



RESEARCH ARTICLE

PERIODONTALLY ACCELERATED OSTEOGENIC ORTHODONTICS (PAOO) - A REVIEW  
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ABSTRACT

The periodontally accelerated osteogenic orthodontics (PAOO) technique is a combination of a selective decortication-facilitated orthodontic technique and alveolar augmentation. It provides an increased net alveolar volume after orthodontic treatment. The purpose of this article is to describe the history, biology, clinical surgical procedures, indications, contraindications and recent modifications of the PAOO procedure.

Key words:

Periodontally Accelerated Osteogenic  
Orthodontics (PAOO), Corticotomy,  
Osteogenic, Orthodontics, Rapid  
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INTRODUCTION

Adult patients seeking orthodontic treatment to correct esthetic and occlusal aberrations are increasing significantly. However, successful orthodontic treatment can be difficult in adult patients due to psychological and biological changes and may increase the duration of treatment. As the dent alveolar development ceases after a particular age; the average orthodontic treatment time for adults is considerably longer than for adolescent patients, ranging from 18.7 to 31 months (Wilcko et al., 2001). In addition, cell mobilization and conversion of collagen fibers is much slower in adults than in children so they are more likely to experience more periodontal complications like root resorption (because of an aplastic marrow) and less vascular periodontal membrane, as

well as denser, avascular, and aplastic bone (Reitan, 1985). Short treatment time is a constantly recurring request by many adult patients, hence clinicians have searched for alternative methods to accelerate tooth movement.

Historical background

Surgically assisted orthodontic tooth movement has been used since the 1800s. Corticotomy-facilitated tooth movement was first described by L.C. Bryan in 1893. Periodontists began using labial/lingual vertical corticotomy with subapical horizontal osteotomy to increase the rate of tooth movement based on Heinrick Köle's combined radicular corticotomy/supraapical osteotomy technique (Köle, 1959). Major active tooth movement can be accomplished in 6-12 weeks compared to average orthodontic treatment time for adults, ranging from 18.7 to 31 months (Vig, 1990; Kocadereli, 2002) In the 1990s, the Wilckobr others, by using computed tomography and their knowledge of corticotomy and Regional acceleratory

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phenomenon (RAP) patented the procedure as periodontally accelerated osteogenic orthodontics (PAOO) technique in 1995. Recently in 2008, Wilckobrothers (Wilcko *et al.*, 2008) introduced a new technique known as periodontally accelerated osteogenic orthodontics (PAOO) which is the combination of selective decortication-facilitated orthodontics technique and alveolar augmentation. This technique has various advantages like reduced treatment time, less root resorption due to decreased resistance of cortical bone, more bone support due to the addition of bone graft, history of relapse reported to be very low, and less need for extraoral appliances and headgear.

### Biology Underlying PAOO

The rapid tooth movement produced after PAOO is substantially different than periodontal ligament cell-mediated tooth movement. It is the movement of teeth due to demineralization and remineralization of the alveolar bone around the tooth by a normal healing process<sup>1</sup>. Recent evidence suggests a localized osteoporosis state, as a part of a healing event called regional acceleratory phenomenon (RAP), may be responsible for the rapid tooth movement after PAOO (Schilling *et al.*, 1998). Frost (1983 and 1989) in 1983 described RAP, he noted that the original injury accelerates the normal regional healing processes. RAP is a cascade of physiologic healing events; it can reduce the duration of hard and soft-tissue healing stages by two- to tenfold. RAP in humans begins within 10 days of surgery, typically peaks at 1 to 2 months, and may take from 6 to more than 24 months to subside.

### Case Selection

PAOO can be used to accelerate tooth movement in most of the cases requiring orthodontic treatment. It is particularly effective in treatment of moderate to severe crowding, in Class II malocclusions requiring expansion or extractions, and mild Class III malocclusions (Wilcko, 2001; Shih, 1985).

### Indications (Dibart, 2009)

- Dehiscences and fenestrations on the prominent root surfaces. PAOO not only prevents formation of new fenestrations and dehiscences, it can also correct existing ones ultimately leading to increased bone volume.
- Anterior open bites and deviated midlines.
- Crossbites and tooth size arch length discrepancies upto 10 mm to 12 mm.
- Except for severe Class III skeletal dysplasia, PAOO can replace orthognathic surgery.
- Moderate-to-severe malocclusions in both adolescents and adults.

### Contraindications (Dibart, 2009)

- Patients with severe active periodontal disease and inadequately treated endodontic problems.
- Patients on medications such as bisphosphanate, NSAIDs, steroids which disturb bone remodeling.

