Original Article

Periotomes Versus Conventional Elevators for Orthodontic

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ABSTRACT

Tooth extraction traditionally involves forceps and elevators, which can cause significant tissue trauma. Preserving soft and hard tissue architecture is crucial for long-term oral health, function, and aesthetics. The periotome, a novel instrument combining a mini scalpel and miniature elevator, offers a potential alternative to conventional extraction methods.Aim: To evaluate the efficacy of periotomes compared to conventional elevators during orthodontic premolar extractions.Methods: A comparative split-mouth study was conducted with 15 patients requiring bilateral premolar extractions. Extractions were performed using two different techniques: -Test side: Periotomes-Control side: Coupland No. 1 elevator Both sides used a wedging technique without flap elevation, with tooth delivery accomplished using premolar forceps. The study assessed multiple parameters including:-Extraction duration-Intraoperative pressure perception-Postoperative pain (days 1, 3, and 7)-Gingival laceration grading-Potential complications-Rescue analgesic consumption Statistical analysis was performed with a significance level set at P<0.05 and a 95% confidence interval. Results: While periotomes required longer extraction times, they demonstrated superior outcomes across multiple parameters including, reduced intraoperative pressure perception, decreased postoperative pain, minimal gingival laceration, fewer complications and reduced rescue analgesic usage.Conclusion: Despite longer extraction times, periotomes provide a more atraumatic approach to tooth extraction compared to conventional elevators,potentially offering improved patient comfort and tissue preservation.

Key Words :Periotome, atraumatic extraction, orthodontic extraction, conventional elevators

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INTRODUCTION

Dental extractions are common procedures performed by various professionals in different clinical settings. The traditional extraction process involves severing periodontal attachment, luxating the tooth with an elevator, and removing it with forceps. While avoiding trauma is the primary concern, preventing cortical plate fracture is crucial to avoid ridge narrowing.[1]Premolar extractions are widely accepted in malocclusion treatment due to their arch position and eruption timing.[2] Conventional extraction techniques, however, pose potential risks. Elevators used to luxate teeth can cause alveolar bone fracture or cell necrosis due to compression-induced pressure.[3,4,5] Typically inserted mesially with leveraging force, elevators may traumatize soft tissue and cause gingival laceration. Forceps application can potentially weaken or fracture lingual or buccal plates.Modern clinical practice emphasizes preserving hard and soft tissues during extractions, forming the basis of atraumatic extraction techniques. Minimally invasive procedures focus on applying force to the periodontal ligament, which facilitates hyaluronic acid accumulation and helps dissolve the ligament, enabling controlled tooth removal. Various atraumatic extraction techniques have emerged in recent decades. The periotome, a novel instrument combining a mini scalpel and miniature elevator, offers a promising alternative. Its thin metallic blade and miniature elevator use gentle

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oscillating wedging movements near the root apex. Particularly beneficial in endodontically treated teeth and crown fracture cases, the periotome helps remove teeth while maintaining soft and hard tissue architecture and preserving the osseous housing.[6] The purpose of this clinical split-mouth study is to evaluate the efficacy of periotome versus conventional elevators in orthodontic extractions, potentially offering insights into minimizing surgical trauma and preserving tissue integrity during tooth removal.

Subjects and Methods:

This split-mouth study was approved by the institutional ethics committee, with informed consent obtained from all participants. Conducted in the Department of Oral & Maxillofacial Surgery from June 2023 to January 2024, the study included 15 patients (30 sides) requiring bilateral maxillary premolar extractions.Inclusion criteria: Patients aged 13-30 years undergoing orthodontic treatment requiring bilateral premolar extractions. Exclusion criteria: ASA III-IV patients, chronic smokers, those with comorbidities, uncontrolled diabetes, hypertension, immunocompromised status, bleeding disorders, or patients on medications interfering with pain response. The study was divided into two groups of 15 sides each. Local anesthesia (2% Lidocaine with 1:2,00,000 adrenaline) was administered. Test side extractions were performed using periotomes (Figure 1), while control side extractions used a Coupland No. 1 elevator (Figure 2). Both sides employed a wedging technique without flap elevation, with tooth delivery using premolar forceps.Extractions were performed by a single operator and reviewed by two blinded observers. Assessed parameters included:

- Extraction duration
- Intraoperative pressure perception using a 0-10 cm VAS (Figure 3)
- Postoperative pain on days 1, 3, 7
- Gingival laceration grading[7] (Table 1)
- Complications like bone plate fracture, root fracture, excessive bleeding, delayed wound healing, pain beyond 7 days, and dry socket.
- Rescue analgesic consumption till postoperative day 7.

The opposite side tooth was extracted after a minimum of one week.

Fig 1:Application of periotome

Fig 2: Application of elevator

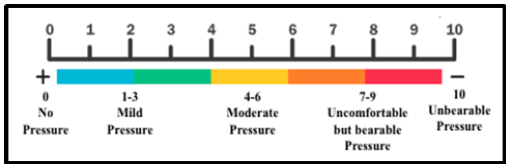


Figure 3: Intraoperative pressure perception 100 mm Visual Analogue Scale

Table (1): Gingival Laceration Grade[7]

GRADE	Grade 1	Grade 2	Grade 3	Grade 4
LENGTH	0-5mm	5-10mm	>1cm	Torn Gingiva
DEPTH	Abrasion	Partial	Complete	

STATISTICAL ANALYSIS

Data were analyzed using descriptive statistics including range, mean ± standard deviation, median (IQR), frequencies, and percentages. Normality was assessed using the Kolmogorov-Smirnov test. Comparisons between groups utilized:

- Mann-Whitney U test for non-parametric quantitative variables
- Chi-square ($\chi 2$) test for categorical data
- Fisher exact test when expected frequency was less than 5

Statistical analysis was conducted using SPSS 21.0 for Microsoft Windows. Significance level was set at 5% with a 95% confidence interval ($p<0.05$).

Results:

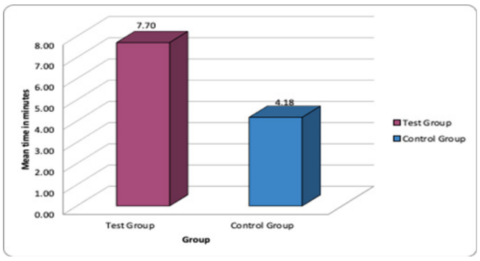
The study included 15 patients with 30 sides randomly divided into test and control groups. Patient demographics were 13 females (86.7%) and 2 males (13.3%), with a mean age of 16.20 years (range 13-21 years).Extraction duration analysis (Table 2, Graph 1) revealed:

- Test side: Mean 7.70 minutes (SD = 1.48)
- Control side: Mean 4.18 minutes (SD = 1.28)

Statistical analysis showed a significant difference between sides (p=0.001, p<0.05), with the test side requiring significantly longer extraction time.

Table (2):- Duration of extraction (minutes)

	Test Side		Control Side		Z	p-value
	Mean	SD	Mean	SD		
TIME TAKEN (minutes)	7.70	1.48	4.18	1.28	-4.419	0.001



Graph 1: Duration of extraction in test and control groups

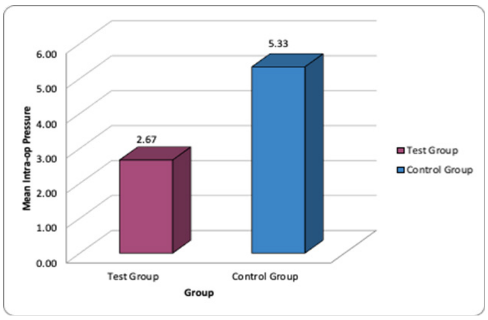
Intraoperative pressure perception using Visual Analogue Scale (Table 3, Graph 2):

- Test side (periotome): Mean 2.67 (SD = 1.50)
- Control side (Coupland elevator): Mean 5.33 (SD = 1.80)

