Uprighting Mandibular Second Molars with Direct Miniscrew Anchorage

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Partial or total impaction of the mandibular second molar is relatively rare, occurring in only .3% of the general population and 2-3% of orthodontic patients.[1,2] Causes may include arch-length deficiency, extraction or premature loss of the adjacent first molar, premature eruption of the mandibular third molar, and unusual angulation of the erupting second molar.[3,4] If not treated, the condition can lead to serious problems, including dental caries and periodontal disease involving the first and second molars, as well as external root resorption of the first molar.[5]

Conventional orthodontic methods of uprighting mandibular molars involve preparation of an anchorage tooth or segment. Multiple appliances are usually needed, and unwanted movement of the anchorage unit can occur.[6] The recent development of skeletal anchorage allows direct application of precise force systems to the target tooth or segment, producing efficient tooth movement in a short time. This article describes the use of direct miniscrew anchorage for mandibular second molar uprighting.

Biomechanical Considerations

An impacted second molar tends to be locked under the distal height of contour of the first molar, so that a distalizing force is needed to release its mesial cusp before a single force or moment can be applied to upright the molar. In cases of mild mesial angulation, the perpendicular distance from the center of resistance to the line of force at the bracket level is great enough to produce a sufficient moment and distalizing force (Fig. 1A,B). An open-coil spring or elastomeric chain attached to the miniscrew head can be used to generate the single force needed to upright the tooth.

By contrast, in cases of moderate-to-severe tipping, the moment generated from a single force is limited because of the reduced distance from the line of force to the center of resistance[6] (Fig. 1C). A single force can still be used initially to release the mesial marginal ridge from the height of contour of the first molar, but an uprighting spring must then be inserted to provide a sufficient tipback moment. Extrusive force is an unavoidable side effect, but does not create serious problems in

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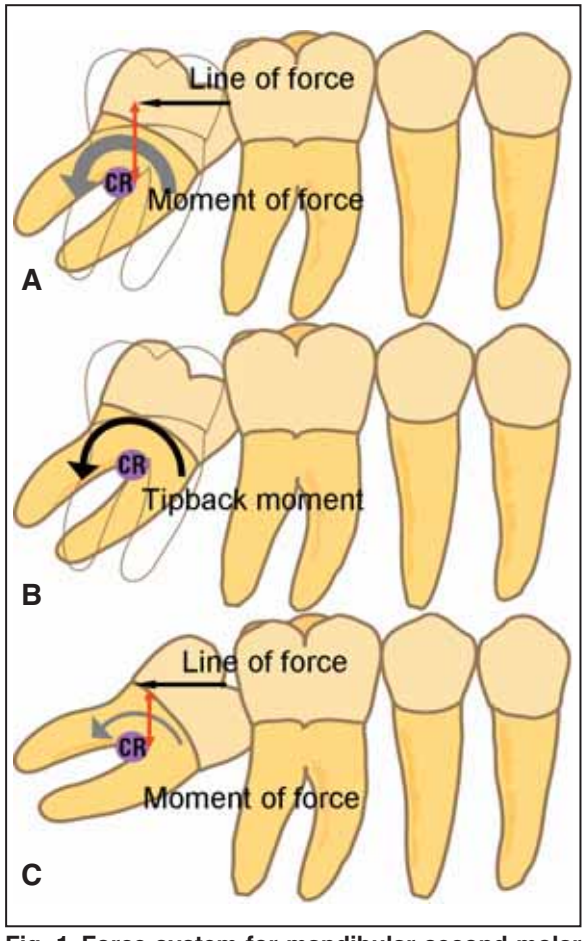

Fig. 1 Force system for mandibular second molar uprighting. A. Relatively large moment produced in case with mild mesial tipping. B. Tipback moment used for uprighting. C. Relatively small moment produced in case with moderate-to-severe mesial tipping.

most cases, since eruption ceases before the tooth reaches its final occlusal height.

Clinical Considerations

Before treating an impacted second molar, the adjacent teeth should be checked for caries and the surrounding periodontal tissues for inflammation. The panoramic radiograph will indicate the angulation of the second molar as well as the presence of the third molar. Periapical radiographs should be obtained if caries of the adjacent first molar is suspected.

