Corticotomy-Assisted Space Closure in Adult Patients with Missing Lower Molars

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Mini-implant anchorage now allows simple and efficient adjunctive treatment prior to prosthetic restoration of a missing tooth in an atrophic alveolar ridge. Options for pre-prosthetic management of atrophic mandibular ridges include bone grafting, guided bone regeneration, and ridge expansion. These procedures can be complex and invasive, however, involving high failure rates, the risk of bone fracture, and the need for donor sites.[1,2]

Protraction of a second molar into the space of a missing first molar is a viable alternative when a sound third molar is present, but the thick cortical bone makes it difficult to maintain root parallelism during mesial movement, especially in the mandible (Fig. 1). Corticotomy is an alternative that can expedite space closure while maintaining control over tooth angulations in adult patients with long-standing edentulous sites. Surgical com-

Fig. 1 Cone-beam computed-tomographic image of patient with missing lower first molar and atrophied alveolar ridge.

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TABLE 1
PROS AND CONS OF CORTICOTOMY DESIGNS

Corticotomy Design	Pros	Cons
Circumscribed	• Limited surgical area involving target tooth only	• Higher risk of root injury • Possibility of damage to flap
Triangular	• Enhanced tooth movement by regional accelerated phenomenon (RAP) in target area	• Risk of root injury • Large flap size
Indentation	• Reduced risk of root injury • Applicable for thinner cortical bone • Smaller flap size	• Distal area of target tooth not strongly affected by RAP

plications, although rare, may include pain, root, nerve, and artery damage, as well as devitalization of teeth.

Wilcko and colleagues first combined accelerated tooth movement with corticotomy.[3,4] Other authors following similar approaches have reported increased rates of tooth movement.[5-7] Although faster treatment has been the main perceived benefit of this procedure, it also improves control of root positions, enabling space closure even through narrow, knife-shaped arches.

The present article introduces an efficient and practical space-closing modality utilizing corticotomy for bodily protraction of lower molars in narrow alveolar ridges.

Corticotomy Design

There are three basic types of corticotomy that might be planned in adult patients with missing lower first molars in atrophic alveolar ridges (Table 1):

1. Traditional or circumscribed corticotomy involves 2mm vertical and horizontal cuts in the cortical bone circumscribing the teeth to be moved (Fig. 2A). It can be used in cases of thin bony root coverage.
2. Triangular corticotomy describes the removal of triangular portions of the buccal and lingual cortical plates (Fig. 2B). It can be implemented when more efficient root movement is required or where the buccal cortical bone is too thin for decortication or indentation.
3. Indented decortication, a modification of the technique described by Wilcko and colleagues,[3] involves making several perforations on the buccal, lingual, and occlusal surfaces of the cortical plate with a round bur (Fig. 2C). The bone layer covering the root surface must be thick enough for this procedure.

In each of the three types of corticotomy, a flap is reflected by making a crevicular incision and vertical incisions mesial and distal to the target tooth. Appropriate cuts are then made through the full thickness of the cortical bone using a round bur at 800rpm under profuse saline irrigation.

Case 1: Circumscribed Corticotomy

A 26-year-old female presented with the chief complaint of protruded upper anterior teeth and chin (Fig. 3). Both lower first molars were missing due to extensive caries; the right first molar had been recently extracted, the left many years previously. Both upper first molars were overerupted, and the lower second molars were mesially tilted. Cephalometric analysis showed a skeletal Class III malocclusion with a horizontal growth pattern. The canines were in a Class II relationship, and the patient exhibited a severe

overjet and deep overbite. While the lower left third molar was fully erupted, the panoramic radiograph showed that both the upper and lower right third molars were impacted. There was a large vertical bony defect in the lower right quadrant due to the recent molar extraction.

After the patient declined any surgical intervention, a treatment plan was designed involving extraction of the upper first premolars to correct the proclined upper incisors, as well as corticotomy-assisted protraction of the lower molars to close the first-molar spaces.

The upper first molars were intruded with power chain to miniscrews (8mm long, 1.6mm in diameter*) inserted buccally and lingually between the upper second premolars and first molars on each side. The deep overbite was resolved through intrusion of the upper anterior teeth, using a reverse-curve archwire, and the lower anterior teeth, using anchorage from a specially designed miniplate between the lower incisors.

Nine months into treatment, uprighting and protraction of the mesially tilted lower second molars were initiated with bilateral corticotomies. Vertical cuts extending 2mm apical to the root apices were made with a No. 6 round bur, followed by a horizontal connecting cut circumscribing the second molars on each side (Fig. 4). After a one-week rest period, 200g of force was applied to each side with a power chain between the second-molar band and a hook fixed to the archwire distal to the canine. The lower first-molar spaces were then closed in 14 months using only conventional anchorage (Fig. 5). Overall treatment time was 42 months.

