Accelerated orthodontics with alveolar decorication and augmentation: A case report

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This case report reiterates the fact that selective alveolar decorication in conjunction with periodontal alveolar augmentation with a bone graft indubitably and efficaciously produces rapid orthodontic tooth movement. A 29-year-old woman presented with a Class I malocclusion and increased bidentoalveolar protrusion with increased spacing between the maxillary and mandibular incisors. She readily agreed to selective alveolar decorication in conjunction with periodontal alveolar augmentation with a bone graft when presented with the proposal that her malocclusion could be corrected in one-third the treatment time required for conventional orthodontics. A preadjusted edgewise appliance (Roth prescription, 0.022 × 0.028-inch slot) was placed prior to the surgical procedure. One week later, full-thickness labial and lingual flaps were reflected in the maxillary and mandibular arches. The alveolar bone was selectively decoricated and periodontally augmented with a bone graft. Starting 1 week postsurgically, orthodontic adjustments were carried out every 2 weeks. From bracketing to debacketing, the entire orthodontic treatment took 7 months. The rapid orthodontic tooth movement was attributed to the regional acceleratory phenomenon, triggered by selective alveolar decorication. The subsequent periodontal alveolar augmentation with the bone graft repaired the bony dehiscences and enhanced the bone volume and dramatically improved the patient’s soft tissue profile. ORTHODONTICS (CHIC) 2012;13:146–155.

Key words: alveolar decorication, periodontal alveolar augmentation, preadjusted edgewise appliance therapy, rapid orthodontic treatment

Accelerated osteogenic orthodontics (AOO) taps the innate potential of living bone. It is a procedure wherein selective decorication of the alveolar bone produces a transient burst in hard and soft tissue remodeling by a process known as the regional acceleratory phenomenon (RAP). The demineralization and remineralization phenomena triggers rapid tooth movement in concordance with efficient orthodontic treatment. This procedure is favored over the bony block movement advocated by Kole. Generson et al achieved rapid tooth movement with the single-stage corticotomy-only technique. Anholm et al, Gantes et al, and Suya reported rapid tooth movement with shortened treatment times with no adverse periodontal effects with corticotomy-facilitated orthodontic treatment. The structural integrity of the periodontium is enhanced with periodontal alveolar augmentation with a bone graft, thus producing an environment resistant to relapse. This causes an increase in the thickness of the alveolar bone at the cephalometric landmarks...
A-point\textsuperscript{9} and B-point,\textsuperscript{10} which considerably improves lip posture. Any pre-existing alveolar fenestrations over root prominences as well as the tell-tale signs of bony dehiscence formation can be effectively addressed with this procedure. The amalgamation of these two techniques—selective alveolar decortication and periodontal alveolar augmentation, called AOO—in conjunction with efficient orthodontic biomechanics paved the way for rapid tooth movement with shortened treatment time.\textsuperscript{11}

Goldie and King\textsuperscript{12} created osteoporotic conditions in rats and demonstrated enhanced tooth movement and decreased root resorption. Sebaoun et al\textsuperscript{13} also demonstrated an increase in apposition and resorption of rat alveolar spongiosa adjacent to the corticotomy site. Bogoch et al demonstrated an increase in apposition and resorption of rabbit tibia (long bone) spongiosa adjacent to the decortication site.\textsuperscript{14} These animal experiments lent further credence to this procedure.

To confirm the validity of these two time-tested procedures, selective alveolar decortication and periodontal alveolar augmentation with a bone graft was performed.

**CASE REPORT**

**Diagnosis and etiology**

A 29-year-old woman presented with forward placement of the maxillary and mandibular anterior incisors with excessive spacing and gingival recession in relation to the mandibular left central incisor.

**Extraoral assessment.** The patient had a mesoprosopic face, convex profile, posterior divergence, incompetent lips, average clinical mandibular plane angle, and complete maxillary incisal display on smiling, with no signs of temporomandibular joint dysfunction (Fig 1).