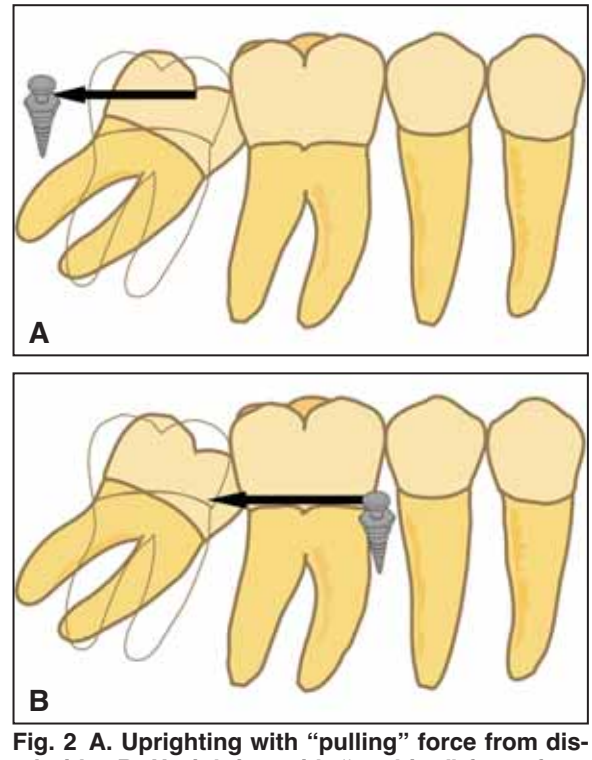

Fig. 2 A. Uprighting with "pulling" force from distal side. B. Uprighting with "pushing" force from mesial side.

An orthodontic miniscrew can be placed on either the mesial or the distal side of the second molar, but the retromolar area is usually preferred,[7-9] so that elastics attached to the miniscrew head will generate a linear "pulling" force from the distal to upright the tooth (Fig. 2A). In an adolescent patient with a developing third molar, however, it is difficult to insert a miniscrew in the retromolar area unless the third molar is extracted. Thick overlying soft tissue and poor accessibility of the insertion site can also hinder miniscrew insertion. In such a case, the miniscrew can be inserted into the buccal alveolar bone on the mesial side to generate a "pushing" force (Fig. 2B). Appliance design should be tailored to the insertion site and the required force system, as the following cases demonstrate.

Fig. 3 Case 1. 12-year-old female patient with mesially angulated mandibular right second molar before treatment.