Treatment improved the patient's anterior protrusion and the axial inclinations of the molars (Fig. 6). Adequate overjet and overbite and a stable occlusion were achieved without discernible root resorption.

Case 2: Triangular Corticotomy

A 25-year-old female presented with missing lower left and right first molars (Fig. 7). The lower

*Jeil Medical Co., Seoul, Korea; www.jeilmed.co.kr.

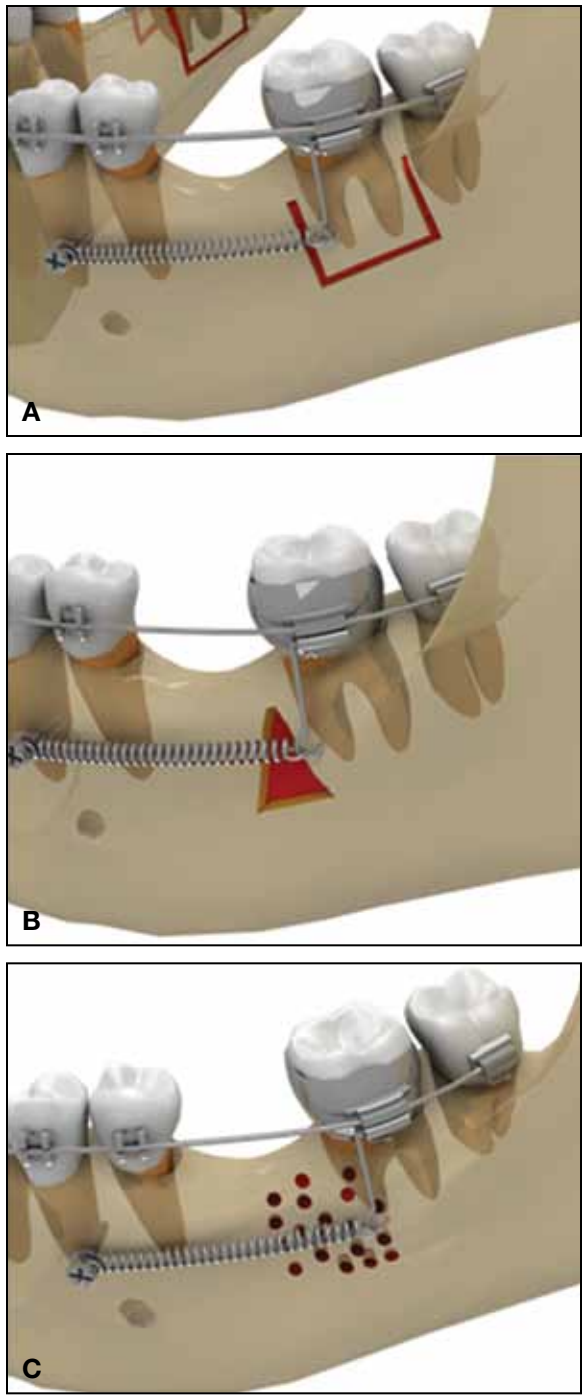

Fig. 2 Three types of corticotomy-assisted space closure with miniscrew anchorage. A. Circumscribed corticotomy. B. Triangular corticotomy. C. Indentation corticotomy.