Statistical analysis revealed a significant difference between sides (p=0.001, p<0.05), with patients experiencing significantly lower intraoperative pressure in the test side compared to the control side

Table (3): Intraoperative pressure perception

	Test Side		Control Side		Z	p-value
	Mean	SD	Mean	SD		
INTRA-OP PRESSURE	2.67	1.50	5.33	1.80	-3.520	0.001

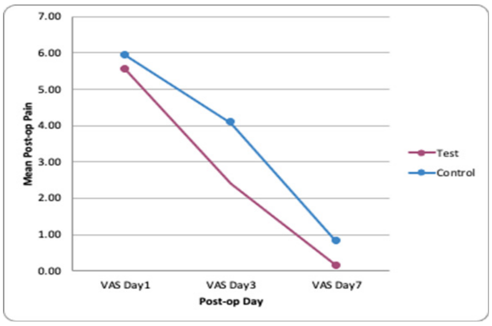


Graph 2: Intraoperative pressure perception in test and control groups

The mean postoperative pain felt by the patients on the test side, using a Visual Analogue Scale, was 5.53 (SD = 1.30) on day 1, 2.40 (SD = 1.55) on day 3 and 0.13 (SD = 0.35) on day 7. The postoperative pain felt by the patients on the control side was 5.93 (SD = 1.67) on day 1, 4.07 (SD = 1.79) on day 3 and 0.80 (SD = 0.83) on day 7. The difference in pain levels on the test and control sides were statistically insignificant for postoperative day 1 while the pain was significantly lesser on the test side on day 3 (p=0.016) and on day 7 (p=0.008). (Table 4, Graph 3)

Table (4): Postoperative pain

POST-OP PAIN	Test Side		Control Side		Z	p-value
	Mean	SD	Mean	SD		
Day 1	5.53	1.30	5.93	1.67	-0.551	0.581
Day 3	2.40	1.55	4.07	1.79	-2.398	0.016
Day 7	0.13	0.35	0.80	0.86	-2.665	0.008

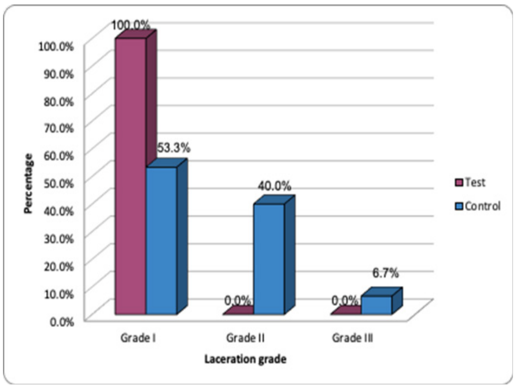


Graph 3: Postoperative pain in test and control groups

All cases on the test side only had Grade I gingival laceration (100%) while on the control side, 8 cases (53.3%) had Grade I laceration (Figure IV), 6 cases (40%) had Grade II laceration and 1 case (6.7%) had Grade III laceration (Figure V). The statistical analysis of the data showed a significant difference between the two sides with a p-value of 0.01 (p<0.05), patients in the had more gingival laceration on the control side. (Table 5, Graph 4)

Table ((5): Gingival laceration

		Test Side		Control Side		Total	Chi-square value	p-value
		No. of cases	%age	No. of cases	%age			
GINGIVAL LACERATION	Grade I	15	100.0%	8	53.3%	23	9.13	0.01
	Grade II	0	0.0%	6	40.0%	6		
	Grade III	0	0.0%	1	6.7%	1		
Total		15	100.0%	15	100.0%	30		