### The Surgical Technique (Suchetha *et al.*, 2013)

PAOO is a clinical procedure that combines selective alveolar corticotomy (whereby only the cortical bone is cut, perforated

or mechanically altered), particulate bone grafting and the application of orthodontic forces. The medullary bone is not changed. The orthodontic activation is done the week before the surgical aspect of PAOO is performed. In all cases, initiation of orthodontic force should not be delayed more than two weeks after surgery to take full advantage of RAP.

### Flap Design

The basic flap design is a combination of a full thickness flap in the most coronal aspect of the flap and a split-thickness dissection performed in the apical portions on both surfaces of alveolus. Vertical releasing incisions are given if required.

### Decortication

The purpose of the decortication is to initiate the RAP response. Vertical corticotomy cuts are made between the roots using a diamond round bur (size 1, 2), stopping just short of the alveolar crest (about 3 mm). These cuts are connected beyond the apices of the teeth with scalloped horizontal cuts. The corticotomies may also be achieved with a piezoelectric knife.

### Particulate Grafting

Grafting is done in most areas that have undergone corticotomies. The volume of the graft material used is dictated by the direction and amount of tooth movement predicted, the pretreatment thickness of the alveolar bone and the need for labial support by the alveolar bone and treat any recession.

### Closure Techniques and Patient Management

The sutures that approximate the tissues at the midline are placed first to ensure the proper alignment of the papillae followed by interproximal sutures and closure of any vertical incisions. The sutures are usually left in place for one to two weeks. Antibiotics and analgesics are administered at the clinician's preference. However, long-term postoperative administration of nonsteroidal anti-inflammatory agents is discouraged, because they may theoretically interfere with RAP. Two weeks postsurgery, accelerated orthodontic treatment can be resumed.

### Advantages of PAOO (AlGhamdi, 2010)

Reduced treatment time

- Less root resorption due to decreased resistance of cortical bone.
- More bone support due to the addition of bone graft.
- Low relapse rate
- Can be used to expedite the rate of movement of individual teeth or dental segments, i.e., canine and incisor retraction.

### Disadvantages of PAOO

- Extra surgical cost.
- Mildly invasive surgical procedure. Post-surgical crestal bone loss and recession may occur.
- Possibility of pain, swelling, infection
- Not applicable to all cases.

## Modifications in the PAOO Technique

### Piezocision/ Corticision

“Corticision” was introduced to achieve accelerated tooth movement with minimal surgical intervention. In this technique, there is use of reinforced scalpel and a mallet to go through the gingiva and cortical bone without raising a flap. The surgical injury created is enough to induce the RAP effect (Park, 2005; Kim *et al.*, 2009). Limitations of this procedure include the inability to graft soft or hard tissues during the procedure and repeated malleting, may cause dizziness after surgery (Peñarrocha *et al.*, 2008). Therefore, use of a new minimally invasive procedure referred to as “piezocision.” was introduced (Shih, 1985). This approach combined microincisions to the buccal gingivae that allow the use of the piezoelectric knife to *Peizocision* decorticate the alveolar bone to initiate RAP. This procedure allows for hard-tissue or soft-tissue grafting via selective tunnelling to correct gingival recessions or bone deficiencies in patients.

### Use of Bone Grafts alone and along with membrane

Grafting is done in most areas that have undergone corticotomies. The most commonly used materials are deproteinized bovine bone, autogenous bone, decalcified freeze-dried bone allograft, or a combination. The use of platelet rich plasma or calcium sulfate has been reported to increase the stability of the graft material. Gingival recession can be treated using connective tissue graft or acellular dermal matrix allograft.

### Orthodontic microsurgery

Vercellotti<sup>19</sup> proposed use of orthodontic microsurgery to maximize the rapid movement and prevent damage to the periodontal tissues known as monocortical tooth dislocation and ligament distraction (MTDLD). The OT7 microsaw of the piezoelectric unit was used to perform the vertical and horizontal corticotomies on the buccal side, whereas the OT8 microsaw was used for the horizontal corticotomies on the palatal side. Dental movement occurs via dislocation of the root and the cortical bone together, without compression of the periodontal ligament and bone resorption. Compared to conventional orthodontic approaches, the average duration of treatment in maxillae and mandibles was reduced by 70% and 60%, respectively. Orthodontic microsurgery was associated with minimal morbidity and found to be a promising means of improving and simplifying orthodontic therapy in adult patients.

### Summary

PAOO was found to be an effective treatment approach in adults to decrease treatment time. Corticotomy with simultaneous augmentation by using bone grafts provided sufficient alveolar bone volume for the correction of anterior crowding without risk of formation of periodontal defects. Use of piezosurgical microsaws was advantageous than conventional surgical burs for selective alveolar corticotomies because of less force necessary to produce a cut and reduce risk of bone damage as a result of overheating. With the increasing number of adults considering orthodontic treatment, the PAOO technique can be an especially attractive treatment option and be a “win-win” situation for both the periodontist and the orthodontist.

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