**Intraoral assessment.** Oral hygiene was satisfactory, with gingival recession and bony dehiscence in relation to the mandibular left central incisor. The nonvital maxillary right central incisor was endodontically treated prior to orthodontic treatment, and there was no history of pernicious oral habits.

The maxillary arch was U-shaped with severely proclined maxillary incisors and excessive spacing in between them. The mandibular arch was also U-shaped with proclined mandibular incisors, mesiolinguval rotation of the mandibular left central incisor, mesiolabial rotation of mandibular left lateral incisor, and mesiolabial rotation of the mandibular right lateral incisor, with gingival recession in relation to the mandibular left central incisor.

Increased overjet and deep bite were both observed. The maxillary and mandibular dental midlines coincided with each other and the skeletal midlines. On both sides, the molar relationship was Class I. The canine relationship was also Class I, and the curve of Spee was 3.5 mm (see Fig 1).
Radiographic assessment. The panoramic radiograph confirmed the presence of all permanent teeth and normal alveolar bone levels, except in relationship to the mandibular left central incisor (Fig 2).

Cephalometric analysis (Table 1) revealed a skeletal Class I pattern, with a nearly orthognathic maxilla and mandible. There was an average mandibular plane angle and severely proclined maxillary and mandibular incisors.
Treatment objectives
The main treatment objectives were to improve the soft tissue profile, achieve lip competence, and enhance smile esthetics. Since the maxilla and mandible were almost orthognathic, greater emphasis was laid on the correction of the increased bidentoalveolar protrusion, the excessive spacing present in the maxillary incisors, and the moderate spacing present in the mandibular incisors, in addition to the rotated mandibular anteriors and deep bite. A non-extraction approach was decided upon since adequate spacing was present in the maxillary and mandibular arches. Correction of the bony dehiscence in relation to the mandibular left central incisor was to be addressed with the bone graft. A composite resin veneer for the maxillary right central incisor, subsequent to completion of orthodontic treatment, was advised.

Treatment alternatives
Conventional orthodontics could have been performed but it would have taken 1.6 years to finish. Instead, the patient opted for AOO, since she preferred to complete treatment within a short period of time.

Treatment progress
Prior to the surgical procedure, preadjusted edgewise brackets (Roth prescription, $0.022 \times 0.028$-inch slot) were bonded, complete with transpalatal anchorage. The patient underwent selective alveolar decortication and periodontal alveolar augmentation with Grabio Glascera bone graft (Dorthom Medi Dents). Grabio Glascera is made up of bioactive, ceramic, composite, porous granules—50% bioactive glass and 50% hydroxyapatite.

Clinical procedure
One week before the AOO procedure, maxillary and mandibular 0.014-inch Ni-Ti archwires were engaged from second molar to second molar, with a transpalatal arch serving as an anchorage device.

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Cephalometric analysis</th>
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<tr>
<td>Variable</td>
<td>Norm</td>
</tr>
<tr>
<td>SNA (degrees)</td>
<td>82 ± 2</td>
</tr>
<tr>
<td>SNB (degrees)</td>
<td>80 ± 2</td>
</tr>
<tr>
<td>ANB (degrees)</td>
<td>2 ± 2</td>
</tr>
<tr>
<td>UI to NA (degrees)</td>
<td>22</td>
</tr>
<tr>
<td>UI to NA (mm)</td>
<td>4</td>
</tr>
<tr>
<td>LI to NB (degrees)</td>
<td>25</td>
</tr>
<tr>
<td>LI to NB (mm)</td>
<td>4</td>
</tr>
<tr>
<td>Go-Gn-SN (degrees)</td>
<td>32 ± 2</td>
</tr>
<tr>
<td>LI to A-Pog (mm)</td>
<td>1 ± 2</td>
</tr>
<tr>
<td>UI to SN (degrees)</td>
<td>102 ± 2</td>
</tr>
<tr>
<td>LI to MP (degrees)</td>
<td>90 ± 2</td>
</tr>
<tr>
<td>N-Me (mm)</td>
<td>123 ± 5</td>
</tr>
<tr>
<td>N-ANS (mm)</td>
<td>56 ± 3</td>
</tr>
<tr>
<td>ANS-Me (mm)</td>
<td>70 ± 5</td>
</tr>
<tr>
<td>E-plane (mm)</td>
<td>–2 ± 2</td>
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Under local anesthesia, surgery was performed on both the maxillary and mandibular arches. Labial and lingual sulcular incisions were made using a 12-BP blade around all remaining maxillary and mandibular teeth. No vertical releasing incisions were made. Flaps were reflected beyond the apices of the teeth, with care taken not to disturb any of the neurovascular bundles exiting the bone or the genioglossus attachment. The interdental papillae were reflected with full-thickness labial and lingual flaps (Figs 3 and 4).

