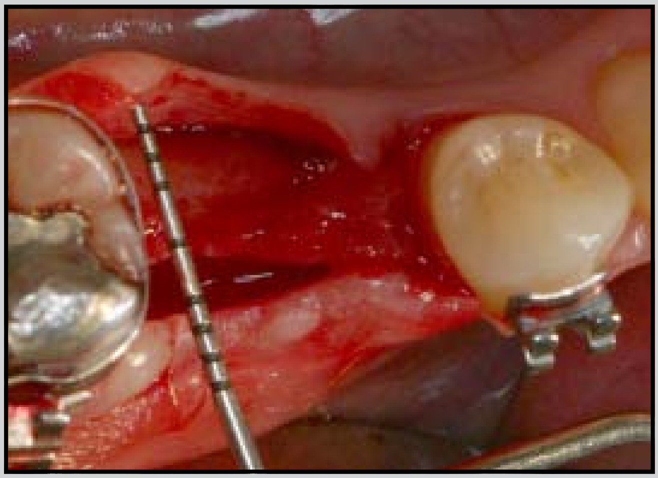

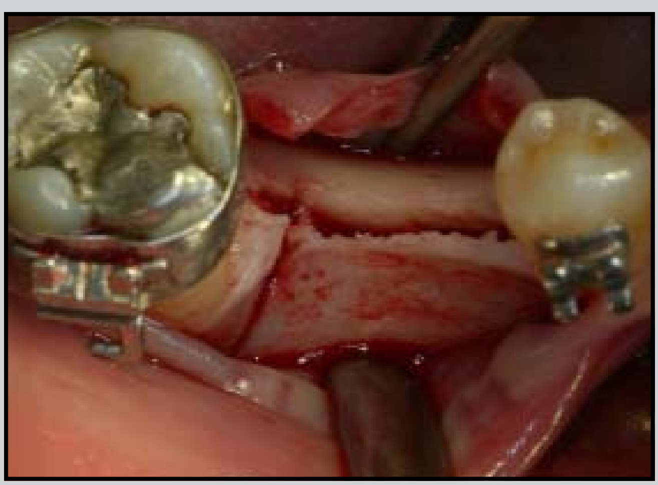

Rapid Orthodontic Treatment After the Ridge-Splitting Technique—A Combined Surgical-Orthodontic Approach for Implant Site Development: Case Report

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This article presents a clinical case of bilateral partial edentulism in the posterior mandible with severe horizontal and moderate vertical bone atrophy. A new technique using rapid orthodontics after ridge splitting is presented. The split-crest technique was carried out using piezosurgical instruments in the first molar and second premolar areas to widen the bone crest and open a channel for tooth movement. Immediately after, orthodontic appliances were used to move the first premolars distally and the second molars mesially into the surgical site. The rationale was to facilitate and accelerate orthodontic movement of the teeth, which is otherwise difficult in a cortical knife-edged ridge. The bone defect was filled with the alveolar bone of the adjacent teeth that were moved into the surgically opened path. Adequate bone volume for implant placement was generated in the first premolar area. Implants were then inserted, and the patient was rehabilitated. (Int J Periodontics Restorative Dent 2012;32:395–402.)

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Early loss or agenesis of posterior teeth is often accompanied by severe atrophy of the bone crest. Resorption occurs mostly and more rapidly in a horizontal direction, narrowing the ridge by up to 50% of its original dimension in the first 12 months.[1,2] Researchers have demonstrated that following tooth extraction, bundle bone resorption affects the alveolar buccal plate, resulting in horizontal collapse.[2,3] A successful procedure to solve horizontal defects is the split-crest technique.[4,5] This technique has proven to be successful in widening a narrow crest for implant placement.[6] Additional bone graft on the vestibular aspect is often suggested to increase the bone thickness and prevent bone resorption after expansion.[7] An alternative to surgical augmentation is horizontal (distal or mesial) tooth movement in the atrophic alveolar ridge.[8,9] Clinical reports[8–10] and research have shown that when a tooth is moved to an edentulous area with reduced bone width and height, the supporting periodontal tissue and alveolar bone are moved with it. In fact, on

Fig 1 *Initial panoramic radiograph showing several missing teeth and defects.*

Figs 2a and 2b (left) *Lateral and* (right) *occlusal views of the defect at the mandibular second premolar/first molar site.*

the tension side, bone and connective tissue are generated and maintain their original height and width, leaving behind an area in which an implant can be placed adequately without any grafting.[11] However, moving a tooth into a narrow alveolar ridge is clinically challenging, potentially slow, and risky.[12] More recently, the use of intrabony incisions has been advocated to accelerate orthodontic movements.[13,14] This technique has been used mainly to solve cases of crowding or to obtain arch expansion.[15] In this scenario, bone regeneration is necessary for the patient to receive an implant-supported fixed prosthesis to replace the missing teeth.

