COMPARISON OF MODIFIED PIEZO-ASSISTED ALVEOLAR DECORTICATION WITH CONVENTIONAL ORTHODONTIC TREATMENT IN ADULTS

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ABSTRACT:

Abstract

Background: Orthodontic tooth movement is a harmonious sequence of physical phenomenon and biological tissue remodeling. Piezocision, is a new minimally invasive technique for accelerating tooth movement which incorporates micro-incisions confined to the oral side. The main aim of this study is to compare the effectiveness of modified piezocision assisted orthodontic treatment versus conventional mechanics in various aspects of orthodontic tooth movement.

Method: An in vivo study was done to compare the rate of tooth movement between piezocision and conventional orthodontic treatment at a time interval of 2 weeks, 4 weeks, 6 weeks, 8 weeks period. Fourteen subjects were selected and were divided into two groups; Group A (control group), group B (piezocision group). After 19 * 25 SS arch wire was placed, piezo cuts were given distal to canine in all four quadrants in piezocision group. En masse retraction was done with NiTi closed coil spring. The rate of space closure, periodontal data, inter canine width, inter molar width, inclination of upper and lower incisor and patient centric data was measured from baseline to the follow up (8 weeks).

Result: The results showed that the rate of tooth movement was increased in the piezocision group than the control group. There were no significant changes seen in inter molar width and periodontal health between the groups. 1˚ -2˚ changes was seen in the maxillary and mandibular incisor inclination between baseline to follow up. The subjects in piezocision group experienced moderate pain and were highly satisfied with the surgical procedure.

Conclusion: Piezocision technique is efficient in accelerating tooth movement than the conventional technique. Piezocision proves to be effective from the patients and clinician's point of view and provides benefits that can contribute to greater acceptance in dental and patient communities.

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INTRODUCTION:

Orthodontics is a branch of dentistry that specializes with the diagnosis, investigation and correction of the mal positioned teeth and the jaws. Moving the teeth in the dentoalveolar complex is a harmonious sequence of physical phenomenon and biological tissue remodeling. Orthodontic tooth movement is a process in which the application of a force induces bone resorption on the pressure side and bone apposition on the tension side. Understanding the biology underlying orthodontic tooth movement has great clinical implication. The average active orthodontic treatment takes about 18-24 months, which is a prolonged commitment[1].

Wilcko et al. (1995) first proposed that rapid tooth movement after corticotomy could be due to a mechanism of demineralization-remineralization that creates a bone remodeling regional acceleratory phenomenon (RAP), rather than the movement of a tooth-containing bony block. While acceleration of orthodontic tooth movement by surgical techniques has been shown to be effective, nonsurgical approaches have always been preferred by clinicians and patients for their noninvasiveness. Such techniques range from systemic/local administration of biological molecules to innovative physical stimulation technologies like resonance vibration, magnetic field forces, cyclic forces, light electrical currents, low-intensity laser irradiation and photo bio-modulation[2].

Piezocision, a new minimally invasive technique was introduced by Dibart et al in 2009. This approach incorporates micro-incisions confined to the oral side to facilitate the use of the piezoelectric knife and selective tunneling to graft hard or soft tissue[3]. Piezocision can be used to accelerate orthodontic treatment. Literature suggests that rate of tooth movement increased in piezocision group than the control group. Jolly et al in his study has shown an increase in orthodontic tooth movement by 1.7 times in piezocision group.[4]

Many studies have compared the rate of canine and enmasse retraction between piezocision and conventional orthodontic group.[5,6] The piezo cuts were given on either side of canine through the periosteum up to the alveolar bone in the case of canine retraction and in entire anterior region in enmasse retraction cases. This study we have given a single piezocison cut distal to canine and evaluated the rate of tooth movement between piezocision and control group during en masse retraction.The objective of the study was to measure and compare the amount of space closure during enmasse retraction, to measure the changes in the inter molar width, inter canine width, to evaluate the changes in the incisor inclination in radiograph , to evaluate the changes in the periodontal health with indices and to assess the patient centered data.