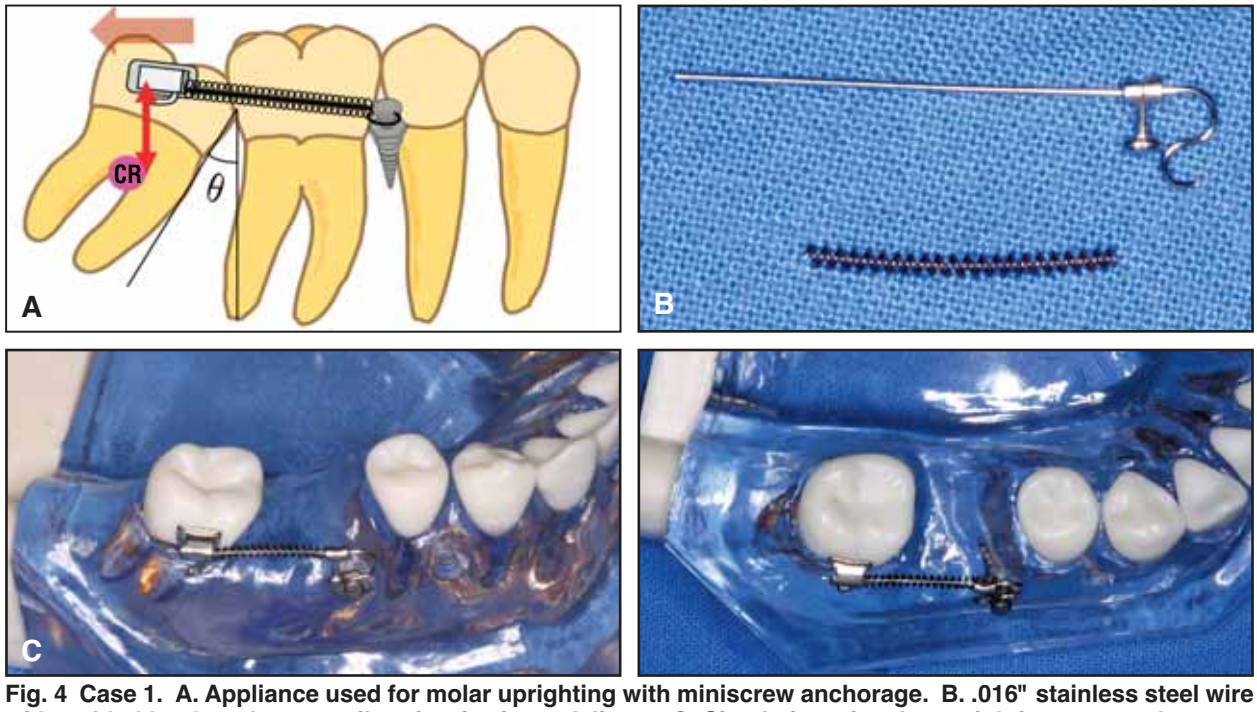

Fig. 4 Case 1. A. Appliance used for molar uprighting with miniscrew anchorage. B. .016" stainless steel wire with welded hook and open-coil spring for force delivery. C. Simulation of molar uprighting on typodont.

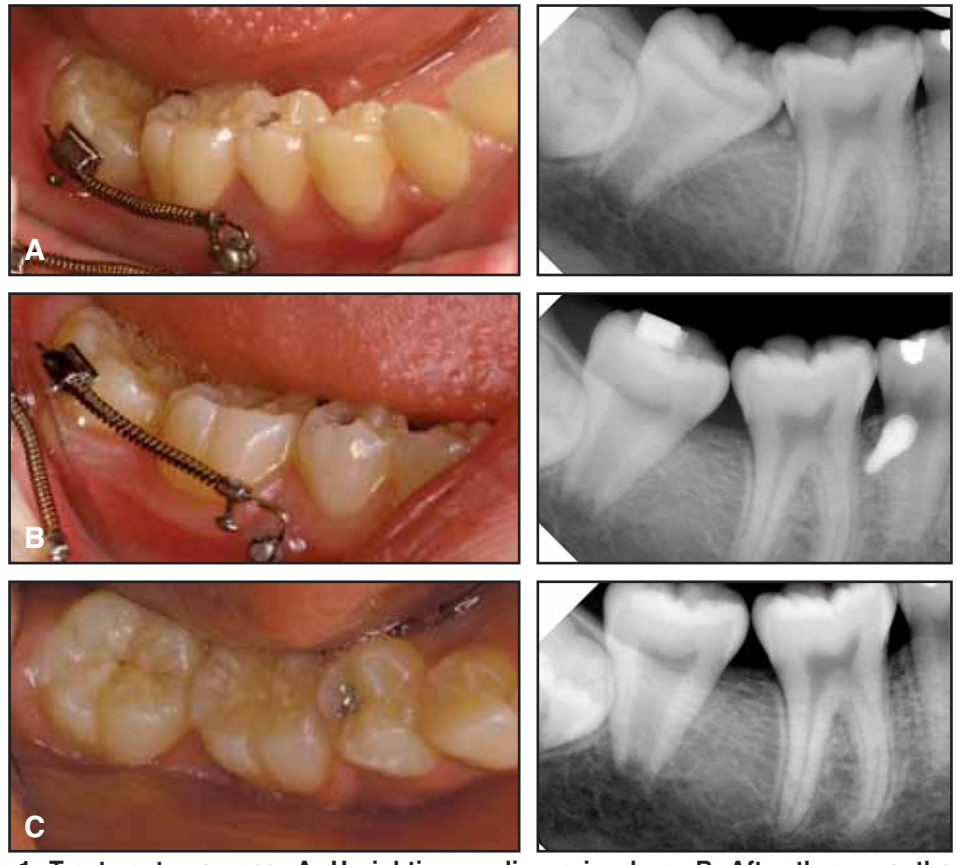

Fig. 5 Case 1. Treatment progress. A. Uprighting appliance in place. B. After three months of uprighting. C. After five months of uprighting.

