when the patient has adequate space and good quality of posterior bone

‡Leone S.p.A., Sesto Fiorentino, Firenze, Italy; www.leone.it.
††Registered trademark of Ormco Corporation, Orange, CA; www.ormco.com.
‡‡S.S. White Technologies, Piscataway, NJ; www.sswt.com.
§PSM Medical Solutions, Tuttlingen, Germany; www.psm.ms. Distributed in the U.S. by Mondeal North America, Inc., Indio, CA; www.mondeal-ortho.com.

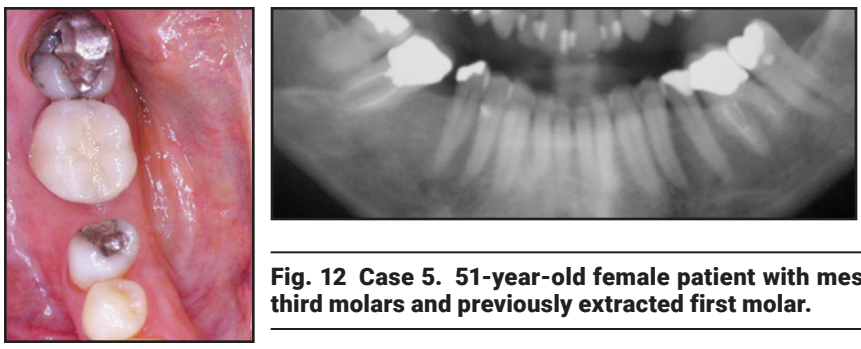

Fig. 12 Case 5. 51-year-old female patient with mesially tipped lower right second and third molars and previously extracted first molar.

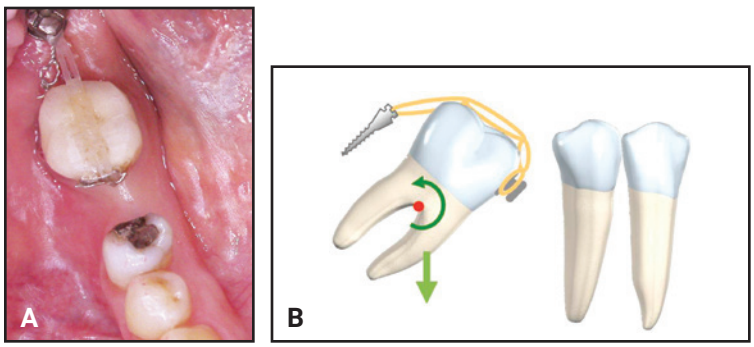

Fig. 13 Case 5. A. Five months after extraction of lower right third molar. B. Biomechanical scheme, with miniscrew§ and elastomeric chain.

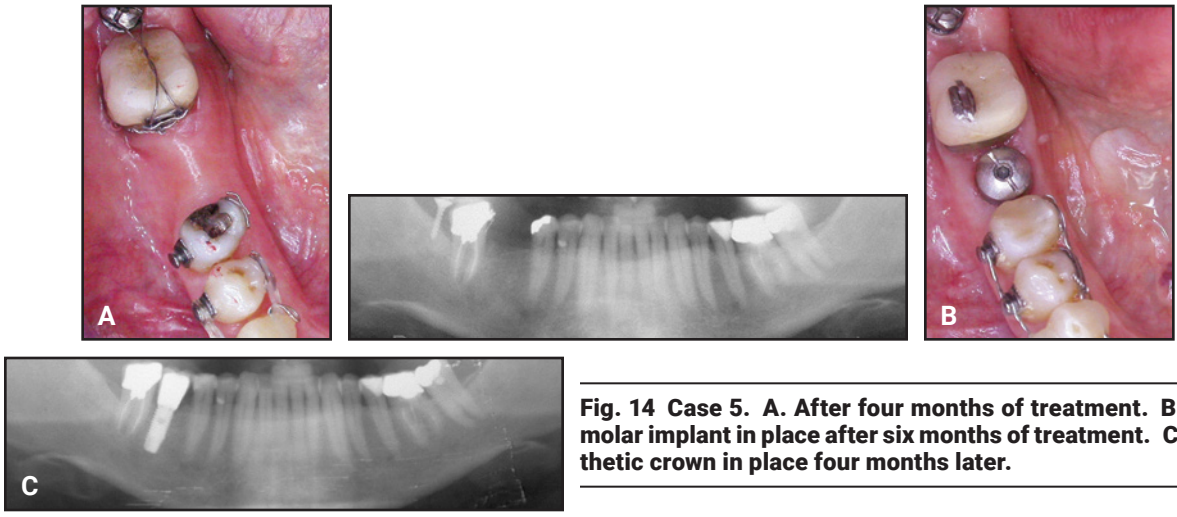

Fig. 14 Case 5. A. After four months of treatment. B. First-molar implant in place after six months of treatment. C. Prosthetic crown in place four months later.

and soft tissue. The point of application of the chain creates an efficient distal rotation moment and ensures vertical control of the entire tooth.

