

## Piezosurgery Assisted Periodontally Accelerated Osteogenic Orthodontics: A Review

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### ABSTRACT

The need for orthodontic treatment has surged in recent years, particularly among young patients. However, the prolonged treatment time is the most common source of discomfort among orthodontic patients. The duration of fixed orthodontic treatment can range from two to three years, which raises the risk of consequences like as external root resorption, periodontal disorders, and patient cooperation. Wilckodontics, also known as PAOO (Periodontally Accelerated Osteogenic Orthodontics), is a cutting-edge interdisciplinary strategy, in which orthodontic movement is enhanced by alveolar corticotomy to increase the rate of tooth movement. This is made possible by stimulating and invigorating the innate potential of living bone. This method has been reported to reinforce tooth movement and allows conventional orthodontic tooth movement (OTM) to speed up. It increases the envelope of movement two to three fold in addition to alveolar augmentation in patients having orthodontic treatment because their teeth are limited to nonflexible alveolar bone. This methodology increases alveolar volume as a substitute for bicuspid extraction. This article reviews the therapeutic advents, fundamentals of its use and examines the key indications, contraindications and its newer modifications including the utilization of piezoelectric methodologies.

**Key words:** Osteogenic orthodontics, Piezosurgery, Reconstructive surgery, Osteoporosis

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### INTRODUCTION

Alveolar osteogenic orthodontics or "Periodontally accelerated osteogenic orthodontics" (PAOO) is a novel systematic exploration of improvements in orthodontic therapy. Adult orthodontic therapy has gained popularity as a result of increased awareness of orthodontic treatment and increased aesthetic demand from patients and oral health is an integral element of overall health, and awareness is the foundation for planning it. The long treatment period, dentofacial aesthetics, and the type of appliances in use have become potential problems pertaining to adult orthodontic treatment. Furthermore, patients wish their braces removed quickly

and the treatment time reduced. It has been noted that the prolonged orthodontic treatment, especially in adults can cause periodontal disease and bone loss, which consequently contributes to relapse. Loss of bone and tissue is a typical component of several disorders including trauma, periodontal disease, reconstructive surgery, ageing and osteoporosis. Fixed orthodontic therapy is linked to enamel decalcification which is a well-known orthodontic treatment concern, also leads to periodontal disease. According to a study, in less than 30% of patients, adequate mandibular alignment was maintained after ten years of standard therapy. In a study on mandibular incisor relapse, Rothe, et al. found that patients with thinner mandibular cortices following debonding have a higher chance of dental relapse [1-7].

The pursuit of an "optimum response" of alveolar bone to applied "ideal force" has moved both periodontal and orthodontic specializations into the field of surgical dentofacial orthopaedics [8]. Due to the time and expense demands of regenerative treatments, practitioners are becoming increasingly interested in learning variables that influence the clinical result following reconstructive

surgery in order to deliver the best feasible care to patient [4]. We are not reliant on pre-existing alveolar volume with this approach, and teeth can be moved 2 to 3 times further in almost one-third to one-fourth the total time it takes for regular orthodontic therapy [5]. PAOO have been reported to obviate the need for some orthognathic surgery. Patients aged 11 to 78 have been treated with remarkable biologic impunity due to their minimal morbidity. It also provides practitioners with a step-by-step technique for reducing side effects such recurrence, root resorption, insufficient basal bone, and bacterial time/load factors including caries and infection [3].

### HISTORICAL REVIEW

The notion of "bony block movement", in which disruption is caused to the cortical bone's thick, dense layer which provides the most resistance to tooth movement, was first proposed by Henrich Kole, et al. [5,9,10]. This resulted in moveable bone blocks in which teeth were implanted, enabling easy tooth mobility. In the year 1980, Harold M. Frost identified a direct link between the severity of the bone's injury, as well as the speed with which it heals. He coined this term "regional acceleratory phenomenon" (RAP) [5,9-11]. After integrating corticotomy and their studies on RAP in the 1990s, "Wilckodontics" also known as Periodontally Accelerated Osteogenic Orthodontics (PAOO) was first established in 1995 by the Wilcko Brothers-Dr. Thomas Wilcko (Periodontist) and Dr. William Wilcko (Orthodontist) [12].

### Biological rationale

Harold M. Frost suggested in osseous/soft tissue surgery, surgical ablation of the tissues resulted in dramatic remodeling near the injured site and a lot of activity was observed (RAP). The RAP is a regional regeneration/remodeling process in which tissue regenerates quicker than normal in response to unpleasant stimuli. Bone repair is 10 to 50 times faster than normal bone turnover as a result of this phenomenon. The development process of woven bone starts in the periosteal area and works its way up to the medullary bone, where it reaches its maximum thickness provides mechanical stability of bone after injury. The cortical woven bone begins to remodel into lamellar bone, whereas the medullary woven bone resorbs [11,13,14]. A brief localised demineralization-remineralization process in the alveolar bone was observed by Wilcko et al. The collagenous soft tissue matrix of the bone which remains remineralized further after OTM. As a result of the remineralization process, the orthodontic treatment outcome becomes more stable. They hypothesized that RAP would appear as a result of the aforementioned mechanism. This in turn affects the alveolar bone during damage (corticotomy) and during active tooth movement [15].

### Principle and treatment procedure

This interdisciplinary treatment entails a collaborative

effort between an orthodontist, periodontist, maxillofacial surgeon, and general dentist [15]. OTM is aided by corticotomy-assisted or corticotomy-facilitated orthodontics, which uses controlled surgical damage to promote bone metabolism. It's a procedure that's halfway between orthognathic surgery and conventional methods of orthodontic treatments. The tissues of the alveolar bone, which are largely rich in calcium deposits, are released 20 to 55 days after the regional acceleratory phenomenon, culminating in the mineralization of new bone. In regions where there are cuts, which extended into the crevices of the marrow, this raised the bone reaction and the levels of inflammatory indicators in the body (both local and systemic). Prior to the surgical procedure, orthodontic brackets with wire are used for a week following the treatment. The procedure involves reflection of flap, decortication, bone grafting followed by orthodontic adjustments [15,16].

Piezosurgery has been reported as a precise and safe technique of ostectomy in oral and maxillofacial surgeries [17]. It is a relatively recent surgical method that is utilized in place of, or in addition to the established oral surgical procedures. The movement of the piezosurgical knife is relatively minimal compared to standard instruments, resulting in greater cutting precision and reduced discomfort for the patient [18]. When compared to standard instruments, the piezosurgery device requires less physical force to operate, making it more manageable and allowing for more intraoperative control. Many advantages of piezosurgery over traditional corticotomy devices have been observed, including precise cutting and safety, less force required for greater surgical control, almost bleeding free surgical site selective cutting and minimal operative invasion, the oxygen molecules generated during cutting have an antibacterial effect, and ultrasound vibration stimulates cell metabolism, resulting in faster bone growth and repair, no risk of emphysema, and decreased post-operative pain [19].

### Piezosurgery assisted periodontally accelerated osteogenic orthodontics

Vercellotti, et al. pioneered the use of "piezosurgery" instead of burs to create a conductive environment involving OTM in conjunction with traditional flap elevation. The Monocortical tooth dislocation and ligament distraction (MTDLD) technique combines two distinct dental movements that work independently but concurrently on opposing root surfaces. To reduce cortical bone resistance, a piezosurgical micro saw is used to execute vertical and horizontal microsurgical corticotomies around each tooth root surface matching the direction of movement. When large biomechanical stresses are applied immediately, the root and cortical bone dislocate together. The dislocation force quickly distracts ligament fibers on the root surface in the opposite direction of movement. During the osteogenic phase that follows, normal orthodontic biomechanics are used to achieve the final tooth movement [20]. These procedures were reported to be quite effective,

