Content available at: https://www.ipinnovative.com/open-access-journals

Journal of Contemporary Orthodontics

Journal homepage: https://www.jco-ios.org/

Original Research Article

Comparative evaluation of the efficacy of self-ligating brackets with and without piezocision in relieving lower anterior crowding

Puneeth Kumar[1]*, Sunil Muddaiah[1], Goutham B Reddy[1], Sanju Somaiah[1], Sujith Mathew[1]

[1]Dept. of Orthodontics and Dentofacial Orthopedics, Coorg Institute of Dental Sciences Virajpet, Karnataka, India.

Abstract

Background: This study aimed to evaluate and compare the efficiency of self-ligating brackets with and without piezocision-assisted rapid orthodontic tooth movement in reducing lower anterior crowding.

Materials and Methods: Two groups emanated from the twenty patients who came to the Department of Orthodontics and Dentofacial Orthopedics seeking fixed orthodontic treatment to address lower anterior crowding: Ten patients in Group A received fixed orthodontics with piezocision aided self-ligating bracket. Ten patients in Group B had treatment without the use of piezocision aided self-ligating fixed orthodontics.

Lower anterior crowding was recorded using little's Irregularity Index at beginning of treatment (T_0) and following complete alignment of lower anteriors (T_1). The rate of complete alignment of lower anteriors was assessed and compared between two groups on study models.

Results: Significant difference was seen in the rate of relieving lower anterior crowding with both piezocision and non piezocision groups, however, piezocision group was remarkably faster in relieving lower anterior crowding compared to the non- piezocision group.

Conclusion: A combination of self-ligating brackets and piezocision proved to be very effective and quick in relieving lower anterior crowding.

Keywords: SLB, Piezocision, Little's Irregularity Index

Received: 11-07-2024; **Accepted:** 26-08-2024; **Available Online**: 14-10-2025

1. Introduction

The primary goal of orthodontic therapy is to enhance patient's dentofacial functions and aesthetics in order to improve their quality of life. The treatment duration significantly impacts both patients and orthodontists, especially when dealing with adult patients. The demand for orthodontic systems that offer precision, effectiveness, and rapid results has driven the desire for fewer treatment appointments.[1,2]

Various surgical techniques have been explored to expedite tooth movement, each varying in invasiveness. Among the more invasive procedures is the reflection of periodontal flaps and extensive bone manipulation. Corticotomies, a surgical approach known for its effectiveness in accelerating tooth movement, has been investigated. To mitigate the invasiveness associated with corticotomies, a procedure called 'corticision' was introduced.[3] In this technique, transmucosal cortical incisions are made without flap reflection, using a reinforced scalpel to create the necessary bone injury in the alveolar bone through small gingival incisions. Studies in a feline model demonstrated accelerated anabolic and catabolic bone remodelling without adverse effects such as root resorption. Another modification involves using a piezotome instead of a scalpel, termed 'piezocision'.[4] This approach combines labial interproximal piezoelectric microincisions into the cortical and trabecular bone with bone augmentation via t tunnelling. Recent reports indicate favourable outcomes in terms of accelerated tooth movement and reduced treatment duration with piezocision. In a split-mouth study comparing corticotomies and piezocision for maxillary canine retraction after first premolar extraction, both methods effectively accelerated tooth movement.[5] Furthermore, a randomized clinical research found that the piezocision group saw a significant 43% decrease in overall treatment duration when

*Corresponding author: Puneeth Kumar
Email: puneethgowda577@gmail.com

https://doi.org/10.18231/j.jco.66639.1760435742

compared to a control group receiving traditional orthodontics.[6]

The duration of orthodontic treatment can vary depending on a few different factors. The orthodontist cannot control some circumstances, such as patients not showing up for their visits on time, or the breaking of appliances or the wearing of elastic bands. Thus, in order to accurately evaluate a procedure and its impact on accelerating orthodontic treatment, a more specific time period that is less affected by outside variables must be used. One such model is the evaluation of the mandibular anterior alignment rate in non-extraction therapy. This model can be used to assess how well piezocision relieves lower anterior crowding when self-ligating brackets are used.