MATERIALS AND METHODS:

An interventional study was conducted in Department of Orthodontics, Tagore Dental College and hospital, Rathinamangalam, Chennai to compare the rate of enmasse tooth movement between conventional orthodontic treatment group and piezocision-assisted orthodontic treatment group. Fourteen adult patients from the Department of orthodontics who required orthodontic treatment were selected and divided into two groups, Group A (piezo enhanced group) - 7 subjects and Group B (control) – 7 subjects. Inclusion criteria were as follows a) Patient requiring Orthodontic treatment; b) Adult patient with completed growth; c) Patient with skeletal and dental Class I malocclusion; d) Adequate Dento-oral health ; e)Patient undergoing all 1st premolar extraction.

The exclusion criteria includes a) Gingival recession >2mm; b)Smokers ; c) Altered bone metabolism (eg. osteoporosis, renal osteodystrophy, osteopetrosis, Paget's disease, rickets); d)Mental or motor disabilities ; e)Pregnancy; f)Patients with systemic disease

Risks, benefits, and monitoring of the study were explained to the patients and complete informed consent was obtained.

Armamentarium includes Sonopet Ultrasonic Aspirator piezosurgical unit (stryker., USA)(FIG 1a), Nakagawa serrated tip(5450-800-305)(FIG 1b),BP blade, Digital vernier caliper, William's periodontal probe,2 tone disclosing agent (alphaplac),Closed coil spring ,Dontrix gauge,19*25 SS wire.

FIG 1:a) Piezosurgical unit (b) Nakagawa serrated tip

ORTHODONTIC PROCEDURES:

A 0.22" × 0.25" slot metal brackets (Mini 2000, Ormco, USA) was used for all the patients in the study and the control group. The bonding method was standardized and applied according to the manufacturer's instructions. The sequences of arch wires used are as follows: 0.014". NiTi, 0.018" NiTi, 0.016" × 0.022" NiTi, and 0.017" × 0.025" NiTi, 0.019" × 0.025" SS. Nickel-Titanium arch wires were used for alignment, while 0.019" × 0.025" stainless-steel arch wires were used during retraction. Prior to insertion of 0.019" × 0.025" SS arch wire, alginate impressions for study models, lateral cephalograms, extra- and intraoral photographs, full periodontal evaluations were taken for both the groups (T1). Anterior consolidation was done from canine to canine and Niti closed coil spring (150 gm) was given from molar buccal tube to power arm placed distal to lateral incisor for en-masse retraction followed by peizocision. Reactivation of Niti coil spring was done every two weeks and subsequent records were taken at every 2 week intervals up to 8 weeks.

PIEZOCISION SURGICAL PROCEDURE

According to Dibart et al (2009), the surgical protocol was performed. Local anaesthesia was administered in both arches; vertical interproximal micro incisions were placed distal to canine and 5 to 8 mm below each interdental papilla. Then, with a help of vertical piezoelectric device, 5-mm-long and 3-mm-deep corticotomies were made, and sutures was not placed (FIG 2). The patients were advised to take analgesics (paracetamol) only if necessary.(FIG 1) Anti-inflammatory drugs are usually not prescribed to avoid interference with the regional acceleratory phenomena(RAP). Cautious tooth brushing and the use of a mouthwash (chlorhexidine 0.2%) was recommended for 7 days

