

## Periodontally Accelerated Osteogenic Orthodontics-A Review

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**Abstract:** Dentistry has always come up with wonders when different specialities work hand in hand. Periodontally accelerated osteogenic orthodontics or popularly Wilckodontics is one such wonderful treatment modality which helps in reducing the treatment time by relieving patients of their tedious orthodontic appointments. The technique combines buccal and lingual flap decortications of the bone together with particulate bone grafting and fixed orthodontic treatment. The desired result is obtained within about one third the time needed for conventional technique. The chances of root resorption and relapse have also been found to be reduced with this novel technique. This paper highlights the importance of the underlying Regionally Accelerated Phenomenon and the Periodontal Surgical technique as well as various indications, contraindications, merits and demerits of the technique.

**Keywords:** Periodontally accelerated osteogenic orthodontics, Regional acceleratory phenomenon, Decortication, Particulate bone grafting

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### I. Introduction

Interdisciplinary dentistry has always worked wonders when the amalgamation has been done in the proper manner. The surgical procedure called Periodontally Accelerated Osteogenic Orthodontics or popularly called Wilckodontics can be termed as an amalgamation of Periodontics, Orthodontics and even Oral and Maxillofacial surgery. The periodontium comprises of gingiva, periodontal ligament, cementum and alveolar bone. The alveolar bone is the most mineralized of all and is not an easily malleable tissue. It has its own dynamicity and to regulate its remodeling capacity has always been a challenge on the periodontic as well as orthodontic front. One of the most important reasons why patients are reluctant to wear many orthodontic appliances is its longer duration of treatment. The modern arena of interdisciplinary dentistry or better called "interdisciplinodontics" even has taken traditional orthodontic tooth movement protocols and synthesized periodontal engineering and regenerative surgery, toward a method of rapid tooth movement and also reduces side effects, like root resorption, relapses, inadequate basal bone, bacterial caries and infection<sup>1</sup>

Periodontally accelerated osteogenic orthodontics (PAOO) is an amalgamation of two procedures, alveolar decortication and periodontal augmentation, and has been shown to facilitate rapid orthodontic tooth movement<sup>2</sup> Periodontally accelerated osteogenic orthodontics (PAOO) is a clinical procedure that combines selective alveolar corticotomy, particulate bone grafting, and the application of orthodontic forces. This is theoretically based on the bone healing pattern known as the regional acceleratory phenomenon (RAP). Its results in an increase in alveolar bone width, shorter treatment time, increased post treatment stability, and decreased amount of apical root resorption.

### II. History

Dr. Ilizarov researched the phenomenon and proved that stressing a bone increases metabolic activity and cellular generation, also known in orthopedic science as bone remodeling, resulting in growth of new bone. The phenomenon was named Distraction Osteogenesis. The first surgically assisted orthodontic tooth movement has been documented since the first century<sup>3</sup>. L.C. Bryan in 1893, first described corticotomy facilitated tooth movement. However in 1959, Heinrich Krole<sup>4</sup> described a more morbid technique as a means for rapid tooth movement which involves vertical inter-radicular corticotomy both facially and lingually and are joined with osteotomy cuts 10mm supra-apically. According to his concept, teeth are moved due to the movement of bony blocks of bone with orthodontic forces. Due to the obstruction to the continuity of bone after corticotomy, the segments of bone in which teeth are embedded could be moved rapidly and independent of each other. 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. Duker et al conducted an experiment on beagle dogs in 1975 and demonstrated that rapid tooth movement could be achieved by orthodontic appliances after weakening the bone by corticotomy<sup>10</sup>. The rapid tooth movement does not affect the vitality of the teeth which have been moved. The health of the periodontium is also maintained by avoiding corticotomy of the marginal bone. Recently in 2008, Wilcko et al 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 increases the net alveolar volume after orthodontic treatment by using bone grafts which consists of demineralized reduce the treatment time to 1/3 rd the time of conventional orthodontic treatment.

