

Wilkodontics: A Novel Synergy in time to save time

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ABSTRACT:

The systematic search for improvements in orthodontic therapy is shared by several dental specialties especially periodontics. Rapid orthodontic treatment procedures are now focusing on performing alveolar corticotomies shortly before the application of orthodontic forces. This method has been suggested to enhance tooth movement and, consequently, reduces orthodontic treatment time as a whole. 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.

Key words: Alveolar corticotomies, Accelerated orthodontics, Orthodontic tooth movement.

INTRODUCTION

The term synergy refers to two or more distinct influences or agents acting together to create an effect greater than that predicted by knowing only the separate effects of the individual agents. Over last decades, this definition refines the classic relationship between orthodontic and periodontic specialties in treating patients. Interdisciplinarity orthodontic tooth movement can synchronize with tissue engineering principles of periodontal regenerative surgery to create rapid orthodontic movement and overcome its side effects.¹ Orthodontic tooth movement is influenced by increased alveolar bone metabolism and bone turnover rate, which determines the quantity and quality of orthodontic tooth movement.² High bone turn over signifies increase in the rate of tooth movement whereas slower tooth movement was found in animals with less turn over.^{3,4}

The four types of surgical damage to the alveolar bone include: **Osteotomy** (complete cut through cortical and medullary bone), **corticotomy** (partial cut of cortical plate without penetrating medullary bone), **ostectomy** (removal of an amount of cortical and medullary bone) and **corticectomy** (removal of an amount of cortex without medullary bone).^{5, 6}

The surgical wounding of alveolar bone potentiates tissue reorganization and healing by a way of transient burst of localized hard and soft tissue remodelling⁷

PERIODONTALLY ACCELERATED OSTEOGENIC ORTHODONTICS: PAOO

Historical review

The nature of orthodontic tooth movement needs to be revisited, for research to develop a novel treatment method combining selective alveolar decortication, alveolar augmentation and orthodontic treatment. The method of PAOO is patented by “**wilkodontics**”⁸ based on the emerging concepts of Wilko brothers.

Surgically assisted orthodontic tooth movement has been used since the 1800's. In 1893, Cunningham presented “Luxation, or the immediate method in the treatment of irregular teeth” at the International Dental Congress in Chicago. Corticotomy facilitated tooth movement was first described by L C Bryan in 1893 published in the textbook by SH Guiliford. It was Henrich Kole's publication in 1959, however that set the stage for evolution of corticotomy facilitated orthodontics.⁹ 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”.¹⁰

Bell and Levy published the first experimental study of alveolar corticotomy in 49 monkeys in 1972. They described a model of vertical interdental corticotomy that should have been considered an osteotomy, because they mobilized all dento-osseous segments.¹¹

Further, Duker investigated the affect of corticotomy on tooth vitality and the marginal periodontium in beagle dogs. His results supported the idea of preserving the marginal crest bone in relation to interdental cuts. The cuts must always be left at least 2 mm short of the alveolar crestal bone level.¹²

BIOMECHANICS OF WILKODONTICS: Regional acceleratory phenomenon- RAP

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)**.^{13,14} The regional acceleratory phenomenon (RAP) is a local response of tissues to noxious stimuli by which tissue regenerates faster than normal in a regional regeneration/remodeling process.¹⁵ 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 4 months in human bone. This phenomenon causes bone healing to occur 10-50 times faster than normal bone turnover.¹⁶

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 7. This cortical bridge of woven bone is a fundamental component of RAP, providing mechanical stability of bone after injury. From day 7, 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 (3 weeks in rats). There is also a systemic acceleratory phenomenon (SAP) of osteogenesis due to systemic release of humoral factors.¹⁶

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.¹⁴ RAP results in a decrease in regional bone densities (osteopenia) in healthy tissues where as the volume of bone matrix remains constant.¹³ Orthodontic force application alone is a stimulant sufficient to trigger mild RAP activity. But when tooth movement is combined with selective decortication, RAP is maximised^{16,17}