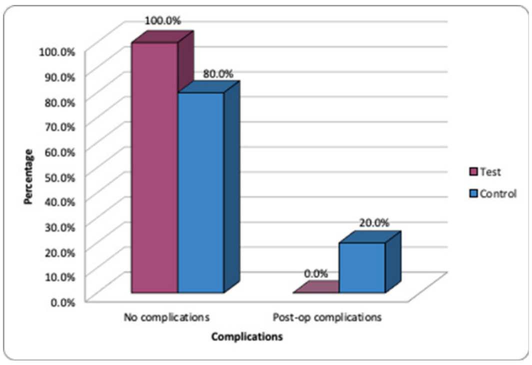


Graph 4: Gingival laceration in test and control groups

There were no complications encountered on the test side (0.0%) while there were 3 cases in which complications were encountered on the control side (20%) with 1 case of buccal cortical plate fracture and two cases of delayed healing (Figure VI) which were managed by the prescription of antibiotics. Although the difference in the rate of complications on the test and control sides was not significant, there were no complications encountered on the test side. (Table 6, Graph 5)

Table (6): Complications

		Test Side		Control Side		Total	Chi-square value	p-value
		No. of cases	%age	No. of cases	%age			
COMPLICA-TIONS	No compli-cations	15	100.0%	12	80.0%	27	3.333	0.343
	Post-op com-plications	0	0.0%	3	20.0%	3		
Total		15	100.0%	15	100.0%	30		

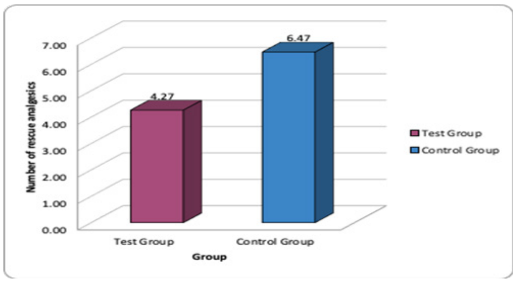


Graph (5): Complications

The mean number of rescue analgesics taken by the patients on the test side till postoperative day 7 was 4.27 tablets (SD=2.12), while on the control side it was 6.47 tablets (SD=2.13). The statistical analysis of the data showed a significant difference between the two sides with a p-value of 0.013 ($p<0.05$), the test side needing a lesser number of analgesics than the control side. (Table 7, Graph 6)

Table (7): Number of rescue analgesics taken till postoperative day 7

	Test Side		Control side		Z	p-value
	Mean	SD	Mean	SD		
RESCUE ANALGESICS (tablets)	4.27	2.12	6.47	2.13	-2.493	0.013



Graph 6: Number of rescue analgesics in test group and control group

Discussion:

Tooth extraction is a crucial aspect of orthodontic therapy, aimed at creating space for tooth repositioning. While minimizing trauma is the primary goal for both patient and orthodontist, preventing ridge narrowing from cortical plate fracture is equally important. Recent decades have witnessed the development of atraumatic extraction techniques, with instruments like the Periotome emerging to preserve soft and hard tissue architecture. This study applied these principles to orthodontic premolar extractions, seeking to achieve minimally invasive tooth removal that facilitates further treatment and enhances patient comfort.In this study, the mean extraction duration for the periotome side was 7.70 min, compared to 4.18 min for the elevator side, indicating longer extraction times with the periotome. This finding differs from some existing literature: Sharma SD et al.[7] reported opposite results, with the periotome group taking 5.78 min and the elevator group 12.81 min. Melek LN et al.[8] found a similar extraction time of 7.44 min for the periotome group, which aligns with our findings. Alraqibah MA et al.[9] observed different times: 4.96 min for the periotome group and 7.96 min for the piezotome group, contrasting with our results. The longer extraction time with the periotome in our study might be attributed to the surgeon's relative inexperience with this specific extraction technique compared to conventional elevators. The mean intraoperative pressure perception while that on the control side was 5.33 . The statistical analysis of the data showed a significant difference between the two sides, patients on the periotome side experiencing lesser intraoperative pressure than on the coupland elevator side. To the best of our knowledge, no other study on periotomes has measured the intraoperative pressure perception or any other parameter to measure patient comfort intraoperatively. Postoperative pain analysis revealed different pain levels between periotome and conventional elevator extraction techniques. On the periotome side, pain scores were 5.53 on day 1, 2.40 on day 3, and 0.13 on day 7. The control side showed higher pain scores, that are, 5.93 on day 1, 4.07 on day 3, and 0.80 on day 7. While day 1 pain differences were statistically insignificant, the test side demonstrated significantly lower pain on days 3 and 7. Sharma SD et al.[7] found similar results, noting a significant pain reduction of 0.88 in the periotome group, compared to a pain increase of -0.70 in the control group. Kumar N et al.10 also reported comparable findings, with periotome group VAS scores of 0.07 versus 1.2 in the forcep group. The perception of pain is multifactorial and has variables such as whether it was the patient's first experience of extraction or second, this could significantly increase or decrease the patient's pain perception irrespective of the technique used for extraction. But the concurrent results showing reduced pain in the periotome group can largely be attributed to the atraumatic extraction technique and minimal soft tissue reflection or trauma. Gingival laceration analysis showed marked differences between extraction techniques. In our study, the periotome side demonstrated 100% Grade I lacerations, while the control side exhibited more significant tissue damage showing 53.3% Grade I, 40% Grade II, and 6.7% Grade III lacerations. Sharma SD et al.[7] corroborated these findings, reporting a mean gingival laceration grade of 0.20 in the periotome group versus 1.20 in the control group. Kumar N et al.[10] similarly observed that 86% of periotome group cases had Grade I lacerations, compared to only 40% in the control group. Soft tissue lacerations during extraction can occur through periosteal elevator use, flap reflection, and forceps application. Periotomes mitigate this by loosening teeth within the periodontal ligament space, eliminating the need for periosteal reflection, allowing easier forceps application below the cemento-enamel junction and enabling vertical tooth extraction without extensive buccal or palatal movements. These characteristics contribute to the periotome's potential as a minimally invasive extraction technique, particularly in orthodontic procedures where tissue preservation is crucial. In this study, no complications were observed on the test side (0.0%), while the control side experienced 3 cases (20%), including one buccal cortical plate fracture and two cases of delayed healing managed with antibiotics. Kumar N et al.[10] reported similar findings, with 26% cortical plate fractures in conventional extraction methods and no fractures in the periotome group. The higher fracture incidence in conventional methods can be attributed to extensive buccal and palatal motion during extraction. The mean rescue analgesics consumed were 4.27 tablets on the test side versus 6.47 on the control side. Sharma SD et al.[7] found comparable results, with 1.40 tablets in the periotome group versus 2.21 in the control group. However, analgesic consumption remains subjective, influenced by individual pain perception and extraction experience. Although statistically insignificant, the periotome group demonstrated fewer complications and lower analgesic requirements. There were a few limitations of the study such as a small sample size, the marginal bone loss was not analyzed radiographically. Since it was a split mouth study, the second phase of extraction could by default result in lower pain and pressure scores given by the patient in comparison to the first phase. In this study, only the double rooted maxillary first premolars were included, more studies are required to compare the efficacy of periotomes in single rooted versus multirooted teeth. Overall, if we compare parameters of patient comfort and preservation of hard and soft tissues post extraction, the periotome method seems to be the better option when compared with conventional elevators.

Conclusion:

In recent times, there has been a shift towards atraumatic extractions over conventional methods for better patient comfort intraoperatively and postoperatively as well as preservation of hard and soft tissue surrounding the tooth for the future possibility of rehabilitation. Severing the fibers surrounding the

SD: standard deviation, p<0.05 is statistically significant, P1 value: comparing between groups by independent t test. P2 value: overtime comparison in buccal side in each group by paired t test. P3 value: overtime comparison in lingual side in each group by paired t test. P4 value: overtime comparison in overall in each group by paired t test.

