# Periodontally accelerated osteogenic orthodontics - A review

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## ABSTRACT

Due to the increasing number of adult patients seeking orthodontic treatment, there is always a need to look for ways to accelerate tooth movement. Periodontally accelerated osteogenic orthodontics (PAOO) is a clinical procedure that combines alveolar bone corticotomy, particulate bone grafting and the application of orthodontic forces. This procedure is based on bone healing pattern known as the regional acceleratory phenomenon. This procedure results in an increase in alveolar bone width, shorter treatment time, increased post treatment stability and decreased amount of apical root resorption. Tooth movement can be enhanced, and cases completed with increased alveolar volume providing for a more intact periodontium, decreased need for extractions, degree of facial remodeling and increased bone support for teeth and soft tissues, thereby augmenting gingival and facial esthetics. The purpose of this article is to describe the history, biology, surgical techniques, advances, advantages, disadvantages and possible complications of the PAOO procedure.

**Keywords:** Osteogenic orthodontics; alveolar bone; remodelling; tooth movement; corticotomy.

## INTRODUCTION

There is an increase in the number of patients seeking orthodontic treatment for correction of mal-positioned teeth. However, there are several physiological, biological, and clinical differences between the orthodontic treatment procedures of adults and adolescents (1). Treatment for adults involves more specific objectives such as facial and dental esthetics, and the duration of treatment. Growth is an insignificant factor in adults compared to children. Adult patients show slower rates of cell mobilization and conversion and are more prone to periodontal complications since their teeth are confined in non-flexible alveolar bone (2).

Keeping in mind these considerations, orthodontic treatment for adults poses as challenging and different and necessitates special concepts and procedures. The development of corticotomy assisted orthodontic treatment offers solutions to the limitations of orthodontic treatment in adults. This technique provides an increased net alveolar volume after orthodontic treatment. This method has several advantages such as a reduced treatment time, differential tooth movement, enhanced expansion increased traction of impacted teeth, and more post orthodontic stability. This technique has shown that teeth can be moved 2 to 3 times further in 1/3 to 1/4$^{th}$ the time required for traditional orthodontic therapy (3).

A corticotomy is a procedure where only the cortical bone is cut, perforated or mechanically altered in a controlled surgical manner and penetrates into the bone marrow very minimally. This differs from an osteotomy, which is a surgical cut through both the cortical and medullary bone (4).

Conventional orthodontics involves a cell-mediated process predominantly within the periodontal ligament. Sustained forces applied on a tooth causes pleomorphic fibroblasts to get converted into osteoblasts and osteoclasts are derived from influx of blood borne monocytic precursors. Bone resorption occurs in the areas of periodontal ligament reassure and bone apposition occurs in the areas of periodontal ligament tension. The massive cell death and hyalinization zone which are common features on conventional orthodontic treatment, may take 3 to 5 weeks to get eliminated or repaired, the time during which orthodontic tooth movement may not occur. The rapid tooth movement in corticotomy facilitated tooth movement is because of the increased bone turnover in response to surgical trauma. This results in localized decrease in trabecular bone density, which in turn would offer less resistance to tooth movement. Remodelling of bone tissues after trauma is greatly increased to accelerate the repair process and consequent functional recovery. The healing response is thus accelerated in both the hard and soft tissues of the periodontium. Enhancing the clot stabilization around particulate bone grafting materials can provide 3 to 4 times faster orthodontic tooth movement, increases the envelop of motion and alveolar density (5).

### Review of Literature

The PAOO procedure was first introduced by Dr. William Wilcko and Dr. Thomas Wilcko. It is patented

as Wilckodontics (6). Wilcko *et al.,* reported a study that was conducted on 2 patients who presented with class I molar relation with crowding of maxillary teeth along with some amount of constriction in the maxilla. Fixed appliance was placed on both patients and the arch wires were engaged 1 week before the corticotomy procedure. Surgery was performed, and the surgical site was covered by bone graft. This study showed that corticotomy facilitated orthodontic tooth movement decreased the treatment time in both cases and the overall treatment time was completed in 6 months and 2 weeks (3).

Kole's procedure involved the reflection of full thickness flaps, followed by interdental cuts through the cortical bone, without penetrating the medullary bone. However, the sub apical horizontal cuts connecting the interdental cuts were osteotomy in style, penetrating the full thickness of the alveolus. It was suggested that blocks of bone was being moved rather than individual teeth, root resorption would not occur and retention time would be minimized. This invasive nature of treatment made the technique unacceptable (7). Suya reported an improved surgical procedure which differed from Kole's technique where the horizontal osteotomy cut was replaced with a supra apical horizontal corticotomy. This technique was described as being less painful, producing less root resorption and exhibiting less relapse (8). Duker used Kole's basic technique to investigate how rapid tooth movement with corticotomy affects the vitality of teeth, and the periodontium. The health of the periodontium was preserved by avoiding the marginal crest bone during the corticotomy cuts and it was concluded that neither the pulp nor the periodontium was damaged after orthodontic tooth movement (9).

Giray and Kocadereli conducted a study on a patient with severe anterior crowding, anterior cross bite, class III dental relationship. The 4 premolars were extracted and corticotomy was performed on the labial side with orthodontic therapy for retraction of lower anterior teeth. There was reduced treatment time without any adverse effect on the periodontium and vitality (10). Fischer performed a study to check the orthodontic treatment acceleration with corticotomy assisted exposure of palatally impacted canines. One canine was surgically exposed using a conventional surgical technique while the contralateral canine was exposed using a corticotomy assisted technique. After the tooth movement was complete, comparison between the two methods showed a reduction of the treatment time of 28-33% for the coticotomy assisted canines (11). Abbas and Mohamed performed a study to identify the effects of corticotomy facilitated orthodontic technique on orthodontic tooth movement compared to the non-surgical standard orthodontic technique. It was concluded that the corticotomy procedure increases orthodontic tooth movement and reduces the duration of treatment compared to the non-surgical standard orthodontic techniques (12).