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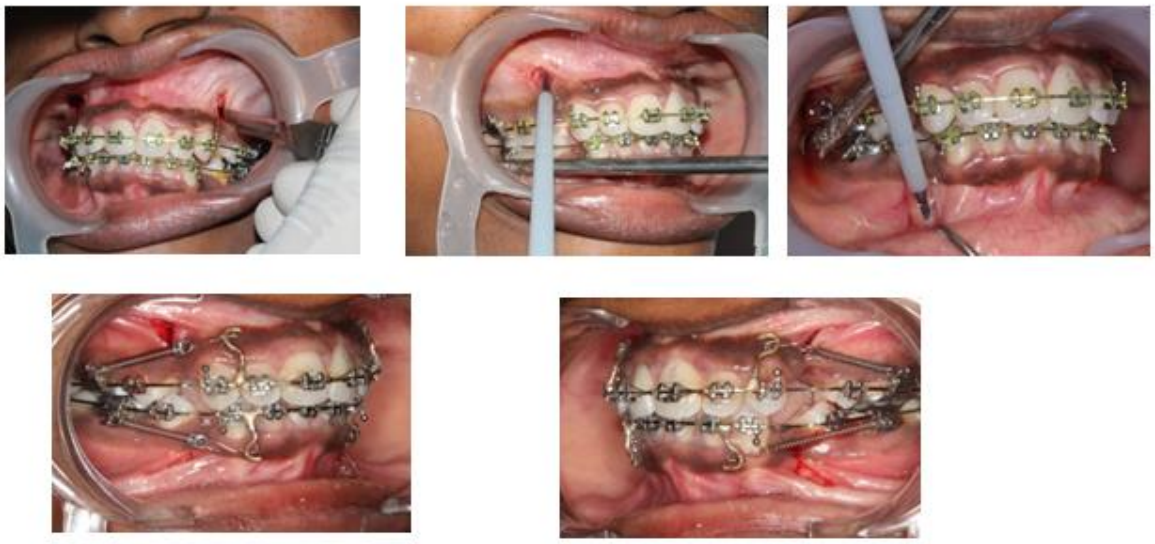

FIG 2: Decortication in maxilla and mandible followed by enmasse retraction with closed coil spring (150 mg).

DATA COLLECTION

ORTHODONTIC DATA:

Space analyses was performed on study models with digital calliper. The rate of tooth movement was measured from the distal surface of the canine to the mesial surface of the second premolar at the most convex point.The inter canine and inter molar distances were measured at baseline (T1) and at 8 weeks (follow up) to determine the level of expansion. The upper incisal angle (upper incisor to SN plane) and lower incisor angles (lower incisor to mandibular plane) were calculated in lateral cephalogram.

PERIODONTAL HEALTH:

Papillary Bleeding Index (PBI, Muhlemann)

The PBI (1977) by Muhlemann was an effective index to motivate patients for improving their gingival health. The rationale of this index is that marginal periodontitis and alveolar bone loss begins inter proximally and the effectiveness of preventive procedures are more easily related to the presence or absence of interdental plaque. The results are translated into numerical scores which are easily comprehensible by the patient.

Plaque index:

Silness and Loe method (1964) was used to assess the thickness of plaque at the cervical margin of the tooth closest to the gums. Disclosing agent was used for plaque detection which is invisible to eyes. New plaque appears pink and old plaque appears as blue in colour after washing.

Patient-centered data:

A questionnaire which had a graduated scale from 0 to 10 for visual analog scale was used to record the patient-centered outcome. The parameters such as: pain experienced after orthodontic appliance placement and piezocision, satisfaction level of patients in terms of the final outcome, the duration of treatment, and patients recommendation of the procedure to a friend were assessed.

STATISTICAL ANALYSIS

Statistical analysis was done using SPSS version 21 software. Non parametric asymptotic two tailed test was used to compare the rate of tooth movement, changes in inter canine width, inter molar width, inclination of upper and lower incisor, plaque and bleeding index between the study and the control group. Friedman test was used to do pairwise comparison within the study period (weeks) for evaluating the rate of tooth movement**.**

RESULTS:

RATE OF TOOTH MOVEMENT:

Table 1 show the rate of tooth movement in both control and study group. The rate of tooth movement increased from 0.3 to 1.7 mm from 2 weeks to 8 weeks in piezo group and 0.2 to 1.3 mm in control group. Asymptotic 2sided tests was used to compare the rate of tooth movement in both the group for every 2 weeks up to 8 weeks of en masse retraction in upper and lower arch. There was statistically significant difference (P<0.00) in the rate of tooth movement within the study and control groups. Significant difference (P=0.000) was also seen in the rate of tooth movement between the piezo and the control group in 2, 4, 6, 8 weeks of tooth movement. The results states that the rate of tooth movement increased 1.5 times in the piezocision group than the control group.

