

Periodontally Accelerated Osteogenic Orthodontics with Piezoelectric Surgery: A Case Report

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Abstract: *Piezosurgery has been applied in dentistry for many years. This paper reviews specifically the treatment applications that have been used in surgically assisted orthodontic treatment since the last decade. Periodontally Accelerated Osteogenic Orthodontics (PAOO) is a surgical technique which results in an increase in alveolar bone width, shorter treatment time, increase post-treatment stability, and decrease amount of apical root resorption. The aim of this case report is to compare the use of micro-motor and piezoelectric surgery unit during decortication in Periodontally Accelerated Osteogenic Orthodontics technique.*

Key words: *Piezoelectric surgery, piezosurgery, Periodontal regeneration, accelerated tooth movement*

I. Introduction

Periodontal Accelerated Osteogenic Orthodontics (PAOO) is a clinical procedure that is a combination of a selective decortication facilitated orthodontic technique and alveolar augmentation.[1] With this technique, one is no longer at the mercy of the pre-existing alveolar volume, and teeth can be moved 2 to 3 times faster in 1/3rd to 1/4th the time required for traditional orthodontic therapy. This procedure is theoretically based on the bone healing pattern known as Regional Acceleratory Phenomenon (RAP). PAOO results in increase in alveolar bone width, shorter treatment time, increased post treatment stability and decreased amount of apical root resorption.[1,2,3]

Piezoelectric surgery (PES) is a new technique for corticotomies created by Vercellotti in 2004. The major advantage of this tool is that micro-vibrations allow a selective cut of only mineralized structures, creating minimal damage to adjacent soft tissues. [4]

Adult individuals seeking orthodontists for the correction of malocclusion is becoming more common. But one of the major drawbacks of conventional orthodontic technique is the time consumed for the treatment that is around eighteen to twenty four months. So the major concern of most of the adult patients who wants to undergo orthodontic treatment is mainly the treatment duration, aesthetics and the outcomes of the treatment.[1,2,5]

To shorten the time for tooth movement, orthodontists from around the world have increasingly sought ways to boost orthodontics treatment efficiency. The search for this efficient, that is new approaches to shorten treatment time without foregoing optimal results, has become a primary goal of all areas of orthodontics. These attempts includes local or systemic administration of medicines like prostaglandins, vitamin D3 and Osteocalcin ,physical or mechanical stimulation such as direct electric current or a samarium-cobalt magnet³; and through surgical intervention which includes dental distraction, alveolar surgeries to undermine inter-septal bone, and alveolar corticotomies.[1,2,6,7]

It is apparent that tooth movement is enhanced by procedures that elevate the remodelling of alveolar bone, and of periodontal and gingival fibrous tissues. It was believed that main reason for tooth movement was cortical plates of the bone and by disrupting its continuity; orthodontics could be completed in much less time than normally expected. This procedure was termed as Accelerated Osteogenic Orthodontics (AOO) and recently as Periodontal Accelerated Osteogenic Orthodontics (PAOO) or Wilckodontics by Wilcko brothers.[1,2,3]

Periodontal Accelerated Osteogenic Orthodontics (PAOO) is a therapeutic procedure which was introduced by Dr. William Wilcko, an Orthodontist and Dr. Thomas Wilcko, a Periodontist. Periodontally Accelerated Osteogenic Orthodontics helps orthodontic tooth movement by accelerated bone metabolism due to controlled surgical damage. It combines selective alveolar corticotomy, particulate bone grafting and the application of orthodontics forces. With this technique, one is no longer at the mercy of the pre-existing alveolar volume, and teeth can be moved 2 to 3 times faster in [1/3] to [1/4] the time required for traditional orthodontic therapy. This procedure is theoretically based on the bone healing pattern known as regional acceleratory

phenomenon (RAP). Periodontally Accelerated Osteogenic Orthodontics results in increased alveolar bone width, shorter treatment time, increased post treatment stability, decreased amount of apical root resorption and decreased formation of fenestrations and dehiscence.[7]

The surgical procedure of Periodontally Accelerated Osteogenic Orthodontics includes sulcular releasing incisions and incisions to preserve the papilla which are done labially to reflect a full-thickness flap from premolar extraction site of one side to other, both in maxillary and mandibular region. A full thickness flap is elevated to expose the underlying alveolar bone, providing access to the alveolar bone surface. Vertical corticotomy cuts are given which extends from a point 2 to 3 mm away from the crest of the alveolar bone to a point 2 mm beyond the apices of the roots. These vertical corticotomies are then connected with a circular-shaped corticotomy in the apical area. If the alveolar bone is of sufficient thickness, solitary perforations are placed in the alveolar bone over the radicular surface. However, when this bone is estimated to be less than 1 to 2 mm in thickness, these perforations are omitted to ensure no damage to the radicular surface. Bone grafts are placed over this corticotomy cuts and primary closure of the flaps with interrupted sutures are done without excessive tension.[7,8,9]