Case report

A 32-year-old woman presented to the authors' private practice with a chief complaint of an unesthetic smile and a desire to replace her missing teeth (Fig 1). Intraoral examination revealed an adequate overbite and overjet, transverse discrepancy, multiple-tooth agenesis, mesial tipping of the molars, absent anterior and lateral guidance, and severe atrophy of the edentulous areas. Specifically, the second premolar/first molar area presented with severe atrophy of the soft and hard tissues, a residual bone crest that was knife-edged with an advanced horizontal component, and a defect that yielded a moderate vertical component (Figs 2a and 2b).

Fig 3 (left) *Knife-edged ridge of the mandibular edentulous area.*

Fig 4 (right) *Horizontal crestal incision.*

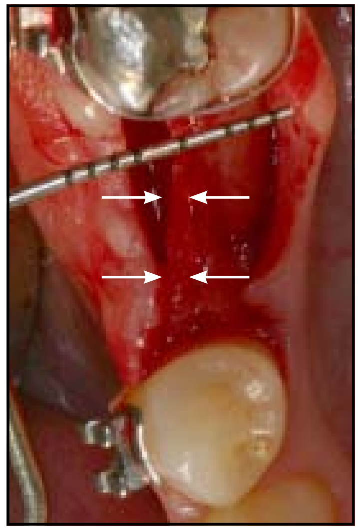


Fig 5 *Separated cortical plates created a channel to allow orthodontic-guided migration of the first premolars.*

The treatment plan included aligning the dental arches, leveling the occlusal plane, and correcting the occlusal scheme through use of orthodontics. A channel was created using Piezosurgery instruments (Mectron Medical Technology) in the edentulous areas to aid in the movement of adjacent teeth. The defects were filled with the alveolar bone of the moved teeth, and a space was created between the canine and first premolar to insert the implants. The treatment plan was to provide an implant-supported prosthesis.

Orthodontic appliances (Victory Series, 3M/Unitek) were placed in the maxilla and mandible; 10 months later, surgery was performed. A midcrestal incision was made using a no. 15C blade (Hu-Friedy). A mucoperiosteal flap was raised, and the knife-edged ridge was exposed (Fig 3). Using a Piezosurgery device, a horizontal midcrestal incision and two vertical releasing incisions were made through the cortical bone deep into the residual marrow space (Fig 4). The split-crest procedure was completed using an Ochsenbein chisel (Hu-Friedy) to separate the two cortical plates to create a path wide enough for orthodontic-guided migration of the adjacent teeth (Fig 5).

A collagen sponge was placed to keep the two cortical plates apart. The flap was closed using 4-0 silk sutures (Ethicon). Immediately after, an elastic chain was placed extending from the second molar

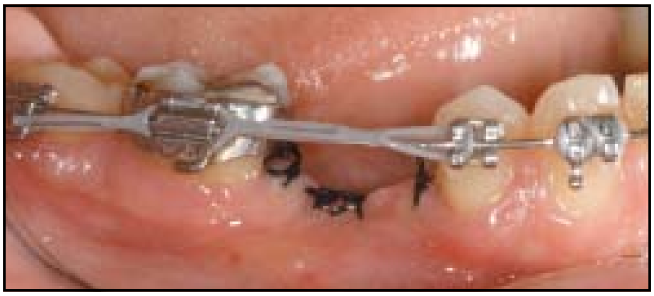


Fig 6 *Elastic chain was used extending from the second molar to the first premolar to allow movement in the newly created path.*

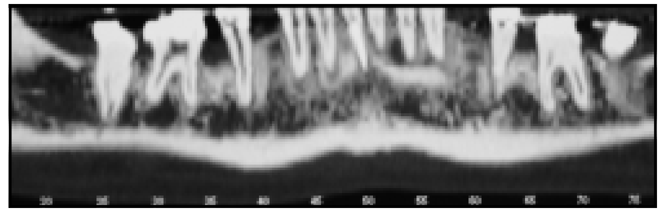


Fig 7 *CT scan showing the quality and quantity of the generated bone, which appears dense and cortical.*

Fig 8 *Implants used for orthodontic anchorage to complete the alignment.*

to the first premolar on both sides, and movement of the teeth into the surgically opened crest was initiated. A 0.019 × 0.025-inch stainless steel Hybrid (3M/Unitek) archwire was used to keep the movement as bodily as possible (Fig 6).