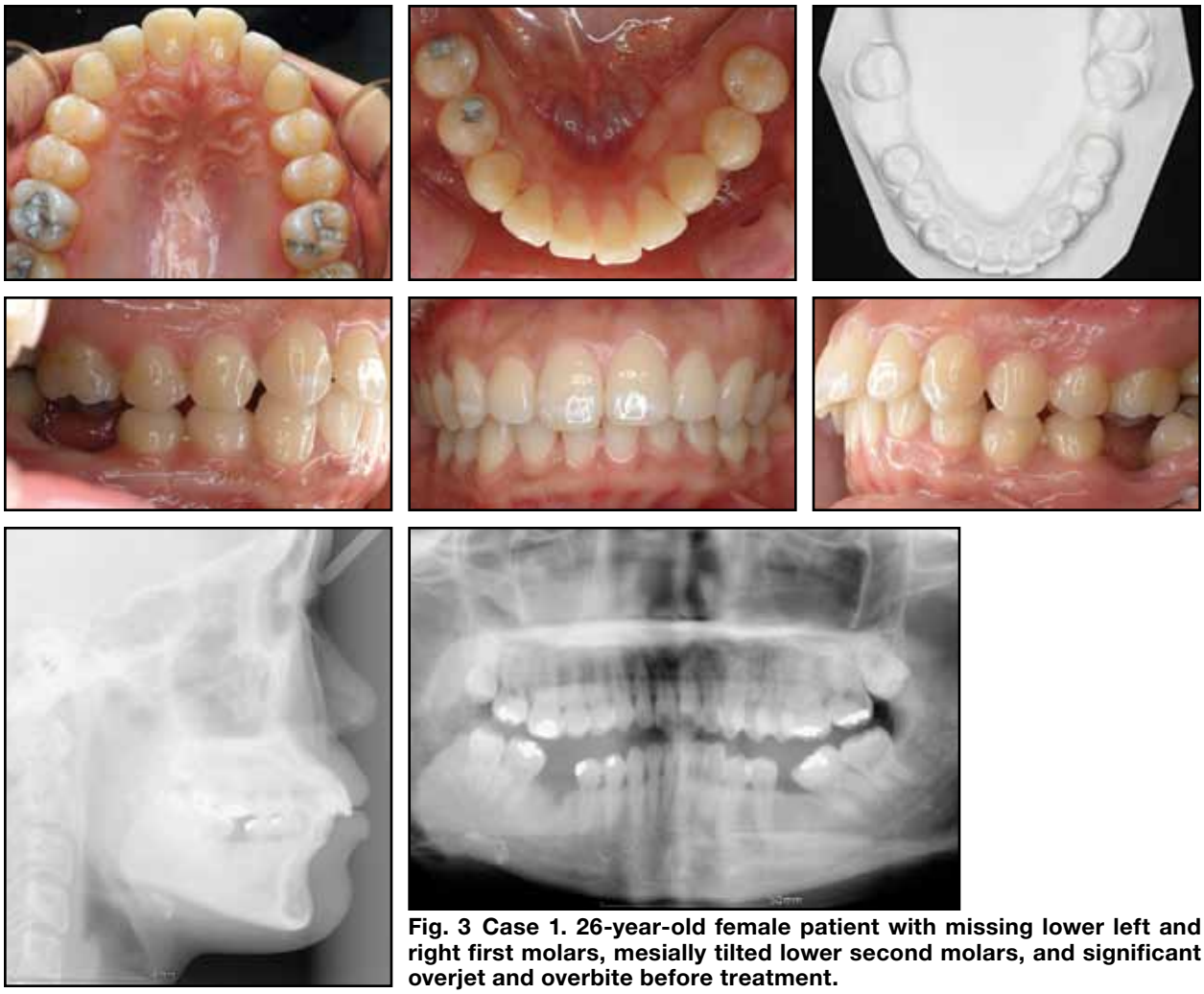

Fig. 3 Case 1. 26-year-old female patient with missing lower left and right first molars, mesially tilted lower second molars, and significant overjet and overbite before treatment.

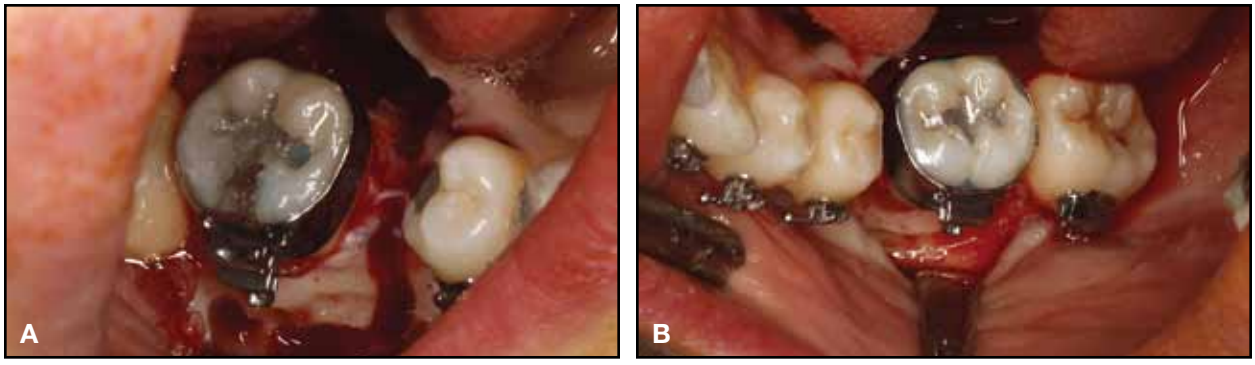

Fig. 4 Case 1. Incisions made with No. 6 round bur, circumscribing right (A) and left (B) lower second molars.