**Table 1: Advantages and reports of various studies**

Author	Aim/Objective	Conclusion
Dibart, et al. [23]	The purpose of treatment was to improve function and appearance by correcting the maxillary midline, opening the bite, achieving a Class I dental connection, and relieving the crowding in both arches.	Piezocision, while extremely valuable and adaptable, is not a "cure-all" and does not, in any event, replace traditional orthognathic surgery for the treatment of skeletal malocclusions requiring skeletal base movement.
Farid et al. [24]	The goal of this study was to compare piezosurgery-assisted corticotomy-facilitated orthodontics [CFO] to traditional rotary tools.	Within the limits of this study, corticotomy-facilitated orthodontics using rotary instruments resulted in tooth movement that was 1.6 times faster than when using piezosurgery
Aksakalli et al. [25]	To assess the degree of canine distalization and transversal alterations, as well as post-distalization index of the gingiva and the mobility, comparing patients undergoing treatment involving premolar extraction with [experimental group] and without piezocision.	Piezocision-assisted distalization increases tooth movement, reduces anchoring loss for posterior teeth, and causes no transverse change in the maxilla. Furthermore, piezocision has no negative consequences for periodontal health.
Thind, et al. 2016[1]	Following PAOO with bur and piezocision the time of treatment, root resorption, bone health, and involvement of fenestration and dehiscence have been examined.	When compared to PAOO with piezosurgery and conventional orthodontic therapy, there is a shorter treatment period and a higher retraction rate with PAOO with piezosurgery.
Chinmay H. Khandait et al. [19]	To demonstrate a new orthodontic method that shortens the treatment time with minimizing the discomfort level to the patient as compared to that with traditional corticotomy procedures	Piezosurgery assisted corticotomy facilitated orthodontic treatment is an effective treatment approach to decrease the treatment time and also to overcome the limitations of traditional corticotomy instruments.
Alvarez et al. [26]	To evaluate the efficacy of surgical procedures employed in rapid orthodontics and to understand the molecular mechanisms involved.	Piezocision may be able to expedite tooth movement in the initial month of treatment, according to obtained evidence. Strong data suggests, however, that this surgery does not shorten the time it takes to rectify crowding in mandible and conduct retraction.
Ratho, et al. [27]	The effectiveness of canine retraction has been assessed and compared between the piezocision and traditional retraction groups.	Piezocision is a time-saving procedure that allows an orthodontist to achieve quicker tooth movement while avoiding the drawbacks of more time-consuming and unpleasant invasive approaches. Reduced surgical procedure time and less postoperative discomfort for patients are other advantages.

but were also quite invasive due to the significant flap elevations and involvement of osseous surgeries. They have the potential to cause both postoperative pain and complications [18].

As a minimally invasive approach to creating surgical injury to the bone without flap reflection, the corticision technique was used by Park et al. in the year 2006 shortly followed by Kim et al. three years later [21,22]. To get through the gingiva and cortical bone without raising a buccal or lingual flap, use of a reinforced scalpel and a mallet was done by the aforementioned authors. The surgical damage caused the RAP effect and as a result there was rapid movement of the teeth during orthodontic therapy. The inability to graft soft or hard tissues to cure inadequacies and fortify the periodontium, as well as the repetitive malting which resulted in dizziness in some patients post-surgery, were the downsides of this approach [18].

Dibart, et al. described "piezocision," a new less invasive method [18]. This approach combines limited micro incisions on the buccal side to allow for the use of the piezoelectric scalpel, as well as selective tunneling for hard or soft tissue grafting. One week after orthodontic appliances are placed, piezocision is performed. A small vertical incision is made buccally and interproximal in the connected gingiva or mucosa once complete anesthesia has been obtained. The soft tissues and periosteum must be sliced to allow the insertion of the piezoelectric knife; therefore a midlevel incision is created between the roots of the teeth involved. The action of piezocision on the bone is confined and selective. The tip of the

Piezotome is put into the previously produced vertical interproximal incisions on the arches or in isolated segments, and corticotomy is performed [23] (Table 1).

**Novel advancements**

The non-invasive process of laser-assisted flapless corticotomy can reduce treatment time and periodontal damage. After Erbium, Chromium doped Yttrium Scandium Gallium Garnet (Er-Cr: YSGG) laser irradiation, it stimulates the motion of teeth by lowering the cortical bone layer (which is more resorption-resistant than spongy bone) without surgical flap reflection [28].

The ability to move teeth more quickly, resulting in shorter treatment times, is unquestionably beneficial in reducing adolescent anxiety about the length of traditional orthodontic treatment. In most cases, the PAOO treatment can correct malocclusion in 3 to 10 months [29]. By combining changes in the structure of the surrounding bone to complement the repositioning of the teeth, this therapy expedites orthodontic treatment. The PAOO technique necessitates the use of various changed diagnostic and therapeutic parameters, which, if learned, transform it into a significant new treatment alternative for patients [30].

**CONCLUSION**

Piezosurgery assisted corticotomy facilitated orthodontic treatment is an effective treatment strategy for reducing treatment time and overcoming the limitations of traditional corticotomy instruments. When compared to piezosurgery, PAOO with surgical bur results in a

significant reduction in treatment time and an increase in retraction rate. However, the results obtained are limited, so more clinical studies with a larger number of subjects and long-term follow-up should be encouraged.

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