The primary objective of this study was to evaluate and compare the effectiveness of self-ligating brackets in addressing lower anterior crowding, both with and without piezocision, using conventional orthodontic treatment in adult patients.

2. Materials and Methods

2.1. Source of the data

The study cohort comprised patients who presented to the Department of Orthodontics and Dentofacial Orthopaedics at the Coorg Institute of Dental Sciences in Virajpet, Karnataka. The study design was approved by "Institutional Review Board" of Coorg Institute of Dental Sciences with an approval no. of IRB/CIDS/417/2022. Sample size was calculated based on days taken to complete alignment using the formula**,** the sample size arrived was 10 in each group. The sample size for this prospective study consisted of 20 patients who were divided into two groups: Group A consisted of 10 patients who were treated with piezocision assisted self-ligating fixed orthodontics (**Figure 1**). Group B consisted of 10 patients who were treated without piezocision assisted self-ligating fixed orthodontics (**Figure 2**). The patients were assigned randomly in both the groups.

$$\frac{(Z\alpha/2 + Z\beta)2 * P1\,(1-P1) * P2\,(1-P2)}{(P2 - P1)2}$$

2.2. Inclusion criteria

1. Adult patients
2. Non-extraction treatment in mandibular arch
3. Presence of complete dentition from mandibular first molar to first molar
4. Absence of spaces in the mandibular arch
5. Crowding of mandibular anteriors (Little's irregularity index ≥5)
6. Subjects having healthy periodontium
7. Before complete alignment of lower anteriors, no therapeutic appliances like elastics, lip bumpers, maxillary expansion appliances or headgear were used.

2.3. Exclusion criteria

1. Medical conditions that interfere with tooth movement like Hyperparathyroidism, Osteoporosis, Hypoparathyroidism, Vitamin D deficiency, Osteomalacia, Fibrous dysplasia, Paget's disease, Multiple myeloma, Osteogenesis imperfect etc.
2. Presence of deciduous teeth in lower anterior region Missing mandibular anteriors.

Figure 1: Pre-treatment photograph and study model of group-A: with piezocision

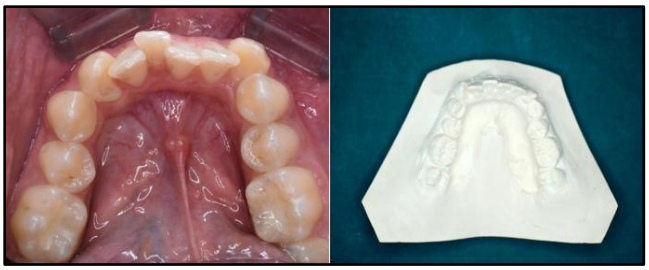


Figure 2: Pre-treatment photograph and study model of group- B: without piezocision

Following bonding of mandibular teeth with 0.022 X 028 inch self-ligating brackets (Damon Q), arch wires were immediately placed following piezocision in group A whereas in group B only arch wires were placed immediately for relieving lower anterior crowding. The arch wire sequence followed for both groups was 0.014 inch copper-nickel- titanium arch wire followed by 0.014×0.025 copper-nickel-titanium arch wire until completion of alignment. The position of the brackets was evaluated during each appointment and if needed brackets were repositioned to achieve ideal alignment. For all patients the irregularity index corresponding to the final time point was ≤ 2 mm (**Figure 3** and **Figure 4**). The time taken to reach alignment for each patient and the rate of tooth alignment was recorded at two intervals:

TO- Beginning of treatment.

T1- Following complete alignment of lower anteriors

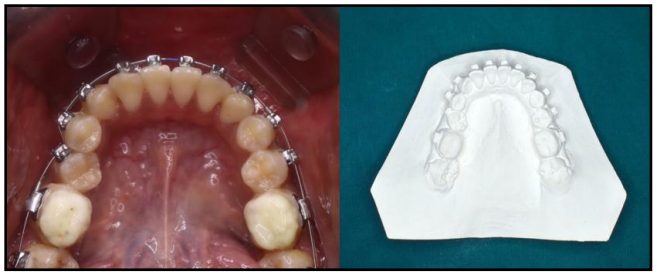


Figure 3: Photographs and study models of group-A: with piezocision after relieving lower anterior crowding.

