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Piezocision assisted orthodontics – Evidence based perspective

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Abstract

Piezocision is a minimally surgical invasive technique wherein subsequent to vertical micro-incisions, 3 mm deep midlevel vertical cuts of length 5-8mm are made with the use of a piezotome in the interproximal buccal alveolar bone in relation to the teeth that are to be selectively moved. These cuts traverse the cortical layer to reach the medullary layer of the alveolar bone to initiate regional acceleratory phenomenon and accelerate orthodontic tooth movement. In situations where one encounters bone dehiscences and root fenestrations the tunnelling procedure is advocated wherein hard and soft tissue grafting is done thereby eliminating the morbid conventional flap elevation procedure. Subsequent to this procedure, orthodontic therapy either with fixed appliances or aligners is then monitored fortnightly. This procedure can also be used in periodontal-prosthetic rehabilitation as also with temporary anchorage devices. An evidence-based approach of this procedure is hereby highlighted.

Keywords: Piezocision; tunnelling; hard and soft tissue grafting; differential anchorage; orthodontic tooth movement

Introduction

Patients seek orthodontic treatment with the sole goal of enhancement of facial esthetics. However, refusal of orthodontic therapy is strongly linked with the premise that it is plagued with prolonged treatment duration.[1, 2] Various factors such as compliance and cooperation of the patient as also complexity of the case does affect treatment duration in orthodontics.[3]

A reduced orthodontic treatment duration with any accelerated orthodontic treatment modality that would lessen the risk to the periodontal and hard tissues is the most sought after ardent desire of not only the patients seeking orthodontic treatment but also the attendant clinicians.[4] Novel modalities either non-invasive or

invasive to accelerate orthodontic tooth movement (OTM) has gained momentum over the past few years.[5-9] Among the surgical techniques, corticotomy has been stated to be clinically effective in accelerating OTM, but due to its invasiveness, post-operative discomfort and technique sensitivity, its clinical acceptance by the patient and the operator has been a matter of grave concern.[10-12] Seminal work on accelerated osteogenic orthodontics which is a combination of selective alveolar decortication and periodontal alveolar augmentation was done by Wilcko et al.[13, 14] Irrespective of the surgical procedure the principle of Regional Acceleratory Phenomenon (RAP) as stated by Frost[15-17] is the one that plays an important role in accelerating OTM. RAP is characterized by a transient burst of catabolic and anabolic reactions that creates a state of osteopenia, temporary demineralization and increased bone turnover rate all occurring in tandem with the degree of surgical insult to the bone.[18]

Piezo surgery in conjunction with invasive conventional flap elevations and osseous surgery to facilitate rapid tooth movement was first introduced by Vercelloti and Podesta in 2007.[19] The discomfort and complications post-surgery was not well accepted by the operator and the patient. Dibart et al[20] introduced the minimally invasive Piezocision technique along with the selective tunnelling procedure with hard or soft tissue grafting in order to ensure an enhanced periodontium and a shortened orthodontic treatment time.

Methodology

PubMed search for articles relevant to the topic "Piezocision-assisted orthodontics"– was carried out. Handpicked articles too were chosen from the references of the specific articles. The Piezocision technique, comparison with the surgically invasive corticotomy procedure, its treatment effect in canine retraction, alleviation of mandibular anterior crowding, randomized controlled trials and systematic review and meta-analysis was minutely analyzed. The salient points are thus hereby discussed and reported.

Discussion

Flapless Piezocision was introduced by dibart et al, to minimize the surgical morbidity of the corticotomy procedure. Proportionate to the extent of surgical insult a dynamic healing process called the regional acceleratory phenomenon occurs which lasts up to a period of about 6 months. An initial transient osteoporotic condition with an increased bone turnover rate facilitates accelerated tooth movement. This RAP response was seen not only when alveolar decortication was done with a bur but also with a piezotome. While on the one hand the former procedure was more surgically invasive the latter was minimally invasive. In contrast to the surgical bur, diffuse and extensive demineralization followed by mineralization was observed with the micro-vibrations produced with the piezotome set at specific settings of the vibration frequency. The Piezocision method also produces differential anchorage as it reduces the density of the bone around the areas so cut to facilitate faster OTM. The RAP can also be reactivated to maintain the demineralization state at the same site as this procedure is very conservative in nature and patient and operator friendly. Another added advantage of this procedure is that it could be done as a localized, generalized or as a sequential procedure in all types of malocclusions and multidisciplinary treatment situations. Patients with pacemaker devices and medically compromised patients such as on bisphosphonate therapy are the ones contraindicated for this procedure. Scarring, infection and inadvertent root injury could be mitigated by judicious use of the procedure. Additive effect of osteocytes' response to the micro-vibrations seemed to