William M Wilcko and Thomas M Wilcko in 2001 had done Periodontally accelerated Osteogenic orthodontics technique on a 24-year-old man with a Class I severely crowded malocclusion and an overly constricted maxilla with concomitant posterior crossbites and a 17-year-old female with a Class I moderately to severely crowded malocclusion. Following the surgery, orthodontic adjustments were made approximately every 2 weeks. From bracketing to debracketing, both cases were completed in approximately 6 months and 2 weeks. At 15 months following surgery in one patient, a full thickness flap was again reflected. Visual examination revealed good maintenance of the height of the alveolar crest and an increased thickness in the buccal bone [1,7,8,9,11]

Studies have been done in 2002 comparing root resorption of central incisor after Periodontally Accelerated Osteogenic Orthodontic technique and Conventional Orthodontic Technique. The sample consisted of 26 subjects and 51 central incisors selected for Periodontally Accelerated Osteogenic Orthodontic technique (group I) and 27 subjects and 52 incisors selected for Conventional Orthodontic Technique (group II). Total length of right and left central incisors were measured by projecting and enlarging the periapical radiographs exactly 10X. It has been revealed that orthodontic treatment resulted in significant mean root shortening in both group I (0.23mm) and group II (0.52mm). T-testing showed that the root resorption was significantly greater in group II than in group I.[13]

Studies were done in 2004 to compare immediate post treatment and retention outcomes in Class I, non-extraction orthodontic patients treated with and without Periodontally Accelerated Osteogenic Orthodontic technique to resolve crowding. Study casts and panoramic radiographs were evaluated using the American Board of Orthodontics Objective Grading System (ABO OGS). It was found that Alveolar corticotomy-facilitated orthodontic treatment resulted in significantly greater improvements during the orthodontic retention period and a better retention outcome as judged using the ABO Objective Grading.[14]

Study was done in 2007 on 8 patients using monocortical tooth dislocation and ligament distraction (MTDLD). Vertical and horizontal corticotomies were done using piezosurgical microsaw. No periodontal defects were observed in any patients including one with severe malocclusion and thin periodontal tissue biotype and also the average treatment time was reduced by 60-70%.[15] In 2012 a study was done to identify the effect of corticotomy-facilitated orthodontic Tooth movement compared with non surgical standard orthodontic technique and study showed that the corticotomy facilitated increases orthodontic tooth movement and also reduces the duration of time. Surgical control for piezosurgery was easier than conventional surgical burs for selective alveolar corticotomies.[16]

Corticotomy is usually achieved by the use of micro-motor hand piece with a No. 1 or No. 2 round tungsten-carbide with saline irrigation. Vercellotti & Podesta (2007) introduced the use of Piezosurgery in conjunction with conventional flap elevations instead of the micro-motor to create an environment conducive to rapid tooth movement.[4]

The aim of the case report is to compare the use of micro-motor bur and piezo electric surgery unit during corticotomy in Periodontally Accelerated Osteogenic Orthodontics.

II. Case Selection

Male patient aged 30 years and 7 months, presented for orthodontic treatment . He did not report any systemic diseases in the history.



Fig.1;Pre-Operative View

The patient was concerned about the treatment time of the conventional orthodontic treatment and was not willing to wear the orthodontic brackets for a long time. The clinical evaluation revealed a diagnosis of Class I molar relationship with bimaxillary protrusion. The patient was taken the Accelerated Osteogenic Orthodontics using micro-motor and tungsten carbide bur was planned to correct the malocclusion.



Fig.2; Corticotomy Cuts Given Using Piezo Electric Surgery

Periodontally Accelerated Osteogenic Orthodontics was completed in both the cases in a single sitting. Both the subjects were recalled after 2 weeks for the application and activation of the orthodontic appliance and were instructed to visit the department every 15 days for activation.

During the procedure, the patient comfort level was more in case of piezo electric unit when compared to the micro-motor. For the operator, the total time consumed for corticotomy was more using piezo electric unit when compared with that of micro-motor. But the major disadvantage of micro-motor was the pressure applied by the operator and the need to use an additional irrigating agent. Piezo electric unit comes with an inbuilt irrigating system and the pressure applied during the corticotomy procedure was very less when compared with micro-motor. The control over the instrument was more in case of piezo electric unit when in comparison with micro-motor. With the use of piezoelectric unit, a precise vertical corticotomy cuts was possible.