The alveolar bone on the labial and lingual aspects of the anterior teeth to be moved was decorticated with round perforations made with a long shank surgical bur (Fig 5), accompanied with copious saline irrigation, penetrating just into the medullary bone. The areas around the first and second molars were left untouched since they would serve as anchorage units.

Five milliliters of the patient's blood was drawn and centrifuged to obtain platelet-rich plasma. Then, 1 mL of platelet-rich plasma, along with a few drops of calcium gluconate, was then mixed well with the Grabio Glascera granules. Periodontal alveolar augmentation (Fig 6) was done with Grabio Glascera bone graft to a thickness of 2 to 3 mm, and the full-thickness flaps were then returned to their original positions and sutured into place with one interrupted loop 3/0 suture interproximally (Fig 7). Postsurgically, amoxicillin (500 mg three times a day for 1 week) and anti-inflammatory drugs (three times a day for 1 week) were given. Chlorhexidine mouthwash was also advised. Suture removal was performed 1 week postoperatively, and nonsteroidal anti-inflammatory drugs (NSAIDs) were asked to be discontinued until orthodontic treatment was complete. Orthodontic treatment was commenced 1 week following surgery. Thereafter, adjustments were made every 2 weeks until treatment was finished (Figs 8 to 10).

**Treatment outcome**

The patient showed remarkable improvement in the correction of the increased bideoalveolar protrusion, spacing, rotated mandibular incisors, and deep bite in just 7 months. A Class I molar and canine relationship was also
achieved. This speedy treatment effect was most probably attributed to the RAP phenomenon. The alveolar fenestrations and bony dehiscence, in relation to mandibular left central incisor, were successfully addressed with the
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Fig 11  Posttreatment intra- and extraoral photographs.

Fig 12  Posttreatment (a) panoramic radiograph and (b) lateral cephalogram.

periodontal alveolar augmentation with the Grabio Glascera bone graft, which provided overall adequate alveolar bone volume. A pleasing facial profile resulted, as evidenced by the end-of-treatment cephalometric analysis (see Table 1) (Figs 11 to 14).
DISCUSSION

This case validates the evidence-based use of AOO. The shortened treatment duration with rapid orthodontic tooth movement that was observed could be attributed to the RAP phenomenon produced by the decortication procedure. The cancellous portion of the alveolar bone gets induced into a more pliable, transient, reversible, demineralized state called osteopenia. Osteopenia is a state of calcium depletion, occurring because of two processes—osteoclasia (surface resorption) and osteocytic osteolysis (osteon remodeling). This is a catabolic process, a resorption response resulting in decreased bone density, but with no change in alveolar bone volume. With demineralization, bone matrix transportation occurs and the remaining collagenous soft tissue matrix of the bone is transported with the root in the direction of movement.

The demineralization is followed by the anabolic process, a formation response wherein new bone is deposited and the osteoid matrix gets remineralized. As long as tooth movement continues, RAP is prolonged. When RAP dissipates, osteopenia disappears. The RAP commences a few days after surgery, peaks between 1 and 2 months when catabolic and anabolic responses are threefold higher, dissipates to a normal steady state by 11 weeks after surgery, and takes approximately 6 to 24 months to resolve completely.

