Management of Deeply Impacted Molars with the Miniscrew-Supported Pole Technique

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Impacted molars occur more often in the mandibular arch than in the maxillary arch, with an overall prevalence of .01-1.8%.[1-4] The most common type of impaction, a mesially inclined molar, is also the most successfully treated.[5] Even a horizontally impacted lower second molar can be uprighted. If a molar is diagnosed in a vertical position, however, its prognosis is more compromised and ankylosis should be suspected.[5,6]

Several methods can be used to treat ectopically erupted molars, but the most conservative involves orthodontically assisted forced eruption. The molar is exposed surgically, a minimal amount of hard tissue is removed, an attachment is bonded, and the raised flap is replaced.[7] Disadvantages are that the tooth cannot be seen until it begins to erupt and that the attachment may debond, requiring another surgical procedure. Other approaches require complex sectional techniques or heavy springs.[8,9] Miniscrews[7,10,11] and miniplates[12,13] are now being used to add anchorage and thus avoid unwanted mechanical side effects.

Options for treating a deeply embedded second molar include surgical uprighting or extraction, with or without transplantation of the third molar into the extraction site. This article illustrates an effective and simple surgical technique using a cantilever arm supported by a miniscrew and a


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dental anchorage unit to force the eruption of a deeply impacted molar. A "pole" acts as a 1st-order lever in which the resistance or charge is the unerupted molar, and the fulcrum is the segment of wire attached to create an anchorage unit. The force is directed from the miniscrew.

Indications

Predictors of ectopic molar eruption include a family history of unerupted molars,[14] an oversize dental follicle,[6,15] and anomalous angulation of the molar.[6,14,16,17] An unerupted molar with its root apex near the canal of the inferior mandibular cortex or maxillary sinus nerve is likely to be ectopic.[18] Delayed eruption relative to the patient's age or to the eruption of other teeth (especially the contralateral molar) or an altered eruption path of other teeth[19] should alert the orthodontist. If the patient is two years older than the mean age at which a tooth is expected to erupt, the tooth may well be impacted.[20]

The proper time to treat an impacted second molar is during early adolescence, generally age 11-14.[15,21] The positions of other teeth should be considered, as when the occlusal face of the most posterior molar is above the level of the molar in question, or when an abnormally positioned third-molar germ forms a barrier that causes impaction of the second molar.[18] Other complicating factors include the absence of a normal molar bulge on palpation,[22] arch-length discrepancy, lack of space in the retromolar area, and crowding in the mandibular arch.[15,18]

The percentage of development of a potentially ectopic molar should be estimated, and radiographic evaluation should be performed every six months.[23] If the position of the molar remains unchanged, surgery is indicated.[20] Other indications for surgical treatment of an ectopic molar are retention of the molar or impaction in the adjacent tooth or another structure[14,20]; root resorption or damage to the adjacent teeth[14]; failure to erupt, with a closed apex[18]; development of more than two-thirds of the root[20]; or occurrence of a follicular cyst.[18,20,23]

The technique described here can be used in any of these situations, but we prescribe it only when conventional surgical exposure and bonding of the impacted tooth have been unsuccessful or when the patient presents with at least three of the following indications:

- Older than age 14.
- Vertical, distal, or mesial molar angulation ≥ 45°.
- Severe bone depth of the molar (position C).
- Proximity to the inferior alveolar nerve canal or the maxillary or mandibular cortical bone.
- Closed apex.
- Alteration of the root apex.
- Previously unsuccessful surgical exposure.
- Signs of primary molar retention.

Procedure

The pole is made from a segment of .021" × .025" nickel titanium wire. A loop is formed in one end using a Hammerhead* or nickel titanium distal cinch-back plier. The shape-memory effect of the wire will provide the extrusive force.

An .021" × .025" stainless steel splinting wire is then bonded to the three teeth mesial to the ectopic molar—in the case of a second molar, the first molar and first and second premolars. A small step should be made in the stainless steel splinting wire between the first molar and second premolar. It is important for the splinting wire to be far enough from the occlusal plane to avoid interfering with the occlusion, and the step should be small enough for patient comfort. The splint also reinforces the anchorage unit to prevent unwanted tooth movement.

After the mouth is rinsed with .2% chlorhexidine for one minute, local anesthesia (2% lidocaine with 1:100,000 epinephrine) is infiltrated in the gingiva overlying the unerupted molar and in the attached gingiva at the level of the premolars, where the miniscrew (10-12mm long, 2mm in diameter) will be inserted. Root sensitivity should be preserved during placement of the miniscrew so the patient can report discomfort if any root damage occurs; blocking the buccal nerve is not recommended.

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Before miniscrew insertion, the interradicular space between the premolars should be assessed by means of cone-beam computed tomography (CBCT) or panoramic radiography. For an ectopic lower molar, the miniscrew is inserted with a manual screwdriver into the gingiva between the first and second premolars at 90° to the cortical surface (Fig. 1). For an upper molar, the miniscrew is inserted into the interradicular space between the first molar and second premolar, 5-11mm from the alveolar crest, with an insertion angle of 30-45° to the dental axis to avoid root damage.[24] A mucoperiosteal flap is raised to expose the molar, and as little bone as possible is removed to allow bonding of an orthodontic attachment (Caplin hook). In some cases, no bone removal is required.

Next, the pole is cut to the appropriate length, based on the angulation of the embedded molar (Fig. 2). In a case with difficult access, the measurement can be made with an .024" brass wire.