However, in 2001 wilko 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.⁶

PAOO-PROCEDURES

Modifying the balance between the resorption and opposition and thereby bypassing the waiting time for the alveolar process to resorb and move the teeth farther without causing irreversible damage to periodontium has been the focus of many research projects^{9,10}. The catabolic activity mediated by osteoclasts is the limiting factor in the rate of tooth movement in which periodontal ligament plays a crucial role.¹⁸

Corticotomy-assisted or corticotomy-facilitated orthodontics is a therapeutic procedure that helps orthodontic tooth movement by accelerated bone metabolism due to controlled surgical damage. It is considered an intermediate therapy between orthognathic surgery and conventional orthodontics.^{9,10}

Initially, vertical cortical scarring incisions were performed interproximally and extending well beyond the dental apices. A sub apical horizontal osteotomy was done at 10 mm supra apical to the anterior teeth penetrating the buccal and lingual cortical plates and in the post medullary bone. This connects vertical incisions to facilitate what was characterised as "Bony Block concept" that resulted in a shorter treatment time (6-12 weeks)

It is generally accepted that heavier forces must be applied in cases of "bone block" movement after corticotomy to move the tooth-bone block. Bone block movement after osteotomy creates a dynamic microenvironment similar to distraction osteogenesis, but does not show regional demineralization in medullary bone.¹⁹

ADVANTAGES OF CORTICOTOMY:

Corticotomy has many advantages compared with osteotomy. It prevents injury of the periodontium, pocket formation, prevents tooth devitalization and shortens treatment time. The nutritive function of the bone is maintained through the spongiosa, although the bone is exposed, avoiding the possibility of bone aseptic necrosis.^{9,10}

INDICATIONS:

The CAO procedure solves some clinical situations that are difficult to treat by conventional orthodontic means, like resolution of tooth crowding, canine retraction after premolar extraction, eruption of impacted tooth, promotes slow orthodontic expansion, molar intrusion for prosthodontic reasons, molar intrusion with open bite correction, and enhancement of post orthodontic stability.²⁰

CLINICAL CASE REPORTS:

Generson et al, described rapid orthodontic treatment for open bite malocclusion in 1978 using alveolar decortication without subapical osteotomy.¹⁷ This modified surgical procedure was reported in 1991 and was referred to as corticotomy facilitated orthodontics.¹⁸

In 1991, Suya reported surgical orthodontic treatment of 395 adult Japanese patients with an improved surgical procedure that he referred to as corticotomy facilitated orthodontics. Suya's surgical technique differed from Kole's with the substitution of supraapical corticotomy cut in place of horizontal osteotomy cut beyond the apices of the teeth. Suya contrasted this technique with conventional orthodontics. This technique was found to be less painful, producing less root resorption and relapse. He recommended completing the major active tooth movements in 3-4 months.¹⁸ In 1986, Anholm et al reported treatment of severe malocclusion using corticotomy facilitated orthodontics.¹⁹

MODIFICATIONS OF CAO PROCEDURE

Concept of compression osteogenesis:

Molars intrusion requires some corticotectomy, depending on the amount of intrusion. Miniplates and microscrews are used with buccal and palatal elastic traction of 100-150 grams per side, observing the results after 2 months (3 mm of intrusion). This procedure may be designated as compression osteogenesis (CO) instead of CAO, because the bone-tooth block is only supported by medullary bone and overlying mucosa.

However, cortical palatal plates may limit this movement at the level of the incisor apices, even when premolar extractions have been done. A horizontal palatal corticotectomy behind the upper

incisor and a horizontal labial corticotomy may resolve this situation (two stages). In this situation, there is a block of bone (pedicled with medullary bone) that must be moved rather than moving teeth through the bone, which is another model of the CO procedure. Thus, a heavier orthopedic force of 500-900 g must be applied by anchorage of palatal bone plates. This concept of compression osteogenesis uses similar biological fundamentals to CAO, but with corticotectomy instead of corticotomy. Thus, movement of the bone block with included teeth in CO is larger and more unstable than movement of teeth in the weakened alveolar bone of CAO.

