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Piezocision-Assisted Orthodontic Treatment for Accelerating Mandibular Anterior Alignment in Adults: A Retrospective Cohort Study

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Abstract

Introduction: Piezocision is a minimally invasive surgical adjunct used to accelerate orthodontic tooth movements. However, evidence regarding its effectiveness in anterior mandibular alignment remains unclear. This study evaluated the association between piezocision-assisted orthodontic treatment and the rate and time required for mandibular anterior decrowding.

Materials and methods: This retrospective observational cohort study analyzed 60 eligible patient records, comprising 30 (50.0%) patients treated with piezocision-assisted fixed orthodontics and 30 (50.0%) treated with conventional fixed orthodontics. The primary outcome was the time to anterior mandibular reduction of crowding. Secondary outcomes included decrowding rate, total treatment duration, change in Little's Irregularity Index (LII), number of visits, and adverse events. Between-group comparisons were performed using appropriate parametric and nonparametric tests, with statistical significance set at $p < 0.05$.

Results: The median time to mandibular anterior decrowding was 112 days in the piezocision group compared with 168 days in the conventional treatment group ($p < 0.001$). The rate of decrowding was significantly higher in the piezocision group than in the conventional treatment group (1.85 ± 0.42 vs. 1.12 ± 0.35 mm/month; $p < 0.001$), while total active treatment duration was significantly shorter (14.2 ± 3.1 vs. 19.6 ± 4.0 months; $p < 0.001$). The change in LII ($p = 0.571$) and post-treatment LII ($p = 0.086$) did not differ significantly between the groups. The median number of orthodontic visits required to achieve decrowding was lower in the piezocision group (8 vs. 12; $p < 0.001$). Pain requiring analgesics for >3 days was documented in 12 (40.0%) patients in the piezocision group and 5 (16.7%) patients in the conventional treatment group ($p = 0.045$).

Conclusion: Piezocision-assisted treatment was associated with faster reduction of crowding and shorter treatment duration, although prolonged pain requiring analgesics was more frequent. These findings should be interpreted cautiously because of the retrospective observational design.

Categories: Dentistry
Keywords: dental crowding, malocclusion, orthodontics, tooth movement techniques, treatment outcome

Introduction

The duration of orthodontic treatment remains an important concern for both the clinicians and patients. Comprehensive fixed orthodontic treatment commonly requires approximately 24 months, although the duration varies according to the severity of malocclusion, treatment objectives, biomechanics, and individual patient characteristics [1]. Prolonged orthodontic treatment may increase the risk of treatment-related complications, including dental caries, periodontal problems, and root resorption, while potentially reducing patient acceptance and satisfaction [2,3]. Consequently, accelerating orthodontic tooth movement while maintaining treatment quality and periodontal health has become an important objective in contemporary orthodontics [4].

Orthodontic tooth movement is mediated by a coordinated interaction between mechanical forces and biological responses in periodontal tissues. Therefore, surgical approaches have been investigated to enhance biological response to orthodontic forces and shorten treatment duration [5]. Conventional corticotomy, introduced as a surgical approach to facilitate tooth movement, was subsequently modified into a less invasive technique such as corticision [6]. Piezocision is a minimally invasive approach in which small gingival incisions are combined with localized piezoelectric cortical incisions, without flap elevation. The selective cutting action of piezoelectric devices is intended to produce localized alveolar injury while minimizing collateral tissue damage [7].

Previous clinical investigations have reported accelerated orthodontic tooth movement following piezocision, including improvements in the alignment of the mandibular anterior teeth and reductions in the overall treatment duration [8-11]. Randomized clinical studies have also evaluated piezocision in relation to mandibular anterior crowding, periodontal outcomes, and patient-reported pain and acceptance [10,11]. However, the clinical benefit of piezocision must be considered, along with potential postoperative discomfort and its effects on periodontal health. Existing evidence suggests that piezocision does not adversely affect periodontal parameters, although transient postoperative pain may occur [10,11].

The present study contributes to the existing literature by retrospectively comparing piezocision-assisted and conventional fixed orthodontic treatment in young adults, with particular emphasis on the time required to achieve mandibular anterior decrowding, the rate of alignment, overall treatment duration, and the number of visits required. In addition, the evaluation of treatment-related adverse events, particularly prolonged postoperative pain, provides a broader assessment of the potential clinical benefits and disadvantages of piezocision. By examining these outcomes in a cohort of adults with comparable baseline crowding and using a standardized definition of successful decrowding based on Little's Irregularity Index (LII), this study provides further clinical evidence regarding the potential role of piezocision in accelerating mandibular anterior alignment.