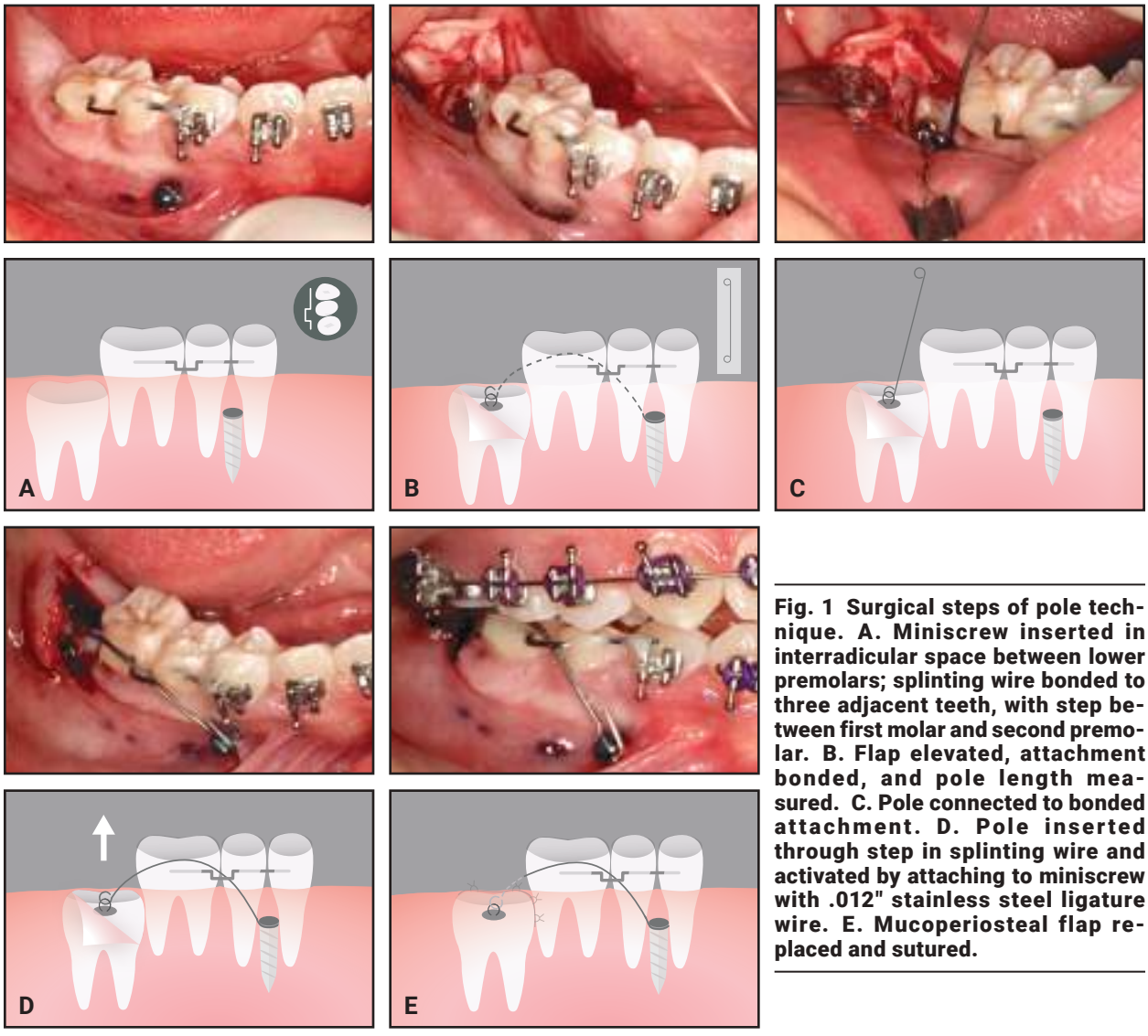

Fig. 1 Surgical steps of pole technique. A. Miniscrew inserted in interradicular space between lower premolars; splinting wire bonded to three adjacent teeth, with step between first molar and second premolar. B. Flap elevated, attachment bonded, and pole length measured. C. Pole connected to bonded attachment. D. Pole inserted through step in splinting wire and activated by attaching to miniscrew with .012" stainless steel ligature wire. E. Mucoperiosteal flap replaced and sutured.

