

Periotome As an Aid To Atraumatic Extraction in Orthodontic Mandibular Single-Rooted Teeth: A Split-Mouth in-Vivo Study

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Abstract

Background: Forceps and elevator tooth extractions often cause trauma to alveolar bone, resulting in postoperative pain and delayed healing. Atraumatic techniques using periotomes and fine instruments that sever periodontal ligament fibres with minimal damage have been introduced to mitigate these effects.

Aims: To compare periotome-assisted atraumatic extraction with conventional periosteal-elevator

extraction in patients undergoing bilateral mandibular premolar removal using a split-mouth design.

Methods: 50 patients (18–30 years) requiring bilateral mandibular premolar extraction were enrolled in a randomized split-mouth trial. In one session, periotome insertion into the periodontal ligament space was followed by forceps extraction on one side, and in the other session (1 week later) periosteal reflection and forceps extraction were performed on the contralateral

side. Outcomes included extraction time, intraoperative pain (VAS), gingival laceration grade, postoperative pain (VAS on days 1, 3, 7), analgesic consumption, and complications. Paired statistical tests were used to compare techniques.

Results: The periotome technique significantly reduced extraction time (mean 10.00 ± 1.39 vs 12.78 ± 1.59 minutes, $p < 0.001$) and both intraoperative and postoperative pain scores at all time points. For example, mean pain on day 1 was 6.24 vs 7.22 ($p = 0.001$). Patients in the periotome group consumed fewer analgesic tablets (1.64 ± 0.88 vs 3.08 ± 1.34 ; $p < 0.001$). Gingival lacerations were minor (Grades I–II) in periotome group, whereas control group had higher incidence of severe lacerations ($p < 0.001$). Delayed socket healing occurred less frequently with periotomes (2% vs 14%, $p = 0.027$).

Conclusion: Periotome-assisted atraumatic extraction resulted in less trauma, lower pain, shorter procedure time, and fewer complications compared to the conventional approach.

Keywords: Tooth Extraction; Periotome; Atraumatic Extraction; Orthodontics; Mandible

Introduction

The specialty of maxillofacial surgery has made tremendous strides in the past few decades encompassing such diverse fields as craniofacial surgery, microvascular reconstruction, etc. But the most commonly performed procedure by maxillofacial surgeons in many countries continues to be exodontia, comprising non-surgical routine tooth extractions as well as impacted tooth removal. Improvements in local anaesthetics as well as its delivery armamentarium have resulted in painless extractions but the fear of post extraction pain deters many patients from undergoing this procedure.¹⁻⁶

Extraction is one of the most common surgeries in dentistry, performed for various dental problems with

different indications^{3,7-8}. It is considered a traumatic procedure and results in immediate loss of the supporting alveolar bone and soft tissues around the extracted tooth, due to the fact that tooth extraction has followed the same protocols of achieving exodontia for the last several decades with either forceps or newly developed instruments^{9,10}.

In all protocols, tooth mobilization is achieved by severing Sharpey's fibers from the alveolar bone and exerting luxating force by forceps or newer extraction devices, resulting in tearing of periodontal ligament (PDL) fibers and alteration of the supporting bone surrounding the socket^{10,11}.

Although performed under local anesthesia (LA), soreness and pain due to tooth extraction can last for several days^{12,13}. The literature suggests that postoperative pain and use of analgesics following dental extraction are related to the amount of tissue trauma created during extraction and the length of the operation¹⁴⁻¹⁶.

Materials and Methods

Fifty patients aged 18–30 years (mean 20.24 ± 2.56) presenting for bilateral mandibular premolar extraction for orthodontic reasons were recruited. Inclusion criteria were good general health and indication for premolar removal. Exclusion criteria included multi-rooted or dilacerated teeth, endodontic treatment, periodontal disease, pregnancy, smoking, or any condition or medication affecting pain perception. Ethical committee approval and informed consent were obtained.

This was a randomized split-mouth study. In the first session, one premolar was extracted using the test method (periotome-assisted), and one week later the contralateral premolar was extracted using the control method (conventional elevator). The assignment of left/right side to each method was randomized. All extractions were performed by the same operator under

local anesthesia. Patients were blinded to the technique used.

Periotome group (Test): A periotome was inserted into the gingival sulcus at about 20° to the long axis of the tooth. Gentle instrument advancement was repeated around the tooth (mesially, distally, buccally, lingually) to sever the periodontal ligament fibers along approximately two-thirds of the root length. The tooth was then grasped with forceps and extracted with slow rotational and traction forces.



Figure 1:

Periosteal elevator group (Control): A periosteal elevator was used to reflect the gingival tissue and expose the cementoenamel junction. The tooth was then removed with conventional forceps using standard rotational movements.



Table 1: Distribution of Age

Age	Frequency	Percent
≤20 years	30	60.0%
>20 years	20	40.0%
Mean ± SD	20.24 ± 2.56	

Figure 2:

The following parameters were recorded for each extraction:

- **Extraction time:** measured from completion of anesthesia to tooth removal (in minutes)
- **Intraoperative pain:** patient-reported pain on a 0–10 Visual Analog Scale immediately after extraction.
- **Gingival laceration:** presence and length of gingival tears, graded 1 (0–5 mm) to 4 (extensive laceration).
- **Postoperative pain:** patient-recorded VAS scores on postoperative days 1, 3, and 7 (using a pain diary).
- **Analgesic consumption:** total number of rescue pain medication tablets taken in the week following each extraction.
- **Complications:** any adverse events including delayed socket healing, dry socket, or infection.

