

Piezocision: The New Trend In Rapid Orthodontic Tooth Movement

Ranjith Raveendran¹ Sameera G Nath^{2*}

¹Professor, Department of Orthodontics, Academy of Medical Sciences, Pariyaram Dental College, Kannur, Kerala, India.

²Associate Professor, Department of Periodontology, KMCT Dental College, Manassery, Kozhikode, Kerala, India.

ABSTRACT

Background: The review paper addresses the newer trend in the field of rapid orthodontic tooth movement, the Piezocision. Piezocision is an innovative, minimally invasive technique that allows rapid orthodontic tooth movement without the need for the extensive and traumatic bur corticotomies. The novelty of Piezocision resides in the “one-sided” flapless buccal approach, where there is no need to operate palatally or lingually. Piezocision offers advantages that should lead to greater acceptance in the dental and patient communities. This new treatment approach that combines minimally invasive surgery and orthodontics can be a powerful tool for rapid orthodontic tooth movements.

Keywords: Rapid tooth movement, piezocision, surgical orthodontics.

INTRODUCTION

Periodontally accelerated osteogenic orthodontics (PAOO) popularised by the Wilcko brothers hypothesized that rapid orthodontic tooth movement resulted from a marked but transient decalcification-recalcification process of the alveolus.¹ This concept is known in the orthopedic literature as the regional acceleratory phenomenon (RAP). The elevation of buccal and lingual full thickness flaps, with extensive decortications of the buccal and lingual alveolar bone, resulted in a physical injury that was responsible for the initiation of a temporary demineralization process. This was coupled with an increased regional bone turnover that characterizes the RAP. This transient osteopenia results in a diminished bone density, with the same bone volume and is responsible for the rapid tooth movement.^{2,3} Wilcko brothers pioneered their “Wilckodontics” work combining alveolar decortication concomitant with bone grafting to expand alveolar volume and allow for rapid tooth movement into the newly expanded sites. Newer trends evolved in accelerating

orthodontic tooth movements. Some were discarded and few were accepted by the dental community.

Vercelotti and Podesta⁴ in 2007 introduced the use of piezosurgery in conjunction with the conventional flap elevations for rapid tooth movement. The procedure generated post-surgical discomfort as well as post-operative complications. Because of these shortcomings they have not been widely embraced by the patient or dental communities.

Park *et al.* (2006)⁵ and Kim *et al.* (2009)⁶ introduced the corticision technique as a minimally invasive alternative to create surgical injury to the bone without flap reflection by the use of a scalpel and a mallet to go through the gingiva and cortical bone. The surgical injury created induced the RAP effect and move the teeth rapidly during orthodontic treatment. This technique, although innovative, has two drawbacks: the inability to graft soft or hard tissues during the procedure to correct inadequacies and reinforce the periodontium, and

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*Correspondence Dr. Sameera G Nath.

Department of Periodontology, KMCT Dental College, Manassery, Kozhikode, Kerala, India.

Email: sameeradr@rediffmail.com

the repeated malleting, which may cause dizziness after surgery.

Dibart et al in 2009⁷ described a new minimally invasive procedure that they called Piezocision™. This technique combines micro-incisions limited to the buccal side that will allow for the use of the piezoelectric knife and selective tunneling that allows for hard or soft tissue grafting. Piezocision can be used to accelerate orthodontic treatment ;enhance the scope of tooth movement through grafting ; achieve differential tooth movement by altering anchorage value through changing the bone density at certain areas; enhance the patient's profile in certain cases by altering the labiomental fold; repair the alveolar cortical bone fenestrations and dehiscences, and improve the periodontium strength by adding hard or soft tissue grafting; possibly enhance the stability of the orthodontic treatment through stronger alveolar cortices, when grafted.

Indications include Class I malocclusions with moderate to severe crowding (extraction and nonextraction), selected class II malocclusions (end-on),selected class III malocclusions (dental), deep bite, open bite, rapid adult orthodontic treatment, orthodontic treatment with clear aligners ,rapid intrusion and extrusion of teeth, simultaneous correction of osseous and mucogingival defects, prevention of mucogingival defects that may occur during or after orthodontic treatment, multidisciplinary treatments.