### **Mechanism Of Regional Acceleratory Phenomenon**

Orthopaedist Herald Frost in 1983 recognised that surgical wounding of osseous tissue results in striking reorganising activity adjacent to the site of injury (in osseous/ soft tissue surgery). He collectively termed this cascade of physiologic healing events –“The Regional acceleratory phenomenon” (RAP)<sup>5,6</sup>The RAP is a local response of tissues to noxious stimuli by which tissue regenerates faster than normal in a regional regeneration/remodeling process<sup>7</sup> This response varies directly in duration, size, and intensity with the magnitude of the stimulus. The duration of RAP depends on the type of tissue, and usually lasts about four months in human bone. This phenomenon causes bone healing to occur 10-50 times faster than normal bone turnover<sup>8</sup>

The healing phases of RAP have been studied in the rat tibia. There is an initial stage of woven bone formation, which begins in the periosteal area and then extends to medullary bone, reaching its maximal thickness on day seven. This cortical bridge of woven bone is a fundamental component of RAP, providing mechanical stability of bone after injury. From day seven, the woven bone in the cortical area begins to undergo remodeling to lamellar bone, but woven bone in the medullary area undergoes resorption, which means transitory local osteopenia. It seems that medullary bone needs to be reorganized and rebuilt after establishment of the new structure of cortical bone, and to adapt to the reestablishment of cortical integrity (three weeks in rats). There is also a systemic acceleratory phenomenon (SAP) of osteogenesis due to systemic release of humoral factors<sup>8</sup>

In human long bones, following surgical injury, RAP begins within a few days, usually peaks at 1-2 months, and may take from 6 to 24 months to subside completely . RAP results in a decrease in regional bone densities (osteopenia) in healthy tissues whereas the volume of bone matrix remains constant.Orthodontic force application alone is a stimulant sufficient to trigger mild RAP activity. But when tooth movement is combined with selective decortication, RAP is maximized<sup>1</sup>. However, in 2001 Wilcko et al revisited the original technique of bony block movement with some modifications.He attempted two cases with severely crowded dental arches, and speculated that the dynamics of physiologic tooth movement in patients who underwent selective decortication which might be due to a demineralization-remineralization process rather than bony block movement. They suggested that this process would manifest as a part of RAP that involves the alveolar bone after being exposed to injury (corticotomy) and during active tooth movement.

### **Proper Case Selection**

PAOO can be done on people of any age, as long they have a healthy periodontal situation. According to DrWilcko, the technique has been done on children as young as age 11 and on senior citizens as old as 77. PAOO can be used in most cases in which traditional fixed orthodontic therapy is used.

### **Indications**

- 1.Class I malocclusions with moderate to severe crowding
- 2.Class II malocclusions requiring expansion or extraction.
- 3.To accelerate canine retraction after premolar extraction
- 4.To enhance post orthodontic stability
- 5.To facilitate the eruption of impacted teeth
- 6.In molar intrusion and open bite correction
- 7.To facilitate slow orthodontic expansion

### **Contraindications**

1. Patients with dental bone loss
2. Periodontal disease
3. Root damage or poor roots.
4. Patients having disease like rheumatoid arthritis which requires regular doses of NSAIDs
5. Class III condition, in which the lower jaw is too long relative to the rest of the face and chin protrudes. Also they have many physical constraints which may not lend themselves to PAOO treatment<sup>9</sup>
6. Patients on long term steroid therapy due to the presence of devitalized areas of bone
7. Patients with compromised width of attached gingiva

### **Surgical Technique**

Accurate patient selection is crucial for the success of the procedure. After the treatment plan has been discussed by the orthodontist and the periodontist, orthodontic brackets are placed and a light wire engaged a week before the surgical procedure<sup>1</sup>. Surgery can be carried out with or without sedation.

### **Flap design**

The objectives of flap design are

1. provide access to the alveolar bone to perform corticotomies
2. to provide coverage of the bone graft
3. to maintain the height and volume of the interdental tissues
4. to enhance the esthetic appearance of the gingival form.

After administration of local anesthesia, sulcular releasing incisions are made lingually and buccally. Full-thickness flaps are carefully reflected buccally and lingually in the coronal aspect of the flap with a split thickness flap reflected at the apices of the teeth to allow mobility of the flap to enable the flap to be closed under minimal tension. Correct identification of the neurovascular structures is important to prevent damage to them. The flaps should be extended beyond the corticotomy sites mesially and distally to prevent vertical releasing incisions. The interdental papilla can be reflected with the flap or left in place. However, the interdental papilla between the maxillary central incisors is preserved for esthetic purposes. After flap reflection, the area is thoroughly debrided and curettage done to remove any inflamed tissue, if present.