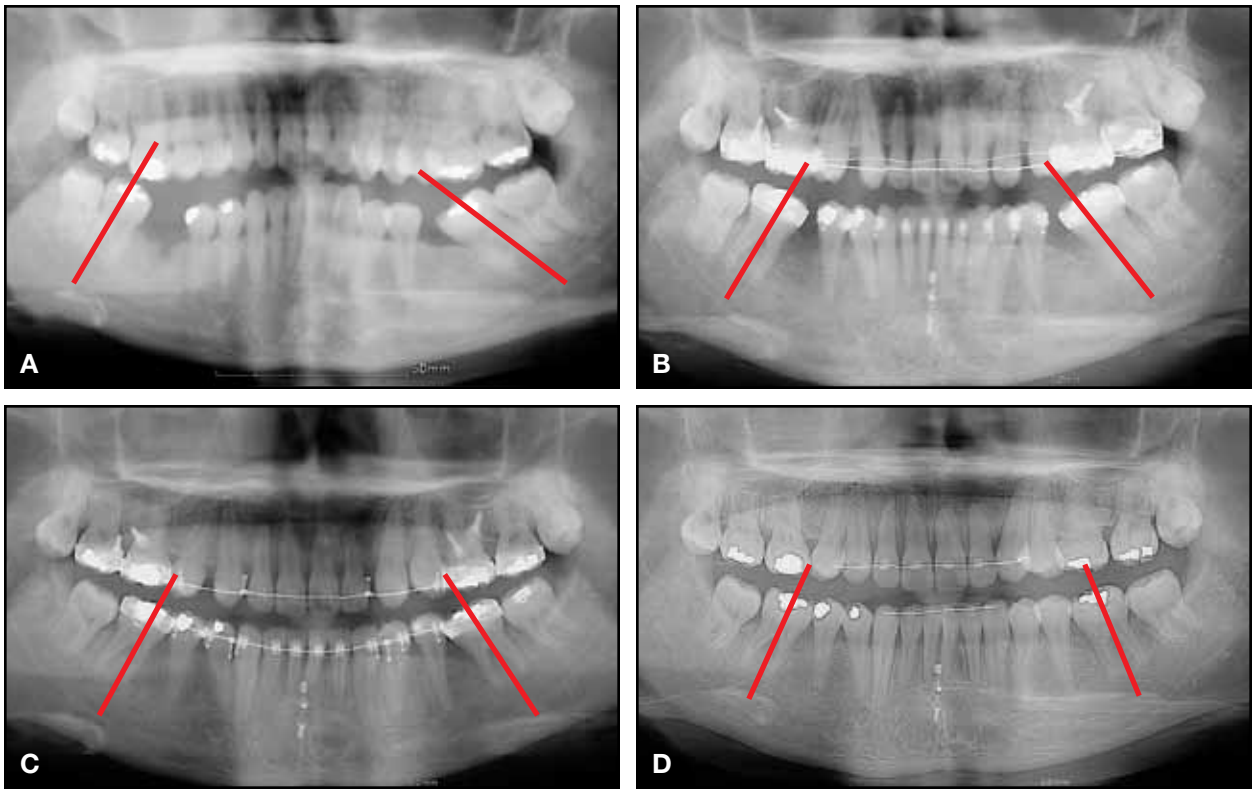

Fig. 5 Case 1. Panoramic radiographic views of treatment progress. A. Before treatment. B. Five months after corticotomies. C. Nine months later. D. After debonding.

Fig. 6 Case 1. Patient after 42 months of treatment.