Contraindications are medically compromised patients, patients taking drugs modifying normal bone physiology (i.e. biphosphanates, corticosteroids etc.),any bone pathology, ankylosed teeth, noncompliant patients, mixed dentition, if the patient and/or the operator has a pacemaker or any other active implant (e.g., a cochlear implant).

TECHNIQUE

Piezocision is performed 1 week after the placement of orthodontic appliances. The patient is anesthetized using Xylocaine 2% with 1/100 000 epinephrine in infiltration. A small vertical incision is performed buccally and interproximally in the attached gingiva or mucosa. The incision into the attached gingiva is preferable as it will give less

visible postoperative scarring. A mid-level incision between the roots of the teeth involved is made, that will allow for the insertion of the piezoelectric knife. Only the teeth to be moved need to be operated upon. The areas not surgerized have a higher anchorage value, since they are not affected by the demineralization process, and can be used as such in the treatment plan. Once the vertical interproximal incisions are completed on the maxillary and mandibular arches or in localized segments, the tip of the Piezotome (BS1) is inserted in the openings previously made and a 3 mm piezoelectrical corticotomy is done.The decortication has to pass the cortical layer and reach the medullary bone to get the full effect of the RAP.

In the areas with thin or little gingiva (recessions) or with thin or no cortical buccal bone (dehiscences, fenestrations), hard and soft tissue grafts can be added via a tunneling procedure. From one of the vertical openings a periosteal elevator is inserted between the periosteum and the bone and a blunt dissection is carried forward to create a tunnel that will host a soft tissue or a bone graft. Once the tunnel has been created, the piezoelectric corticotomy is done in between the roots of the teeth, and a bone graft or soft tissue graft is then added. Once the procedure is finished, only the areas that have been tunneled will require suturing.

The patient is seen a week after the surgery for a follow-up visit and 2 weeks post surgery to start the active phase of the orthodontic treatment. It is very critical for the patient to be seen every 2 weeks thereafter by the orthodontist in order to benefit from the temporary demineralization phase created by Piezocision and allow for faster tooth movement and early completion of treatment.

APPLICATIONS

Piezocision was designed to accelerate orthodontic treatment and at the same time improve the periodontium by hard and/or soft tissue grafting. This procedure combines micro-incisions limited to the buccal gingiva. Virtually all aspects of the accelerated orthodontic treatment utilizing Periodontally Accelerated Osteogenic Orthodontics™ (PAOO) also apply to the Piezocision procedure, and therefore the orthodontic

considerations in relation to both procedures are very similar.

When the bone is injured, a very dynamic healing process occurs at the site of the bone injury that is proportional to the extent of the surgical insult. The RAP begins within a few days of the surgery and usually peaks in 1–2 months and then slows down and disappears as remineralization sets in. Similar research has been done to show the effects of Piezocision on the alveolar bone and tooth movement.⁸ It has been shown that a similar RAP effect is produced when decortications are done by the piezoelectric knife.

Piezocision is a good tool for creating differential anchorage. Piezocision can be done only around the teeth that are going to be moved, and the anchorage values of these teeth can be decreased. Therefore, the need for additional anchorage devices can be eliminated by designing the alveolar decortication according to the desired tooth movements.

Once the bone has been demineralized following the use of burs for corticotomy, there is a 3–4 month window of opportunity to move teeth rapidly through the demineralized bone matrix before the alveolar bone remineralizes (Lee *et al.*, 2008).⁹ The effect of Piezocision on the length of this window of opportunity is being investigated. The more extensive nature of the demineralization created by the piezoelectric knife makes the RAP last up to 6 months. This concept is best observed by the patients treated with Invisalign. Piezocision can be combined with clear orthodontic aligners such as Invisalign (Keser and Dibart, 2011).¹⁰ The patient should be wearing the first aligner and the Piezocision can be performed 1 week after the patient starts to wear the first aligner. After Piezocision the aligners are changed every 5 days instead of 2 weeks. This protocol can be applied in cases where there are 30 aligners or less. If the number of aligners required to correct the malocclusion exceeds this number, redoing the Piezocision should be considered or the subsequent aligners should be changed every 10–14 days instead of 5 days.

