



Original Research Article

The effect of piezocision in canine distalization: A prospective split-mouth study

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ABSTRACT

Introduction: This study evaluated the duration for distalization of canine and the amount of root resorption with and without piezocision.

Materials and Methods: The study sample consisted of 15 adult patients in a prospective split-mouth study design, requiring therapeutic extraction of bilateral maxillary first premolar and bilateral canine distalization. The subjects were evaluated for the time taken for the maxillary canine to achieve a positive contact with the maxillary second premolars bilaterally. Intervention in form of piezocision was carried out on one side of the maxillary arch using piezotome vis-a viz the control side. The study further uses pre & post CBCT records to evaluate the amount of blunting of the maxillary canine root apexes bilaterally when distalization was completed.

Results: Duration of canine retraction in the piezocision group was 4.66 ± 0.52 months which is comparatively faster than that of the control group which took almost 5.72 ± 0.65 months.

Conclusions: The study concluded that the use of piezocision in cases of individual maxillary canine retraction results in a shorter duration of maxillary canine distalization and overall treatment time, with no significant difference in root resorption with or without piezocision.

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1. Introduction

Orthodontics has evolved significantly over the last few decades. Techniques, methodology, mechanics involving the diagnosis and treatment have changed and improved over a while. The only arena presumably where orthodontics is lacking is shortening the duration involved in treatment.¹ Orthodontic treatment usually requires a time of around 20-30 months for treatment of most malocclusions using fixed appliances. Many patients refrain from availing of the treatment due to this long duration of treatment. This subset of patients primarily are adult patients and are quite

apprehensive and thoughtful about the time required for the completion of their orthodontic treatment.²

This shortcoming has been taken into consideration by many researchers over the recent decades and they have tried to overcome this problem. Several attempts have been made to apply innovative, scientifically evidence-based methods to accomplish faster results, even then there still are many doubts and unrequited questions to many of these techniques. These efforts can broadly be characterized into pharmacological, biomechanical, surgical, and physical approaches.³

The pharmacological approaches to accelerate the amount of orthodontic tooth movement includes local injections of prostaglandins, cytokine IL-1, 1,25(OH)₂D₃

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(an active form of vitamin D3), Osteocalcin, relaxin, and parathyroid hormone around the alveolar socket.⁴ These were attributed to a plausible correlation with amplified risk of root resorption and pain levels.^{5,6}

The biomechanical and physical methods for accelerated tooth movement involve the use of vibrational stimulation, resonance vibration, direct electric current, and low-level laser therapy (LLLT).⁷ These methods have a low/moderate quality of evidence and are not recommended for everyday clinical practice. However, the advantage associated with LLLT is the reduction of orthodontic pain during tooth movement and the availability of portable and affordable devices.⁸

To accelerate tooth movement and decrease treatment duration various surgical approaches have been tried like interseptal alveolar surgery, segmental alveolar distraction, osteotomy, corticotomy, surgical stimulation by injection of platelet-rich plasma (PRP), and the latest being the Piezocision technique. All these approaches are a part of a histologic principle called the Regional Acceleratory Phenomenon (RAP).⁹ The Corticision technique is a significantly less invasive alternative to induce surgical injuries to the bone, that doesn't involve reflection of the mucoperiosteal flap.¹⁰

The latest innovation in corticision procedure is the Piezocision technique which involves the use of microsurgical ultrasonic piezoelectric blade substituting the traumatic procedure of malleting to make the cuts of the alveolar cortical bone. This procedure was reported to be effective and safe in osseous surgeries, such as sinus grafting, expansion of alveolar crest, and pre-prosthetic surgery. Piezocision has an excellent advantage of reducing postoperative complications like dehiscence, fenestrations, gingival recession, and root exposure.¹¹

To reduce the duration of the orthodontic treatment, the search for effective and proficient treatment alternatives is continuously going on. In the era of evidence-based dentistry, we must assess this new technique thoroughly before adding the same to our orthodontic armamentarium. Reducing the duration of canine retraction in conventional orthodontics is very important to complete treatment faster.¹² To assess the claims of reduction in treatment time by faster tooth movement, the idea of doing this study was conceived to determine the duration of maxillary canine retraction using Piezocision. This study aims to evaluate the duration for distalization of canine and amount of root resorption with and without piezocision.

2. Materials and Methods

The sample required worked out was 03 patients based on previous studies. However, in this study 15 patients (08 female, 07 male) undergoing therapeutic extraction of maxillary first premolars and distalization of maxillary permanent canines and fulfilling the following inclusion and

exclusion criteria were selected.