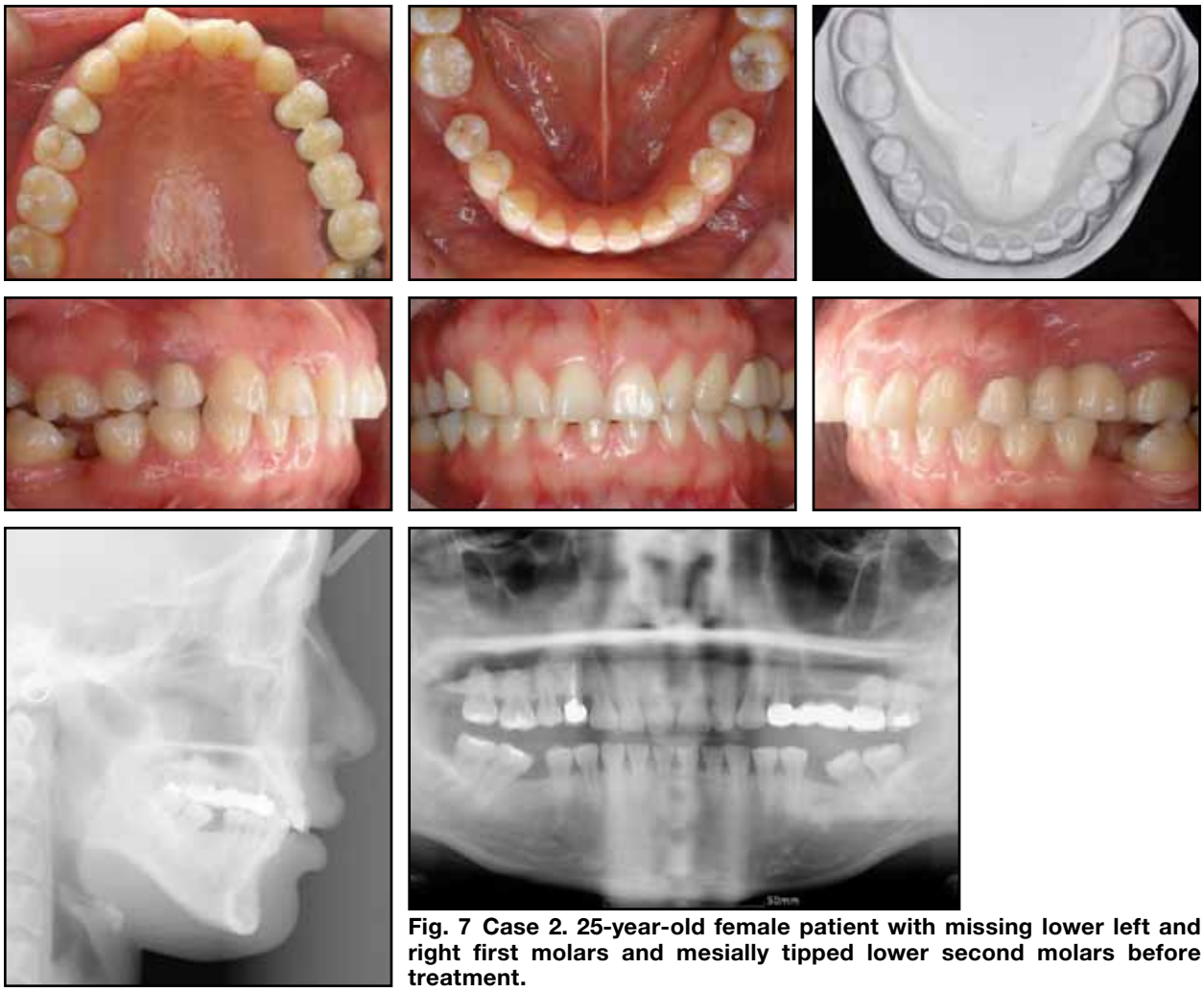

Fig. 7 Case 2. 25-year-old female patient with missing lower left and right first molars and mesially tipped lower second molars before treatment.

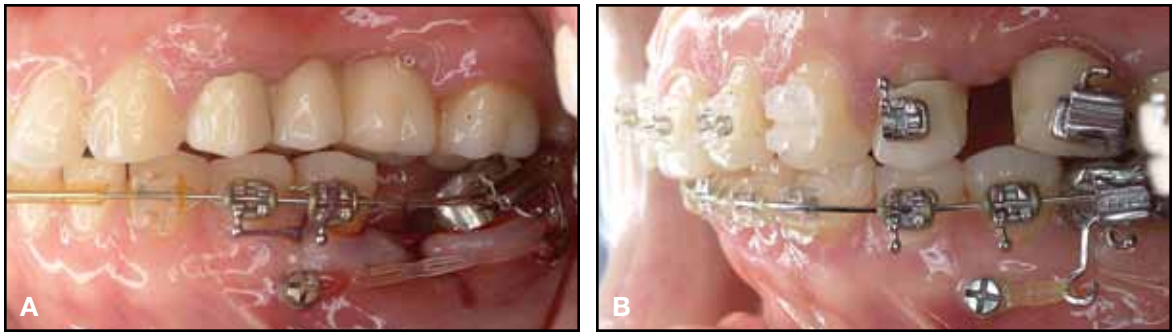

Fig. 8 Case 2. A. One week after buccal and lingual triangular corticotomies, protraction forces applied from power chain attached between buccal miniscrew and lever arm extending from lower left second-molar bracket. B. Upper left second-premolar pontic removed after 10 months of treatment.