Case 6

A 44-year-old male was referred by a general dentist for uprighting of the lower right third molar (Fig. 15). His lower right first and second molars had been previously extracted because of periodontal and orthodontic problems, including crowding. The treatment plan was to upright the third molar using two buccal miniscrews and then insert implants in place of the first and second molars.[10]

Two 1.6mm × 7.5mm miniscrews§ with .022" slots were placed in the edentulous area. An .019" × .025" TMA sectional wire with a running loop activated 60° was connected between a tube on the lower left third molar and the miniscrews, which were bonded to the wire with composite. The aim

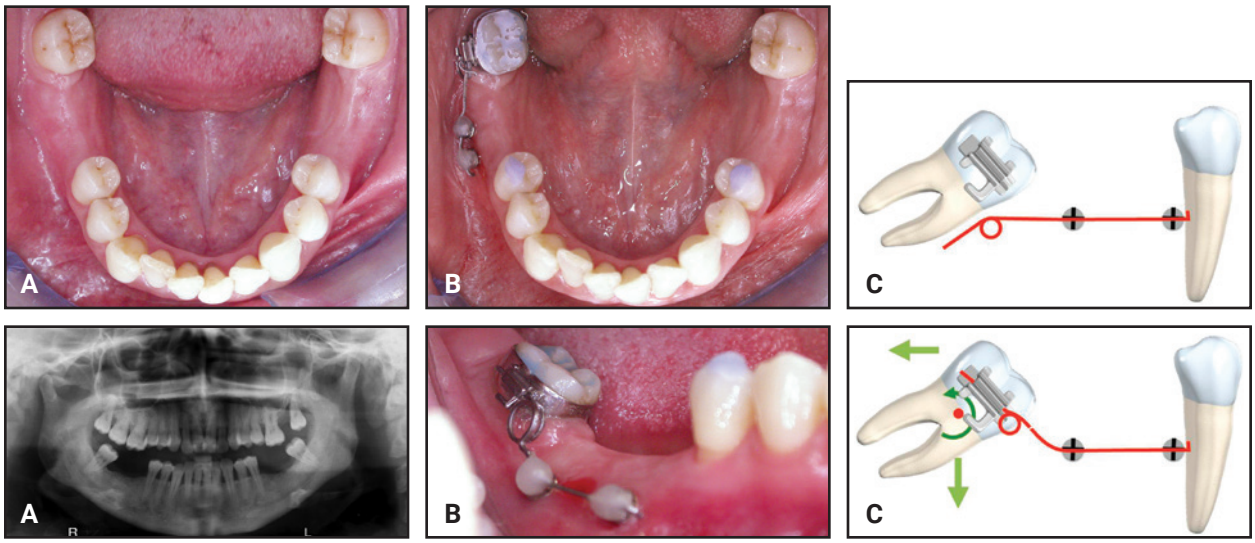

Fig. 15 Case 6. A. 44-year-old male patient with mesially tipped lower right third molar and space needed for future implants. B. Two miniscrews§ inserted in edentulous area. C. Biomechanical scheme, with .019" × .025" TMA sectional wire and running loop activated 60° and connected to miniscrews.