This accelerated and intense regional healing response was utilized to correct the bidental protrusion and deep bite and rapidly close the wide existing spaces between the maxillary and mandibular incisors in just 7 months. Selective alveolar decortication is a physiologically driven process. Uninterrupted vascular supply to surgical areas is critical in maintaining the vitality of hard and soft tissues. The perforations made were as effective as the alternative circumscribed corticotomy cuts, since these perforations provided the necessary bleeding points and communications with the softer inner medullary bone. These communications then act as pathways through which new blood
vessels and pluripotential cells migrate from the medullary bone into the cortical plates. Then, these very pluripotential cells remove old bone and create new bone and make the cortical plates more vital and responsive to the forces of tooth movement. Bone luxation is contraindicated because it could lead to intrapulpal and intraosseous morbidity and can jeopardize the integrity of the neurovascular bundle exiting the apices of the teeth, resulting in devitalization.

Higher susceptibility to root resorption in adults is due to the periodontal ligament becoming less vascular, aplastic, and narrower; the bone becoming more dense, avascular, and aplastic; and the cementum becoming wider.18 Evidence suggests an association between orthodontic root resorption and the presence and removal of necrotic hyalinized periodontal ligament tissue.19 In the AOO procedure, though, root resorption is minimized due to bone matrix transportation.

It has been reported that patients with thinner mandibular cortices are at increased risk for dental relapse subsequent to decrowding.20 In adults, bony dehiscence formation over the roots after traditional orthodontic therapy resolves only partially during retention.21 The AOO procedure with the Grabio Glascera bone graft significantly improved the structural integrity of the periodontium, provided additional support for the roots of the teeth and perioral musculature, and also repaired the bony dehiscence in relation to the mandibular left central incisor. An added advantage to the periodontal health as a result of this procedure is that due to the shortened treatment times, relatively benign commensal bacterial biofilms have less time to assume qualitative changes and convert to destructive cytotoxic (periodontopathic) potential compared with that seen when fixed appliances are worn for 2 to 3 years.

Tooth movements were accomplished in 2 weeks with AOO procedure, as compared with conventional orthodontics in 6- to 8-weeks interval, and the orthodontic adjustments were performed every 2 weeks with the application of normal orthodontic forces.

RAP might be the contributing factor to the increased mobility of the teeth due to increased osteoclastic activity along the periodontal ligament surface following surgery.22 The patient was given fixed lingual retainers for retention, which creates an environment that fosters alveolar remineralization. Bone morphogenetic protein influences the primitive uncommitted stem cells to become more specific cell types in bone morphogenesis.23 Following cessation of active tooth movement, the growth protein component in the soft tissue matrix of the bone stimulates an increase in the osteoblastic activity, resulting in remineralization of the soft tissue matrix.24 It has been reported that during retention, clinical outcomes of periodontal AOO patients improved and did not relapse.25 In essence, the AOO procedure is in vivo tissue engineering, highlighting the ability to morph bone with orthodontic tooth movement, periodontal bone activation, and alveolar augmentation.26

CONCLUSION

In this case, treatment with conventional orthodontics would have taken 1.6 years to complete, but with the implementation of AOO, the teeth were moved three to four times faster, for a treatment duration of 7 months. This caused a dramatic reduction in the bacterial factors, with a consequent decrease in incidence of caries and infection.

The procedure had also caused an increase in the alveolar bone volume, which provided for an intact periodontium and an adequate zone of gingival attachment and interdental papillae with redressal of the gingival recession. There was no loss of tooth vitality nor apical root resorption, and parallelism
of the roots was well maintained. AOO is indispensable for those patients who desire the benefits of orthodontic treatment in a short period of time and is inevitably a useful adjunct in any orthodontist’s armamentarium.

REFERENCES