Fig. 9 Case 2. A. Buccal and lingual triangular corticotomies mesial to lower right second molar. B. Lower first-molar spaces closed after eight months (patient's right) and 10 months (patient's left) of protraction.

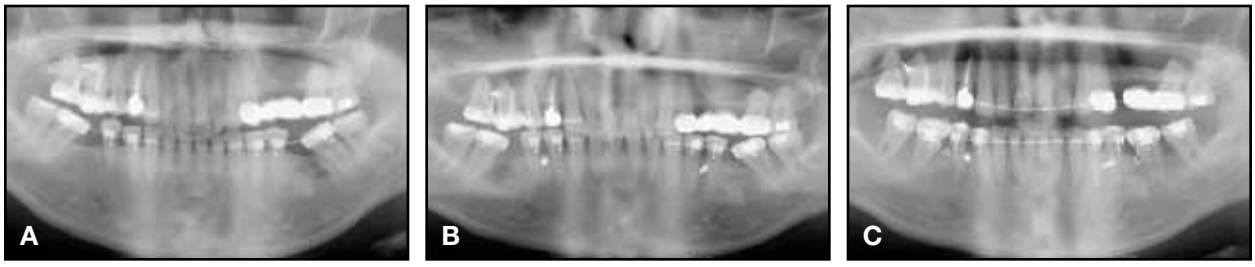

Fig. 10 Case 2. Panoramic radiographic views of treatment progress. A. After left-side corticotomy. B. Two months later, following right-side corticotomy. C. Seven months later.

Fig. 11 Case 2. Patient after early removal of appliances due to pregnancy, after 31 months of treatment.

second and third molars on both sides were tilted mesially, and the upper right first and second molars had overerupted. The upper left second premolar and first molar had been replaced by a four-unit fixed partial denture. The patient showed a Class II canine relationship and an upper-arch space discrepancy of about 5mm.

Treatment began with intrusion of the upper right first and second molars for three months. A triangular corticotomy was then performed in the lower left quadrant. Triangular sections (approximately 7mm per side) of the buccal and lingual cortical plates were removed using a No. 6 carbide round bur. One week later, a miniscrew was placed buccally between the lower left first and second premolars to serve as anchorage for protraction of the second and third molars. A power chain applying 200g of force was attached between the miniscrew and an arm extending from the second molar bracket, placing the power chain parallel to the archwire for bodily movement (Fig. 8A).

Two months later, the same procedures were followed in the lower right quadrant (Fig. 9A). After another eight months, both lower first-molar spaces had closed (Figs. 9B,10); the upper right first premolar was extracted, and the upper left second-premolar pontic was removed (Fig. 8B).

After a total 31 months of treatment, the patient requested early removal of the appliances due to pregnancy. She showed a mild Class II canine relationship and some spacing between the upper left first premolar and the first-molar pontic (Fig. 11). A new upper left fixed prosthesis was planned.

Case 3: Indentation Corticotomy

A 29-year-old female presented with a wide edentulous space from a missing lower left first molar (Fig. 12). She showed Class I canine and right-side molar relationships with moderate crowding and a deviated midline. The upper left first molar was slightly overerupted. The upper and lower left third molars had erupted, but the right third molars had been previously extracted. After the patient refused treatment involving a permanent dental implant in the lower arch, a plan was proposed to intrude the upper first molar using mini-implant anchorage and then perform an indentation corticotomy to assist in protraction of the lower left second and third molars.

The decortication was carried out on the cortical plates of the first and second molars using a No. 6 round bur (Fig. 13). In a modification of the procedure described by Wilcko and colleagues,[3] each root surface received approximately seven indentations, spaced about 1.5mm apart.

A miniscrew was placed between the lower left canine and first premolar to provide anchorage for molar protraction using power chain between the screw head and the second-molar hook. After two months, the screw failed due to mobility and was replaced with a miniscrew between the premolars.

Two months later, the space had been closed, mostly by mesial tilting of the lower left second molar. An uprighting spring was placed between the miniscrew and the lower left second molar for mesial root movement. After another eight months, full space closure could be seen due to bodily movement of the lower second molars (Fig. 14).

After a total 25 months of treatment, the canines and molars were in a Class I relationship, and the upper and lower midlines were coincident (Fig. 15). The post-treatment panoramic radiograph confirmed proper angulation of the lower left second molar.