TABLE 1: RATE OF TOOTH MOVEMNT IN CONTROL AND PIEZOCISION GROUP

TIME	STUDY GROUP			CONTROL GROUP			TOTAL		
	MEAN	SD	P	MEAN	SD	P	MEAN	SD	ASYMPTOTIC P VALUE
2 WEEKS	0.3750	0.07538	0.000	0.2583	0.05149	0.000	0.3167	0.08681	0.001
4 WEEKS	0.8000	0.14142		0.5667	0.06513		.6833	0.16061	0.000
6 WEEKS	1.2667	0.18257		0.9250	0.08660		1.0958	0.22357	0.000
8 WEEKS	1.7500	0.25045		1.3083	0.09962		1.5292	0.29263	0.000

Table 2 shows that the statistically significant difference in the rate of tooth movement was seen between 2 weeks and 6 weeks (P =0.001), 2 weeks and 8 weeks (P=0.00) and between 4 weeks and 8 weeks (P=0.001) in both the control group and piezocision group.

TABLE 2:TEST OF SIGNIFICANCE BETWEEN VARIOUS TIME PERIOD

TIME		TEST STATISTICS	STD. ERROR	SIG.
TWO- FOUR	Control	-1.000	0.527	0.058
	Piezo	-1.000	0.527	0.058
TWO- SIX	Control	-2.000	0.527	0.000
	Piezo	-2.000	0.527	0.000
TWO- EIGHT	Control	-3.000	0.527	0.000
	Piezo	-3.000	0.527	0.000
FOUR-SIX	Control	-1.000	0.527	0.058
	Piezo	-1.000	0.527	0.058
FOUR-EIGHT	Control	-2.000	0.527	0.000
	Piezo	-2.000	0.527	0.000
SIX- EIGHT	Control	-1.000	0.527	0.058
	Piezo	-1.000	0.527	0.058

Table 3 shows the mean rate of tooth movement in maxilla of control group increased from 0.26 in 2 weeks to 1.35 in 8 weeks. In mandible the mean rate of tooth movement increased from 0.25 in 2 weeks to 1.26 in 8 weeks. In study group, the mean rate of tooth movement in maxilla, increased from 0.433 in 2 weeks to 1.93 in 8 weeks. In mandible the mean rate of tooth movement increased from 0.32 in 2 weeks to 1.5 in 8 weeks. The table also shows that there was no statistically significant difference in the rate of tooth movement between the maxilla and mandible in control group at 2 week, 4 week, 6 week, 8 week interval ($p > 0.05$). In study group, statistically significant difference in the rate of tooth movement between the maxilla and mandible was seen at 2 weeks, 4 weeks, 6 weeks, 8 weeks interval ($p< 0.05$).

TABLE 3: RATE OF TOOTH MOVEMENT IN MAXILLA AND MANDIBLE

DURATION	ARCH	CONTROL GROUP			STUDY GROUP		
		MEAN	SD	P	MEAN	SD	P
2 WEEKS	MAX	0.2667	0.05164	0.575	0.4333	0.05164	0.006
	MAND	0.2500	0.05477		0.3167	0.04082	
4 WEEKS	MAX	0.5833	0.07528	0.423	0.9000	0.08944	0.014
	MAND	0.5500	0.05477		0.7000	0.10954	
6 WEEKS	MAX	0.9500	0.10488	0.342	1.4000	0.08944	0.015
	MAND	0.9000	0.06325		1.1333	0.15055	
8 WEEKS	MAX	1.3500	0.10488	0.155	1.9333	0.13663	0.015
	MAND	1.2667	0.08165		1.5667	0.19664	