2.1. Inclusion criteria

1. Malocclusion with an indication of all first premolars extraction.
2. ANB angle less than or equals to 5 degrees.
3. No previous history of orthodontic treatment.
4. Good oral hygiene.
5. Crowding less than 2 mm.

2.2. Exclusion criteria

1. Syndromic cases.
2. Poor periodontal condition.

2.3. Methodology

The study was carried out in a tertiary care government hospital for patients. Who desired to undergo fixed orthodontic treatment and the treatment plan requiring therapeutic extraction of bilateral maxillary first premolar and bilateral canine distalization. It was a split-mouth study hence after initial leveling and alignment, patients underwent piezocision in one quadrant that was randomly selected by an independent clinician not part of the study. However, no piezocision was done on the opposite quadrant in the same patient.

On the piezocision side, local anesthesia in the form of 2% Lidocaine with 1:80,000 adrenaline was administered using the local infiltration technique, vertical interproximal incisions were placed above the interdental papilla on mesial and distal sides of the maxillary canine on the interventional side as shown in [Figure 1]. Piezotome (PIEZOTOME SOLO™) was used to induce a microcut on the buccal aspect of the alveolar bone of approximately 10 mm height and 3 mm depth on the mesial and distal aspect of the maxillary canine as shown in [Figure 2]. The same was measured using a Goldmanfox Probe to confirm the measurements as depicted in [Figure 3]. The distalization phase was initiated immediately in both the quadrants using open coil springs of length 9 mm as depicted in Figure 4]. Producing an estimated force of 150 gm measured using a Dentauram Correx force measuring gauge. Patients were assessed at four weeks intervals until the maxillary canine came in contact with mesial surface of the maxillary second Premolar on both sides. Data were collected at the following time points, T0: before canine retraction, T1a: when the maxillary canine crowns contacts the maxillary second premolar (Piezotome side), T1b: when maxillary canine comes into contact with the maxillary second premolar (Non-Piezotome or control side).

2.4. Methodology for measuring root resorption (Blunting of Root)

CBCT was taken as a pretreatment record and was used to assess the pretreatment root length using NNT viewer version 8.0. Using the multiplanar mode option, the axial thickness was set to 0.15 mm, and cross-sectional thickness was set at 0.15 mm. Following which the maxillary canine longitudinal axis was followed and angulation was adjusted as shown in [Figure 5]. For measuring the fine length of the maxillary canine. The post-treatment CBCT data acquired was also for the same and data was recorded. Following which the difference in the length was calculated i.e., blunting of root.

2.5. Ethical considerations

The research protocol, of the study was reviewed, and approved by the Institutional Ethical Committee. Informed, consent under witness, was obtained from each, participant at enrolment after, each subject has explained the nature and purpose of the study.

3. Results

The data were collected from 15 patients indicated for canine distalization, after completion of distalization. The entire data is statistically analyzed using Statistical Package for Social Sciences (SPSS ver.21.0, IBM Corporation, USA) for MS Windows. The inter-group statistical comparison of continuous variables was done using the independent sample t-test. The underlying normality assumption was tested before subjecting the study variables to a t-test. The mean difference was also calculated along with a 95% confidence interval (CI) of the mean difference. All the results are shown in tabular format to clearly show the statistically significant difference.

3.1. Duration of total canine retraction

The mean \pm SD of the duration of canine retraction in the piezocision group was 4.66 ± 0.52 months which was comparatively faster than that of the control group which took almost 5.72 ± 0.65 months and mean (95% CI) of duration. Piezocision group-control group was 1.06 (-1.51 to -0.62) months faster than the control group in case of a duration of canine distalization. The distribution of the mean duration of canine retraction was significant. Higher in the control group compared to the piezocision group (P-value<0.001). [Table 1]

3.2. Root resorption (Blunting of Apex)

Blunting of apex in piezocision group and control group was 0.53 ± 0.29 mm and 0.58 ± 0.34 mm that shows that the root resorption was lesser in the piezocision group as compared to that of the control, group. The mean difference between

the piezocision group and the control group was -0.050 (-0.28 to 0.19). The distribution of mean root resorption did not differ significantly between the piezocision group and control group thus there was no difference in the amount of root resorption with or without piezocision. (P-value>0.05). [Table 2]



Figure 1: Vertical interproximal incisions

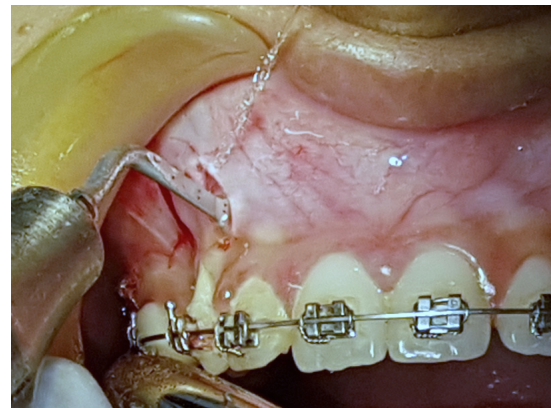


Figure 2: Cortical alveolar bone perforation through the gingival micro Opening with Piezotome



Figure 3: Measuring of depth ofcortical alveolar bone perforation with Goldman fox probe

Table 1: Inter-group distribution of mean duration of retraction.