2.Marginal bone loss (MBL):

As shown in table (5), radiographic evaluation revealed no statistically significant differences in marginal bone loss between the two groups. On the buccal aspect, group I demonstrated a higher mean bone loss (0.60 ± 1.1 mm) compared to group II (0.10 ± 1.0 mm; p = 0.428). Conversely, at the lingual aspect, group II exhibited greater loss (0.70 ± 1.0 mm) than group I (0.02 ± 0.9 mm; p = 0.152). Also, the overall mean MBL was more in group II than group I with no statistical differences (group I: 0.30 ± 0.9 mm; group II: 0.40 ± 0.8 mm; p = 0.739).

Table(5): MBL comparison among the studied groups

	Group I	Group II			
	Mean	SD	Mean	SD	P Value
MBL_Buccal	0.60	1.1	0.1	1.0	0.428
MBL_Lingual	0.02	0.9	0.7	1.0	0.152
Overall	0.30	0.9	0.4	0.8	0.739

SD: standard deviation, p<0.05 is statistically significant, P value: comparing between groups by independent t test. MBL: marginal bone loss.

DISCUSSION:

Ensuring consistent soft tissue healing and maintaining peri-implant health in the posterior mandibular region remains a clinical challenge, owing to its complex anatomical and functional characteristics.[17] All implants demonstrated a 100% survival rate over the short-term follow-up, with no biological, mechanical, or prosthetic complications observed, indicating the overall reliability of the protocol utilized.Soft tissue healing plays a critical role in the early stages of implant integration. In this study, healing was assessed at days 7, 14, and 21 post-operatively using the Landry wound healing index. Both group I and group II exhibited progressive and statistically significant improvement in healing scores over time. However, no significant intergroup differences were detected. These results are in line with previous reports by Rodrigues[9] and Belal[18], who documented favorable outcomes with the use of Ora-Aid as a palatal wound dressing.According to the present study, implant stability was evaluated using RFA, with results expressed in ISQ values. No statistically significant differences in ISQ values were observed between the groups at implant placement or at the four-month follow-up. However, both groups demonstrated a statistically significant increase in ISQ values over time, consistent with studies by Victoria et al.[19], Vollmer et al.[20], and Bavetta et al.[21], all of whom reported increased implant stability following a standard healing period, reflecting successful osseointegration. Radiographic evaluation using cone-beam computed tomography (CBCT) provided objective insights into relative bone density and marginal bone level changes. CBCT remains a valuable tool for implant assessment due to its low radiation exposure and high-resolution imaging.[22] In this study, no statistically significant differences were detected between the groups in terms of buccal, lingual, or overall bone density at baseline or at the time of prosthetic loading. These outcomes suggest that the application of HEC strips did not result in enhanced hard tissue healing compared to the control group. This aligns with the understanding that bone density and osseointegration are more strongly influenced by surgical technique, implant design, and patient-specific bone quality.[15]Mustakim et al.[23] stated that maintaining marginal bone levels is crucial for long-term dental implant success, as bone loss can be influenced by factors like bone quality, systemic health, and patient-specific variables. The current study revealed no significant differences in MBL between the two groups across all measured aspects. Although, radiographic analysis revealed a higher mean bone loss (MBL) in group II for both lingual and overall measurements, this difference did not reach statistical significance but may have a clinical importance. While the differences were not statistically significant, the study group exhibited poor adaptability to wound contours, which poses limitations in clinical application. These findings are in contrast with Rodrigues[9], who stated that Ora-Aid's handling characteristics, including easy adaptation to wound contours and transparent appearance, offer practical advantages in clinical practice. Additionally, it showed slightly inferior radiographic outcomes that might be due to inadequate strip adherence and possible debris stagnation around the implant site. These was in agreement with Salih[24], who reported 3–5 hours of adhesion of ora-aid with no notable complications or morbidity. Belal[18] reported that Ora-aid retained from 6 to 9 days when used as palatal dressing, these was in contrast with the results of the present study that showed limited adhesion time which was considerate as a main issue. These might be due to the difference in wound configuration.

CONCLUSION

Hydroxyethyl cellulose (HEC) adhesive strips offered no significant advantage over conventional suturing in enhancing soft tissue healing, implant stability, relative bone density and marginal bone loss following immediate implant placement in mandibular molars.

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