This study aimed to compare the effectiveness of piezocision-assisted fixed orthodontic treatment with that of conventional fixed orthodontic treatment in accelerating the correction of mandibular anterior irregularity in young adults. The primary objective was to compare the overall alignment time required to achieve correction of anterior mandibular irregularities. The secondary objectives were to compare decrowding rate, total treatment duration, changes in LII, number of visits, and treatment-related adverse events between the two treatment modalities. The alternative hypothesis (H_1) was that piezocision-assisted fixed orthodontic treatment would be associated with a shorter time to achieve mandibular anterior decrowding than conventional fixed orthodontic treatment. The null hypothesis (H_0) was that there would be no significant difference in the time required to achieve mandibular anterior decrowding between the two treatment approaches.

Materials And Methods

Study design and setting

This retrospective observational cohort study was conducted in the Department of Orthodontics and Dentofacial Orthopedics at J.N. Kapoor, D.A.V. Centenary Dental College, Yamuna Nagar, India. This study involved a retrospective review of the clinical records of patients who underwent fixed orthodontic treatment for anterior mandibular crowding. The study was undertaken in 2019 using records generated during the preceding years, from January 2015 to October 2019. This retrospective design was selected because the treatment had already been provided as part of routine orthodontic care, and the relevant clinical, orthodontic, photographic, radiographic, and study model records were available for analysis. No treatment was assigned or modified for the purpose of the present retrospective investigation. This study compared patients who underwent piezocision-assisted fixed orthodontic treatment with those who underwent conventional fixed orthodontic treatment alone. The treatment modality was determined on the basis of the original clinical records and was not assigned by the investigators during the retrospective study. This study was approved by the ethics committee (Reference no.: F/EC/0752/19 dated November 13, 2019) of the college.

Study population, data source, and eligibility criteria

The study population comprised patients who had undergone fixed orthodontic treatment for mandibular anterior crowding during the study period. Data were obtained from existing patient records of the orthodontic department, including diagnostic records, treatment charts, study casts, or digital models where available, intraoral photographs, radiographs, treatment progress records, and follow-up assessments. Mandibular anterior crowding was assessed using LII, which quantifies the cumulative displacement of the anatomic contact points of the six mandibular anterior teeth [12]. Patients with a baseline LII of at least 4 mm were considered eligible for the retrospective analysis. The eligibility criteria are presented in Table *1*.

Inclusion criteria	Exclusion criteria
Age ≥18 years at treatment initiation and completed skeletal growth.	Craniofacial syndromes or congenital dentofacial anomalies.
Permanent mandibular dentition with clinically relevant anterior crowding (baseline Little's Irregularity Index (LII) ≥4 mm).	Previous orthodontic treatment.
Angle Class I or Class II malocclusion with mandibular anterior crowding requiring fixed orthodontic treatment.	Clinically significant periodontal disease or substantial baseline alveolar bone loss.
Non-extraction orthodontic treatment in the mandibular arch.	Systemic conditions or medications known to affect bone metabolism or orthodontic tooth movement.
Sufficient diagnostic and treatment records to permit assessment of the primary and relevant secondary outcomes.	Incomplete records preventing reliable assessment of study outcomes.
For the piezocision group, clinical records documenting performance of the piezocision procedure according to the department's established clinical protocol.	Extraction of mandibular anterior teeth as part of treatment.
	Concurrent use of other orthodontic acceleration techniques, such as micro-osteoperforation or conventional corticotomy.

TABLE 1: Inclusion and exclusion criteria

LII: Little's Irregularity Index

Sample size estimation

This retrospective observational cohort study included consecutive eligible patient records identified from the institutional orthodontic database during the predefined study period. The sample size was determined by the availability of records meeting the prespecified inclusion and exclusion criteria rather than by prospective recruitment. All eligible records were screened, and 60 patients (30 in the piezocision group and 30 in the conventional treatment group) fulfilled the eligibility criteria and were included in the final analysis.