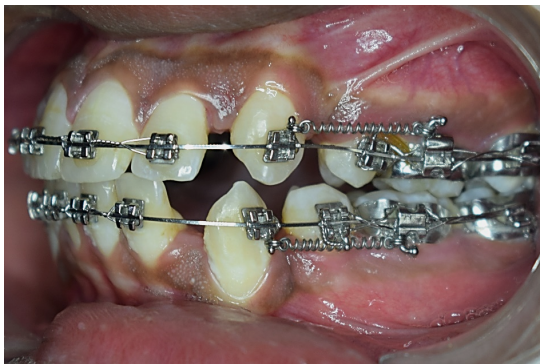
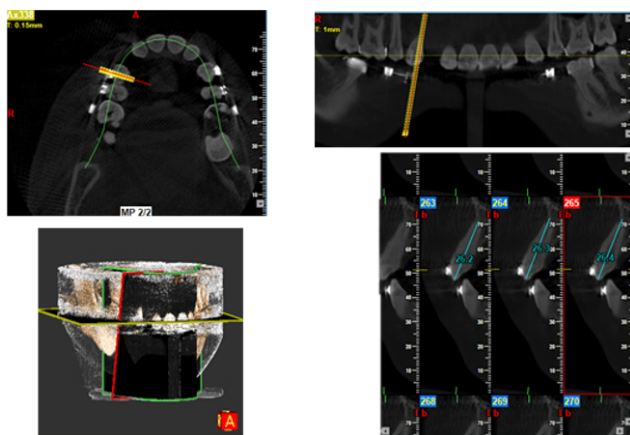
	Piezocision Group (n=15)		Control Group (n=15)		Difference	
	Mean	SD	Mean	SD	Mean (95% CI)	P-value
Duration of Retraction (months)	4.66	0.52	5.72	0.65	-1.06 (-1.51 to -0.62)	0.001***

Values are mean and SD. P-values by independent sample t test. P-value<0.05 is considered to be statistically significant. ***P-value<0.001.

Table 2: Inter-group distribution of mean root resorption

	Piezocision Group (n=15)		Control Group (n=15)		Difference	
	Mean	SD	Mean	SD	Mean (95% CI)	P-value
Root Resorption (mm)	0.53	0.29	0.58	0.34	-0.05 (-0.28 to 0.19)	0.691 ^{NS}

Values are mean and SD. P-values by independent sample t test. P-value<0.05 is considered to be statistically significant. NS-Statistically non-significant.

**Figure 4:** Canine retraction in controlled side**Figure 5:** CBCT in multiplanar mode showing cross-section of canine and length of the canine

4. Discussion

Empirical evidence suggests that the average duration of active orthodontic treatment is around one and a half to two years. This range varies significantly and is influenced by several factors including, the severity of the malocclusion, non-extraction versus extraction, non-

surgical versus orthognathic surgery, patient cooperation, and clinical expertise in treating orthodontic cases.^{13,14} Such long treatment duration affects the esthetic concerns of the patient¹⁵ and is also associated with several adverse effects such as suboptimal oral hygiene, root resorption, white spot lesions, gingival recession, and dental caries.¹⁶ With more and more adults seeking orthodontic care, there is a paradigm shift towards reducing the treatment duration.

Piezocision is one of the techniques to accelerate tooth movement. Dibart⁷ was the first to begin the Piezocision technique. Which was initiated by giving a primary incision on the buccal gingiva, avoiding interdental papilla. An incision on the attached gingiva was given using blade 15 and vertical cuts were given on the bone using piezotome. For patients, overall reduced treatment duration increases the motivation level and allows for exemplary compliance, which is necessary for orthodontic treatment. Reducing the duration of orthodontic treatment saves the patient from time-dependent unwarranted adverse effects of treatment also. Various available procedures for accelerating the orthodontic tooth movement can be done like, surgical procedures, device-assisted therapy, or mechanical stimulation methods and drugs.¹⁷ Retracting canines in premolar extraction cases is the most time-consuming procedure. The rate of canine retraction with conventional techniques is ranged from 0.5 to 01 mm per month, which is dependent on several individual case-related factors. Thus, it takes about five to nine months for full canine retraction, thereby fixed appliances therapy using conventional procedure required about one and a half to two years to complete.¹⁸

Evaluation of the duration of total canine retraction in this study is in agreement with a split-mouth study carried out by Aksakalli et al¹⁸ involving 10 patients (20 canines). Aksakalli et al reported that the duration of maxillary canine distalization was 3.5 ± 0.81 months on the Piezocision side, whereas, on the control side, the duration was significantly longer that is 5.59 ± 0.94 months. The present study design consisted of 15 patients (30 canines).

