



Review Article

WILCKODONTICS: A MULTIDISCIPLINARY TREATMENT APPROACH IN DENTISTRY

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ABSTRACT

Wilckodontics also known as Periodontally Accelerated Osteogenic Orthodontics (PAOO) is an emerging technology in the field of dentistry. Wilckodontics has solved the dilemma of rapid orthodontic movement by exploiting the dynamics of bone physiology and redirecting the emphasis in tooth movement to the manner in which the supporting bone responds to orthodontic forces. By stimulating and harnessing the innate potential of living bone the teeth can be made to move through the bone very rapidly and when the tooth movement is completed the bone around the roots of the teeth will rebuild itself. It is an interdisciplinary treatment approach utilizing tissue engineering principles with periodontal regenerative surgery to create rapid orthodontic tooth movement and reduce side effects like root resorption, relapse, inadequate basal bone, and bacterial time-load factors. Favorably positioned teeth, plus an enhanced mucogingival complex, facilitates ideal esthetics, restorative and reconstructive dental treatment. The aim of this article is to present a comprehensive review about Wilckodontics or PAOO technique which includes its historical background, biological rationale, case selection criteria, the surgical technique, orthodontic involvement, clinical applications, modification, benefits, complications and side effects.

Keywords: Wilckodontics, Periodontally Accelerated Osteogenic Orthodontics (PAOO), Orthodontic tooth movement, Tissue engineering.

INTRODUCTION

'Wilckodontics', also known as Periodontally Accelerated Osteogenic Orthodontics (PAOO) or Alveolar Osteogenic Orthodontics, is a relatively new treatment in the dental realm. It is a clinical procedure that combines selective alveolar corticotomy, particulate bone grafting and the application of orthodontic forces. Basically it is a combination of selective decortication facilitated orthodontic technique and alveolar augmentation.¹ This technique allows teeth to

be moved 2-3 times further in 1/3rd to 1/4th the time required for traditional orthodontic treatment. This procedure is theoretically based on the bone healing pattern known as the regional acceleratory phenomenon (RAP).² It promises to radically shorten the time in orthodontics with a dental surgical procedure, increased post- layer of cortical bone, treatment stability, decreased amount of apical tooth movement. This new method is a combination of time-tested and proven techniques from the fields of orthodontics and

periodontics. This procedure increases the alveolar volume and enhances the periodontium, enhances the stability of orthodontic treatment outcome, increases the scope of treating malocclusion otherwise treated by orthognathic surgery and decreases the active orthodontic time over three folds thus augmenting facial and gingival esthetics.³ The additional benefit of this technique is the prevention of periodontal problems by creating sufficient bone in areas where bone is usually very thin or lacking.

Historical Review

Rudimentary surgical intervention to affect the alveolar housing and to speed tooth movement has been used for more than 100 years.⁴ In 1950's Russian orthopedic surgeon Dr. Gabriel Ilizarov perfected the technique of Distraction Osteogenesis (DO) – growth of new bone by means of surgically "distracting" the bone. Corticotomy facilitated tooth movement was first described by L.C. Bryan in 1893 published in a textbook by S. H. Guilford.⁵ As early as the 1950s, periodontists began using a corticotomy (surgical procedure whereby only the cortical bone is cut, perforated or mechanically altered) technique to increase the rate of tooth movement. In 1959, Henrich Kole was the first to describe modern day corticotomy assisted orthodontics. Kole believed that it was the continuity and thickness of the denser layer of cortical bone that offered the most resistance to tooth movement. He theorized that by disrupting the continuity of this cortical layer of bone, he was actually creating and moving blocks of bone in which teeth were embedded. He postulated this theory as "bony block movement" The procedure involves the reflection of full thickness flaps to expose buccal and lingual alveolar bone, followed by interdental cuts through the cortical bone and then subapical horizontal cuts connecting the interdental cuts are made penetrating the full thickness of the alveolus. But because of invasive nature of Kole's technique, it was never widely accepted.⁶In the early 1960s; craniofacial surgeons began using DO techniques to rapidly expand palates in growing patients. Generson et al in 1978 revised Kole's technique with a one stage corticotomy without the supra-apical osteotomy.⁷ In 1980s, Harold Frost; a distinguished orthopedist realized that there was a direct correlation between the degree of injuring a bone and the intensity of its healing response. He called this the Rapid Acceleratory