Because the study was retrospective, no formal a priori sample-size calculation was performed. A post-hoc power analysis was conducted using G*Power version 3.1.9.7 (Heinrich-Heine-Universität Düsseldorf, Düsseldorf, Germany), using the Wilcoxon-Mann-Whitney test, an observed rank-biserial effect size of 0.60 for the primary outcome (time to decrowding), a two-sided significance level of 0.05, and a total sample of 60 participants (30 per group). The estimated statistical power was 99.6% for the observed effect size. However, this post-hoc estimate was interpreted cautiously because it depends on the observed effect size and does not independently establish the adequacy of the sample size. The relatively small sample may limit the precision and generalizability of the findings; therefore, the results should be interpreted alongside the effect estimates and their 95% confidence intervals.

Exposure and comparison groups

Patients were categorized into two groups according to the treatment documented in their existing orthodontic records. The piezocision group consisted of patients who received piezocision-assisted fixed orthodontic treatment, whereas the conventional group consisted of those who received fixed orthodontic treatment without a surgical acceleration procedure. As treatment allocation had already occurred as part of the clinical care, no randomization, allocation concealment, or prospective intervention was performed in the present study. Therefore, the two groups were considered observational exposure groups rather than randomized treatment arms.

Fixed orthodontic treatment

All eligible patients underwent fixed orthodontic treatment using a labially placed pre-adjusted edgewise appliance with McLaughlin, Bennett, and Trevisi (MBT) prescription brackets and molar tubes with a 0.022 × 0.028-inch slot, as documented in the original clinical protocol. The initial aligning archwire was a 0.016-inch heat-activated nickel-titanium wire, followed sequentially by a 0.018-inch stainless-steel wire, 0.019 × 0.025-inch heat-activated nickel-titanium wire, and a 0.019 × 0.025-inch stainless-steel wire. Complete mandibular anterior alignment was defined according to documented clinical endpoints and LII measurements.

Piezocision procedure

Patients in the piezocision group underwent a minimally invasive piezocision procedure as an adjunct to fixed orthodontic treatment. The procedure was performed under local anesthesia and involved three to five vertically oriented interproximal microincisions in the labial cortical region of the mandibular anterior teeth. Each incision was approximately 4-5 mm in length and positioned approximately 4-6 mm below the interdental papillae. The number and location of incisions were determined according to the clinical criteria documented by the treating clinician, including the distribution and severity of anterior crowding.

A piezoelectric microsaw was introduced through each incision to perform localized cortical incisions to an approximate depth of 3 mm under continuous irrigation [13]. The procedure was performed using the Piezotome piezoelectric surgical system (ACTEON, Mérignac, France). All the procedures were performed by an experienced orthodontist. No flap elevation or suturing was performed (Figure *1*). The procedure was performed after immediate bracket bonding. These procedural details were extracted from the available records for the retrospective analysis.

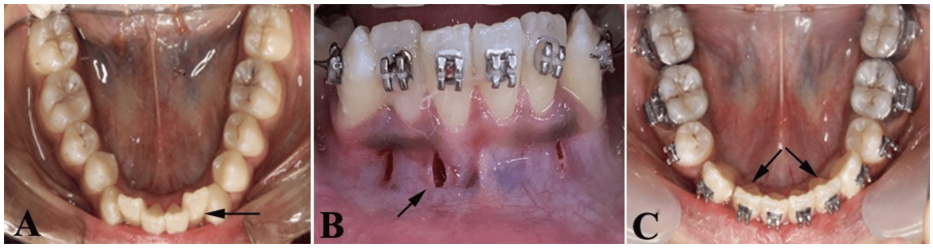


FIGURE 1: Clinical photographs illustrating the piezocision procedure and subsequent improvement in mandibular anterior crowding

(A) Preoperative occlusal view showing mandibular anterior crowding, (B) labial view demonstrating the interproximal microincisions made during the piezocision procedure (arrows), and (C) occlusal view showing relief of mandibular anterior crowding, particularly in the lateral incisor region (arrows).

Original images of a patient from the study.

Assessment of mandibular anterior irregularity

Mandibular anterior irregularity was assessed using LII on mandibular study casts. Measurements were obtained using a digital vernier caliper with an accuracy of 0.01 mm (Digimatic NTD 12-15 PMX; Mitutoyo Corporation, Kawasaki, Japan). The primary outcome was time to mandibular anterior decrowding, defined as the number of days from initiation of fixed orthodontic treatment to the first documented visit at which the LII decreased below 2 mm. Secondary outcomes included the rate of mandibular anterior decrowding (mm/month), total active treatment duration (months), change in LII from baseline to the end of treatment, post-treatment LII, number of orthodontic visits required to achieve decrowding, and documented treatment-related adverse events. The rate of decrowding was expressed in millimetres per month and represented the reduction in mandibular anterior irregularity over the corresponding observation period. Time to decrowding was analyzed separately as the number of days from initiation of fixed orthodontic treatment to the first documented visit at which LII fell below 2 mm. Because the rate of decrowding and time to decrowding are related measures of alignment progress, the rate was interpreted as a complementary outcome rather than an independent measure of treatment effectiveness.

Periodontal outcomes

Periodontal complications were identified from the available clinical records during the orthodontic treatment period. Documented periodontal adverse events, including gingival recession and other periodontal complications, were recorded and compared between the piezocision and conventional treatment groups.

Pain, discomfort, and patient-reported outcomes

Where documented in the clinical records, pain and discomfort were assessed using a 10-cm visual analogue scale (VAS), with endpoints representing no pain (0 cm) and the worst pain imaginable (10 cm) [14]. Assessments were recorded immediately after treatment (0 hours), at 24 hours, and at seven days, where available. In the piezocision group, pain could reflect both the surgical procedure and orthodontic tooth movement, whereas in the conventional group, pain was considered orthodontic treatment-related discomfort associated with appliance placement or activation rather than postoperative pain following surgery. Analgesic consumption during the first seven days was extracted from the available clinical records. Prolonged analgesic use was defined as documented analgesic consumption for more than three days following the relevant treatment procedure. The completeness of pain scores, analgesic-use records, and complication documentation was considered separately for each group. Missing or undocumented

assessments were not interpreted as evidence of an absence of pain, analgesic consumption, or adverse events. Pain and analgesic consumption were considered patient-centered outcomes because piezocision involves localized surgical intervention that may produce transient discomfort, as reported in previous clinical research [15].

Data extraction and quality control

The extracted variables included age, sex, baseline LII, overjet, overbite, mandibular intercanine width, arch perimeter, Angle's classification, treatment initiation date, appliance characteristics, archwire sequence, adjustment intervals, piezocision procedure details, LII measurements at follow-up visits, time to decrowding, total treatment duration, number of orthodontic visits, and documented complications. Two investigators (SD and AJ) independently extracted the relevant information from eligible records. Discrepancies between the investigators were resolved through discussion and consensus, with adjudication by a senior investigator (VS) when required.

Statistical analysis

Statistical analyses were performed using Statistical Product and Service Solutions (SPSS, version 21.0; IBM SPSS Statistics for Windows, Armonk, NY). Data distribution was assessed using the Shapiro-Wilk test. Normally distributed continuous variables were summarized as mean ± standard deviation, whereas non-normally distributed continuous variables were summarized as median and interquartile range. Baseline continuous variables were compared between the piezocision and conventional groups using the independent-samples t-test for normally distributed variables or the Mann-Whitney U test for non-normally distributed variables. Categorical variables were analyzed using Pearson's chi-square test or Fisher's exact test, as appropriate. The primary outcome, time to mandibular anterior decrowding, was compared between the two groups using the Mann-Whitney U test because the outcome was not normally distributed. Secondary continuous outcomes were analyzed using the independent-samples t-test or Mann-Whitney U test according to distributional characteristics. Categorical adverse events were compared using Pearson's chi-square test or Fisher's exact test, as appropriate. Effect sizes and 95% confidence intervals were reported where appropriate. Statistical significance was defined as a two-sided $p < 0.05$.

Results

All 60 patients included in the final analysis achieved the predefined decrowding endpoint (LII < 2 mm). Time to decrowding was defined as the number of days between initiation of fixed orthodontic treatment and the first documented visit at which the LII fell below 2 mm. Sixty patients met the eligibility criteria and were included in the final analysis, with 30 (50.0%) in the piezocision group and 30 (50.0%) in the conventional treatment group. Baseline demographic and clinical characteristics were comparable between the groups. The proportion of female participants was 18 (60.0%) in the piezocision group and 17 (56.7%) in the conventional group, with no significant intergroup difference. Baseline LII, mandibular intercanine width, overjet, arch perimeter, and Angle's classification were also comparable between the groups (Table *2*).

Variable	Piezocision (n = 30)	Conventional (n = 30)	Test statistic	p-value	Effect size
Age (years), mean ± SD	27.4 ± 6.2	28.1 ± 5.8	t = −0.46	0.647	d = −0.12
Sex: female, n (%)	18 (60.0)	17 (56.7)	χ^2 = 0.069	0.793	V = 0.034
Sex: male, n(%)	12 (40.0)	13 (43.3)			
Baseline Little's Irregularity Index (mm), median (IQR)	6.2 (5.1–7.8)	6.0 (5.0–7.5)	U = 421.5	0.674	r = −0.06
Mandibular intercanine width (mm), mean ± SD	25.8 ± 2.1	26.0 ± 2.3	t = −0.35	0.727	d = −0.09
Overjet (mm), mean ± SD	3.2 ± 1.1	3.1 ± 1.0	t = 0.37	0.713	d = 0.10
Arch perimeter (mm), mean ± SD	64.5 ± 3.8	65.1 ± 4.0	t = −0.60	0.551	d = −0.15
Angle Class I, n (%)	22 (73.3)	23 (76.7)	χ^2 = 0.089	0.765	V = 0.039
Angle Class II, n (%)	8 (26.7)	7 (23.3)	χ^2 = 0.089	0.765	V = 0.039

TABLE 2: Baseline demographic and clinical characteristics of patients in the Piezocision and conventional orthodontic treatment groups

Data are presented as mean ± standard deviation (SD) for normally distributed continuous variables, median (interquartile range (IQR)) for non-normally distributed continuous variables, and frequency (percentage) for categorical variables, normally distributed continuous variables were compared using the independent-samples t-test, and non-normally distributed continuous variables using the Mann-Whitney U test, categorical variables were compared using Pearson's χ^2 test, a two-sided $p < 0.05$ was considered statistically significant, effect sizes are reported as Cohen's d for t-test comparisons, rank-biserial correlation (r) for Mann-Whitney U test comparisons, and Cramér's V for categorical comparisons.

LII: Little's Irregularity Index, mm: millimetres

The primary outcome, time to mandibular anterior decrowding, was significantly shorter in the piezocision group. The median time to decrowd was 112 days compared with 168 days in the conventional group ($p < 0.001$). The decrowding rate was also significantly higher with piezocision ($p < 0.001$). Additionally, the total orthodontic treatment duration was significantly shorter in the Piezocision group ($p < 0.001$). In contrast, the change in LII and post-treatment LII did not differ significantly between the groups. Patients who underwent piezocision also required significantly fewer visits to achieve reduced crowding ($p < 0.001$) (Table *3*).

Outcome	Piezocision (n = 30)	Conventional (n = 30)	Test statistics	p-value	Effect size
Time to decrowd (days), median (IQR)	112 (95-134)	168 (145-196)	U = 178.5	< 0.001*	r = −0.60
Rate of decrowding (mm/month), mean ± SD	1.85 ± 0.42	1.12 ± 0.35	t = 7.31	< 0.001*	Cohen's d = 1.89
Total treatment duration (months), mean ± SD	14.2 ± 3.1	19.6 ± 4.0	t = −5.84	< 0.001*	Cohen's d = −1.51
Change in LII (mm), mean ± SD	5.8 ± 1.4	5.6 ± 1.3	t = 0.57	0.571	Cohen's d = 0.15
Post-treatment LII (mm), median (IQR)	1.2 (0.8-1.6)	1.4 (1.0-1.9)	U = 334.0	0.086	r = −0.26
Number of visits to decrowding, median (IQR)	8 (7-10)	12 (10-14)	U = 178.5	< 0.001*	r = −0.60

TABLE 3: Primary and secondary treatment outcomes in the piezocision and conventional orthodontic treatment groups

Data are presented as mean ± standard deviation (SD) or median (interquartile range (IQR)), as appropriate. An independent-samples t-test was used for approximately normally distributed continuous variables, and the Mann-Whitney U test was used for non-normally distributed continuous variables; *p < 0.05 was considered statistically significant; effect sizes are reported as Cohen's d for t-test comparisons and rank-biserial correlation (r) for Mann-Whitney U test comparisons.