be another advantage of this procedure.[21, 22] The novelty of this procedure was that there was no need of a palatal nor a lingual approach as a "one-sided" buccal approach was all that was needed to initiate RAP. The transient osteopenia does cause an increase in the mobility of the teeth being moved. As higher forces are applied to maintain the transient osteopenic state and the mechanical stimulation of the alveolar bone, an increase in the mobility of the teeth is but a natural occurrence. With concomitant remineralization, the teeth are subsequently stabilized in the alveolar bone housing. Though this procedure finds its use in all types of malocclusions, its use in Class I malocclusion to expand the arches, move teeth buccally to relieve crowding as also to correct cross bites deserves special mention. In situations where such buccal tipping is desired and the gingival biotype is thin, hard and soft tissue grafting too can be done to mitigate bone dehiscences/root fenestrations. Though this procedure could be used successfully in the treatment of Class II malocclusion and deep bite cases, its use in Class III malocclusion wherein the skeletal bases is at fault, the conventional orthognathic surgical approach is deemed a much better alternative.[23]

Besides localized and generalized Piezocision, sequential Piezocision is yet another novel staged approach wherein at different times during orthodontic treatment selected segments or areas of the arch are demineralized to help achieve certain desired specific results.[24] Root resorption was reported less in the corticotomized patients due most probably to the demineralized state of the bone facilitating faster OTM with less resistance.[25-26] A 43% reduction in treatment time of the Piezocision group was reported by some authors with no significant increase in overall gingival scores.[27] On the other hand, only a 27% reduction in treatment time was observed by Yavuz MC et al.[28]

The blade thickness of piezo surgery knife of about 0.6mm can be a deterrent in situations where one encounters close proximity of the roots. Hence, in order to avoid root injury, the Piezocision technique could be used in conjunction with computer guided surgery.[29-30] The use of computed tomography has been used successfully to create a three-dimensional model of the arch. By this means a surgical guide can be fabricated to help determine the location and depth of the corticotomies in order to prevent injury to vital anatomical structures and dental roots.[31] A rigid, translucent 3D computer-assisted Piezocision guide with buccal slots for precision in depth, angulation and location together with it being sufficiently porous enough to permit the coolant to reach the surgery site could further enhance the exactness of the procedure and mitigate the risk of surgical complications.[32]

It should also be noted that transitory bacteremia after the Piezocision procedure could pose the possibility of bacterial endocarditis in susceptible patients. Streptococcus mitis/oralis, Streptococcus pluranimalium and Gemmell sanguinis were detected in 3 postoperative blood samples taken 30-60 secs after the Piezocision procedure. The time limit of 30-60 secs was advocated as robust data showed that the peak value of bacteremia was attained between 30 and 60 seconds after dental extraction. No transient bacteremia was detected in the pre-operative samples.[33]

Previous reports showed insignificant differences in the correction of mandibular anterior crowding with Piezocision, but on the other hand, in comparison with conventional orthodontics, Piezocision assisted space closure in premolar extraction cases did exhibit significant difference.[34] In a randomized clinical trial

comparing Piezocision and laser assisted flapless corticotomy procedures, it was reported that the rate of canine retraction was accelerated without any sign of rotation or untoward effect on anchorage.[35] In a systematic review and meta-analysis that was done to compare Piezocision assisted orthodontics and conventional orthodontics in relieving anterior crowding, it was concluded that Piezocision had an upper hand in alleviating crowding and in the reduction of tooth alignment time with insignificant differences in pain perception levels.[36] In a study comparing Piezocision and corticotomy facilitated orthodontics, the authors reported that for accelerating canine retraction both the techniques were equally effective and that Piezocision assisted orthodontics was 1.5 times faster than conventional orthodontics.[37] A systematic review on the effectiveness of Piezocision and corticotomy on canine retraction revealed that the canine retraction rate was 1.5 to 2 times faster with the Piezocision procedure and that both the procedures did not have any deleterious effects on periodontal parameters such as probing depth, plaque index and the periodontal status such as gingival recession, attachment levels, alveolar crest levels, root resorption or mobility scores.[38] It has also been reported that Piezocision as an effective surgical procedure in reducing treatment duration and accelerating canine retraction is also fraught with low quality evidence.[39]