Phenomenon (RAP).² Dr. Thomas Wilcko (Periodontist) and William Wilcko (Orthodontist), of Erie, PA in 1995 further modified the corticotomy assisted orthodontic technique with the addition of alveolar augmentation and named the procedure as Periodontally Accelerated Osteogenic Orthodontics (PAOO)⁴ later patented as "Wilckodontics" based on the emerging concepts of Wilcko brothers. In May 1998 the AOOTM procedure was introduced at the 98th Annual Session of the American society of Orthodontists. Hajji SS (2000) reported that the active orthodontic treatment period in patients with corticotomies were 3 to 4 times more rapid compared with patients without corticotomies. According to his research, average orthodontic time was 6.1 months for non extraction PAOO and 18.7 and 26.6 months for non extraction and extraction therapies without PAOO. In 2001, Wilcko et al reported a revised rapid orthodontic corticotomy-facilitated technique that included periodontal alveolar augmentation; which demonstrated acceleration of orthodontic treatment to one third of the usual time.⁸ Wilcko et al mentioned, in cases of rapid orthodontics with corticotomies, that corticotomies could increase tooth movement by increasing bone turn over and decreasing bone density.⁹

Biological Rationale

Rapid tooth movement was thought to be due to the movement of bony blocks of bone after decortication. This was reported by Heinrich Kole in 1959. 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). Regional acceleratory phenomenon was developed by Frost and Jee in 1983.² The clinical technique involves selective alveolar decortications of bone, a form of periodontal tissue engineering that results in an increased turnover of alveolar spongiosa with areas of alveolar demineralization.¹⁰ 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^{11, 12}. Following the completion of orthodontic treatment, remineralization takes place resulting in greater stability in the orthodontic treatment outcome. Shih and Norrdin¹¹ demonstrated that

when intraoral cortical bone was injured by corticotomy, RAP accelerated the normal regional healing processes by transient bursts of hard and soft-tissue remodelling. Conceptually, increase in tissue turnover begins within a few days of injury, typically peaks at 1–2 months, usually lasts 4 months in bone and may take 6 to more than 24 months to subside.^{1, 10} As long as tooth movement continues, the RAP is prolonged. Osteopenia is a condition that favours rapid tooth movement. When RAP dissipates, the osteopenia disappears and the radiographic image of normal spongiosa reappears.¹²

Patient Selection Criteria

Proper patient selection is crucial for the success of the procedure. Both the orthodontist and the periodontist should agree upon the need for corticotomy, treatment plan and the extent and location of the decortication cuts.¹³ This procedure has been shown to be particularly effective in treating moderate to severe crowding, in Class II malocclusions requiring expansion or extractions, and mild Class III malocclusions^{1,11}. As long as healthy periodontium is present, PAOO can be done at any age (from 11 years to 77 years of age)¹. Following cases are not considered for this technique:

1. Patient having active periodontal disease is not a candidate for PAOO.
2. PAOO should not be considered in patients having dental bone loss, root damage or poor roots.¹⁴
3. Patients having Rheumatoid Arthritis which requires regular doses of NSAIDs may not be a good candidate for PAOO.⁶ NSAIDs interfere with the production of prostaglandin hormone in body and slow down the bone growth process which is vital to PAOO. In addition, NSAIDs given during the first 24 hours following trauma (surgical or otherwise) inhibit clotting. Therefore, patient taking NSAIDs on a regular basis before or after undergoing AOO surgery is a contraindication.
4. PAOO should not be used in cases where bi-maxillary protrusion is accompanied with a gummy smile. Segmental osteotomy is a preferred choice.
5. Should not be considered as an alternative for surgically assisted palatal expansion in treatment of severe crossbite.

6. Class III condition in which lower jaw is too long relative to the rest of face and the chin has many physical constraints which make them unsuitable for PAOO.¹⁵

Surgical Technique

After the treatment plan has been discussed thoroughly by the orthodontist and the periodontist, orthodontic brackets are placed and a light wire engaged a week before the surgical procedure. It is the duty of the orthodontist to formulate and coordinate the treatment plan. Surgery can be carried out with or without sedation in following steps:

Flap Design: The objectives of flap design include providing access to the alveolar bone to perform corticotomies, to provide coverage of the bone graft, to maintain the height and volume of the interdental tissues, and to enhance the esthetic appearance of the gingival form. After administration of local anesthesia, sulcular releasing incisions are made lingually and labially. Full-thickness flaps are carefully reflected labially 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 sutured with minimal tension. Proper identification of the neurovascular structures is important to prevent damage to these structures. 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 place⁴. 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: Alveolar bone is activated with selective alveolar decortications, both on lingual and labial side by use of a no. 1 or no. 2 round bur or it may also be achieved with a piezoelectric knife (piezocision).^{16, 17} The purpose of the decortication is to initiate the RAP response. Vertical groove is placed in the interradicular space, midway between the root prominences in the alveolar bone. This groove extends from a point 2 to 3 mm below the crest of the bone to a point 2 mm beyond the apices of the roots.¹⁸ (Figure 1) Vertical corticotomies are then connected with a circular-shaped horizontal corticotomy. If the alveolar bone is



