Piezocision Assisted Orthodontics: A new approach to accelerated orthodontic tooth movement

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Abstract:

Over the past decade the percentage of adult patients seeking orthodontic treatment has been steadily increasing to enhance their smile or their masticatory function. These adult orthodontic patients have expectations and concerns about their treatment that are different from the concerns that children and adolescents may have. An aesthetic appliance and a short treatment time have been a recurring request of adult patients. To address and reduce overall treatment time, a number of surgical techniques have been developed to accelerate orthodontic tooth movement. However, these have been found to be quite invasive, leading to low acceptance in patients and the dental community. Piezocision assisted Orthodontics is a recently introduced, minimally invasive procedure, combining micro incisions with selective tunnelling that allows hard or soft tissue grafting and piezoelectric incisions. This novel approach leads to short orthodontic treatment time, minimal discomfort, and great patient acceptance, as well as stronger periodontium.

Key words: Piezocision, adult orthodontics, accelerated orthodontic tooth movement

Introduction:

A n increasing number of adult patients have been demanding orthodontic treatment, using an aesthetic appliance that can be completed within a shorter period of time. Newer appliances such as clear brackets, lingual orthodontics & clear aligners have somewhat fulfilled the aesthetic demands of adult patients. Another factor important to adult patients is the length of treatment time. In recent decades major attempts have been made to shorten the length of treatment. These techniques include rapid distraction of the canines[1] and corticotomy-facilitated orthodontics[2]. In the late 1990s the Wilcko brothers added the alveolar augmentation to the corticotomies and developed the Accelerated Osteogenic Orthodontics (AOO) procedure and claimed that the orthodontic treatment time could be reduced by 75% in the majority of orthodontic cases[3].

An alternative approach has been introduced by Park et al[4] consisting of incisions directly through the gingiva and bone using a combination of blades and a surgical mallet.

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While decreasing the surgical time (no flaps or sutures; only cortical incisions), this technique did not offer the benefits of bone grafting to increase periodontal support in the areas where expansive tooth movement was desired. In addition, the extensive hammering in office to perform the cortical incisions appears to be somewhat aggressive. Moreover, dizziness and benign paroxysmal positional vertigo have been reported, following the use of the hammer and chisels in the maxilla. In 2007, Vercelotti and Podesta introduced the use of piezosurgery, instead of burs, in conjunction with the conventional flap elevations to create an environment conducive to rapid tooth movement. In 2009 Dibart et al described a new minimally invasive procedure that they called Piezocision. This technique combines micro-incisions limited to the buccal gingiva that allow the use of a piezoelectric knife to give osseous cuts to the buccal cortex and initiate the regional acceleratory phenomenon (RAP) without involving palatal or lingual cortex. The procedure allows for rapid tooth movement without the downside of an extensive and traumatic surgical approach while maintaining the clinical benefit of a bone or soft-tissue grafting concomitant with a tunnel approach. Piezocision can also be combined with Invisalign in selected cases to produce outcomes that are less time consuming as well as satisfies patient’s desire of aesthetic appliance.

**Surgical Steps**

1. The surgery is performed 1 week following placement of the fixed orthodontic appliance.
2. After local anaesthesia, vertical interproximal incisions are made, below the interdental papilla, on the buccal aspect of each jaw using a microsurgical blade or a blade No. 15.
3. These incisions are kept minimal (microincisions) except when made in the areas of bone grafting.
4. The incisions go through the periosteum, which allows the blade to reach the alveolar bone.
5. A Piezo surgical knife (BS 1 insert, Piezotome™, Satelec Acteon Group, Merignac, France) is used to create the cortical alveolar incision through the gingival micro-opening to a depth of approximately 3 mm.
6. When the corticotomies are finished, the areas requiring bone or soft tissue augmentations are tunneled using a small periosteal elevator through the vertical incisions followed by grafting in the tunneled areas. Vertical incisions are then closed using a resorbable 5-0 suture.
7. The areas that have not been “tunneled” do not need suturing.
8. If the patient is comfortable, he/she may go home under antibiotic and analgesic cover.