In a randomized controlled trial, twenty-four adult patients with crowding of a mild nature were allocated randomly to a test group in whom localized piezo-assisted orthodontics sans grafting was performed and a control group treated with conventional orthodontics. In the Piezocision group the overall treatment time was reduced by 43% as compared with the control group. With the exception of residual scars posing a risk in high smile line patients with piezo-assisted orthodontics the other periodontal parameters such as papilla bleeding & plaque index and pocket & recession depth remained unchanged between both the groups.[27] In another randomized controlled trial the authors reiterated the fact that along with less root resorption two times more enmasse retraction was obtained with the Piezocision procedure.[40] In yet another randomized controlled trial study in adults following conventional orthodontic treatment versus Piezocision assisted orthodontics with a customized appliance, the patient-reported outcome measures revealed high satisfaction and acceptance with the Piezocision procedure despite greater pain perception and apprehension.[41] In a randomized controlled trial that was done to orthodontically correct severely crowded mandibular anterior teeth, it was reported that the flapless Piezocision technique was indeed effective in accelerating OTM.[42] In another randomized clinical trial done to investigate the duration of mandibular crowding alleviation with conventional orthodontics and piezo tome-corticision orthodontics, it was observed that there was no difference in the duration required to correct lower anterior crowding with either of the procedures. Since this research was conducted in a single center, generalizability of the results in a broader sense might be a limiting factor.[34] A systematic review comparing conventional orthodontics to Piezocision assisted orthodontics elicited weak evidence which in the opinion of the authors could also be biased due to the various types of tooth movements encountered in the studies.[26] Animal studies were contradictory with some claiming accelerated OTM in the antero-posterior direction while others were of the opinion that the OTM was directly proportionate to the degree of surgical insult.[43,44] But, animal studies, however, have confirmed a 50% reduction in overall treatment time with this procedure and the coupled remodelling of the alveolar bone.[45]

Systematic review of few clinical trials need to be taken with great caution as a lot of bias is introduced in the eligibility criteria as they deal with different phases of orthodontic treatment like (only alignment phase, only non-extraction or extraction of first premolars-like situations). High quality evidence with low risk of bias and more multi-centre randomized controlled trials to support Piezocision assisted orthodontics would certainly add more credence to this minimally invasive procedure in the near future.

Conclusion

Piezocision is a generalized, localized or sequential alveolar decortication technique performed with a piezo tome. It could also be used with the selective tunnelling procedure with hard and soft tissue augmentation. It effectively entails the use of differential anchorage technique and reduces the overall treatment time required by orthodontics by accelerating orthodontic tooth movement due to the occurrence of the regional acceleratory phenomena. It is a minimally invasive procedure sans the downslides of the traumatic and extensive conventional surgical approach along with good patient preference and acceptance.

References

1. Rosvall MD, Fields HW, Ziuchkovski J, Rosenstiel SF, Johnston WM. Attractiveness, acceptability, and value of orthodontic appliances. American Journal of Orthodontics and Dentofacial Orthopedics, 2009; 135, 276.e1–e12.

2. Talic, NF. Adverse effects of orthodontic treatment: a clinical perspective. The Saudi Dental Journal 2011; 23: 55–59.

3. Mavreas, D. and Athanasiou, A.E. (2008) Factors affecting the duration of orthodontic treatment: a systematic review. European Journal of Orthodontics 2008; 30: 386–395.

4. Amit G, Kalra JP, Pankaj B, Suchinder S, Parul B. Periodontally accelerated osteogenic orthodontics (PAOO)-a review. Journal of Clinical and Experimental Dentistry 2012; 4: e292–e296.

5. Shenava S, Nayak KU, Bhaskar V, Nayak A. Accelerated orthodontics-a review. International Journal of Scientific Study 2014; 1:35–39.