LII: Little's Irregularity Index, mm: millimeter

Regarding adverse events, root resorption exceeding the predefined threshold was observed in four (13.3%) patients in the piezocision group and two (6.7%) in the conventional group, without a significant difference. Gingival recession and periodontal complications were similar and did not differ significantly between groups. However, pain requiring analgesic use for more than the predefined duration was significantly more frequent in the piezocision group, occurring in 12 (40.0%) patients compared to five (16.7%) patients in the conventional group (p = 0.045) (Table *4*).

Adverse event	Piezocision (n = 30)	Conventional (n = 30)	Test statistics	p-value	OR (95% CI)	Cramer's V
Root resorption >2 mm, n (%)	4 (13.3)	2 (6.7)	χ^2 = 0.741	0.389	OR = 2.15 (0.36-12.8)	0.111
Gingival recession >1 mm, n (%)	3 (10.0)	1 (3.3)	Fisher's exact	0.612	OR = 3.22 (0.32-32.9)	0.135
Periodontal complications, n (%)	2 (6.7)	1 (3.3)	Fisher's exact	1.000	OR = 2.07 (0.18-24.2)	0.077
Pain requiring analgesics >3 days, n (%)	12 (40.0)	5 (16.7)	χ^2 = 4.022	0.045	OR = 3.33 (1.02-10.9)	0.259

TABLE 4: Adverse events and complications in the piezocision and conventional orthodontic treatment groups

Data are presented as frequencies and percentages; Pearson's χ^2 test or Fisher's exact test was used according to expected cell frequencies. p < 0.05 was considered statistically significant; odds ratios (ORs) > 1 indicate higher odds of the adverse event in the piezocision group.

CI: confidence interval, mm: millimeter

Discussion

This study showed that piezocision-assisted orthodontic treatment was associated with faster mandibular anterior decrowding than conventional fixed orthodontic treatment. The median time to decrowding was

112 days in the piezocision group compared with 168 days in the conventional group, accompanied by a significantly greater rate of decrowding and shorter overall treatment duration. This finding is biologically plausible because the controlled cortical injury produced by piezocision has been proposed to induce a transient regional acceleratory phenomenon, characterized by increased local bone turnover and temporarily reduced resistance to orthodontic tooth movement [16]. The magnitude and duration of this biological response may vary according to the extent of the surgical intervention and the orthodontic protocol used.

The accelerated decrowding observed in the present study is consistent with findings from several previous studies. Gibreal et al. reported faster correction of severe mandibular anterior crowding following flapless piezocision [11]. However, evidence is not uniform. Uribe et al. found no significant difference in mandibular anterior alignment time between piezocision and conventional treatment [17]. Differences in baseline crowding severity, appliance systems, surgical techniques, frequency of follow-up, archwire sequences, and follow-up duration may contribute to the variability in findings across studies. Systematic reviews have likewise highlighted substantial heterogeneity among studies evaluating piezocision and have characterized the certainty of the available evidence as low [18,19].

The significantly higher rate of decrowding in the piezocision group may have clinical relevance because the potential benefit of this procedure may relate to more rapid resolution of the initial alignment phase rather than solely to a reduction in total treatment duration. This accelerated tooth movement may be related to the regional acceleratory phenomenon, a transient and reversible biological response to localized surgical injury [20]. Piezocision-induced microtrauma has been associated with increased bone turnover and cellular and molecular changes that may temporarily enhance bone remodeling, thereby potentially reducing resistance to orthodontic tooth movement during the early healing period [16]. A recent systematic review of animal studies reported increased bone turnover following piezocision and faster orthodontic tooth movement, with the biological response described as transient, reversible, and proportional to the extent of surgical injury [21]. These findings may be particularly relevant for patients for whom early improvement in anterior crowding is an important treatment consideration. The lower number of visits required to achieve decrowding in the present study may also indicate potential clinical efficiency; however, visit frequency can be influenced by treatment scheduling and practice protocols and should not be interpreted as a direct reduction in healthcare burden without formal economic evaluation.

Despite the faster initial correction, the groups did not differ significantly in the overall change in LII or post-treatment LII. These findings suggest that the observed benefit of piezocision was primarily related to the rate at which the predefined decrowding threshold was reached rather than to the magnitude of overall correction achieved with fixed orthodontic treatment. This interpretation is consistent with Charavet et al., who reported that the accelerating effect of piezocision was particularly evident during the alignment phase [22], with less apparent benefit during subsequent finishing stages. Thus, an accelerated initial response should not necessarily be interpreted as a proportional shortening of every phase of orthodontic treatment.

