

**WILCKODONTICS: AN INNOVATIVE ACCELERATED APPROACH IN  
INTERDISCIPLINARY TREATMENT STRATEGY**

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**ABSTRACT**

The systematic interdisciplinary treatment approach is shared by several dental specialties especially periodontics. In the present era where lot of people are seeking orthodontic treatment, the multidisciplinary treatment approach for quick and better results cannot be overlooked. Also, orthodontic treatment frequently results in undesirable periodontal changes since the teeth are confined to the nonflexible alveolar bone. To accelerate the tooth movement the orthodontists and the periodontists together have worked out a success formula which is termed Periodontally Accelerated Osteogenic Orthodontics (PAOO) or this method has been suggested to enhance tooth movement and, consequently, reduces orthodontic treatment time as a whole. This method not only enhances the width of the alveolar bone but also decreases the duration of the treatment and chances of apical root resorption, reducing the chances of relapse. A proper case selection, careful surgical procedure and accurate orthodontic movements are important for the success of wilckodontics. Thus, this article attempts to review the historical perspective of these therapeutic approaches, discusses the biological reasons underlying its use, mentions its main indications and contraindications and its modifications.

**KEYWORDS:** Regional accelerated phenomenon, Alveolar corticotomies, Accelerated orthodontics,

**INTRODUCTION**

Synergistic treatment between Orthodontic and periodontics specialties helps in developing harmony that results in less damage to components of periodontium, the soft tissue around crown and the attachment apparatus that connects the root to bone.<sup>[1]</sup> Also, Rapid orthodontic tooth movement can be achieved with synchronization of tissue engineering principles of periodontal regenerative surgery. So, specialists worked together in a technique called wilckodontics that allows teeth to be moved 2-3 times further in 1/3rd to 1/4th the time required for traditional orthodontic treatment.<sup>[2]</sup> Wilckodontics is periodontally accelerated osteogenic orthodontics (PAOO) otherwise called corticotomy facilitated osteogenic orthodontics. This clinical procedure combines selective alveolar corticotomy, particulate bone grafting and the application of orthodontic forces.<sup>[3]</sup> This is based theoretically on the healing pattern of bone known as regional acceleratory

phenomenon (RAP).<sup>[4]</sup> Wilckodontics results in the following: a) An increase in width of alveolar bone, b) Shorter treatment time, c) Greater post treatment stability, d) Decreased apical root resorption.<sup>[5]</sup> The surgical wounding of alveolar bone potentiates tissue reorganization and healing by a way of transient burst of localized hard and soft tissue remodelling.<sup>[6]</sup>

**Historical Background**

Surgical aid is being used in orthodontic tooth movements (OTM) since 1800. LC Bryan in the year 1893 first described the corticotomy –facilitated tooth movement, in a text book called ‘Orthodontia’: Malposition of the Human Teeth, Its Prevention and Remedy. However in 1959, Heinrich Krole described a more morbid technique as a mean for rapid tooth movement which involves vertical inter-radicular corticotomy both facially and lingually and are joined with osteotomy cuts 10mm supra-apically named as

combined radicular corticotomy or supra apical osteotomy technique. 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.<sup>[7]</sup> The term bony block arose from Kole's work, to describe the suspected mode of movement after corticotomy surgery. Rapid tooth movement was believed to occur with surgical preparation of the alveolus, suggesting that the continuity and thickness of the denser layer of cortical bone offered the most resistance to tooth movement.<sup>[8]</sup>

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. 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.<sup>[9]</sup>

In the early 1990s, Dr Wilcko's, using computed tomography, discovered that reduced mineralization of the alveolar bone was the reason behind the rapid tooth movement following corticotomies. They used their knowledge of corticotomy and their observations of RAP to develop their patented periodontally accelerated osteogenic orthodontics (PAOO) technique in 1995. It is based on a treatment method combining selective alveolar decortication, alveolar augmentation and orthodontic treatment.<sup>[10]</sup> This method of PAOO is patented as "Wilckodontics". Based on the emerging concepts of Wilcko brothers.<sup>[11]</sup> Recently, William Wicko and Thomas Wilcko have demonstrated rapid orthodontic tooth movement following selective labial and lingual decortication of alveolar bone in the area of desired tooth movement using a technique called accelerated osteogenic orthodontic tooth movement (AOOTM).