6. Andrade I, Jr Sousa AB, da Silva G G. New therapeutic modalities to modulate orthodontic tooth movement. Dental Press Journal of Orthodontics 2014; 19: 123–133.

7. Teixeira CC, Khoo E, Alikhani M. Different methods of accelerating tooth movement. In: Clinical Guide to Accelerated Orthodontics: Springer International Publishing Switzerland. 2017;19–31.

8. Baloul SS, Gerstenfeld LC, Morgan EF, Carvalho RS, Van Dyke TE, Kant arci A. Mechanism of action and morphologic changes in the alveolar bone in response to selective alveolar decortication–facilitated tooth movement. Am J Orthod Dentofac Orthop. 2011;139: S83–S101.

9. Kau CH, Kant arci A, Shaughnessy T, et al. Photo bio modulation accelerates orthodontic alignment in the early phase of treatment. Prog Orthod 2013; 14:30.

10. Zawawi, K.H. Patients' acceptance of corticotomy-assisted orthodontics. Patient Preference and Adherence 2015; 9:1153–1158.

11. Fischer TJ. Orthodontic treatment acceleration with corticotomy assisted exposure of palatally impacted canines. The Angle Orthodontist, 2007; 77: 417–420.

12. Hassan AH, Al-Fraidi AA, Al-Saeed SH. Corticotomy assisted orthodontic treatment. Open Dentistry Journal, 2010; 4:159–164.

13. Wilcko WM, Wilcko T, Bouquet JE, Ferguson DJ. Rapid orthodontics with alveolar reshaping: two case

reports of DE crowding. The International Journal of Periodontics & Restorative Dentistry 2001; 21: 9–19.

14. Wilcko WM, Ferguson DJ, Bouquet JE, Wilcko T. Rapid orthodontic DE crowding with alveolar augmentation: Case report. World J Orthod 2003; 4:197–205.

15. Frost HM. The regional acceleratory phenomena: A review. Henry Ford Hosp Med J 1983; 31:3–9.

16. Frost HM. The biology of fracture healing. An overview for clinicians. Part I. Clin Orthop Relat Res 1989; 248:283–293.

17. Frost HM. The biology of fracture healing. An overview for clinicians. Part II. Clin Orthop Relat Res 1989; 248:294–309.

18. Cano J, Campo J, Bonilla E, Colmenero C. Corticotomy assisted orthodontics. Journal of Clinical and Experimental Dentistry 2012; 4:e54–e59.

19. Vercellotti T, Podesta A. Orthodontic microsurgery: A new surgically guided technique for dental movement. Int J Periodontics Restorative Dent 2007; 27:325–331.

20. dib art S, Sebaoun JD, Surmenian J. Piezocision: A minimally invasive, periodontally accelerated orthodontic tooth movement procedure. Comp end Contin Educ Dent 2009; 30:342–344.

21. dib art S, Kesar E, Nelson D. (2015) Piezocision™-assisted orthodontics: past, present, and future. Seminars in Orthodontics 2015; 21: 170–175.

22. Jean-David MS, Surmenian J, Dibart S. Accelerated orthodontic treatments with Piezocision: a mini–invasive alternative to alveolar corticotomies. Orthodontia Française 2011; 82: 311–319.

23. dib art S, Surmenian J, Sebaoun JD, Montesani L. Rapid treatment of class II malocclusion with Piezocision: two case reports. Int J Periodontics Restorative Dent. 2010;30(5):487–493.

24. Keser EI, Dibart S. Sequential Piezocision: A novel approach to accelerated orthodontic treatment. Am J Orthod Dentofacial Orthop 2013; 144:879-89.

25. Shoreibah EA, Ibrahim SA, Attia MS, Diab MM. Clinical and radiographic evaluation of bone grafting in corticotomy-facilitated orthodontics in adults. J Int Acad Periodontol. 2012; 14:105–13.

26. Yi J, Xiao J, Li Y, Li X, Zhao Z. Efficacy of Piezocision on accelerating orthodontic tooth movement: a systematic review. The Angle Orthodontist 2017; 87: 491–498.

27. Charavet C, Lecloux G, Bruwier A, Rom pen E, Maes N, Limme M, Lambert F. Localized Piezoelectric Alveolar Decortication for Orthodontic Treatment in Adults: A Randomized Controlled Trial. Journal of Dental Research 2016; 1:7.