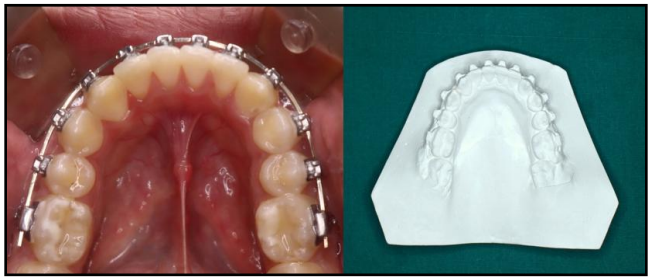


Figure 4: Photographs and study models of group-B: without piezocision after relieving lower anterior crowding

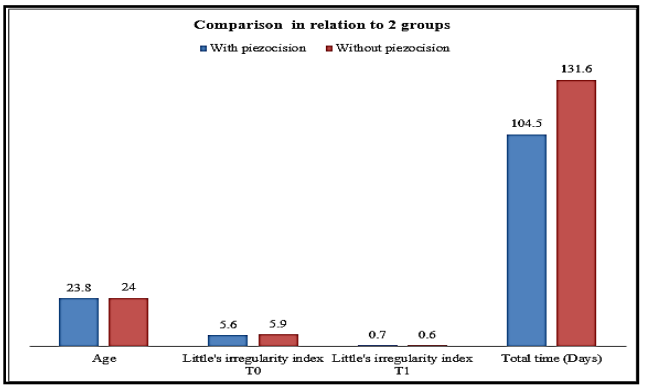
3. Piezocision Procedure

Microsurgical small vertical incisions were given using No: 15 BP blade in the interproximalarea on buccal aspect of anterior teeth (canine to canine), below interdental papilla as far as possiblein the attached gingiva. These interproximal incisions between roots of teeth allowed insertion of piezoelectric knife. The piezotome tip was inserted into the previously made incision and piezoelectric alveolar perforation of about 3mm deep was performed (**Figure 5**). To get complete effect of regional acceleratory phenomenon (RAP), the perforations were made to penetrate cortical layer and reach the medullary bone. The main advantage of this activation procedure involved temporary demineralization phase created by piezocision which in turn hastened tooth movement thereby helping in early completion of alignment.

Figure 5: Piezocision procedure

4. Result

Both piezocision and non-piezocision groups in adjunct with self ligating brackets were effective and fastened relieving of lower anterior crowding. However, piezocision group was remarkably faster in relieving lower anterior crowding compared to the non- piezocision group, with the piezocision group exhibiting a mean time of 104.5 days to relieve lower anterior crowding, whereas the group without piezocision required a mean of 131.6 days (**Table 1** and **Graph 1**). This significant difference highlights the faster correction rate associated with combination of self ligating brackets and piezocision in relieving lower anterior crowding. Care was taken to maintain equillibrium in gender and age distribution. Taking into consideration the significance of this study, Little's Irregularity Index (LII) was employed to select patients, ensuring that the degree of crowding in both groups was nearly identical. This approach helped minimize bias during patient selection.



Graph 1: Comparison in relation to 2groups

Table 1: Comparison between Little's irregularity index at T0 and T1 in relation to 2 groups

		Mean ±Std.deviation	Minimum	Maximum	p value
Age	With Piezocision	23.80± 2.044	21	29	0.856
	Without Piezocision	24.00±2.749	21	29	
Little's irregularity index T0	With Piezocision	5.60± 0.944	5	8	0.408
	Without Piezocision	5.90±0.994			
Little's irregularity index T1	With Piezocision	0.70 ±0 .675	0	2	0.749
	Without Piezocision	0.60±0.699			
Total time (Days)	With Piezocision	104.50± 4.972	98	136	<0.001
	Without Piezocision	131.60±5.103			