### **Decortication**

Corticotomy is defined as a surgical procedure whereby only the cortical bone is cut, perforated or mechanically altered. Decortication should just be enough to initiate the RAP response and not to create bone segments<sup>10</sup>. Alveolar bone is activated with selective decortications performed lingually and labially using round burs with water irrigation. Corticotomies can also be achieved using piezoelectric knife<sup>11</sup>. Vertical corticotomy cuts are made just short of the alveolar crest between the roots of teeth. The corticotomy extends from a point 2-3 mm below the crest of the bone to a point 2mm beyond the apices of the roots. These cuts are connected by scalloped horizontal corticotomy cuts. Cortical perforations are made at selected areas to increase the blood supply to the graft material<sup>12</sup>.

### **Particulate grafting**

Bone graft materials are placed in decorticated areas. The most commonly used materials include deproteinized bovine bone, autogenous bone, decalcified freeze dried bone allograft, or a combination of these. Wilcko et al introduced the use of mix of demineralized freeze-dried bone with bovine bone and clindamycin. The particulate bone graft can also be wet with plate-rich plasma to facilitate the placement of the graft and to increase the stability of the graft material. The volume of particulate bone graft used is 0.25-0.5ml per tooth. Excess amount of grafting material should be avoided to prevent interference with flap placement. Connective tissue graft or acellular dermal matrix allograft ( Alloderm ) can be used to treat any recession cases<sup>1</sup>.

### **Closure**

The flaps are approximated with non resorbable interrupted sutures without excessive tension. The specific suture used is based upon the thickness of the tissues<sup>18</sup>. The sutures are then left in place for a minimum of 2 weeks. For the epithelial attachment to re-establish itself, it is important to allow the sutures to be left for a sufficient period of time. Premature suture removal may lead to flap displacement, dark triangles, and gingival recession<sup>1</sup>. No packing is required.

### **Post surgical orthodontics**

An immediate heavy orthodontic force should be applied on the teeth after flap repositioning. The initiation of orthodontic force should not be delayed more than 2 weeks as there is limited amount of time to accomplish accelerated tooth movement.

### **Post surgical management**

Antibiotics, analgesics and antiseptic mouthwash should be prescribed to the patient. Long-term administration of nonsteroidal anti-inflammatory agents is discouraged as these may interfere with the regional acceleratory process. To decrease any postoperative swelling, ice packs can be applied to the affected areas. The patient should be recalled to the periodontist every 3 months during orthodontic treatment for the assessment of periodontal health and oral hygiene status<sup>13</sup>.

### **Advantages**

1. Enhanced scope malocclusion treatment ( i.e., an increase in the limits of tooth movement and a decreased need for extractions)
2. Decreased treatment times (increased rate of tooth movement)
3. Increased alveolar volume and a more structurally complete periodontium(correction of preexisting fenestrations and dehiscence)
4. Alveolar reshaping, enhances patient's profile
5. Simultaneous recovery of shallow unerupted teeth
6. In certain situations, the additional alveolar bone can also provide improved lip posture
7. Less likelihood of root resorption.
8. History of relapse has been very low
9. There is less need for appliances and head gear
10. Both metal and ceramic brackets can be used

### **Disadvantages**

1. Expensive procedure
2. Mildly invasive procedure and like all surgeries it has risk of some pain, swelling, and the possibility of infection.
3. Patients who take NSAIDs on a regular basis or have other chronic health problems will not be treated with this technique.

### **III. Conclusion**

PAOO has expanded the realm of traditional orthodontic tooth movement (OTM) protocols. It has been found to have a greater role in those cases of young females in our country who are coming to see an orthodontist a few weeks before their marriage when they feel a lack of esthetics. Still more research is needed in this area to expand the sphere of this technique to newer indications and situations. Long term follow up studies and randomized controlled clinical controls will be a watchword in this regard.

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