Post-surgical complications were less in both the cases. The subject who underwent corticotomy with piezo electric unit had less pain and swelling

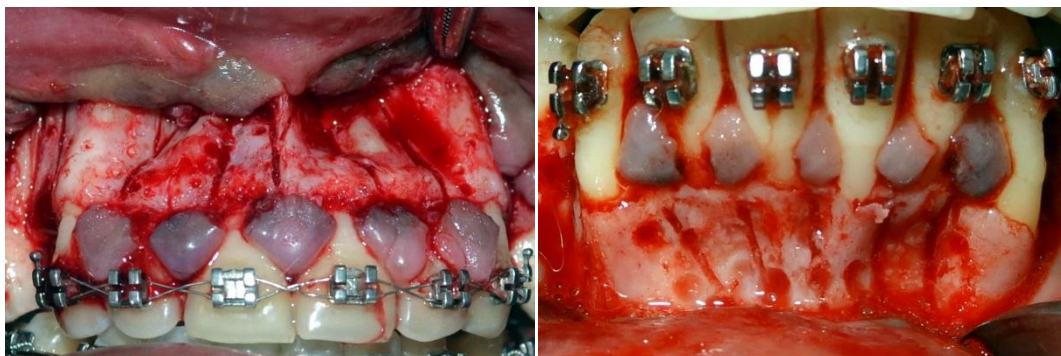


Fig.2;Corticotomy and perforations Given

III. Discussion

Periodontally Accelerated Osteogenic Orthodontics is a promising technique that has many applications in the orthodontic treatment of adults because it helps to overcome many of the current limitations of this treatment, including lengthy duration, potential for periodontal complications, lack of growth and the limited envelope of tooth movement.[1,2]

The mechanism behind Periodontally Accelerated Osteogenic Orthodontics 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. Periodontally Accelerated Osteogenic Orthodontics effects and mechanism were confirmed by recent well designed histological studies.[1,2,3]

Wilcko et al. (2009) attributed the increased rate of tooth movement after corticotomy-facilitated orthodontics to a Regional acceleratory phenomenon (RAP), which is characterized by greater bone turnover and a drop in mineral content [9].

The onset of RAP in alveolar bone is accompanied by a burst of osteoclastic activity resulting in lower bone density and augmented osteoblastic activity. Tooth movement is affected by alveolar mineralization, the greater the mineralization of the alveolar bone the more difficult teeth are to move. Moreover, osteoclastic activity is known to be integral to tooth movement. Thus, faster tooth movement is expected when stimuli lead to greater bone turnover and lower bone density.[17]

Periodontally Accelerated Osteogenic Orthodontics was reported to accelerate the tooth movement.[18] In this case report, retraction was started two weeks post-surgery as recommended by Wilcko et al. On contrary Chung et al started retraction immediately after corticotomy. Two weeks delay between surgery and initiation of retraction was followed so that the post-operative pain and swelling could subside in patient. Elastomeric modules were used for retraction and force levels were calibrated at 200g per side. Elastomeric modules were changed every two weeks in study group and every four weeks in control group.[19,20]

The surgical technique used in the case described here, piezocision, demonstrates a similar clinical outcome when compared with the classic decortication approach but has the added advantages of being quick, minimally invasive, and less traumatic to the patient. It allows for 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. The localized bone injury after piezocision triggers a whole cascade of localized events that are part of the RAP process, and include intensive osteoclastic as well osteogenic activities. This physiological response to injury, with its considerable amount of transient medullary bone demineralization, can be used by the therapist to move the teeth rapidly to the patient's advantage. In the case described here there was no need for bone or soft-tissue grafting. The procedure was much simpler, as it required only piezocision of the alveolar interproximal bone without any hard- or soft-tissue grafting. No suturing was needed and the procedure was completed in 20 minutes.

There have been several reports regarding the adverse effect on the periodontium after corticotomy. These reports range from no problem to gingival recession and decrease in width of attached gingiva. In this case report we have modified the incisions which preserve the interdental papilla, so no recession was reported in any of the cases.

The patient were given Non Steroid Anti Inflammatory Drugs and Antibiotics after the surgery. In both the cases, pain and swelling was reported for 2-3 days and which gradually subsided. But comparatively it was lesser in piezo electric unit than micro-motor burs. No other complications were reported.

In comparison to traditional orthodontics, the fact that, the teeth can be moved more rapidly with the corticotomy techniques, thus resulting in shortened treatment times, is certainly advantageous to the patient's periodontal health because less time in fixed appliances reduces patient "burnout" and substantially reduces the time available for relatively benign commensal bacterial biofilms to assume qualitative changes and convert to a destructive cytotoxic ("periodontopathic") potential often seen when fixed appliances have remained on the teeth for more than 2-3 years.[20]

IV. Conclusion

Piezocision is an innovative, minimally invasive technique designed to achieve rapid orthodontic tooth movement without the downside of extensive and traumatic conventional surgical approaches. This novel technique can be combined with different orthodontic treatment modalities to satisfy today's adult patient population.

This multidisciplinary team approach: Periodontally Accelerated Osteogenic Orthodontics (PAOO) or Wilckodontics seems to be promising not only for reducing orthodontic treatment duration, but also for biological aspects during and after orthodontic treatment. Periodontally Accelerated Osteogenic Orthodontics enhances bone remodeling and augmentation, accelerates tooth movement and significantly

reduces the duration of treatment. The use of both micro-motor with tungsten-carbide bur and piezoelectric surgery unit are equally efficient for corticotomy procedure. Even though each method has its own advantages and disadvantages, the overall advantage is for the conventional micro-motor than that of the piezoelectric surgery unit.

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