28. Yavuz MC, Sunar O, Buyuk SK, Kantarcı A. Comparison of Piezocision and discission methods in orthodontic treatment. Progress in Orthodontics 2018; 19:44.

29. Cassetta M, Pandolfi S, Gian Santi M. Minimally invasive corticotomy in orthodontics: a new technique using a CAD/CAM surgical template. Int J Oral Maxillofac Surg. 2015; 44:830–3.

30. Alikhani M. Clinical guide to accelerated orthodontics. Springer Science and Business Media, 2017. 28.

31. Milano F, dib art S, Montesani L, Guerra L. Computer-Guided Surgery Using the Piezocision Technique. Int J Periodontics Restorative Dent 2014; 34:523–529.

32. Hou H, Li C, Chen M, Lin P, Liu W, Cathy Tsai Y, Huanga R. A novel 3D-printed computer-assisted Piezocision guide for surgically facilitated orthodontics. Am J Orthod Dentofacial Orthop 2019; 155:584-91.

33. Ileri Z, Akin M, Erdur EA, Dagi HT, Findik D. Bacteremia after Piezocision. Am J Orthod Dentofacial Orthop 2014; 146:430-6.

34. Uribe F, Davoody L, Mehr R, Jayaratne YSN, Almas K, Sobue T, Allareddy V, Nanda R. Efficiency of piezo tome-corticision assisted orthodontics in alleviating mandibular anterior crowding—a randomized clinical trial. Eur J Orthod;2017 Nov 30;39(6):595-600.

35. Alfa Wal AMH, Hajeer MY, Ajaj MA, Hamadah O, Brad B. Evaluation of Piezocision and laser-assisted flapless corticotomy in the acceleration of canine retraction: a randomized controlled trial. Head & Face Medicine 2018; 14:1-12.

36. Afzal E, Fida M, Malik DS, Irfan S, Gul M. Comparison between conventional and Piezocision-assisted orthodontics in relieving anterior crowding: a systematic review and meta-analysis. Eur J Orthod 2021; Jun 8;43(3):360-366.

37. Abbas NH, Sabet NE, Hassan IT. Evaluation of corticotomy-facilitated orthodontics and Piezocision in rapid canine retraction. Am J Orthod Dentofacial Orthop 2016; 149:473-80.

38. Viwattanatipaa N, Charnchairerk S. The effectiveness of corticotomy and Piezocision on canine retraction: A systematic review. Korean J Orthod 2018;48(3):200-211.

39. Mheissen S, Khan H, Samawi S. Is Piezocision effective in accelerating orthodontic tooth movement: A systematic review and meta-analysis PLOS ONE, 2020: 1-17.

40. Hatrom, Abdulkarim A.; Zawawi, Khalid H.; Al-Ali, Reem M.; Sabban, Hanadi M.; Zahid, Talal M.; Al-Turki, Ghassan A.; Hassan, Ali H. Effect of piezocision corticotomy on en-masse retraction: A randomized controlled trial. Angle Orthodontist 2020; 90:648-654.

41. Charavet C, Lecloux G, Jackers N, Maes N, Lambert F. Patient-reported outcomes measures (PROMs) following a Piezocision-assisted versus conventional orthodontic treatments: a randomized controlled trial in adults. Clinical Oral Investigations, 2019.

42. Gibreal O, Hajeer MY, Brad B. Efficacy of Piezocision-based flapless corticotomy in the orthodontic correction of severely crowded lower anterior teeth: a randomized controlled trial. Eur J Orthod; 2018;1-8.

43. Charavet C, Van Hede D, Anania S, Maes N, Lambert F. Multilevel biological responses following piezocision to accelerate orthodontic tooth movement: a study in rats. Journal of World Federation of Orthodontists 2019; 8:100–106.

44. Kim YS, Kim SJ, Yoon HJ, Lee PJ, Moon W, Park YG. Effect of piezo puncture on tooth movement and bone remodelling in dogs. American Journal of Orthodontics and Dentofacial Orthopedics 2013; 144:23–31.

45. dib art S, Yee C, Surmenian J, et al. Tissue response during Piezocision-assisted tooth movement: a histological study in rats. Eur J Orthod. 2014; 36(4):457-464.