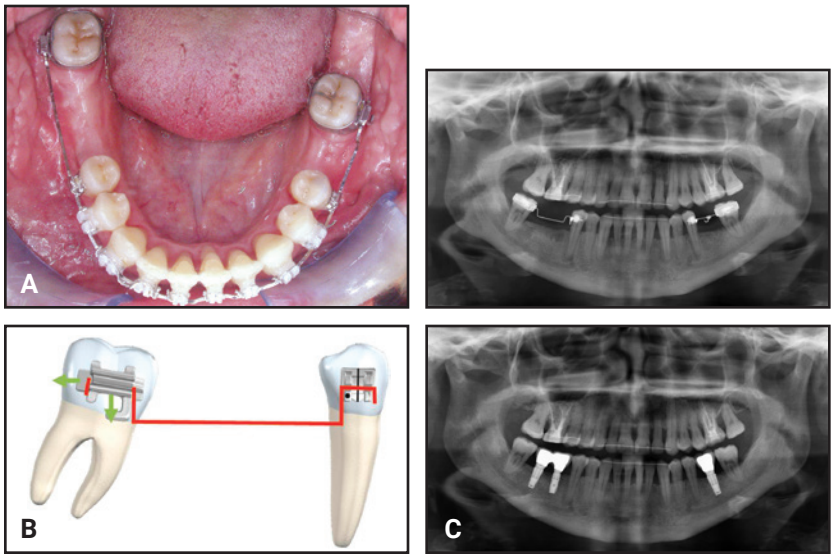

Fig. 16 Case 6. A. After five months of treatment. B. Biomechanical scheme, with .019" × .025" stainless steel wire.‡‡ C. Implants placed after 10 months of treatment.

of this phase was to rotate the tooth with mesial root movement and opposite crown movement. After five months, an .019" × .025" stainless steel wire‡‡ was placed with 1st-, 2nd-, and 3rd-order bends to complete three-dimensional positioning of the lower right third molar (Fig. 16). After 10 months of treatment, the molar was positioned correctly, and the implants were inserted.

This case illustrates the use of two miniscrews with a sectional wire and running loop to upright a molar when there is insufficient space distal to the impacted molar. The biomechanical approach avoids undesirable forces on adjacent teeth.

Discussion

The biomechanics for uprighting molars using TADs have proved to be efficient and easy to perform at the chair. As shown in Case 1, adverse effects such as mesial tipping or intrusion of the anchorage unit can be avoided by applying the force directly from the miniscrew head. In case of instability or loss of the screw, the side effects are minimal, resulting mainly in interruption of the desired orthodontic movement. On the other hand, if the miniscrew is used for indirect force application, side effects in case of screw failure may include undesired movement of the anchorage unit and prolongation of treatment.

‡‡S.S. White Technologies, Piscataway, NJ; www.sswt.com.
§PSM Medical Solutions, Tuttlingen, Germany; www.psm.ms. Distributed in the U.S. by Mondeal North America, Inc., Indio, CA; www.mondeal-ortho.com.

REFERENCES

1. Bondemark, L. and Tsiopa, J.: Prevalence of ectopic eruption, impaction, retention and agenesis of the permanent second molar, Angle Orthod. 77:773-778, 2007.
2. Kim, M.; Kim, M.; and Chun, Y.S.: Molar uprighting by a nickel-titanium spring based on a setup model, Am. J. Orthod. 146:119-123, 2014.
3. Lai, Y.; Chu, M.P.; and Vijayaraghavan, T.V.: Uprighting molars with twisted superelastic nickel titanium wires, J. Clin. Orthod. 35:100-105, 2001.
4. Sawicka, M.; Racka-Pilszak, B.; and Rosnowska-Mazurkiewicz, A.: Uprighting partially impacted permanent second molars, Angle Orthod. 77:148-154, 2007.
5. Majourau, A. and Norton, L.A.: Uprighting impacted second molars with segmented springs, Am. J. Orthod. 107:235-238, 1995.
6. Lee, K.J.; Park, Y.C.; Hwang, W.S.; and Seong, E.H.: Uprighting mandibular second molars with direct miniscrew anchorage, J. Clin. Orthod. 41:627-635, 2007.
7. Nienkemper, M.; Ludwig, B.; Kanavakis, G.; Pauls, A.; Wilmes, B.; and Drescher, D.: Uprighting mesially impacted lower third molars with skeletal anchorage, J. Clin. Orthod. 50:420-426, 2016.
8. Sohn, B.W.; Choi, J.H.; Jung, S.N.; and Lim, K.S.: Uprighting mesially impacted second molars with miniscrew anchorage, J. Clin. Orthod. 41:94-97, 2007
9. Greco, M.; Meddis, V.; and Giancotti, A.: The G-chain and miniscrew anchorage: Simple mechanics for molar uprighting, J. Clin. Orthod. 46:24-25, 2012.
10. Derton, N.; Perini, A.; Mutinelli, S.; and Gracco, A.: Mandibular molar uprighting using mini-implants: Different approaches for different clinical cases—Two case reports, Orthod. (Chic.) 13:138-145, 2012.