Nickel-titanium open-coil springs were later used to speed up the orthodontic movement. Seven months later, the first premolars had moved far enough distally to reach the second molars. The bone defect was then filled, and a 7-mm area of newly generated bone was left distal to the canine. A computed tomography (CT) scan was requested to assess the quality and quantity of the generated bone. The examination revealed an adequate amount of bone formation both in height and width. The quality of the newly formed bone appeared dense and cortical (Fig 7).

A 3.25 × 11.5-mm NT implant (3i Biomet) was placed on both sides of the mandible in the first premolar region, and healing abutments were inserted immediately. Two months after surgery, an impression was taken, and 2 weeks later, provisional crowns were placed on the implants. The implants were then used for orthodontic anchorage to complete the orthodontic therapy (Fig 8).

Discussion

Implant rehabilitation in atrophic posterior edentulous areas is often challenging. This is particularly true for the mandible because of the presence of the inferior alveolar canal and the prevalence of cortical bone. Guided bone regeneration has been proven successful,[7,16] but flap release, muscular tension, and lack of vascularization, together with a low supply of keratinized tissue, are obstacles to overcome for predictable results.[17,18] Split-crest techniques have been proposed to treat horizontal defects.[5] Clinical outcomes with ridge splitting have been proven to be predictable in the maxilla because of the presence of spongious medullary bone. The physical features of medullary bone include elasticity and flexibility; these properties allow atraumatic expansion. Clinical applicability of ridge expansion in the mandible is more difficult because of a lack of medullary bone and prevalence of cortical bone. Physical features of mandibular bone include a lack of elasticity and high resistance to expansion, which may result in bone fracture. New ultrasonic devices for bone sectioning have been proven successful in widening the narrow cortical bone crest to place implants with good primary stability, but flap opening and vestibular expansion of the cortical plate might be detrimental to bone survival.[6] In addition to the aforementioned anatomical limitations, the presence of a combined vertical defect would require an additional surgical procedure.[19]

Malocclusion, absence of an ideal amount of space for implant replacements, and tipping of the adjacent teeth into the edentulous area resulted in orthodontic therapy for this patient. Therefore, horizontal movement of the mandibular molars and premolars into the edentulous space was planned to "fill" the bony defect and leave the area previously occupied by the first premolar full of newly generated bone. Although this type of treatment has been proven effective,[8–11] clinical experience suggests that horizontal movement into a knife-edged ridge can be risky and inefficient. Such a ridge is constituted of mainly cortical bone, which has high mechanical resistance to tooth movement. Studies on orthodontic closure of remodeled edentulous spaces in the molar areas have suggested that incomplete space closure, bone dehiscence, loss of marginal periodontal attachment, long treatment times, and gingival invagination on the pressure side are potential adverse effects.[8,20–22]

In this clinical case, the alveolar ridge had a severe horizontal atrophy and the adjacent teeth had to be moved over a long span. However, the split-crest technique alone would not have taken care of the vertical component of the defect and could have been traumatic and difficult to perform in a knife-edged cortical crest.

Since surgical and orthodontic therapy each have limitations when performed alone, the two approaches were combined to form the rapid