INTER CANINE WIDTH:

Table 4 shows the mean inter canine width changed from 32.883mm to 32.533mm in study group from baseline to follow up. The control group showed an decrease from 34.31mm to 33.75mm There was no statistical significant difference found between the control and the piezo group in the baseline (p=0.423) and follow up(p= 0.522) respectively. But significant difference was found within the study group (p=0.027) and in control group (p=0.027) group from the baseline to the follow up.

TABLE 4: INTER CANINE WIDTH CHANGES IN STUDY AND PIEZOCISION GROUP

TIME	STUDY GROUP			CONTROL GROUP			ASYMPTOTIC P VALUE
	MEAN	SD	P	MEAN	SD	P	
BASELINE	32.8833	5.40830	0.027	34.3167	4.37512	0.027	0.423
FOLLOW UP	32.5333	5.48039		33.7500	4.39488		0.522

Table 5 shows the mean and standard deviation of the inter canine width changes in the maxilla and mandible within the study and the control group from the baseline to the follow up. In control group, the mean maxillary inter canine width changed from 38.16mm to 37.63mm from baseline to follow up and the mandibular width changed from 30.47mm to 29.9mm.The mean inter canine width of maxilla in study group changed from 37.56mm to 37.26 mm . In mandible the mean inter canine width changed from 28.2mm to 27.8 mm. There was significant inter canine width changes seen in both the groups between the maxilla and the mandible both in the baseline and the follow up(p=0.050)

TABLE 5:INTER CANINE WIDTH CHANGES IN MAXILLA AND MANDIBLE

TIME		CONTROL GROUP			STUDY GROUP		
	ARCH	MEAN	SD	P	MEAN	SD	P
BASELINE	Maxilla	38.1667	1.47422	0.050	37.566	28.2000	0.050
	mandible	30.4667	1.10151		28.2000	32.8833	
FOLLOW UP	Maxilla	37.6333	1.38684	0.050	37.2667	2.56970	0.050
	Mandible	29.8667	1.05987		27.8000	32.5333	

INTER MOLAR WIDTH:

Table 6 shows the mean inter molar width changed from 44.433mm to 44.700mm in study group from baseline to follow up. The control group showed an increase of 44.06mm to 44.65mm. There was no statistically significant difference found between the control and the piezo group in the baseline and follow up, (p= 0.749) and (p=0.810) respectively. But significant difference was found within the study group (p=0.042) and in control group (p=0.027) groups from the baseline to the follow up.

TABLE 6: INTER MOLAR WIDTH CHANGES IN STUDY AND PIEZOCISION GROUP

TIME	STUDY GROUP			CONTROL GROUP			ASYMPTOTIC P VALUE
	MEAN	SD	P	MEAN	SD	P	
BASELINE	44.4333	2.40472	0.042	44.0667	4.22548	0.027	0.749
FOLLOWUP	44.7000	2.47063		44.6500	4.03125		0.810

Table 7 shows the mean and standard deviation of inter molar width changes in the maxilla and mandible within the study and the control group from the baseline to the follow up. In control group, the mean maxillary inter molar width changed from 47.86mm to 48.26 mm from baseline to follow up and the mandibular width changed from 40.266 to 41.033. The study group showed an increase of 46.40 mm to 46.7 mm in maxilla and 42.46 mm to 42.70 mm in mandible. There was significant inter molar width changes seen in both the groups between the maxilla and the mandible both in the baseline and the follow up(p=0.050)