Figure 1

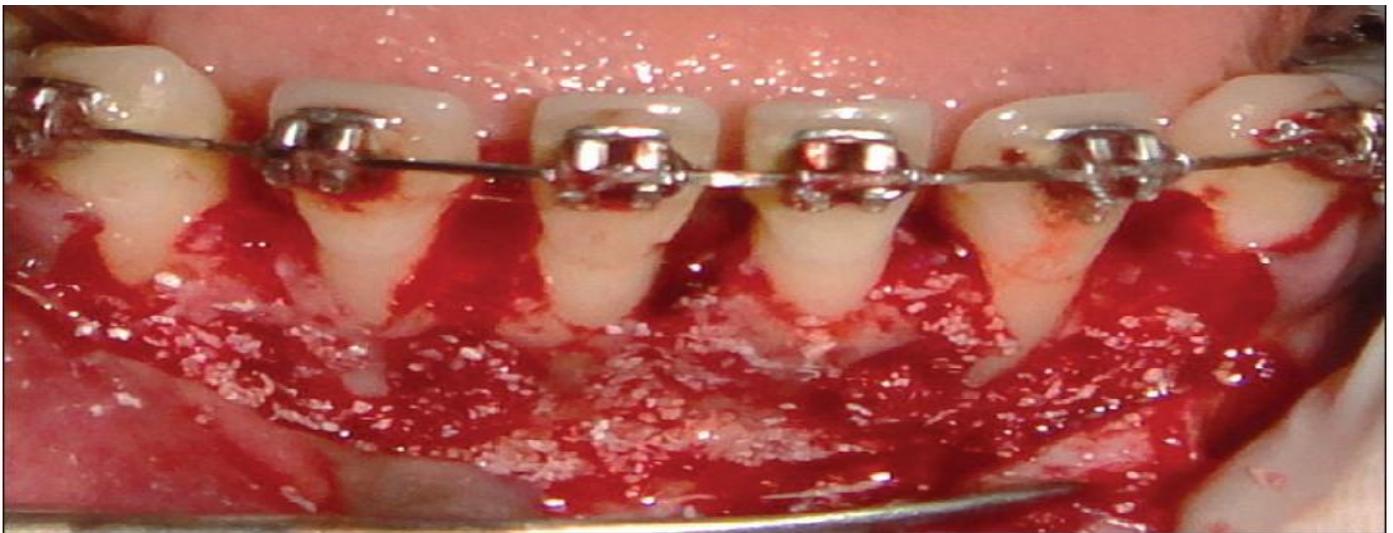


Figure 2



Figure 3

of sufficient thickness, solitary perforations may be placed in the alveolar bone avoiding important neurovascular structures. Both corticotomy cuts and perforations should extend through the entire thickness of the cortical plate, just barely into the cancellous bone avoiding risk of damage to underlying structures like maxillary sinus and mandibular canal.

Particulate bone grafting: It is done in most areas that have undergone corticotomies. Approx volume of particulate bone graft used is 0.25 to 0.5 ml per tooth depending on the pretreatment thickness, the direction and magnitude of orthodontic forces and the lip support. (Figure 2) The materials most commonly used for grafting after decortication are deproteinized bovine bone, autogenous bone, decalcified freeze-dried bone allograft, or a combination.¹⁸ Excessive graft should not be placed to avoid interference with repositioning of flap.¹⁶

Flap closure: Primary closures of the gingival flaps without excessive tension are the therapeutic endpoints. Flap should be closed using nonresorbable interrupted loop sutures. Total recovery from procedure takes 7 to 10 days. Antibiotics and analgesics are prescribed for five days along with chlorhexidine mouth rinses. Sutures are left for 1-2 weeks. (Figure 3)

Orthodontic Adjustments

The placement of orthodontic brackets and activation of the arch wires are typically done the week before the surgical aspect of PAOO is performed. After full recovery from the procedure, orthodontist adjusts brackets about every two weeks. However, if complex mucogingival procedures are combined with the PAOO surgery, the lack of fixed orthodontic appliances may enable easier flap manipulation and suturing¹⁸. After flap repositioning, an immediate heavy orthodontic force can be applied to the teeth and in all cases initiation of orthodontic force should not be delayed more than 2 weeks after surgery. A longer delay will fail to take full advantage of the limited time period that the RAP is occurring¹⁹. The orthodontist has a limited amount of time to accomplish accelerated tooth movement. This period is usually 4 to 6 months, after which finishing movements occur with a normal speed.^{3, 4}. Depending on the case, orthodontic treatment extends from 3 months to 9 months and retainers for at least 6 months is compulsory.