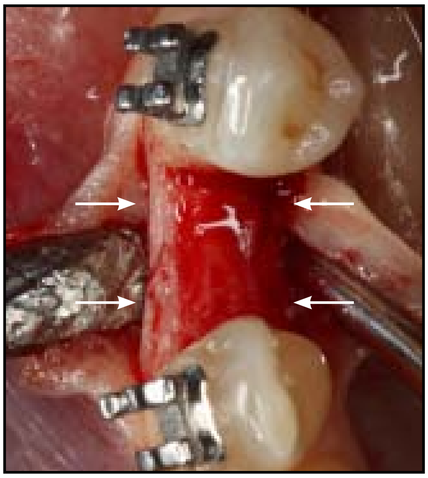
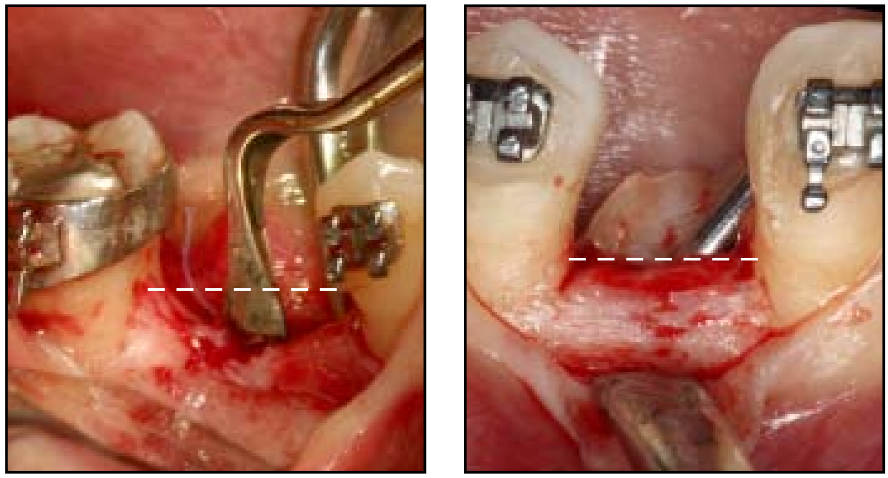


Fig 9 *Increased thickness of newly formed bone is evident.*



Figs 10a and 10b *Bone height* (left) *before and* (right) *after ROARS treatment.*

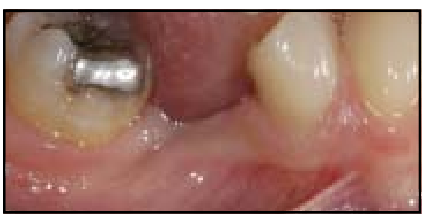


Fig 11a (above) *Narrow band of keratinized tissue seen at baseline.*

Fig 11b (right) *A wider band of keratinized tissue was noted at the end of treatment.*

orthodontics after ridge splitting (ROARS) technique. This synergistic strategy offers the clinician two advantages. The first is to overcome the anatomical obstacle to the orthodontic movement by surgical separation of the lingual cortical plate from the buccal one, opening a path wide enough to allow easier and faster tooth movement. The second is to use the tissue regenerative potentiality of the periodontium in the adjacent teeth to generate new bone and soft tissue by orthodontic movement. Combining the two techniques offers major advantages to each single approach: The surgery is less invasive and orthodontics is more effective. The outcome is an adequate amount of newly formed bone in both the horizontal and vertical directions with reduced risks and over a shorter period of time (Fig 9).

It is crucial to understand that the defect was both horizontal and vertical. The horizontal component was adjusted through surgery by opening the crest; the vertical component was solved through orthodontic tooth movement. The height of the newly generated bone was at the same level of the bone peak adjacent to the tooth that was moved. Therefore, the initial difference in height between the edentulous area and the alveolar bone peaks was corrected (Figs 10a and 10b).

Another advantage of this technique is that, together with the bone, an abundant quantity of soft tissue is generated. The newly formed band of keratinized tissue improves esthetic and mechanical resistance (Figs 11a and 11b).

Fig 12 *Definitive screw-retained restoration 1 year after implant placement.*

Fig 13 (right) *Radiograph showing a stable bone level at the 1-year follow-up.*

It is important to highlight that the presence of an intact alveolar support and healthy periodontium on the teeth adjacent to the atrophic area is a requirement to successfully apply this technique.[10] In fact, only a tooth that fits these requirements can be used predictably to fill the defect.

Treatment ended 1 year after implant placement with a screw-retained restoration (Fig 12). The final radiograph showed a stable bone level at the 1-year follow-up (Fig 13).

Conclusions

The technique presented is a valid alternative to regenerate bone and soft tissue in a knife-edged ridge. In clinical cases that need orthodontic treatment, the ROARS technique could be a successful option. Its clinical application is recommended only if the teeth adjacent to the defect have intact alveolar bone and a healthy periodontium.

Acknowledgment

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