#### **Biomechanics of PAOO Procedure**

Heinrich Kole in 1959 reported that decortications would lead to movement of bone blocks leading ultimately to rapid tooth movement.<sup>[11]</sup> In 2001, Wilcko et al reported that rapid tooth movement was not the result of movement of bony blocks but is due to the demineralization and remineralization of the alveolar bone around the tooth by a normal healing process known as regional acceleratory phenomenon (RAP).<sup>[12]</sup> Orthopedist Herald Frost, 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>[13,14]</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. The decortication of bone results in an increased turnover of alveolar spongiosa with areas of alveolar demineralization. This results in osteopenia, where its mineral content temporarily decreased which enables teeth to be moved more rapidly and further through the collagenous soft tissue matrix of the bone.<sup>[15]</sup> Following the completion of orthodontic treatment, remineralization takes place resulting in greater stability in the orthodontic treatment outcome. RAP causes bone to heal 10-50 times faster. Following surgical injury in human long bone, RAP begins within a few hours, maximum action is usually reached in 1-2 months and usually may take 6-24 months to complete. Application of orthodontic force can stimulate or trigger mild RAP activity. RAP can be maximized when selective decortication is combined with tooth movement. To sum up, surgically assisted periodontally driven orthodontic treatment is a combination of bone regeneration (somatic cell therapy) and gene therapy (alteration of gene expression). Tissue engineering principles and periodontal regeneration in PAOO, is an entirely new technology in dentofacial orthopedics, to obtain a steady state tissue response to accomplish orthodontic tissue movements rapidly.<sup>[15]</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>[16]</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.<sup>[14]</sup> RAP results in a decrease in regional bone densities (osteopenia) in healthy tissues where as the volume of bone matrix remains constant.<sup>[17]</sup> 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. 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 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.<sup>[18]</sup>

#### INDICATIONS

- a. Resolve crowding and shorten treatment time.
- b. Accelerate canine retraction after premolar extraction
- c. Enhance post orthodontic stability
- d. Facilitate eruption of impacted teeth
- e. Facilitate slow orthodontic expansion
- f. Molar intrusion and open bite correction

#### V. Contraindications

- a. Patients with severe active periodontal disease.
- b. Patients with inadequately treated endodontic problems.
- c. Patients on long term medications which will slow down bone metabolism, such as bisphosphonate and NSAIDs. NSAIDs lead to prostaglandin inhibition resulting in reduced osteoclastic activity thus disturbing bone remodeling.
- d. Patients on long term steroid therapy due to the presence of devitalized areas of bone.

#### Case Selection and Treatment Planning

In PAOO, case selection and treatment plan are combined effort of the orthodontist and periodontal surgeon. Orthodontist determines the OTM plan, arch segment to contract or expand and anchorage units. The periodontal surgeon considers the periodontal status, muco-gingival conditions and esthetic needs of the patient.<sup>[19]</sup> To take full advantage of RAP procedure the orthodontic bracket bonding and activation of arch wire should be performed within two weeks. Anchorage must be established before PAOO procedure in class 2 malocclusions. Adjustments should be done at 2 week interval, during active orthodontic treatment period to decrease the risk of recalcification in mid treatment. Appropriate motivation for proper maintenance of oral hygiene should be given. Muco-gingival surgeries if required should be done before bracketing.

#### Surgical Technique

**1) Flap design:** Full access to the surgical site is the ideal requisite of flap design. Mesial and distal extension is decided and vertical releasing incisions are avoided. Gingival collars are preserved on both palatal and buccal gingiva. Full thickness flap is elevated towards the coronal aspect and partial thickness towards the apical portion to avoid tension at the time of closure. The ideal design should allow full accessibility to the corticotomy site, provide full coverage for graft material and enhance aesthetics wherever required.

**2) Decortication:** Corticotomies<sup>[20]</sup> are done in mid interdental areas, using no 2 carbide bur which are connected with circular cuts. Corticotomies should be performed on both labial and palatal aspects of alveolar

bone. No mobile segments of bone should be created to initiate RAP. Instruments used are commonly hand piece or a piezosurgical knife. Care should be taken on all anatomic structures and one has to follow all general principles of surgery.