Seifi *et al.,* performed a study with the aim to introduce orthodontic tooth movement by reducing the cortical bone layer following Erbium-Chromium doped Yttrium Scandium Gallium Garnet (Er-Cr:YSGG) laser irradiation without reflection of the soft tissue flap. This laser assisted corticotomies enhanced the rate of orthodontic tooth movement on the intervention side significantly (13). Bhat *et al.,* treated six adult patients with bimaxillary protrusion in which extraction of upper and first premolars were planned. The modified corticotomy procedure was carried out using local anaesthesia. It was concluded that corticotomy assisted orthodontics is an effective treatment alternative in adults with severe malocclusion to decrease treatment time, and increase quality of treatment (14). Bhattacharya *et al.,* conducted a study among patients who required orthodontic treatment with extraction of 1st premolar and divided into control and corticotomy groups. The pre and post retraction CT scans were recorded and concluded that alveolar corticotomy not only accelerates the orthodontic treatment, but also provides the advantage of increased alveolar bone width to support the teeth and overlying structures (15).

**Surgical techniques**

*Principle:* Unlike usual corticotomy, PAOO does not just cut into the bone, but decorticates it, which means that some of the bone's external surface is removed. What follows next is a phase of Osteopenia, where the mineral content of the bone is temporarily decreased. The tissue of the alveolar bone releases rich deposits of calcium and the new bone begins to mineralize in 20-40 days. While the alveolar bone is in the transient state, the orthodontic appliance can move teeth very quickly and because the bone is softer and there is less resistance to the force of the fixed appliance. The orthodontist determines the plan for the movement, which involves identifying the teeth which will provide anchorage and those portions of the arch that will be expanded or contracted. In class II malocclusions requiring retraction, the anchorage is established before the PAOO procedure (16).

The placement of the brackets and activation of the wires is usually done one week before the corticotomy procedure is performed. Initiation of orthodontic force should not be delayed more than 2 weeks after surgery. The time taken for accelerated tooth movement is usually a period of 4-5 months after which finishing

movements occur with a normal speed. Within this period or rapid movement, the orthodontist needs to advance arch wires sizes rapidly. The basic flap design is a combination of a full thickness flap in the coronal portion and split thickness flap in the apical portion. Split thickness is done to provide mobility of the flap so that it can be sutured with less tension. The periosteal layer is removed to provide access to the alveolar bone and helps to identify underlying neurovascular structures. Inter dental papilla is preserved to obtain better esthetics. In case of anterior teeth, tunneling can be done from the distal aspect. The decortication process is done using a No. 1 or No. 2 round bur and peizo electric knife. The groove is placed between the root prominences which extends 2-3 mm below the crest of the bone. The vertical corticotomies are then connected with circular shaped corticotomy. Care should be taken to prevent damage to the underlying structures.

Grafting is done in the areas that have undergone corticotomies. Volume of the graft material depends on the direction and amount of tooth movement, thickness of alveolar bone and need for bone support. Materials that are used for bone grafting include autogenous bone, deproteinized bovine bone graft, decalcified freeze dried bone allograft. The use of materials like platelet rich plasma or calcium sulphate increases the stability of the graft material. Flaps are approximated and closed with non-resorbable sutures. No packing is required. The sutures are moved after 1-2 weeks (17).

The PAOO procedure can take several hours to complete while treating both dental arches. Usage of short term steroids also enhances patient comfort and clinical healing. Antibiotics and pain medications are also administered. The most commonly reported post-surgical complications are oedema and ecchymosis. The application of ice packs to the affected area can help to reduce the severity of post-operative swelling or oedema. The patient is instructed to return for post surgical evaluation and prophylaxis every week for the first month, and then monthly thereafter.

**Modifications of the techniques**

The PAOO procedure can be combined with gingival augmentation procedures, in case of patients with significant gingival recession. In such cases, a sub epithelial connective tissue graft is placed over the denuded root surface in addition to particulate graft placement. The graft is harvested by removing 1 to 2 mm thickness of gingival connective tissue from elevated palatal flap (4).

*Advantages:*

- Decreased treatment time
- Less likelihood of relapse
- Increase in the limits of tooth movement and decreased need for extractions
- Alveolar reshaping enhances patient profile
- Increased alveolar volume and a more structurally complete periodontium.

*Disadvantages:*

- Mildly invasive procedure and has a risk of swelling, pain, and possible infection
- Contraindicated in patients who take NSAIDs on a regular basis and patients with chronic health problems
- Expensive procedure.

**Advances in surgical techniques**

- Conventional Piezocision: Usage of piezo surgery in conjunction with the conventional flap (17).
- Novel Piezocision: Microincisions limited to the buccal side using the piezoelectric knife and selective tunneling for hard or soft tissue grafting (18).
- Corticision: Usage of reinforced scalpel and mallet to go through the gingival and cortical bone without raising flap (19).
- Alveocentesis: Micro osteoperforation technique, performed using PROPEL system (20).
- Photobiomodulation: Laser is used to stimulate osteoblastic and osteoclastic lineage which is helpful in bone remodeling process. Accelerates tooth movement by 30% (21).
- Accledent: Non-invasive procedure based on micro impulses to hasten tooth movement (22).

## CONCLUSION

PAOO has been proven to significantly reduce the treatment time taken for orthodontic procedures in adults. It enhances esthetics and post orthodontic stability, and increases the access of patients towards orthodontic therapy.

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