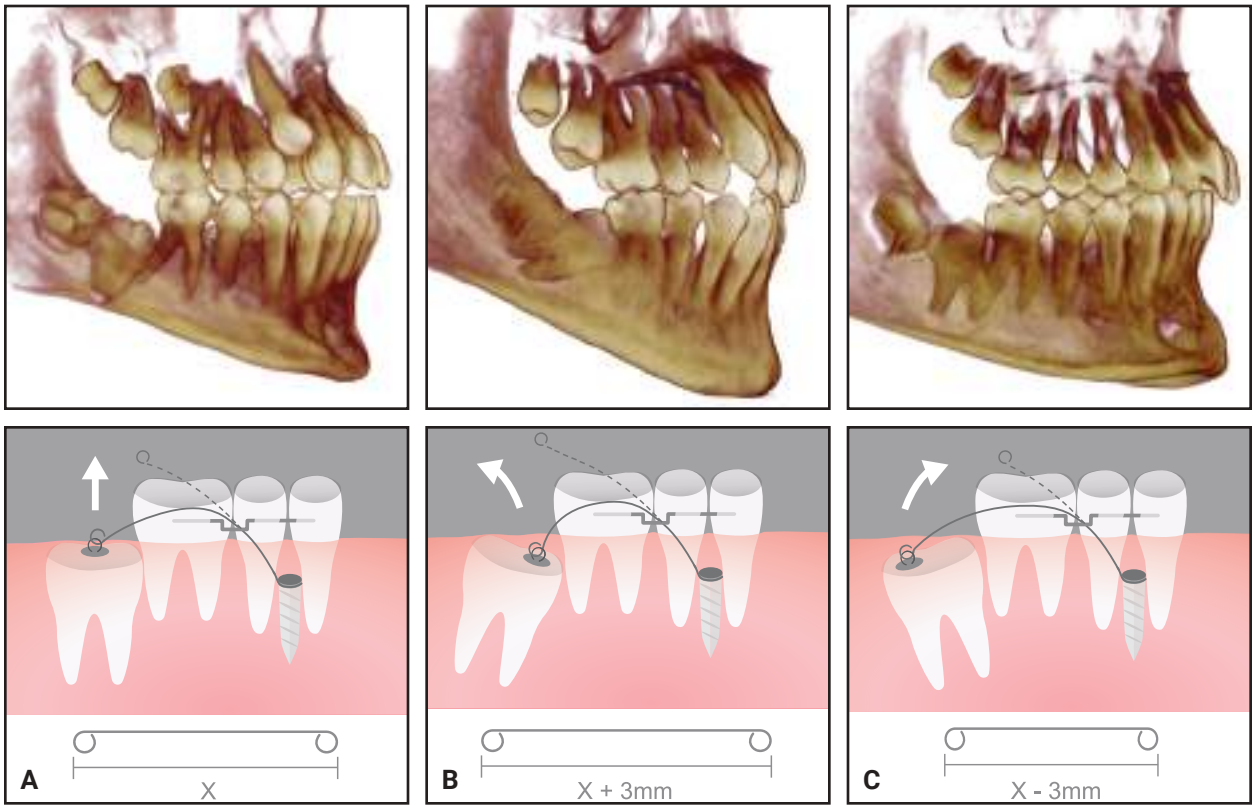

Fig. 2 Selection of pole length according to angulation of ectopically erupted molar. A. Vertical molar position requires pole length equal to distance between surgical attachment and miniscrew to generate movement in occlusal direction. B. Mesially angulated molar requires pole length 3mm greater than distance between attachment and miniscrew to ensure point of force application remains distal to center of resistance (CR), generating extrusive posterorotational moment. C. Distally angulated molar requires pole length 3mm less than distance between attachment and miniscrew to ensure point of force application remains mesial to CR, generating extrusive anterorotational moment.

Because the pole length is one of the most important aspects of this technique, the molar position should be analyzed ahead of time using two- or three-dimensional radiographs. If the molar is vertical or unangulated, the length of the pole should be equal to the distance from the surgical attachment to the miniscrew, so that the vector of force applied to the molar has an occlusal direction. If the molar is mesially angulated, the length of the pole should be 3mm greater than the distance from the attachment to the miniscrew, so that the point of application remains distal to the center of resistance (CR), generating an extrusive and posterorotational movement. If the molar is distally angulated, the length of the pole should be 3mm less than the distance from the attachment to the miniscrew, so that the application of the force remains mesial to the CR, generating an extrusive and anterorotational movement. A major advantage of this approach is that it can achieve different moments depending on the length of the pole arm and, therefore, can be used to upright any ectopic molar, regardless of angulation.

The previously formed loop is placed over the miniscrew, and another helix is bent at the other end of the pole, according to the angulation of

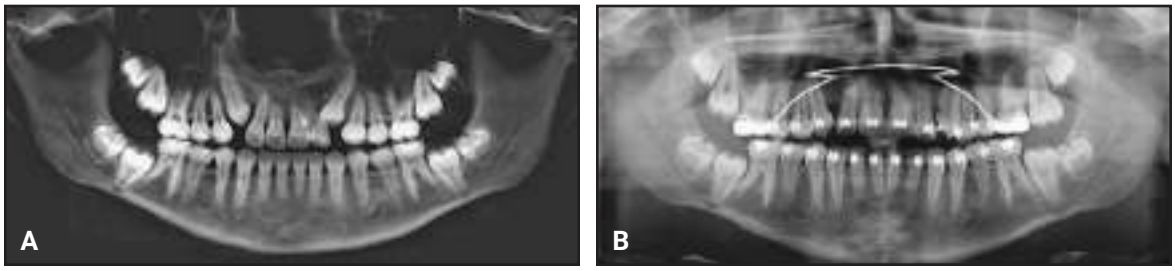

Fig. 3 Case 1. A. 12-year-old female patient with impacted upper canines, root resorption of upper incisors, and unerupted second molars before treatment. B. Panoramic radiograph taken seven months after start of treatment shows no change in position of lower second molars.

the molar. The pole should first be connected with the bonded attachment and then with the miniscrew through the step in the splinting wire. The connection to the miniscrew with an .012" stainless steel ligature wire generates the activating force on the molar. Depending on the inclination of the molar and the pole length, this ligature will remain more or less tight. Finally, the mucoperiosteal flap is sutured into place, covering the ectopically erupted tooth. The sutures are removed after 10-14 days.