TABLE 7: INTER MOLAR WIDTH CHANGES IN MAXILLA AND MANDIBLE

TIME	ARCH	CONTROL GROUP			STUDY GROUP		
		MEAN	SD	P	MEAN	SD	P
BASE LINE	Maxilla	47.8667	0.95044	0.050	46.4000	1.50997	0.050
	Mandible	40.2667	0.64291		42.4667	0.75719	
FOLLOW UP	Maxilla	48.2667	1.10604	0.050	46.7000	1.70000	0.050
	mandible	41.0333	0.40415		42.7000	0.60828	

INCLINATION OF UPPER AND LOWER INCISOR:

Table 8 shows the inclination changes in the maxilla and mandible between study and control group from baseline to follow up. There was significant difference found in the maxillary incisor inclination between study and control group from baseline to follow up. (p=0.050). Both the groups showed an average increase of 1˚ from baseline to follow up. There was no significant difference found between study and control group from baseline to follow up (p=0.822) in mandibular incisor inclination. Control group showed 2˚ increase from base line to follow up, whereas study group showed 1˚ increase from baseline to follow up.

TABLE 8: CHANGES IN INCISOR INCLINATION IN MAXILLA AND MANDIBLE

GROUP	MAXILLA				P
	BASELINE		FOLLOW UP		
	MEAN	SD	MEAN	SD	
CONTROL	113.6667	4.16333	112.3333	4.19325	0.05
STUDY	119.5000	1.80278	118.3333	1.52753	
	MANDIBLE				
CONTROL	98.1667	2.02073	96.1667	1.75594	0.822
STUDY	97.8333	1.60728	96.6667	1.44338	

PLAQUE INDEX AND BLEEDING INDEX:

There was no statistically significant difference found in the plaque and bleeding index in both the groups. Table 9 shows the mean plaque index increased from 0.74 to 0.8300 in study group from baseline to follow up. The control group showed an increase of 0.74 to 0.79. Plaque index showed a mild increase in mean score by 0.1 in piezo group and 0.05 in the control group after 8 weeks of follow up. No significant difference was seen in plaque index between study and control group in base line (p=1.00) and follow up (p=0.7). Bleeding index showed no statistically significant difference within the control group (p= 1.00) and study group (p=0.655). Significant difference was not seen between the study and the control group in the baseline(p=0.3) and the follow up (0.114).

TABLE 9: ASSESSMENT OF PLAQUE INDEX AND BLEEDING INDEX

INDEX	TIME	STUDY GROUP			CONTROL GROUP			ASYMPTOTIC P VALUE
		MEAN	SD	P	MEAN	SD	P	
PLAQUE INDEX	BASE LINE	.7467	.12503	0.18	.7467	.1250	0.41	1.000
	FOLLOW UP	.8300	0.06928		.7900	.0692		0.700
BLEEDING INDEX	BASE LINE	.9983	.12751	0.65	1.083	.1909	1.00	0.376
	FOLLOW UP	1.0000	.00000		1.083	.0721		0.114

VISUAL ANALOG SCALE:

Table 10 shows statistically significant difference in pain perception between the study and the control group (p= 0.043). Study group experienced more pain than the control group.

TABLE 10: PAIN ASSESSMENT USING VISUAL ANALOG SCALE.

GROUP	MEAN	SD	P
STUDY	4.6667	0.57735	0.043
CONTROL	1.6667	0.57735	

LEVEL OF SATISFACTION:

Table 11 shows the mean of 0.66% in the study group will undergo surgical procedure and all the patient will recommend surgical procedure to others.