5. Discussion

Extended orthodontic treatment duration remains a common concern among orthodontic patients. Given the growing preference for shorter treatment times, researchers have explored various techniques to expedite the process. Notably, piezocision and self-ligating brackets has emerged as a promising method, demonstrating favourable outcomes in accelerating tooth movement and reducing overall treatment duration. In this sophisticated randomized clinical trial, the objective is to compare the efficacy of relieving lower anterior crowding with and without piezocision, utilizing self-ligating brackets. Little's irregularity index scoring, a reliable method for evaluating lower anterior crowding based on measurements from patient study models, was used in this investigation (**Figure 6**). Gender was not anticipated to have an impact on the observed outcomes, according to an examination of gender distribution, which showed balanced representation throughout the research groups. According to earlier study by Smith et al. (2018)[7] gender has no bearing on the effectiveness of orthodontic treatment or the way patients respond to treatments. This conclusion is consistent with that research. Furthermore, the findings of a research by Nijkamp et al. (2017)[8] which show that orthodontic therapies can provide equivalent results regardless of gender, are supported by the lack of disparities based on gender in Little's irregularity score at baseline and post-treatment.

Figure 6: Digital vernier caliper to measure little's irregularity index on study models.

The frequency distribution of Little's irregularity index was non-significant between the two groups at baseline. This suggests that the baseline irregularity of dental alignment was comparable between the groups, indicating a balanced starting point for any subsequent analysis or treatment evaluation.

These findings are consistent with previous studies by Al-Mashhadany et al., 2019[9] suggesting that baseline irregularity indices do not significantly differ between treatment groups. Additionally, the non-significant difference in Little's irregularity index between groups at T1 implies that post-treatment outcomes from Piezocision and conventional treatment were comparable, which is consistent with the results of a meta-analysis conducted by Heo et al. (2020)[10] which concluded that Piezocision and conventional orthodontic treatments were equally effective.

At T1, the mean Little's irregularity index for the Piezocision group was 0.70 with a standard deviation of 0.675, whereas the mean index for the group without Piezocision was 0.60 with a standard deviation of 0.699. Similarly, at T1, there was no significant difference between the two groups irregularity indices ($p = 0.749$). In terms of overall process duration, the group undergoing piezocision required 104.50 days with a standard variation of 4.972, whereas the group not undergoing piezocision required 131.60 days with a standard deviation of 5.103. Between the two groups, there was a high significant difference in total time ($p < 0.001$). In general, the groups with and without piezocision did not differ significantly in terms of age or Little's irregularity index at T0 and T1. However, there was a significant difference in the total time taken for the procedure, with the group without Piezocision requiring a longer duration.

These results highlight how Piezocision with self-ligating brackets may be more effective than other orthodontic tooth movements in terms of treatment efficiency. Furthermore, the idea that Piezocision plus self-ligating brackets accelerated the benefits of orthodontic treatment is further supported by the notable difference in treatment length between the Piezocision with self-ligating brackets and conventional groups. These results were in accordance to the results of previous studies by Chen et al., 2018,[11] Kadavakolanu et al., 2021[12] and Li et al., 2019.[13-15]

The strength of this study lies in its comprehensive approach to assessing the effectiveness of Piezocision in orthodontic treatment. Firstly, the study employed a well-defined methodology, including a comparison between two treatment groups (with and without Piezocision) and meticulous analysis of gender distribution, baseline irregularity indices, and treatment outcomes at different time points. Furthermore, the study's focus on Little's irregularity index, a widely used measure of dental alignment, enhances its clinical relevance. Lastly, the discussion of gender distribution and its potential impact on treatment outcomes demonstrates the study's attention to detail and efforts to ensure the validity of its findings across diverse patient demographics. Overall, these strengths underscore the study's credibility and add to the existing body of knowledge on Piezocision in orthodontic practice.

6. Conclusions

Within the limitations of this study, the following footprints can be laid out:

1. Self-ligating brackets with piezocision and without piezocision were effective in relieving lower anterior crowding.

2. Gender does not significantly affect orthodontic treatment outcomes or response to interventions with piezocision and without piezocision.

3. Piezocision in combination with self-ligating brackets was very effective and faster in relieving lower anterior crowding.

7. Source of Funding

None.

8. Conflict of Interest

None.

References

1. 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*. 2019;41(2):188–95.: http://dx.doi.org/10.1093/ejo/cjy042.
2. Charavet C, Lecloux G, Jackers N, Albert A, Lambert F. Piezocision-assisted orthodontic treatment using CAD/CAM customized orthodontic appliances: a randomized controlled trial in adults. *Eur J Orthod*. 2019;41(5):495–501. http://dx.doi.org/10.1093/ejo/cjy082.
3. Yavuz MC, Sunar O, Buyuk SK, Kantarcı A. Comparison of piezocision and discision methods in orthodontic treatment. *Prog Orthod.* 2018;19(1):44. http://dx.doi.org/10.1186/s40510-018-0244-y.
4. Bakathir MA, Hassan AH, Bahammam MA. Piezocision as an adjunct to orthodontic treatment of unilateral posterior crossbite. *Saudi Med J.* 2017;38(4):425–30: http://dx.doi.org/10.15537/smj.2017.4.16390.
5. Yıldırım HS, Ateş M, Gün IO, Kuru B, Çakırer B, Kuru L. Osteocalcin and cross-linked C-terminal telopeptide of type I collagen in gingival crevicular fluid during piezocision accelerated orthodontic tooth movement: A randomized split-mouth study. *Niger J Clin Pract.* 2023;26(4):470–7.
6. Moradinejad M, Chaharmahali R, Shamohammadi M, Mir M, Rakhshan V. Low-level laser therapy, piezocision, or their combination vs. conventional treatment for orthodontic tooth movement: A hierarchical 6-arm split-mouth randomized clinical trial. *J Orofac Orthop.* 2024;85(2):110–22: http://dx.doi.org/10.1007/s00056-022-00427-1.
7. 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):473–80. http://dx.doi.org/10.1016/j.ajodo.2015.09.029.
8. Dibart S, Yee C, Surmenian J, Sebaoun JD, Baloul S, Goguet-Surmenian E. et al. Tissue response during Piezocision-assisted tooth movement: a histological study in rats. *Eur J Orthod.* 2014;36(4):457–64. http://dx.doi.org/10.1093/ejo/cjt079.
9. Sultana S, Ab Rahman N, Zainuddin SLA, Ahmad B. Effect of piezocision procedure in levelling and alignment stage of fixed orthodontic treatment: a randomized clinical trial. Sci Rep. 2022;12(1):6230.: http://dx.doi.org/10.1038/s41598-022-09851-0.
10. Elkalza A. Evaluation of piezocision in rapid canine retraction. *Egyp Orthd J.* 2017;51(6):59–71. : http://dx.doi.org/10.21608/eos.2017.78360.
11. Charavet C, Van Hede D, Maes N, Albert A, Lambert F. Disentangling the effects of CAD/CAM customized appliances and piezocision in orthodontic treatment: *Angle Orthod*. 2021;91(6):764–71: http://dx.doi.org/10.2319/112620-962.1
12. Al-Areqi MM, Abu Alhaija ES, Al-Maaitah EF. Effect of piezocision on mandibular second molar protraction. *Angle Orthod.* 2020;90(3):347–53. http://dx.doi.org/10.2319/080419-511.1.
13. Türker G, Yavuz İ, Gönen ZB. Which method is more effective for accelerating canine distalization short term, low-level laser therapy or piezocision? A split-mouth study. *J Orofac Orthop*. 2021;82(4):236–45. : http://dx.doi.org/10.1007/s00056-020-00250-6.
14. Xue H, Zheng J, Cui Z, Bai X, Li G, Zhang C. et al. Low-intensity pulsed ultrasound accelerates tooth movement via activation of the BMP-2 signaling pathway. PLoS One [Internet]. 2013;8(7):e68926: http://dx.doi.org/10.1371/journal.pone.0068926.
15. Mundi R, Petis S, Kaloty R, Shetty V, Bhandari M, Buckley MJ. et al. Osteoblasts increase their rate of division and align in response to cyclic, mechanical tension in vitro. *Indian J Orthop.* 1988;4(3):225–36.

Cite this article: Kumar P, Muddaiah S, Reddy GB, Somaiah S, Mathew S. Comparative evaluation of the efficacy of self-ligating brackets with and without piezocision in relieving lower anterior crowding. *J Contemp Orthod*. 2025;9(4):523-527.