Although only one activation of 150-200g is required at the time of surgery, the patient should be checked every two weeks until the molar erupts in the oral cavity. This close monitoring will avoid any excessive extrusion of the molar caused by the large amount of force. Once the molar has erupted, the miniscrew is removed and brackets and tubes are placed on the premolars and molars to continue with alignment.

Case 1: Ectopic Lower Molar Eruption

A 12-year-old female presented with impacted upper canines (Fig. 3). Intraoral examination revealed an open bite of about 2mm associated with a tongue-thrust habit. A Class I molar relationship was observed on the right side and a Class II molar relationship and posterior crossbite on the left, with the lower midline deviated 3mm to the left.

Because the CBCT showed root resorption of the upper incisors from the impacted canines, we started orthodontic treatment without waiting for eruption of the second molars. Although the lower third molars were above the level of the second molars, we decided not to remove the third molars unless there were eruption problems with the second molars.

Roth-prescription .022" × .028" brackets** were bonded in both arches, and .016" nickel titanium archwires were placed. Surgery was performed to expose both canines. A wider .016" × .022" nickel titanium archwire was used because of the incisor resorption and moderate bimaxillary protrusion.

Seven months after the start of treatment, a panoramic radiograph showed no change in position of the lower second molars. Since these molars were oriented vertically, below the cementoenamel junctions of the adjacent first molars, and the radicular apices were close to the inferior cortex, the pole technique was performed for the lower left molar using a 10mm miniscrew*** (Fig. 4). Five weeks later, the tooth had erupted enough to bond a tube to its surface. The same surgical procedure with a 10mm miniscrew was then performed on the right molar, which erupted into the oral cavity 11 weeks later. After a healing period of one month, the right second molar was incorporated into the archwire. A year after the initial surgery, the alignment was complete.

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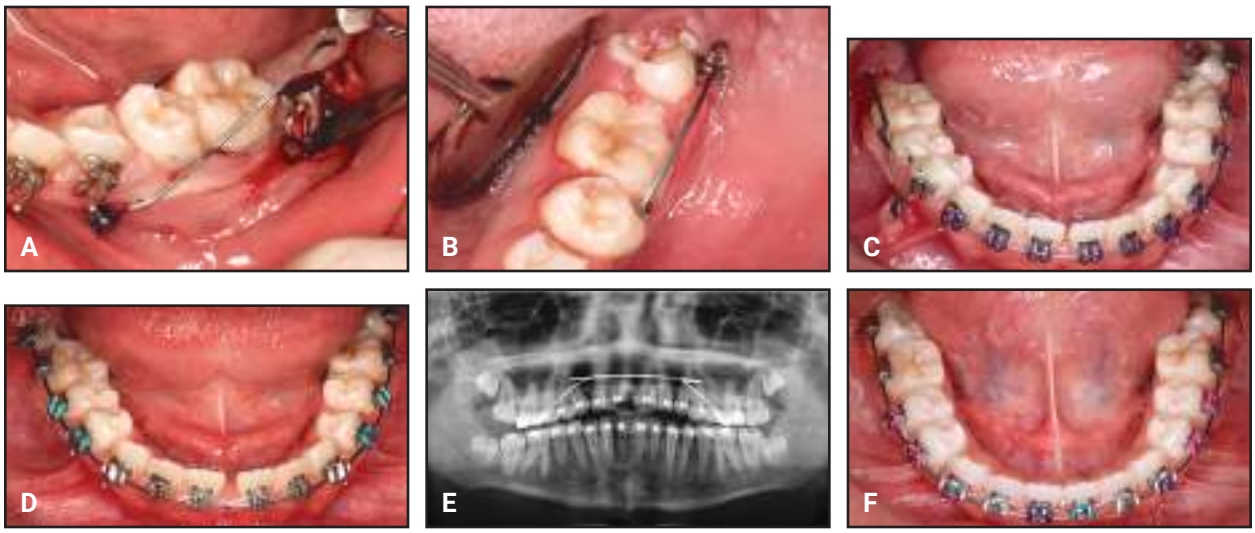

Fig. 4 Case 1. A. Surgery with pole technique on lower left second molar. B. Eruption of lower left second molar after five weeks of traction. C. Pole technique used on lower right second molar. D. Three and a half months later, after eruption of both lower second molars. E. Progress radiograph showing eruption of both lower second molars. F. Alignment complete one year after initial surgery.