Case 1

A 12-year-old female presented with a mesially angulated mandibular right second molar that was locked under the distal height of contour of the adjacent first molar (Fig. 3). The patient's occlusion and alignment were adequate, except for a slight protrusion of the maxillary central incisors, and she did not want comprehensive treatment. Her former dentist had tried to upright the molar with an elastic separating module, but this effort was not successful. A decision on whether to extract the third molar had not yet been made.

A single miniscrew* with a collar diameter of 1.8mm and a length of 7mm was inserted under local anesthesia in the buccal alveolus between the first molar and second premolar. A small buccal tube** was bonded to the distobuccal surface of the second molar. A length of .016" stainless steel wire was welded to the miniscrew, with an open hook on the mesial side,[5] and an open-coil spring was attached to apply a distalizing force against the molar tube (Fig. 4). The spring was replaced every four weeks.

Uprighting of the second molar was completed in five months without any additional appli-

*Orlus Orthodontic Mini-Implant, Ortholution, 207 Dunchon B/D., #416-1, Seongnae-dong, Gangdong-gu, Seoul 134-844, Korea; www.ortholution.com.
**TOMY Inc., 818, Shinmachi, Ohkuma-machi, Futaba-gun, Fukushima-ken, 979-1305, Japan; www.tomyinc.co.jp.

Fig. 6 Case 2. 13-year-old female patient with moderate mesial angulation of mandibular left second molar before treatment.

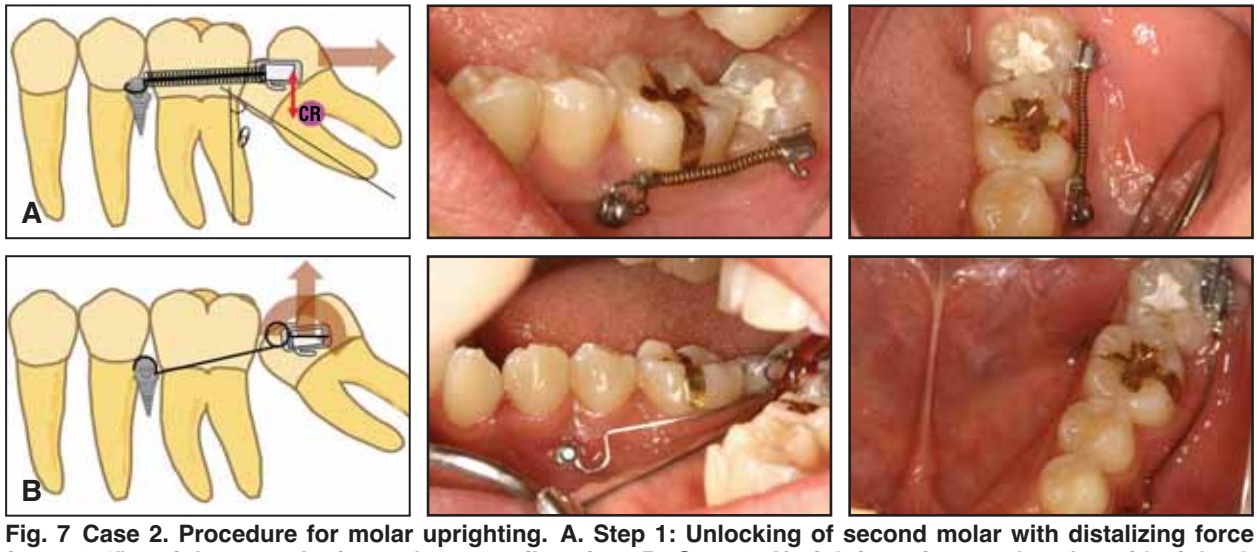

Fig. 7 Case 2. Procedure for molar uprighting. A. Step 1: Unlocking of second molar with distalizing force from .016" stainless steel wire and open-coil spring. B. Step 2: Uprighting of second molar with tipback moment from .016" × .022" stainless steel wire spring.

ances (Fig. 5). The uprighting of the second molar was not hindered by the presence of the third molar, although the two teeth appeared close together on the initial panoramic radiograph. The patient did not report any discomfort from the appliance.

Case 2

A 13-year-old female presented with a mesial impaction of the mandibular left second molar. Clinical and radiographic examination revealed a moderate mesial angulation of the second molar, which was locked beneath the distal height of contour of the first molar (Fig. 6). Dental caries was present in the first and second molars, but could not be treated because of poor accessibility. The third molar was present, and the extraction decision was complicated by the possibility that the second

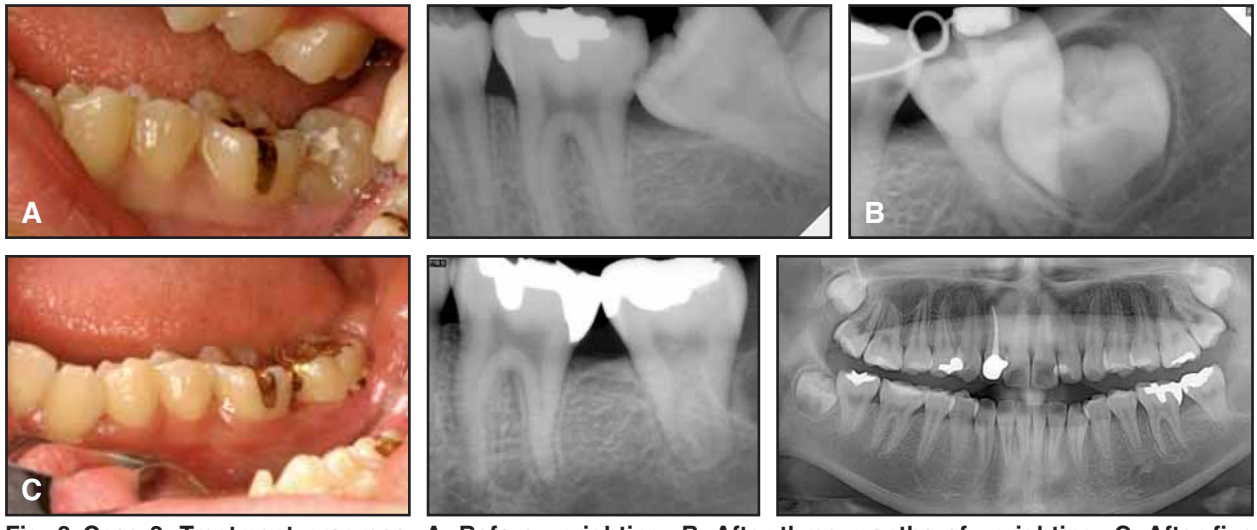

Fig. 8 Case 2. Treatment progress. A. Before uprighting. B. After three months of uprighting. C. After five months of uprighting, final restoration of first and second molars, and extraction of third molar.

molar caries might spread distally.

The first step in treatment was to unlock the second molar by inserting a miniscrew mesial to the first molar and applying a distalizing force with an .016" stainless steel wire and an open-coil spring, as in Case 1 (Fig. 7A). Spontaneous uprighting of the second molar was not expected because of its severe angulation. Therefore, after the second molar was unlocked, an .016" × .022" stainless steel uprighting spring was attached to the miniscrew to provide the appropriate tipback moment for completion of the uprighting (Fig. 7B).

After the second molar uprighting, final restorations of the first and second molars were performed, and the third molar was extracted (Fig. 8). The total treatment time was five months.

Case 3

A 16-year-old male presented with an unerupted mandibular right second molar. Clinical and radiographic examination revealed a mesial impaction of the molar, which was in close proximity to the third molar germ (Fig. 9). Extraction of the third molar was required to allow repositioning of the second molar.