**Orthodontic perspective:**

It is of paramount importance for the orthodontist and surgeon to understand that the surgically induced high tissue turnover is restricted to the immediate proximity of the surgical cuts, creating what might be referred to as a localized spatio-temporal window of opportunity. Attention must be given to perform the bony incisions only around the teeth where tooth movement is planned. As such, the relative anchorage value of the teeth away from the surgical site remains high and anchorage value of teeth adjacent to the surgical site is low. RAP is transient, but continuous mechanical stimulation of the teeth would prolong the osteopenic effect induced by the procedure. Hence, it is imperative to see the patient and adjust the orthodontic appliance every 2 weeks.

During the course of treatment, a sharp increase in tooth mobility may be observed,
resulting from the transient osteopenia induced by the surgery. Also it is important to emphasize that higher forces are applied to the teeth as compared to conventional orthodontic treatment to maintain mechanical stimulation of the alveolar bone and the osteopenic state, allowing rapid treatment.

Discussion:

Rapid orthodontic tooth movement has recently been the focus of different research studies, with the rationale being that shorter the overall treatment time, fewer the complications and the more compliant and satisfied is the patient. Different approaches have demonstrated enhanced rate of orthodontic tooth movement after such procedures as local injection of prostaglandins, local injection of 1,25(OH)2 D3, local injection of osteocalcin, and alterations in alveolar calcium metabolism. These therapies are biochemical in nature and have been limited to the animal model. Surgical injury of the cortical bone adjacent to the area of desired tooth movement also has been reported to initiate biochemical changes leading to rapid tooth movement. Surgical injury to the alveolus induces a considerable amount of medullary bone demineralization immediately adjacent to the decortication site. This dramatic tissue turnover is expressed both spatially and temporally, and mechanically induced transient osteopenia enables rapid tooth movement. The teeth move in the bone that has temporarily lost its original density but not its volume[9]. Adding a bone graft to the technique has allowed an increase in alveolar volume and enhancement of the existing periodontium[3]. These physical modifications have proven to be beneficial in several ways: increased stability of the clinical outcomes (less orthodontic relapse), increased scope of malocclusion correction (at times, avoiding orthognathic surgery), and reduced active orthodontic treatment time[5] (by an average of 3-fold).

The corticotomies that are performed using burs have an inherent disadvantage of damaging the teeth and bone along with probability of producing marginal osteonecrosis and impairing bony regeneration. Piezoelectric incisions recently have been reported to be safe and effective in osseous surgeries, such as preprosthetic surgery, alveolar crest expansion, and sinus grafting. Because of its micrometric and selective cut, the piezoelectric knife is said to have safe and precise osteotomies without any osteonecrosis[10]. Furthermore, it works only on mineralized tissues, sparing soft tissues and their blood supply. Vercellotti later used it for periodontally accelerated orthodontic tooth movement[5]. These authors were still using extensive periodontal flaps and incisions from a buccal and lingual approach, which has great clinical results but also leads increased chair-side time and patient discomfort.

The Piezocision[6,7] demonstrated similar clinical outcome when compared to classic decortication approach but has the added advantages of being quick, minimally invasive, and less traumatic to the patient. It takes typically 1 hour to complete both arches as compare to 3 to 4 hours with earlier methods. This technique is quite versatile because it allows soft-tissue grafting at the time of surgery to correct mucogingival defects if needed, as well as bone grafting in selected areas by using localized tunneling.

Conclusion:

Piezocision is an innovative, minimally invasive technique to achieve rapid orthodontic tooth movement without the downside of the extensive and traumatic surgical approaches. This novel technique also allows the possibility for hard and/or soft tissue augmentation, leading to an enhanced periodontium and an increased scope of tooth movement. Piezocision proves to be efficient from both the patient’s and clinician’s standpoints and offers the
advantages that should lead to greater acceptance in the dental community.

References:


