

Comparison of Amount of Space Closure During En-Masse Retraction of Maxillary Anterior Teeth Using Three Accelerated Orthodontic Treatment Techniques- Micro Osteo-Perforation, Photo Bio-Modulation and Peizocision : A Retrospective Study

Sharath Kumar Shetty¹; Mahesh Kumar Y²; Suchithra B K^{3*}

¹Professor & HOD, Department of Orthodontics & Dentofacial Orthopaedics,
K. V. G Dental College & Hospital, Sullia, Karnataka, India

²Professor, Department of Orthodontics & Dentofacial Orthopaedics, K.V.G Dental College & Hospital, Sullia, Karnataka, India

³Post Graduate Student, Department of Orthodontics & Dentofacial Orthopaedics, K. V. G Dental College & Hospital, Sullia, Karnataka, India

Abstract:- AIM: The study aimed at comparing the amount of space closure using peizocision (PZ) and micro-osteoperforation (MOP) and low-level laser therapy (LLLT). **Materials and methods:** A retrospective study consisted of 3 groups, sample number of minimum 8 patients per group were estimated using statistical model called an Analysis of Variance, or ANOVA model. Three sets of data were collected. Which included patients who were treated with upper first premolar extraction for en-masse retraction of maxillary anterior teeth using NiTi closed coil spring with regional acceleratory procedures. The data collected was divided into 3 groups, GROUP 1- micro osteo perforations (n=8), GROUP 2- photo bio modulation (n=8), GROUP 3- peizocision (n=8).sing digital Vernier calipers, a direct approach was used to measure all the stone casts obtained before canine retraction (T0) and after the retraction was completed after three months (T1). The statistical analysis was performed on the data acquired about the amount of space closure of en-masse retraction of maxillary anteriors in the PZ, LLLT, and MOP groups. **Results:** Compared to MOP (2.60mm) and LLLT (2.44mm), the PZ group had a greater mean amount of space closure (5.06mm). In conclusion, the quantity of space closure in piezocision was significantly higher than that in MOP and LLLT, although there was no statistically significant difference between the two. It is imperative that treatment duration be shortened. Finding the most effective and practical method to speed up tooth movement using the biomechanical mechanisms that are currently in place is therefore necessary

Keywords:- Accelerated Orthodontics Micro Osteo Perforation, Peizocision, Low-Level Laser Therapy, Space Closure, En Masse Retraction.

I. INTRODUCTION

The longer treatment duration is one of the main worries for patients receiving orthodontic treatment.¹ Since the extended course of treatment has been linked to a higher risk of gingival irritation, decalcification, dental cavities, root resorption, and decreased patient cooperation, it is advantageous to accelerate the rate of tooth movement.² The development of less invasive techniques for accelerated orthodontic tooth movement (AOTM) has resulted in shorter treatment periods and higher patient satisfaction during the last 10 years.³ Accelerating tooth movement has a number of techniques employed, including piezocision (PZ), mucoperiosteal flap surgery, low-level lasers, corticotomies, and micro-osteoperforation (MOP).

Regional Acceleratory Phenomenon (RAP) is the basis for the widely utilized acceleratory orthodontic treatment known as micro-osteoperforation (MOP), which requires minimal surgical intervention.⁴ Patients are more accepting to non-invasive acceleratory orthodontics techniques, which produce outcomes comparable to those of surgical techniques.⁴ One such technique is low-level laser therapy (LLLT), which only affects the target tissue. By elevating the baseline metabolic rate of the cells responsible for bone remodelling, this technique speeds up the orthodontic tooth movement, which leads to rapid bone deposition and resorption.⁵

Piezocision is a flapless technique for alveolar decortication, first described by Dibart in 2009. It involves making labial vertical incisions through the soft tissue in between each tooth, excluding the papilla. This method allows for the creation of microincisions that are limited to the buccal

gingiva using a piezoelectric knife. This allows for the creation of osseous cuts in the buccal cortex and the beginning of the RAP.³

Therefore, the purpose of this study was to assess and compare the amount of space closure that occurred during the en masse retraction of the maxillary anterior teeth utilizing photobiomodulation, PZ, and MOP.

II. MATERIALS AND METHODOLOGY

A. *Samples for the Study are the Records of the Patients Undergone Orthodontic Treatment at the Department of Orthodontics , Who Fulfilled the Inclusion Criteria.*

- Inclusion Criteria;
 - Maxillary 1st premolar extraction for en masse retraction of anterior teeth
 - Age group 18-30
 - Angles class I bimaxillary protrusion
 - Class II Division I malocclusion (ANB≤5).
- Exclusion Criteria;
 - Patients who have previously used systemic corticosteroids, calcium channel blockers, and antibiotics for an extended period of time.
 - Patients who have already received orthodontic treatment.
 - Patients whose orthodontic therapy is contraindicated due to a history of systemic disorders.
 - Individuals with compromised dental health
- Sample size calculation: To obtain a power of 80% and with 0.05 significance level ($p \leq 0.05$), a sample number of minimum **eight patients** were estimated using statistical model called an Analysis of Variance, or ANOVA model.

B. *Methodology:*

- Three sets of data was collected which included patients who were treated with upper 1st premolar extraction for en masse retraction of maxillary anterior teeth using NiTi closed coil spring with regional acceleratory procedures
- The data collected was divided into 3 groups ,
 - GROUP 1- micro osteo perforations (n=8)
 - GROUP 2- photo bio modulation (n=8)
 - GROUP 3- peizocision (n=8)

The orthodontic records for this retrospective study will be obtained from the files of the Department of Orthodontics.

➤ *This Study will be Divided into 3 Groups,*

Group 1 consisted of patients treated with micro osteoperforation, in which the perforations were performed at two sites-interdentally between the maxillary canine and lateral incisor on both the sides and in the extraction space of

maxillary first premolar on both the sides. Perforations were made at equidistance distal to canine in extraction area and 2 perforations mesial to canine with a perforation width and depth of 2mm and 5mm respectively

Group 2 consisted of patients treated with peizocision. Local anesthesia was given followed by two vertical inter proximal incisions, below the interdental papilla, on the labial surface with a blade. The incisions were given through the periosteum till the alveolar bone. A peizocision knife was then used to create the cortical micro openings to the depth of approximately 3mm

Group 3 consisted of patients treated with low-level laser therapy for en masse retraction of maxillary anteriors with upper first premolar extraction on both sides. The irradiation was done with a gallium –aluminum-arsenic diode laser with a wavelength of 980nm. Low-level laser irradiation was applied on a total of 10 points, 5 on the buccal side and 5 on the palatal side. The points irradiated on the buccal side was mesial and distal to the apical area, mesial and distal to the cervical area, and 1 point approximately at the middle of the root of canine, lateral incisor and central incisor of experimental side. The same areas on the palatal side were irradiated on the experimental side.

C. *Measurement of Tooth Movement*

Measurement of tooth movement was done on study models, which was taken immediately before the start of en masse retraction and 3rd month after the procedures were done on all the three groups.

The extraction space in both sides were measured from the middle most point of distal surface of canine to the middle most point of mesial surface of second premolar before and after retraction till three months. All cast measurements were made using a digital caliper with an accuracy of 0.01 mm.

III. RESULTS

This retrospective study was carried out in the Department of Orthodontics and Dentofacial Orthopaedics, in patients who had received accelerated orthodontic procedures during en masse retraction of maxillary anteriors using LLLT-assisted technique, micro osteo perforation and peizocision over a period of 3 months. The comparison of the amount of space closure for LLLT, MOP and PZ is shown in [Table 1/Figure 1]. There was a statistically significant difference seen with respect to Peizocision when compared with LLLT group and MOP group and the p-value was 0.0. In the Peizocision group, the mean amount of space closure was 5.06mm whereas the Micro osteo perforation and the LLLT group showed no statistical significance when compared with each other. Table 2 and 3 shows that the difference between the groups is statistically significant.

Table 1: The Mean and Standard Deviation of the Amount of Tooth Movement, Which Occurred in the Duration of Three Months, is as Follows:

SL.NO	Method	Mean	Standard Deviation
1	MOP	2.60	0.59
2	Laser Group	2.44	0.22
3	Peizocision group	5.06	0.35

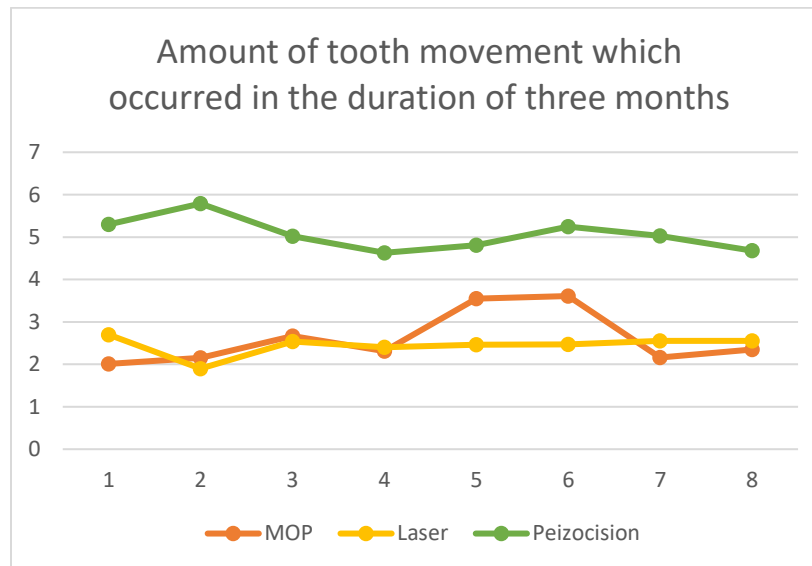


Fig 1: Represents the Amount of Tooth Movement, Which Occurred in the Duration of Three Months.

Table 2: ANOVA test

Movement	Sum of Squares	df	Mean Square	F	P value
Between Groups	34.505	2	17.252	85.547	.000
Within Groups	4.235	21	.202		

The table shows that the difference between the groups is statistically significant.

Table 3: Post Hoc Tests

(I) Group	(J) Group	Mean Difference (I-J)	P Value	95% Confidence Interval	
				Lower Bound	Upper Bound
MOP	Laser Group	00.15	00.77	-0.41	0.72
	Peizocision group	-2.46*	00.00	-3.02	-1.89
Laser Group	MOP	-00.15	00.77	-0.72	0.41
	Peizocision group	-2.61*	00.00	-3.18	-2.05
Peizocision group	MOP	2.46*	00.00	1.89	3.02
	Laser group	2.61*	00.00	2.05	3.18

*The mean difference is significant at the 0.05 level.

The table shows that the difference between the groups is statistically significant between the four groups mentioned above.

IV. DISCUSSION

Methods for accelerating orthodontic tooth movement have attracted more attention. Patients' demand for shorter treatment times with orthodontic equipment is one of the main factors of accelerated orthodontic tooth movement .⁶Several

writers investigated the mechanism behind the rapid movement of the teeth. It was first referred to as a "bony block movement"⁷; however, Wilcko and Wilcko⁸ described how the RAP accelerated the tooth movement, changing the prior understanding from a "bony block movement" to the physiological idea of "RAP." Numerous methods that take advantage of the RAP phenomenon have been studied, which includes laser-assisted photo-biomodulation, corticotomies, peizocision, periodontal distraction, and micro-osteotomies.

In order to accelerate tooth movement without the invasiveness of PAOO, corticision⁹ was developed. The flapless technique reduces the length of the operation, the discomfort experienced afterward, and the difficulties that arise.⁹

The PiezocisionTM procedure was first described by Dibart.¹² It brought together the benefits of corticision, a less invasive surgical technique, and PAOOTM, which allows for grafting, along with the advantages of using a piezoelectric knife rather than a bur for decortications. By cutting only mineralized tissue, the piezoelectric knife creates accurate osteotomies free from osteonecrotic damage.¹¹ According to a research by Abdulkarim A. Hatrom¹⁹, en-masse retraction together with piezocision corticotomy is a successful therapeutic approach for accelerating tooth movement.

In order to accelerate tooth movement, Cheung et al.¹² recommended the use of mini-implant-facilitated MOPs. The holes were created using 1.2-mm mini-implants that are readily accessible in the market. Thus, another way to make holes to accelerate tooth movement is to employ commercially available mini-implants. In a research involving animals, Teixeira et al.¹³ found that in experimental rats, the rate of tooth movement increased 2.13 times 28 days following three MOPs. According to Baloul et al.¹⁴, tooth movement was 1.3 times quicker on day 42 in mice that had received 10 MOPs by flap elevation. Using three MOPs on the buccal cortex of a human first premolar that had been excised for canine retraction, Alikhani et al.¹⁵ found that the rate of tooth movement was 2.3 times greater in their experimental group than in control group.

Until far, most investigations have used a lower wavelength spectrum laser operating in the 780-980 nm region, with 810 nm being the most often used wavelength. The first study to examine how a 980 nm laser affected orthodontic tooth movement was Yassaei S et al. in 2016 [16]. In their comprehensive study, Michelogiannakis D et al. (2019) found that there is disagreement and variation in the iatrogenic effects of LLLT when used to accelerate tooth movement. In contrast to traditional space closure mechanics, several investigations in the literature have examined the acceleratory impact on tooth movement and the related iatrogenic effects of LLLT and MOP independently.¹⁶

Most study findings that have been published show that the rates of orthodontic tooth movement are expanding. The rate of extraction space closure showed statistical significance between the low-level laser therapy group and the control side in a research by Naseem Joy Garg et al.

Piezocision demonstrated a considerable increase in the rate of canine retraction in a research by Aishwarya Ramkumar et al., while MOP only shown a minor increase.¹⁹

Most severe malocclusions may be corrected by piezocision in five or nine months. A wider range of treatments, including the correction of severe crowding, are possible using piezocision.¹⁸

PZ was found to be 1.5 times faster than conventional orthodontics in a study by Abbas assessing the effectiveness of PZ and corticotomy-facilitated orthodontics in rapid canine retraction; the findings of this study indicated that PZ is 1.22 times faster than MOP, which is consistent with the current study.²⁰

This result is consistent with a study by Allen Joseph,¹⁶ wherein LLLT (4 mm) and MOP (4.05 mm) demonstrated comparable efficiency during tooth acceleration when compared to one another.

This retrospective study was conducted to compare the amount of space closure using 3 different RAP procedures ie micro osteo perforations, low level laser therapy and piezocision over a period of 3 months. The results showed that the difference between the groups is statistically significant indicating the amount of space closure was more in piezocision group. The micro osteo perforation and the photo bio-modulation group showed no statistical difference when compared with each other.

V. CONCLUSION

- Within the limitations of the present study, it can be concluded that Peizocision showed a significant increase in the amount of space closure during enmasse retraction when compared with the micro osteo-perforation and the photo bio-modulation group.
- The micro osteo perforation and the photo bio-modulation group showed no statistical difference when compared with each other.
- All the techniques may be used as a safe adjunct during routine orthodontic therapy for accelerating tooth movement.

➤ ABBREVIATIONS

- PZ-peizocision
- MOP-micro osteo perforation
- LLLT-low level laser therapy
- AOTM-accelerated orthodontic tooth movement
- RAP-regional acceleratory phenomenon
- PAOO-periodontally accelerated osteogenic orthodontics.

REFERENCES

- [1]. Fink DF, Smith RJ. The duration of orthodontic treatment. *Am J Orthod Dentofacial Orthop.* 1992;102(1):45-51.
- [2]. Andrade Jr I, Sousa ABS, Silva GG. New therapeutic modalities to modulate orthodontic tooth movement. *Dental Press J. Orthod.* 2014;19(6):123-33.
- [3]. Evaluation and Comparison of the Rate of Canine Retraction Using Two Accelerated Orthodontic Treatment Techniques: An In Vivo Study Aishwarya Ramkumar1 , Raghunath N2 , Avinash BS
- [4]. Frost, Harold M. The regional acceleratory phenomenon: A review. *Henry Ford Hospital Medical Journal.* 1983;31(1):03-09.
- [5]. Shenava S, Nayak KU, Bhaskar V, Nayak A. Accelerated orthodontics–A review. *Int Journal of Scientific Study.* 2014;1(5):35-39.
- [6]. Keser E, Naini FB. Accelerated orthodontic tooth movement: surgical techniques and the regional acceleratory phenomenon. *Maxillofac Plast Reconstr Surg.* 2022 Jan 5;44(1):
- [7]. Yaffe A, Fine N, Binderman I (1994) Regional accelerated phenomenon in the mandible following mucoperiosteal flap surgery. *J Periodontol* 65(1):79– 83.
- [8]. Wilcko WM, Wilcko T, Bouquot JE, Ferguson DJ (2001) Rapid orthodontics with alveolar reshaping: two case reports of decrowding. *Int J Periodontics Restorative Dent* 21(1):9–19
- [9]. Kim SJ, Park YG, Kang SG (2009) Effects of corticision on paradental remodeling in orthodontic tooth movement. *Angle Orthod* 79(2):284–291.
- [10]. Dibart S, Sebaoun JD, Surmenian J (2009) Piezocision: a minimally invasive, periodontally accelerated orthodontic tooth movement procedure. *Compend Contin Educ Dent* 30:342–344 346, 348–350 23.
- [11]. Kotrikova B, Wirtz R, Kremlin R, Blank J, Eggers G, Samiotis A, Muhling J (2006) Piezosurgery- a new safe technique in cranial osteoclasts. *Int J Oral Maxillofac Surg* 35(5):461–465.
- [12]. Cheung T, Park J, Lee D, et al. Ability of mini-implant-facilitated micro-osteoperforations to accelerate tooth movement in rats. *Am J Orthod Dentofacial Orthop* 2016;150(6):958–967.
- [13]. Teixeira CC, Khoo E, Tran J, et al. Cytokine expression and accelerated tooth movement. *J Dent Res* 2010;89:1135e41.
- [14]. Baloul SS, Gerstenfeld LC, Morgan EF, Carvalho RS, Van Dyke TE, Kantarci A. Mechanism of action and morphologic changes in the alveolar bone in response to selective alveolar decortication-facilitated tooth movement. *Am J Orthod Dentofacial Orthop* 2011;139(4 Suppl):S83e101
- [15]. Alikhani M, Raptis M, Zoldan B, et al. Effect of micro-osteoperforations on the rate of tooth movement. *Am J Orthod Dentofacial Orthop* 2013;144:639e48.
- [16]. JOSEPH A, Prashantha GS, SABRISH S, SAGARKAR R, MATHEW S. Comparison of Rate of Tooth Movement, Root Resorption and Pulp Vitality during En masse Anterior Retraction with Micro-osteoperforation and Low Level Laser Therapy: A Randomised Clinical Trial. *Journal of Clinical & Diagnostic Research.* 2022 Aug 1;16(8).
- [17]. Garg NJ, Singh G, Kannan S, Rai D, Kaul A, Gupta A, Goyalia A, Gupta G. Effect of 810 nm diode laser therapy on the rate of extraction space closure. *Journal of Indian Orthodontic Society.* 2014 Jul;48(3):143-8.
- [18]. Effect of 810 nm Diode Laser Therapy on the Rate of Extraction Space Closure. *The Journal of Indian Orthodontic Society.* 48. 143-148. 10.5005/jp-journals-10021-1235.
- [19]. Keser EI, Dibart S. Sequential piezocision: a novel approach to accelerated orthodontic treatment. *Am J Orthod Dentofacial Orthop.* 2013 Dec;144(6):879-89.
- [20]. Ramkumar A, Raghunath N, Avinash BS. Evaluation and comparison of the rate of canine retraction using two accelerated orthodontic treatment techniques: An in vivo study. *World.* 2020;11(2).
- [21]. Abbas NH, Sabet NE, Hassan IT. Evaluation of corticotomy-facilitated orthodontics and piezocision in rapid canine retraction. *Am J Orthod Dentofacial Orthop* 2016;149(4):473–480.