Although full fixed appliances were needed to correct the patient's anterior crowding, the impacted second molar was treated independently with anchorage from a single miniscrew inserted in the retromolar area. The third molar was extracted at the same appointment as the miniscrew insertion, with a soft-tissue flap reflected to maximize visibility (Fig. 10). A metal button was bonded to the occlusal surface of the second molar, and a sterilized elastomeric chain was attached from the miniscrew head to the button to exert a single distalizing force.

Molar uprighting was completed in two months, with no additional appliances needed. The miniscrew and elastomeric chain were then removed after careful reflection of the flap (Fig. 11).

Discussion

Molar uprighting can be performed either surgically or orthodontically. Surgical correction involves minimal treatment time,[3] but trauma to the pulp and surrounding periodontal tissue may cause pulp necrosis, ankylosis, or surface root resorption. There is also a risk that the root may rupture during the procedure. Even after correct repositioning

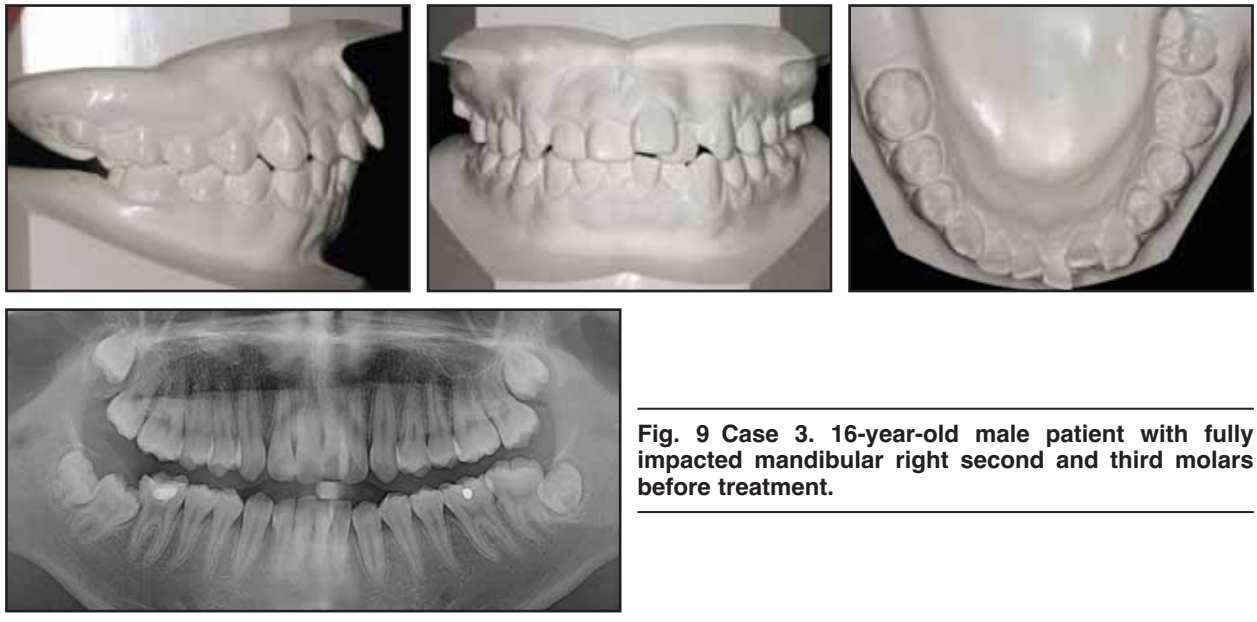

Fig. 9 Case 3. 16-year-old male patient with fully impacted mandibular right second and third molars before treatment.

of the molar, occlusal equilibration may be needed, and the post-surgical stability of the tooth may be questionable.

Orthodontic second molar uprighting has traditionally been achieved with a simple separating wire, a nickel titanium coil spring, a variety of uprighting springs, or a sectional archwire, all requiring anterior anchorage.[5,6,10-12] More recently, Park and colleagues have described molar uprighting with miniscrew anchorage in the retromolar area,[8] and Yun and colleagues have reported using indirect anchorage from a miniscrew inserted on the mesial side.[13]

The use of direct miniscrew anchorage for molar uprighting has the following advantages:

1. It requires only one miniscrew and a single bracket or button attachment, minimizing patient discomfort.
2. The miniscrew insertion, appliance fabrication, and delivery can be done at a single appointment, unlike conventional treatment requiring impressions and laboratory work.[14]
3. The simple design reduces chairtime compared to more complex indirect anchorage.
4. Direct application of force to the target tooth eliminates the possibility of unwanted movement of the anchorage unit, which can occur even with indirect miniscrew anchorage as a result of technical errors in passive bracket placement or a weak attachment between the miniscrew and the anchor tooth.
5. If the miniscrew is inserted in the premolar area, molar uprighting can be performed without third molar extraction, eliminating the need to wait for healing of the extraction site.