In the present study, the maxillary canine retraction was completed within 4.66 ± 0.52 months in the experimental group in the piezocision side of the maxillary arch except for one patient whose retraction was completed in the 5.5 months in the experimental side.

Aboul-Ela et al¹² stated that a Class I canine relationship was achieved within 02-03 months in the experimental sides with corticotomy. Corticotomy Facilitated Orthodontics (CFO) claims to have dramatically reduced the overall treatment duration. Thus, the author attributed this reduction in duration of treatment to the removal of resistance that was due to dense cortical bone. Leethanakul et al¹⁹ also showed a similar result and demonstrated that canine distalization of 5.4 mm was observed in 03 months when the interseptal bone reduction was performed. These are also in accordance with the present study.

Reduction in duration of time can be attributed to the regional acceleratory phenomenon (RAP) that occurs due to piezocision. Initially described in Orthopedics by Frost in 1983, following bone injury, RAP is initiated followed by a rise in turnover of the bone and reduction of the mineral content of the bone. The underlying biologic mechanism for the reduced duration is due to transient osteopenia, osteoclast recruitment, demineralization, and accelerated bone turnover which are the characteristics of RAP.¹⁸ During orthodontic tooth movement, the main pro-inflammatory cytokines that are released are IL-1, TNF, and IL-6.²⁰ Micro-perforations created during RAP increases expression of these factors and activation of osteoclast precursor cells which are accompanied by higher osteoclastic activation thus resulting in greater tooth movement.

However, some studies have shown that there is no effect of piezocision on the duration of teeth movement. These studies were conducted to assess the consequence of piezocision on treatment duration. Mehr et al.²¹ evaluated the time taken for mandibular crowding relief with piezocision-corticision incorporated during orthodontic therapy and did not find it more efficient than conventional orthodontics. A similar finding was reported by Uribe et al²² in their study, where they found no major difference in the duration required to correct mandibular crowding with piezotome-corticision assisted (102.1 ± 34.7 days) and conventional orthodontics (112 ± 46.2 days). Above mentioned studies showed that piezocision was effective for canine distalization compared to crowding alleviation.

Evaluation of Root Resorption (Blunting of Apex) various studies have shown that corticotomy decreases root resorption and periodontal ligament hyalinization. A study carried out by Charavet and Lecloux found that there was less root resorption on the pressure side of extracted premolars after corticotomy-facilitated arch expansion and hyalinization necrosis of periodontal ligament when compared with the control group.²³ Abbas NH²⁴ found that root resorption didn't increase following treatment in the

piezocision group and also observed that there was a lesser amount of root resorption on the experimental side using CBCT. Thus this suggests that there were no adverse effects on root length following piezocision-assisted orthodontic treatment. However, Segal¹⁵ suggested that if piezocision is carried out close to the roots, it could increase root resorption.

Patterson and co-workers²⁵ studied the orthodontically induced inflammatory root resorption which is an effect of piezocision. There was an average increase of 44% root resorption following piezocision. The authors concluded that iatrogenic root resorption may increase when orthodontic forces and RAP following piezocision procedure are combined, thus the orthodontic force level should be carefully weighed and regularly monitored during treatment. In our study there was no difference between the control and piezocision side as $P = 0.691$ ($P\text{-value} < 0.05$) as the RAP induced by piezocision can be described as a demineralization-remineralisation process, rather than bony block movement, resulting in shorter treatment duration and minimum root resorption.

5. Conclusion

With this split-mouth prospective clinical study the undermentioned conclusions can be drawn along with the considerations of the limitations of clinical settings:

1. Piezocision procedure reduces the time required for retraction of maxillary canine when compared to non-surgical side. The time on the piezocision side was 4.66 ± 0.52 months while on the non-piezocision side that was 5.72 ± 0.65 months.
2. Blunting of apex in piezocision group and control group was 0.53 ± 0.29 mm and 0.58 ± 0.34 mm respectively. There was no statistically significant difference in the amount of blunting of root apex with or without piezocision.

6. Source of Funding

None.

7. Conflict of Interest

None.

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