Discussion

Selective alveolar corticotomy has been shown to shorten treatment, enhance stability, and open new possibilities for tooth movement.[8-10] Corticotomy-assisted space closure can be a viable treatment option in cases of atrophic alveolar bone and inappropriate crown/root ratios due to vertical bone loss. An early technique involving ostectomy of the alveolar extraction socket was reported to accelerate canine distalization into the first-premolar extraction space.[11] Later, Wilcko and colleagues applied selective alveolar decortication lines and cuts as deep as .5mm around the teeth to be moved.[12]

Gantes and colleagues have shown that tooth

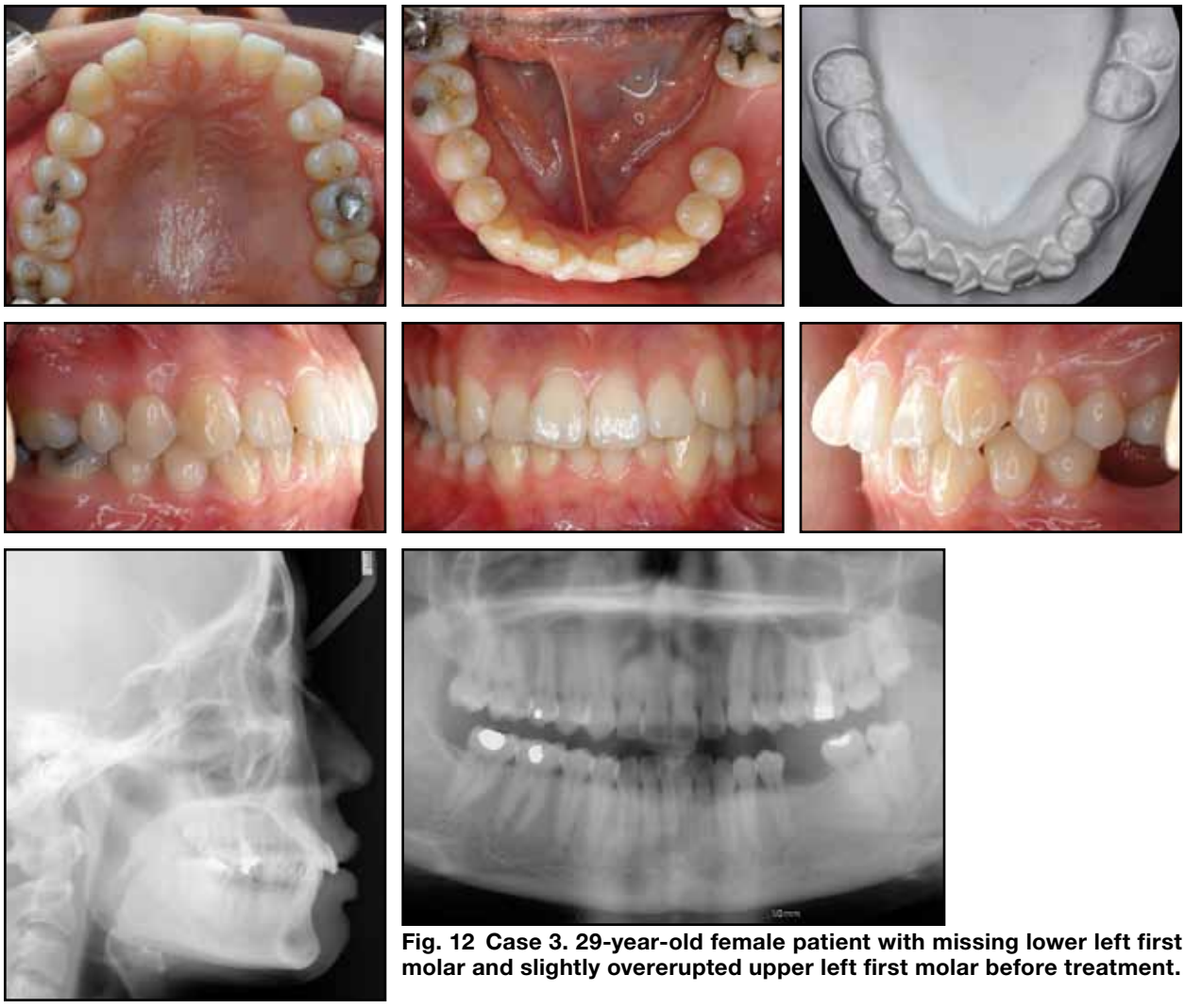

Fig. 12 Case 3. 29-year-old female patient with missing lower left first molar and slightly overerupted upper left first molar before treatment.

movement begins shortly after selective alveolar corticotomies.[13] Baloul and colleagues suggested that alveolar decortication enhances the rate of tooth movement during initial tooth displacement, resulting in a coupled mechanism of bone resorption and bone formation during the early stages of treatment.[14] Mostafa and colleagues found that corticotomy doubled the rate of orthodontic tooth movement in dogs.[15] The treatments described in the present article were all finished in about nine months. This reduced treatment time compared to conventional tooth movement might be due to the

Fig. 13 Case 3. Indentation corticotomy on buccal aspects of lower left first- and second-molar cortical plates.