Clinical Applications

Several clinical applications for Wilckodontics or PAOO procedure have been reported^{3, 4, 5, 16, 18} which include the following:

1. Facilitate eruption of impacted teeth
2. Facilitate slow orthodontic expansion
3. Accelerate retraction of canine after premolar extraction
4. Resolve crowding and shorten treatment time.
5. Enhance stability after orthodontic treatment
6. Open bite correction and molar intrusion
7. Manipulation of anchorage

Benefits of Wilckodontics

1. Rapid tooth movement, Lesser treatment time and lesser relapse than conventional orthodontics
2. More bone to support teeth and less periodontal problems around teeth
3. No hospital visit and less cost as with orthognathic surgery²⁰
4. Less root resorption, less furcation invasion, less chances of gingival recession and subsequent cervical abrasion following orthodontic treatment and no effect on the vitality of the pulps of the teeth in the area of corticotomy was reported.²¹ The reduced treatment duration of PAOO may reduce the risk of root resorption. Ren et al.²² reported rapid tooth movement after corticotomy in Beagles without any associated root resorption or irreversible pulp injury.
5. After PAOO, there is more bone to support teeth and no change in facial profile
6. There is less need for appliances and headgear (depending on the case)
7. Both metal and ceramic brackets can be used
8. It can be used with temporary anchorage devices (TADs) to aid in tooth movement.
9. Use as a part of biologic orthodontic therapy.
10. Complications and Side Effects
11. Adverse effects to the periodontium after corticotomy, ranging from no problems to slight interdental bone loss and loss of attached gingiva, to periodontal defects observed in some cases with short interdental distance.²⁰ Other side effects include:
12. Subcutaneous hematomas of the face and the neck in some cases²¹

13. It is an expensive procedure, often not covered by insurance.
14. It is a mildly invasive surgical procedure. Patient may experience some pain, swelling, and the possibility of infection.
15. Some form of anesthesia must be used.
16. Patients who take NSAIDs on regular basis or have some chronic health problems cannot be treated with this technique.
17. It does not lend itself to Class III malocclusion cases

Modification of Wilckodontics

One of the drawbacks faced in this technique is the exposure of the root surfaces in some areas which can be due to the thin gingival biotype as well as thin cortical plate of bone. Hence, the usage of autogenous soft tissue graft such as connective tissue grafting which is still considered to be the gold standard among all other soft tissue grafting techniques can be included under the full thickness flap reflected. The graft can be harvested from the keratinized palatal side. Platelet rich plasma, platelet rich fibrin, and growth factors can also be included under the flap. The usage of platelet rich fibrin increases the stability of the graft.¹⁸ Two cases of decrowding were reported by Wilcko and coworkers which demonstrated selective alveolar decortication, bone augmentation and orthodontic treatment. Rapid tooth movement was achieved in both cases without any significant apical root resorption. The authors suggested that the regional acceleratory phenomenon to be responsible for the tooth movement in these patients.¹

SUMMARY AND CONCLUSION

The mechanism behind Wilckodontics or PAOO technique can be summarized as the induction of bone metabolism via decortication lines and points around the teeth to be moved to enhance bone and periodontal turnover, resulting in a transient stage of osteopenia during treatment. This enhances and accelerates tooth movement if followed by a short period of orthodontic appliance treatment.

A successful treatment by Wilckodontics or PAOO technique can be achieved by proper coordination between the orthodontist, periodontist, oral & maxillofacial surgeon and proper case selection. This technique puts orthodontics on a fast track by incorporating the changes in the structure of surrounding bone to accompany the repositioning of the

teeth. Considering the increasing demand of adult orthodontics patients to decrease their treatment time, this technique will lead to an increase in the number of patients accessing to orthodontic treatment. This technique requires utilization of numerous modified diagnostic and treatment parameters, but once these are mastered, this is a powerful new treatment option for the patients.

Wilckodontics effects and mechanism are confirmed by recent well designed histological studies. However, long term treatment outcome of Wilckodontics is still unavailable as this technique is still relatively new. More clinical research is needed to determine the optimal and long term effects of this technique.

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