These safety findings are also clinically relevant. Root resorption, gingival recession, and periodontal complications were numerically more frequent in the piezocision group than in the conventional treatment group, although none of these differences was statistically significant. These findings are broadly consistent with previous studies reporting no significant deterioration in periodontal parameters or increase in root resorption following piezocision [22,23]. Aksakalli et al. reported no adverse periodontal effects [23], whereas Charavet et al. reported stable periodontal and radiographic parameters after treatment [22]. Nevertheless, the occurrence of these events in the present cohort supports continued periodontal and radiographic monitoring during treatment rather than assuming that piezocision is entirely free of adverse events.

Pain requiring analgesic use for >3 days was significantly more frequent in the piezocision group than in the conventional treatment group. This finding is biologically plausible because piezocision involves an additional localized surgical intervention that may contribute to short-term postoperative discomfort. Previous patient-reported studies have similarly described increased pain or discomfort following piezocision, although symptoms generally decrease during the subsequent days [24,25]. Therefore, patients should be counselled that the potential benefit of faster initial decrowding may be accompanied by additional short-term postoperative discomfort.

The lower number of visits observed in the piezocision group should be interpreted in the context of the shorter time to decrowding. Because the number of visits and elapsed time to achieve alignment are related outcomes, particularly when appointments occur at regular intervals, fewer visits may partly reflect the shorter alignment period rather than an independent treatment advantage. Therefore, visit count is considered a complementary indicator of clinical attendance and should not be interpreted as independent confirmation of the acceleration effect.

Clinically, these findings suggest that piezocision may be considered as an adjunct for selected patients seeking faster correction of mandibular anterior crowding, provided that the potential benefit of earlier decrowding is balanced against postoperative discomfort and possible treatment-related adverse events. The principal limitations of the present study include its retrospective, single-center design, potential selection

and treatment-allocation bias, reliance on the completeness and accuracy of existing clinical records, and relatively modest sample size. Furthermore, the between-group comparisons were unadjusted for potential confounders. Although the measured baseline demographic and clinical characteristics were comparable between groups, this does not exclude residual confounding related to baseline LII, age, sex, Angle's classification, or other unmeasured factors. Consequently, the observed differences in decrowding time and overall treatment duration should be interpreted as associations rather than definitive causal effects attributable to piezocision. The absence of multivariable adjustment also limits the ability to establish the independent association between piezocision and treatment outcomes. The heterogeneous findings reported in previous trials and systematic reviews further support the need for larger, prospective, multicenter studies incorporating appropriate adjustment for baseline characteristics, standardized orthodontic protocols, longer follow-up periods, and systematic assessment of root resorption and periodontal outcomes to better establish the effectiveness and safety of piezocision [18,19].

Conclusions

In this retrospective cohort study, piezocision-assisted orthodontic treatment was associated with faster mandibular anterior decrowding, a greater rate of decrowding, shorter overall treatment duration, and fewer visits required to achieve decrowding compared with conventional treatment. However, pain requiring analgesics for more than three days was more frequent in the piezocision group, whereas other documented adverse outcomes did not differ significantly between the groups. These findings suggest that piezocision may be considered as an adjunct for selected patients seeking earlier correction of mandibular anterior crowding. Nevertheless, the observational design and potential for selection and treatment-allocation bias warrant cautious interpretation, and the findings should be confirmed in well-designed prospective studies.

Additional Information

Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

Concept and design: Shivangi Dagar, Vikas Sehgal, Rattan Khurana, Kanish Aggarwal

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Critical review of the manuscript for important intellectual content: Shivangi Dagar, Vikas Sehgal, Nymphea Pandit, Rattan Khurana, Amita Jayant, Kanish Aggarwal

Supervision: Shivangi Dagar, Kanish Aggarwal

Disclosures

Human subjects: Informed consent for treatment and open access publication was obtained or waived by all participants in this study. Insitutional Ethical Committee of J.N. Kapoor, D.A.V Centenary Dental College issued approval F/EC/0752/19. **Animal subjects:** All authors have confirmed that this study did not involve animal subjects or tissue. **Conflicts of interest:** In compliance with the ICMJE uniform disclosure form, all authors declare the following: **Payment/services info:** All authors have declared that no financial support was received from any organization for the submitted work. **Financial relationships:** All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. **Other relationships:** All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

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