Stability after treatment has always been an important concern after orthodontic treatment. Thinner mandibular cortices are a risk feature for bony dehiscence after decrowding orthodontic treatment. Techniques that increase alveolar volume with grafts may resolve this situation. Thus, where 5 mm of crowding was considered the limit for traditional orthodontics without extraction, this may be extended to 10-12 mm without risk of dehiscence. Retention and stability with CAO are better than with conventional orthodontics. However, there have been no long-term prospective longitudinal studies supporting these initial results.

Kanno et al. described a CO procedure used to treat a case of severe open bite, moving the upper posterior bone-tooth segments 7 mm in a superior position. They used anchor plates and elastics 3 weeks after surgical intervention in two stages. Satisfactory results were obtained after 6 months of orthodontic treatment.²¹

Dibart et al. described a tunnel approach with piezoelectric bone cuts. Several vertical incisions are distributed on the attached gingiva through piezoelectric vertical corticotomies. The tunneling approach allows placement of the bone graft. A case of mild crowding was solved within 17 weeks of active treatment with this approach.²²

ALVEOLAR CORTICOTOMIES (ACS)

Alveolar corticotomies (ACS) are defined as a surgical intervention limited to the cortical portion of the alveolar bone. Whereas in osteotomies both cortical and trabecular bone material is removed in considerable quantities. In ACS the incision must pierce the cortical layer, and at the same time, penetrate into the bone marrow only minimally.²³

Another example of this growing interest can be illustrated by an event that took place in the last Meeting of the American Association of Orthodontists, held in Washington in May 2010: The highest award for research in orthodontics in the United States and Canada (the Milo Hellman Award) was bestowed on a study that assessed the mechanism and morphological changes in alveolar bone following alveolar corticotomies.²⁴

INDICATIONS FOR THE USE OF ACS IN ORTHODONTICS

These can be grouped into three main categories: (1) to accelerate corrective orthodontic treatment, as a whole, (2) to facilitate the implementation of mechanically challenging orthodontic movements, and (3) to enhance the correction of moderate to severe skeletal malocclusions. Reports can be found that describe the successful use of ACS in the enhanced correction of severe bimaxillary protrusion,²⁵ closure of complex skeletal open bites,²⁶ intrusions and molar uprighting combining ACS and mini-implants,²⁷ and optimization of treatment of patients with cleft lip and palate.²⁸

CONTRAINdications

Recently, Wilcko et al gave an objective account of scenarios where the use of ACS-orthodontics should be avoided. These include (1) patients showing any sign of active periodontal disease, (2) individuals with inadequately treated endodontic problems, (3) patients on prolonged use of corticosteroids, (4) persons under medications that slows down bone metabolism, such as bisphosphonates and NSAIDs.⁶

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.²⁹

Monocortical tooth dislocation and ligament distraction (MTDLD) technique:

The monocortical tooth dislocation and ligament

distraction (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.³⁰

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.^{31, 32}

SUMMARY AND CONCLUSIONS:

In conclusion, wilkodontics the new synergy of orthodontics interplaying with periodontics on the same bony platform has made adult orthodontics a reality. This credit goes to the regional accelerated phenomenon due to transient osteopenia. This tissue response elicited was proved to be beneficial in the treatment of clinical situations like decrowding, molar intrusion etc. However, review of literature could not reveal any established guidelines for selection of osteotomy or corticotomy though the later proved to be advantageous. Thus, understanding the biomechanics of bone remodeling may increase the clinical applications of corticotomy facilitated orthodontics with or without alveolar augmentation. Wilkodontics can be an especially attractive treatment option and be a "win-win" situation for both the doctor and patient if research attempts to relieve this clinical dilemma.

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