Active treatment was finished in 24 months. After the appliances were removed, an Essix† retainer was delivered for the upper arch, and a 2-2 fixed lingual retainer was bonded because of the root resorption. The lower teeth were stabilized with a 3-3 bonded lingual retainer.

Case 2: Ectopic Upper Molar Eruption

A 14-year-old male was diagnosed with a Class II, division 1 malocclusion; a 6mm overjet; and a unilateral posterior crossbite on the left side (Fig. 5). CBCT was performed because of the delayed eruption of the upper left second molar.

Eight months after the start of orthodontic treatment, a panoramic radiograph was taken to check the molar's status. Because there was no sign of eruption, surgery was performed with the pole technique and a 10mm miniscrew (Fig. 6). Three months later, when the molar had erupted, the miniscrew was removed and a tube was bonded to the molar. After alignment, the sagittal malocclusion was corrected with intermaxillary Class II elastics on the right and a Forsus‡ appliance on the left.

The duration of active treatment was 20 months. After appliance removal, an upper Essix retainer was delivered and a lower 3-3 lingual retainer was bonded.

Discussion

Various devices have been developed to upright mesially angulated impacted molars with either direct or indirect miniscrew anchorage.[11,25-28] The miniscrews are usually placed in the retromolar area because the force will then be applied distal to the CR of the mesially impacted molar, generating an extrusive counterclockwise movement.[10,12] The major disadvantages of this approach are patient discomfort, a short force span that reduces the effectiveness of the mechanics, and limited usefulness in the maxillary arch.[27] In our procedure, the longer wire span enables a wider range of action, resulting in effective tooth movement.[11] The single miniscrew is easier to

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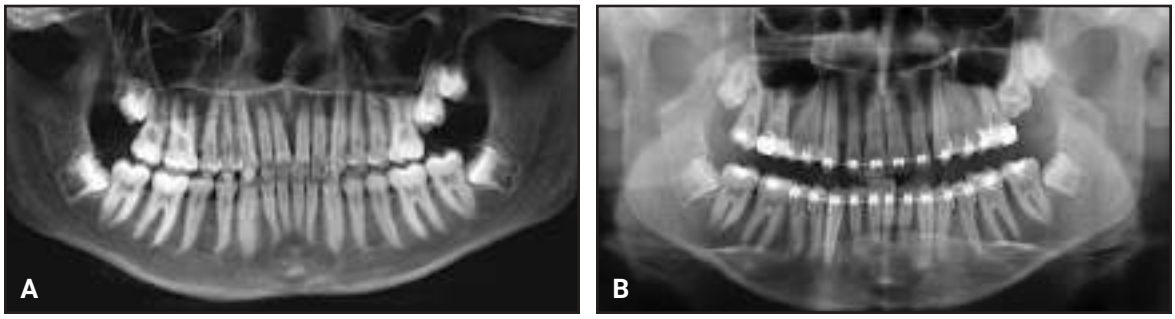

Fig. 5 Case 2. A. 14-year-old male Class II, division 1 patient with delayed eruption of upper left second molar before treatment. B. Panoramic radiograph taken eight months after start of treatment shows no change in position of upper left second molar.

Fig. 6 Case 2. A. Surgery with pole technique on upper left second molar. B. Eruption of upper left second molar after three months of traction. C. Continuation of orthodontic alignment.

place and control than miniplates[12,13] or multiple miniscrews[7,11] and is more conducive to proper oral hygiene and mastication.

Since the force applied in our technique is greater than the 50-150g used in other methods,[10,28] the molar eruption can be achieved more quickly. The pole is simply attached to the miniscrew for easy and immediate activation. No chains, elastic threads, or springs[10,25] need to be changed after surgery.