Melsen and colleagues have shown that third molar extraction may affect the center of resistance of the second molar during uprighting, leading to undesired distal movement of the second molar.[15] In their computer simulation, the second molar demonstrated significant mesial root movement and distal crown tipback, even without proper mechanics for root movement. On the other hand, if the third molar is not extracted, but is in direct contact with the second molar root, it can hinder second molar uprighting, and movement of the anchorage segment may occur. Therefore, miniscrew anchorage is preferable to conventional preparation of an anchorage unit when the third molar is present.

Fig. 10 Case 3. A. Third molar extraction and insertion of retromolar miniscrew for attachment of uprighting appliance. B. Elastomeric chain placed beneath soft-tissue flap.

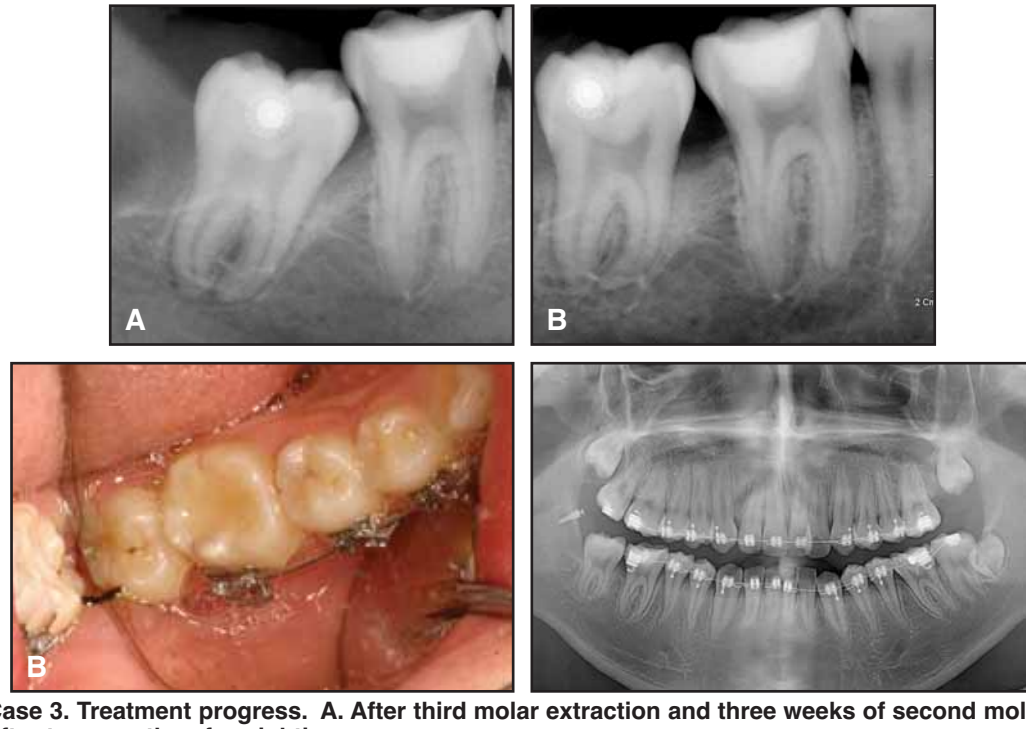

Fig. 11 Case 3. Treatment progress. A. After third molar extraction and three weeks of second molar uprighting. B. After two months of uprighting.

In the first two cases reported in this article, molar uprighting was achieved without third molar extraction. In Case 3, third molar extraction was required because of the inaccessibility of the second molar. The "closed" molar uprighting appliance was placed at a single appointment, including third molar extraction, miniscrew insertion, and elastic attachment.