TABLE 11: EVALUATION OF LEVEL OF SATISFACTION

	Patient 1	Patient 2	Patient 3
Will you again undergo/Recommend surgical procedure	yes	yes	no
Recommend other for surgical procedure	yes	yes	yes

DISCUSSION:

Regional Acceleratory Phenomenon (RAP) is a cascade of physiologic healing events that takes place after surgical wounding of cortical bone. RAP which was introduced by Harold Frost, is a local response to the noxious stimulus, which defines a process by which formation of tissue is faster than the normal regional regeneration process. Some studies reports that there is an increase in inflammatory markers such as cytokines and chemokines in response to orthodontic forces. Surgical irritation of the bone increases these factors that in turn increase the tooth movement. A histological study by Sebaoun et al 2008[7] reported that the selective alveolar decortication increases the turnover of the alveolar spongiosa. Surgical procedure leads to significant increase in alveolar demineralization leading to osteopenia which causes rapid tooth movement.

The conventional corticotomy procedure includes full elevation of the mucoperiosteal flap both in buccal and lingual aspects, placed with a micromotor under irrigation or piezosurgical instruments. This technique seems to be invasive causing postoperative pain and swelling, damage to adjacent vital structure and low acceptance by the patients. To reduce the morbidity associated with the conventional surgical technique, a flapless corticotomy using piezosurgery called piezocision was introduced. Piezocision accelerates tooth movement and also improves the periodontium by hard and soft tissue grafting. This procedure includes the micro incision in buccal gingiva, and the decortications are created through the incisions to the depth of 3mm. Tunneling is done in the areas where bone augmentation is required. When the bone is injured, healing process occurs at the site of the bone injury that is proportional to the level of surgical insult. This reduces the invasiveness of the traditional surgical technique to accelerate tooth movement.[8]

Many studies have compared the rate of canine retraction between piezocision and control group. To our knowledge not many studies compared the rate of tooth movement during enmasse retraction between piezocision placed distal to canine and the control group. Hence, this study aimed to evaluate the rate of tooth movement between piezocision and control group during enmasse retraction of the anterior teeth in 2 week intervals up to 8 weeks from the initiation of enmasse retraction. This study also compared the periodontal health and the patient centric data.

In this study, the rate of tooth movement increased almost 1.5 times in piezocision group at every 2 weeks interval, while the rate was 0.5 in control group. This increase in rate of tooth movement in piezocision group might be attributed to RAP phenomenon. The result of the study was in concordance with the study done by Hatrom et al (2020)[9], who reported that rate of tooth movement in en masse retraction was increased in the piezocision than the control group, and also more amount of extraction space was closed by the piezocision group. In his study, the rate of space closure per month was about 1.2 mm in the piezo group and 0.6mm in the control group.. Contrarily, Tuncer et al 2017[10] has stated that, even though significant difference in the retraction rates was not seen between the two groups, there was a slight increase in the rate of tooth movement in the piezocision group. He suggested that the nature of decortication plays an important role in starting the regional acceleratory phenomenon. He also stated that there is an increased risk of premature closure of the piezosurgical cuts than the conventional corticotomy which limits the duration and intensity of RAP phenomenon.

In a study done by Dibart et al (2014)[11], significant difference in the rate of tooth displacement was not seen from 3-14 days, but showed a two fold increase after 28 days. Hence the rate of tooth movement was assessed 2 weeks after piezocision. This study shows the rate of tooth movement increased steadily in piezocision group from 2 week to 8 weeks which was similar to the study of Khalil et al(2018)[12] who states that the peak of RAP is achieved in the first month after surgery which subsides gradually after 4 months. But Buschang et al (2012)[13] suggests that duration of RAP effect is incompletely understood and might wane after certain point of time.

The study also shows that the rate of tooth movement in piezocision group, is high in maxilla than the mandible. This might be due to the increased bone density seen in mandible (<1250 HU)

increases the resistance to tooth movement than in the maxilla (850-1250 HU ,Misch 1999) as stated by Charavet (2016)[14]

Assessment of dental models showed insignificant difference between the study and the control groups. In our study, slight decrease in the inter canine distance was observed in both the groups, which was statistically insignificant when compared between the groups. Intra group comparison between the maxilla and the mandible showed that there is significant difference in the inter canine width. A previous study by Tuncer et al (2017)[10] has reported similar results which states that this transverse constriction in inter canine region might be attributed due to the palatal tipping and distobuccal rotation seen during retraction. Due to the reduced bone density and decreased arch wire deformation, this effect is seen less in the piezocision group as compared with the control group. Studies done by Gianelly et al(1985), Luppanapornlarp and Johnston (1993)[15] also showed similar results.