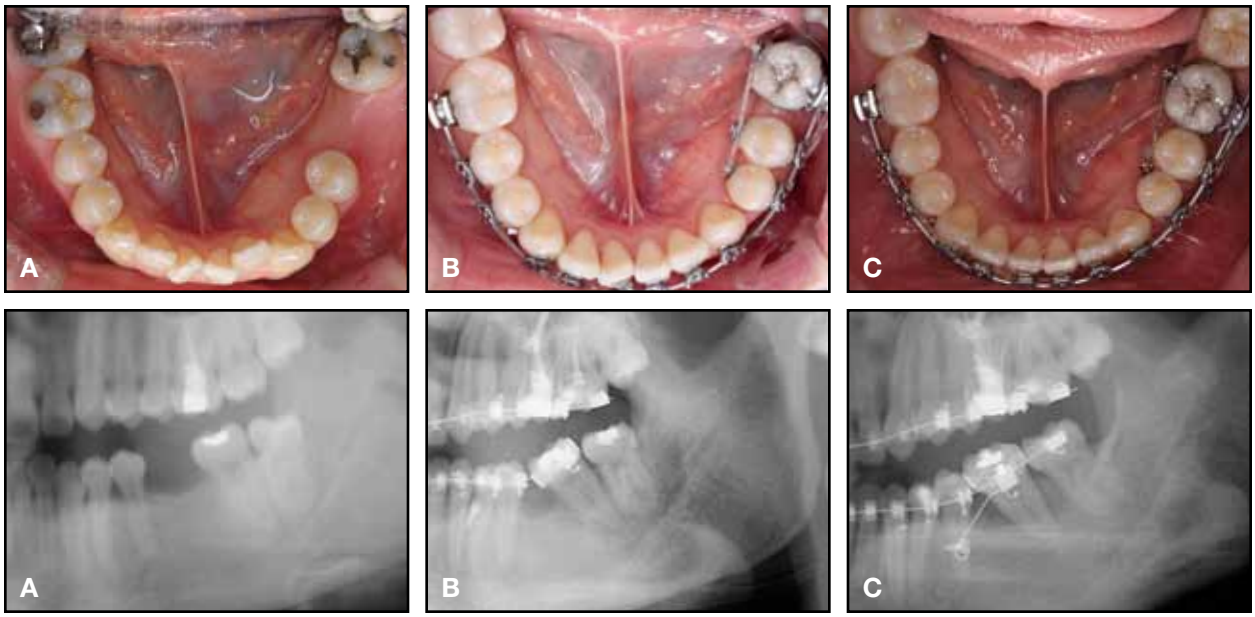

Fig. 14 Case 3. Progress of space closure. A. Before treatment. B. After two months of protraction. C. After 10 months of protraction and uprighting.

regional accelerated phenomenon (RAP).[16-18]

In each case shown here, leveling and alignment and intrusive movements were performed prior to the corticotomy to prevent interference with molar protraction. After corticotomy, protraction forces were applied with power chains or coil springs between miniscrews and long lever arms from the second-molar bands to ensure bodily movement.

In Case 2 (triangular corticotomy), the triangle's horizontal line extended to the final position of the second-molar root apex, and the occlusal-cortical plate was preserved to function as anchorage for additional root movement. The triangle's vertical and horizontal dimensions will depend on the root length and the size of the space to be closed, respectively. In a situation involving a wider mesiodistal space (as in the case of an upright second molar), a trapezoidal cut should be made, connecting points 2mm apical to the cemento-enamel junction and the apex of the mesial second-molar root with the intended final positions of those two points.

We found all three corticotomy procedures to be effective means of molar protraction in our patients, providing increased three-dimensional control without significant mesial tipping. Although the triangular design appeared to produce the most efficient root movement, further comparative studies of these methods are recommended.

Conclusion

Selective alveolar corticotomy can be a feasible treatment modality for adults with missing teeth when a fixed prosthesis or implant restoration is not possible or desired.

Fig. 15 Case 3. Patient after 25 months of treatment.

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