Despite its advantages over other techniques, direct miniscrew application has some limitations: 1. In cases of lingually tipped or rotated molars, a single force or moment may be insufficient to upright the tooth. Sequential application of different force systems may be required, involving frequent changes of appliances and more complicated treatment mechanics. Movement of the second molar must be carefully monitored, because the uprighting moment can cause tipping toward either

the buccal or the lingual side.[15]
2. Direct miniscrew application is not indicated in cases of molar extrusion, because the force system lacks an intrusive component. When molar intrusion is needed, the biomechanical system becomes more complex: either a V-bend archwire can be used to provide a larger moment to the molar, or a Sander molar uprighting spring*** can be inserted.[15,16]

Conclusion

Direct application of an appropriate force system using miniscrew anchorage is a simple and effective method of uprighting an impacted mandibular second molar. The third molar can be left in place during the procedure, which involves pure rotation around the center of resistance. Even when third molar extraction is indicated, the extraction and placement of the uprighting appliance can be accomplished in a single appointment, significantly shortening treatment time and minimizing patient discomfort.

***Part No. 307-1012, Forestadent USA, 2315 Weldon Parkway, St. Louis, MO 63146; www.forestadentusa.com.

REFERENCES

1. Grover, P.S. and Lorton, L.: The incidence of unerupted permanent teeth and related clinical cases, Oral Surg. Oral Med. Oral Pathol. 59:420-425, 1985.
2. Wellfelt, B. and Varpio, M.: Disturbed eruption of the permanent lower second molar: Treatment and results, A.S.D.C. J. Dent. Child. 55:183-189, 1988.
3. Haralabakis, N.B.; Tsianou, A.; and Nicolopoulos, C.: Surgical correction of mesially impacted mandibular second molars, J. Clin. Orthod. 37:209-212, 2003.
4. Lang, R.: Uprighting partially impacted molars, J. Clin. Orthod. 19:646-650, 1985.
5. Sawicka, M.; Racka-Pilszak, B.; and Rosnowska-Mazurkiewicz, A.: Uprighting partially impacted permanent second molars, Angle Orthod. 77:148-154, 2007.
6. Roberts, W.W. III; Chacker, F.M.; and Burstone, C.J.: A segmental approach to mandibular molar uprighting, Am. J. Orthod. 81:177-184, 1982.
7. Costa, A.; Raffaini, M.; and Melsen, B.: Miniscrews as orthodontic anchorage: A preliminary report, Int. J. Adult Orthod. Orthog. Surg. 13:201-209, 1998.
8. Park, H.S.; Kyung, H.M.; and Sung, J.H.: A simple method of molar uprighting with Micro-Implant Anchorage, J. Clin. Orthod. 36:592-596, 2002.
9. Giancotti, A.; Muzzi, F.; Santini, F.; and Arcuri, C.: Miniscrew treatment of ectopic mandibular molars, J. Clin. Orthod. 37:380-383, 2003.
10. Kogod, M. and Kogod, H.S.: Molar uprighting with the piggyback buccal sectional arch wire technique, Am. J. Orthod. 99:276-280, 1991.
11. Aksoy, A.U. and Aras, S.: Use of nickel titanium coil springs for partially impacted second molars, J. Clin. Orthod. 32:479-482, 1998.
12. Orton, H.S. and Jones, S.P.: Correction of mesially impacted lower second and third molars, J. Clin. Orthod. 21:176-181, 1987.
13. Yun, S.W.; Lim, W.H.; and Chun, Y.S.: Molar control using indirect miniscrew anchorage, J. Clin. Orthod. 39:661-664, 2005.
14. Halterman, C.W.: A simple technique for the treatment of ectopically erupting permanent first molars, J. Am. Dent. Assoc. 105:1031-1033, 1982.
15. Melsen, B.; Fiorelli, G.; and Bergamini, A.: Uprighting of lower molars, J. Clin. Orthod. 30:640-645, 1996.
16. Zachrisson, B.U. and Bantleon, H.P.: Optimal mechanics for mandibular molar uprighting, World J. Orthod. 6:80-87, 2005.