When combining Piezocision with Invisalign, Align Technology's software "ClinCheck" is a very helpful tool. The superimposition feature

gives the clinician a very accurate picture of the tooth movement planned. The location of the cuts can be planned according to the tooth movement predicted on the superpositions. It was observed that changing the aligners quickly and seeing the results faster improves the compliance and had been very well accepted by the adult patients.

A split-mouth study was done by Gun and Cakirer (2013),¹¹ to evaluate the effects of Piezocision on the canine distalization rate and rotation, in first premolar extraction cases. When the movement was studied at 10 weeks the canine distalization was two times more on the Piezocision side than the control side, and the canine rotation was similar on both sides. The study concluded that Piezocision is a minimally invasive alternative to corticotomies, significantly shortening the orthodontic treatment time.

When Piezocision is used, grafts can be placed without the need of a flap elevation. The area where bone graft is needed can be tunneled, the graft material can be placed with a syringe and sutured, and the alveolus of that area can be expanded. Another positive effect of bone augmentation during alveolar decortication is that it improves the patient's profile. By grafting the mandibular anterior region, a deep labiomental fold can be corrected and the profile can be enhanced.

Therefore in addition to accelerating the treatment, the RAP changes the orthodontic treatment planning in two major ways: (1) in anchorage planning, by creating a transient osteopenia, and (2) the treatment timing and progress during the "window of opportunity," where the teeth move faster.

In recent years, the Piezocision technique has evolved from being used throughout the whole mouth in one surgical setting, to a more "staged" approach, where demineralization of selected areas or segments of the arch are being demineralized at different times during orthodontic treatment to help achieve specific results (Keser and Dibart, 2013).¹² Localized piezocision is primarily used to facilitate interdisciplinary treatment. It could be used for one arch or one segment of the arch (segmental Piezocision).

Piezocision can be used in combination with lingual appliances. The incisions and the decortifications are done on the buccal side only and there will be no need for decortification on the lingual side. The orthodontic adjustments should be done every 2 weeks and the wires should be advanced as fast as possible.

POSSIBLE COMPLICATIONS

Anterior bite control

The orthodontist need to pay extra attention to the anterior vertical relationship during the initial leveling and alignment stage of the orthodontic treatment. If necessary precautions are not taken, as the bone is demineralized at the decorticated areas, the proclination effect of the initial arch wires on the anterior segment would be exaggerated and the bite will open. A bite opening effect would be advantageous in deep bite cases only.

Complications related to surgery

Possible complications are the loss of the interdental papilla if the incision and Piezocision are done too close to the interdental papilla. It is of paramount importance to stay away from the papilla and do the incisions at mid root level. Secondly, damage to the roots may happen when not using the proper tip or not evaluating properly the underlying anatomy. In the case of close root proximity, it is best, if unsure, to skip that site.

Advantages of Piezocision

1. Minimally invasive, innovative procedure.
2. Minimal post-operative discomfort.
3. Short surgical time.
4. Allows concomitant soft and/or hard tissue augmentation.
5. Challenging orthodontic tooth movements can be done (i.e., lingual or palatal tipping of roots, etc.).
7. High patient acceptance.
8. Can be repeated several times during the course of orthodontic treatment to reactivate the RAP if necessary.

Points to remember

- Patient compliance is crucial in accelerated orthodontic treatment.

- Orthodontic activations every 2 weeks are needed with fixed appliances. When aligners are used they should be changed every 5 days.
- Wires should be advanced as fast as possible.
- Vertical control is important, starting from the beginning of the treatment.
- Regular retention protocol is used after the treatment.
- The surgical piezoelectrical cut should pass the alveolar cortex to reach the medullary bone. This is very important to get the most RAP effect.

CONCLUSIONS

Piezocision is an innovative, minimally invasive technique that allows rapid orthodontic tooth movement without the need for the extensive and traumatic classical surgical approach. The novelty of Piezocision resides in the "one-sided" flapless buccal approach, where there is no need to operate palatally or lingually. Because of its minimal morbidity it can be repeated several times during the same treatment to reactivate the RAP when specific movements are required. Piezocision offers advantages that should lead to greater acceptance in the dental and patient communities. This new treatment approach that combines minimally invasive surgery and orthodontics can be a powerful tool for rapid orthodontic tooth movements.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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