**3) Bone grafts:** Commonly de-proteinized bovine bone, decalcified free-dried bone allograft and autogenous bone grafts are used solely or in combination within or with platelet concentrations such as platelet rich plasma in corticotomy areas. Around 0.25 to 0.5 ml of graft material is required per teeth. Barrier membrane use is usually discouraged.

**4) Modifications in grafting:** In certain cases due to thin gingival biotype as well as thin cortical plate of bone, exposure of root surface can be seen in some cases. In such cases use of autogenous soft grafts such as connective tissue grafting (gold standard) can be included under full thickness flap. Connective tissue graft can be harvested from palate. Platelet rich plasma, platelet rich fibrin, and growth factors can also be included under the flap along with bone grafts to increase the stability of the graft.

**5) Primary closure:** For predictable bone augmentation, flap should be closed without excessive tension. Flap is usually sutured at the mid line in the interproximal areas followed by other areas. Suture material of choice is non resorbable sutures. Suture removal is carried out usually in 7-14 days postoperatively. Periodontal pack is not usually preferred.

**6) Patient management:** The time taken for surgery may vary according to the individual cases. Complicated bimaxillary cases may take several hours which may demand sedation of the patient. Antibiotics, analgesics and NSAIDs can be given for patient comfort and clinical healing enhancement. NSAIDs should not be given for long term as they are considered to be interfering with RAP. Narcotic pain killers can be prescribed for a week. Common post-surgical complication include pain, edema and ecchymosis. Ice packs can be applied for suppressing swelling. Chlorhexidine mouthwash can also be prescribed.

**7) Orthodontic adjustments after PAOO surgery:** Orthodontist adjust the braces every 2 weeks, after complete recovery from surgical procedure. Completion can take 3-9 months depending up on the case. A retainer will have to be used for at least 6 months. According to the patient selection a metal or ceramic bracket can be used.<sup>[21]</sup>

**10) Modification of CAO procedure:** A) Compression osteogenesis (CO): Procedures like molar intrusion may be designated with CO instead of CAO (corticotomy accelerated osteogenesis), as the medullary bone and overlying mucosa supports the tooth bone block. The CO concept is similar to CAO concept, but uses

corticotomy instead of corticotomy. CAO causes movement of teeth in the weakened alveolar bone but CO causes movement of bone block along with teeth.

Kanno et al, used CO procedure to treat severe open bite case and obtained desired results in 6 months by moving the upper posterior bone tooth segments 7mm in a posterior direction and using anchor plates and elastics after 3 weeks of surgery.<sup>[22]</sup>

B) Alveolar corticotomies (ACS): The incision must pierce the cortical layer and should penetrate minimally into bone marrow, in ACS. Thus ACS is defined as a surgical intervention limited to the cortical portion of the alveolar bone. In osteotomies, considerable amount of both cortical and trabecular bone material is removed.

#### Pros and Cons of PAOO Surgery

**Pros:** Less time than traditional orthodontic procedures, less likelihood of root resorption, history of relapse is very low, less need for appliances and headgear (depending on the case), the technique has its roots in proven orthopedic research and treatments, both metal and ceramic brackets can be used.

**Cons:** Expensive procedure, mildly invasive surgical procedure and like all surgeries, it has risk of some pain, swelling and the possibility of infection, patients who take NSAIDs on a regular basis or have other chronic health problems cannot be treated with this technique. NSAIDs lead to prostaglandin inhibition resulting in reduced osteoclastic activity thus disturbing bone remodeling., patients on long term steroid therapy due to the presence of devitalized areas of bone, it does not lend itself to severe class III malocclusion cases.

#### Novel approaches for PAOO

##### Lasers

Laser assisted flapless corticotomy is a useful non-invasive procedure for reducing treatment time and damage to periodontium. It enhances the orthodontic tooth movement by reducing the cortical bone layer (resistant to bone re-sorption relative to spongy bone) following Erbium, Chromium doped Yttrium Scandium Gallium Garnet (Er-Cr: YSGG) laser irradiation, without surgical flap reflection.<sup>[23]</sup>