With the pole technique, the miniscrew is inserted mesial to the ectopically erupted molar, thus improving stability and accessibility.[25] Melo and colleagues reported a 90% success rate for lower molar uprighting with mesial miniscrews, although they attached the cantilever directly to a miniscrew placed perpendicular to the buccal face of the alveolar bone.[26] If the miniscrew is inserted distally,[10-13,28] most cases will require removal of the third molar and a waiting period for healing before the desired anchorage can be placed. In our method, the third molar is extracted only if the bud blocks the second-molar crown and a lack of space impedes eruption of the second molar. Since the pole technique is employed to resolve complicated molar impactions that may involve root dilacerations or even contact with the cortical bone, it can be useful to preserve the third-molar bud in case the second molar ultimately requires extraction and a replacement is needed.[29]

Although our procedure has been used mainly for second molars, it has also been employed with first molars and with lower canines whose root apices are in contact with the mandibular cortex (Fig. 7). It has also been successfully applied in cases in which an ectopically erupted tooth does not respond to the usual bracket-and-chain uprighting technique.

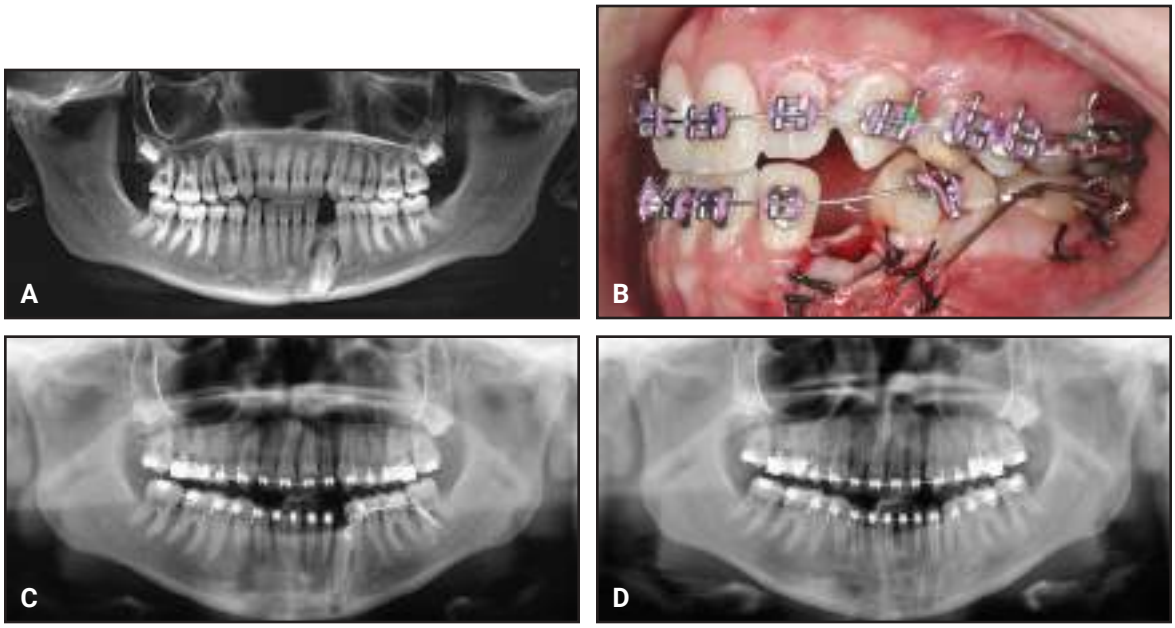

Fig. 7 Patient with ectopically erupted lower left canine. A. Before treatment. B. Surgery with pole technique. C. Three months after surgery. D. 10 months after surgery.

Conclusion

Combined surgical-orthodontic treatment with the pole technique supported by a miniscrew seems to be an effective procedure for managing deeply impacted molars. This technique simplifies access to the retained tooth by using only one miniscrew located mesially and away from the surgical field. It requires just a single activation and can be used for all impacted teeth, especially molars with any type of angulation. More studies are needed to confirm long-term results and identify potential complications.

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