Inter molar width changes did not show any significant changes in both the groups as the piezocision cuts did not involve the molar region and the anchorage was reinforced in both the groups by engaging the second molar. Decreased anchorage loss in both sagittal and vertical direction, prevents worsening of the profile due to posterior mandibular rotation. A study done by Aksakalli et al(2015)[5]showed an increase in the inter molar width in Class III cases after canine distalization which might be due to the protraction of molar in the narrower part of the arch during space closure.

In this study, the inclination of upper anteriors shows 1˚ change in 8 weeks in both control and study. Inclination of lower anteriors shows 1˚- 2˚ change in both the groups. Since the study was conducted only for a limited period of time, the total amount of axial inclination changes could not been assessed. But the results of this study was similar to the study by Tuncer[10] where he proved that that piezosurgery do not cause any changes in the type of tooth movement and the tooth moves by a combination of controlled tipping and bodily retraction. Hatrom et al[9] showed an insignificant change in the axial inclination of the anteriors which was attributed to the use of modified bidimensional brackets with 0.022 inch posterior bracket slot and 0.018 inch anterior bracket slot as suggested by Rinchuse and Giancotti. The bidimensional bracket produces more easier and reduced tipping of anteriors during retraction.

The periodontal evaluation of our study suggests that there is no significant changes seen between the groups during the entire duration of the study. Our results correlated with the previous studies done Abbas et al[6] and Aboul-Ela[16], where no adverse periodontal changes was observed due to the scar caused by piezocision. Patients with piezocision showed a very mild increase in the plaque and bleeding index which might be due to the difficulty in maintaining the oral hygiene because of the periodontal incisions. Those patients have to be educated about the necessity of oral hygiene practices.

Patient centered data reveals that the study group experienced more amount of pain during initial activation following piezocision when compared to control group. Mehr (2013) also proved that piezocision had insignificant role on the pain perception and both the studies showed that patient were satisfied with overall experience of the orthodontic treatment and would motivate other patients to undergo piezocision.

Surgical approach in accelerating orthodontics is the most clinically used with more predictable and stable results. Piezocision is an innovative technique in accelerating the tooth movement that can also be used with invisalign which improves aesthetics and reduces the treatment time. Eventhough piezocision was done only distal to canine, its efficiency in decreasing the overall treatment time is comparable to piezocision done for the entire anterior tooth for enmasse retraction. Thus the null hypothesis is rejected and the rate of tooth movement in enmasse retraction between piezocision was significantly higher(1.5 times) when compared to the control group.

LIMITATIONS AND FUTURE STUDIES:

Patients were not randomized as they were selected one by one as found eligible according to inclusion criteria. Use of Split mouth technique with a larger sample size is advised for further studies as

difference in the biological system might lead to bias in finding the overall efficiencyof the piezosurgery.

CONCLUSION:

The results of this study can be concluded as:

- Piezocision technique is efficient in accelerating tooth movement than the conventional technique.
- The rate of tooth movement in maxilla is more than the mandible.
- Dental cast variables such as inter canine and inter molar width did not show any significant difference between both the groups.
- Cephalometric variables showed significant difference in the axial inclination of the upper incisor while changes in the axial inclination of the lower incisor were similar in both the groups.
- Piezosurgery might change the tissue reaction without causing any considerable changes in the periodontal parameters.
- Level of satisfaction was considerably similar in both the groups with study group showing a mild increase in pain perception.
- Piezocision proves to be effective from the patients and clinician's point of view and provides benefits that can contribute to greater acceptance in dental and patient communities.

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