##### Monocortical tooth dislocation and ligament distraction (MTDLD) technique

The MTDLD technique combines two different dental movements that work separately but simultaneously on opposite root surfaces. On the root surface corresponding to the direction of movement, vertical and horizontal microsurgical corticotomies are performed around each tooth root with a piezosurgical microsaw to eliminate cortical bone resistance. The immediate application of strong biomechanical forces produces rapid dislocation of the root and the cortical bone together. On the root surface opposite the direction of movement, the dislocation force produces rapid distraction of ligament

fibers. During the osteogenic process that follows, application of normal orthodontic biomechanics achieves the final tooth movement.<sup>[24]</sup>

Tomaso Vercellotti, Andrea Podesta et al have developed a new surgical-orthodontic technique to maximize the rapidity of movement and prevent damage to the periodontal tissues. These goals may be achieved with a piezosurgical technique. (TV) 10-26 that permits microsurgical corticotomy around each root and the immediate application of biomechanical force. This technique avoids involvement of the periodontal tissue fibers, which is necessary in traditional orthodontic movement, thereby preventing periodontal and bone resorption. The greatest amount of dental movement occurs in approximately the first 30% of total treatment time with the MTDLD technique.<sup>[25]</sup>

#### DISCUSSION

The effects of ACS on the acceleration of tooth movement was documented in rats<sup>[26,27]</sup> dogs, cats<sup>[28]</sup> and humans<sup>[29,30]</sup> based on split mouth study designs. The outcome of these experiments show that the rate of tooth movement is doubled on the corticotomy treated site (about 1mm/month).

**According to Dr. Wilcko** brothers the rate of tooth movement is primarily due to localized demineralization-remineralsation processs that occurs in the cancellous bone surrounding the tooth socket and secondarily due to alterations within the periodontal ligament. This was verified using surface computed tomography scan. Many studies.<sup>[31,32]</sup> documenting the histologic and physiologic effects of initial stages of tooth movement have shown that hyalinization of the periodontal ligament occurs on the pressure side. This hyaline formed inhibits bone resorption in the periodontal ligament. Further experiments in dogs have shown that hyaline is gradually removed from periodontal ligament by macrophages that differentiate from mesenchymal cells that migrate to that area. This takes upto four weeks. During this initial period no tooth movement occurs. So, during alveolar corticotomy, RAP accelerates the appearance of macrophages that remove hyaline as early as one week after initiation of orthodontic forces.<sup>[33]</sup> This early hyaline removal allows early bone resorption and rapid tooth movement. Studies comparing the rate of tooth movement showed that the tooth movement peaked at 22-25 days and then decelerated.<sup>[34]</sup> During this three week period, corticotomy facilitated side moved twice than the control side. Similar results were obtained in a study<sup>[35]</sup>, conducted in adults to retract maxillary canines following premolar extractions. Based on the outcome of these studies the length of RAP was probably four months, after which the rate of tooth movement returns to normal. Reviews<sup>[36-39]</sup> on corticotomy claim that it shortens the treatment time. However, one cannot measure treatment time without measuring treatment quality. Yet to date there are no RCT's focusing on this aspect of corticotomy. In support of wilcko's concept, it

has been seen that bone grafting enhances the stability of orthodontic treatment results. Some cases report a greater volume of bone in Computed tomographic Scans.<sup>[40]</sup> However is the new bone incorporated into native cortical –plate, or is it fibroosseous material encapsulated on the outside of the cortical plate was evaluated. The scans suggest that it is a fibroosseous encapsulation. Moreover a distinct disadvantage of this procedure is the additional cost, invasive nature and morbidity associated with the surgery.<sup>[41]</sup>

## CONCLUSION

In contrast to conventional orthodontic treatment which takes almost 18-24 months, the relatively new procedure wilckodontics takes only 3-9 months without compromising the quality of bone. Wilckodontics, encompassing regional accelerated phenomenon has resulted in better post orthodontic stability, reduce the incidence of root resorption and increase the alveolar bone thickness by the inclusion of bone graft which results in more stable periodontium significantly reduce the treatment time accelerated tooth movement. However, long term treatment outcome of PAOO is still unavailable as the technique is still relatively new. A successful treatment therapy can be achieved by proper synergy between the orthodontist and periodontist and proper case selection. Thus, understanding the biomechanics of bone remodelling may increase the clinical applications of corticotomy facilitated orthodontics with or without alveolar augmentation.

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