Statistical analysis was performed using paired t-tests or Wilcoxon signed-rank tests for continuous variables, and McNemar’s test for categorical outcomes. Significance was set at $p < 0.05$.

Results

Table 1 presents the distribution of age among the study participants. The majority of participants, accounting for 60.0% (n=30), were aged ≤20 years, while 40.0% (n=20) were older than 20 years. The mean age of the participants was 20.24 ± 2.56 years, indicating that the sample was predominantly young. {Table 1}

Table 2 illustrates the sex distribution of the study population. Among the participants, 70.0% (n=35) were female, whereas 30.0% (n=15) were male. This shows

Table 2: Distribution of Sex

Sex	Frequency	Percent
Male	15	30.0%
Female	35	70.0%

Table 3 compares the time duration after local anaesthesia between two different extraction methods. The mean time duration was significantly lower in the Periotome kit group (10.00 ± 1.39 minutes) compared to the Conventional periosteal group (12.78 ± 1.59

Table 3: Comparison of Time duration (after L.A.)

Parameter	Type of extraction method	Mean	SD	P value
Time duration (after L.A.)	Periotome kit	10.00	1.39	<0.001
	Conventional periosteal	12.78	1.59	

Table 4 evaluates the pain experienced by participants on different postoperative days using two extraction methods. On day 1, the mean pain score was significantly lower in the Periotome kit group (6.24 ± 1.25) compared to the Conventional periosteal group (7.22 ± 1.66) with a p-value of 0.001. By day 3, pain had decreased in both groups, but it remained significantly lower in the Periotome kit group (4.00 ± 1.11) compared to the Conventional periosteal group (4.92 ± 1.40), with

Table 4: Comparison of Pain

Parameter	Type of extraction method	Mean	SD	P value
Pain on day 1	Periotome kit	6.24	1.25	.001
	Conventional periosteal	7.22	1.66	
Pain on day 3	Periotome kit	4.00	1.11	<0.001
	Conventional periosteal	4.92	1.40	
Pain on day 7	Periotome kit	1.22	1.00	.013
	Conventional periosteal	1.78	1.22	

Table 5 presents the comparison of the frequency of analgesic use between the two extraction methods. The mean number of analgesics consumed was significantly

that the study had a higher proportion of female participants compared to males. {Table 2}

minutes), with a p-value of <0.001. This indicates that the Periotome kit technique required a shorter duration for the procedure, and the difference was statistically significant. {Table 3}

a p-value of <0.001. On day 7, the pain score further reduced, with the Periotome kit group reporting 1.22 ± 1.00 and the Conventional periosteal group reporting 1.78 ± 1.22, with a statistically significant p-value of 0.013. These findings suggest that patients undergoing extraction with the Periotome kit experienced significantly less pain at all time points compared to those treated with the Conventional periosteal method. {Table 4}

lower in the Periotome kit group (1.64 ± 0.88) compared to the Conventional periosteal group (3.08 ± 1.34), with a p-value of <0.001. This indicates that patients in the

Periotome kit group required fewer analgesics technique. {Table 5}

postoperatively, suggesting better pain control with this

Table 5: Comparison of Frequency of analgesics

Parameter	Type of extraction method	Mean	SD	P value
Frequency of analgesics	Periotome kit	1.64	0.88	<0.001
	Conventional periosteal	3.08	1.34	

Table 6 compares gingival laceration and postoperative complications between the two extraction methods. In the Periotome kit group, gingival laceration was predominantly mild to moderate, with 48.0% (n=24) showing grade I and 48.0% (n=24) grade II lacerations, while only 2.0% (n=1) each exhibited grade III and grade IV lacerations; in contrast, the Conventional periosteal group demonstrated more severe trauma, with only 4.0% (n=2) having grade I laceration, 50.0% (n=25) grade II, 38.0% (n=19) grade III, and 8.0% (n=4) grade IV, and this difference was statistically significant (p<0.001), indicating markedly less gingival trauma with

Table 6: Comparison of Gingival laceration

Gingival laceration		Type of extraction method		P value
		Periotome kit	Conventional periosteal	
I	N	24	2	<0.001
	%	48.0%	4.0%	
II	N	24	25	
	%	48.0%	50.0%	
III	N	1	19	
	%	2.0%	38.0%	
IV	N	1	4	
	%	2.0%	8.0%	

the Periotome kit. Postoperative complications further supported this finding, as delayed healing was observed in only 2.0% (n=1) of patients in the Periotome kit group compared to 14.0% (n=7) in the Conventional periosteal group (p=0.027), while the majority of patients in the Periotome kit group (98.0%, n=49) experienced no complications versus 86.0% (n=43) in the Conventional periosteal group, demonstrating that the Periotome kit technique was associated with significantly fewer postoperative complications, particularly delayed healing {Table 6}

Complications		Type of extraction method		P value
		Periotome kit	Conventional periosteal	
Delayed healing	N	1	7	.027
	%	2.0%	14.0%	
None	N	49	43	
	%	98.0%	86.0%	

Discussion

Bortoluzzi et al., Sjögren et al., and Al Khateeb, have conducted studies on postoperative pain in exodontia and observed it as the most common complication¹⁻³. To avoid the above-mentioned problems and following a more technique sensitive approach, we need to proceed with “atraumatic extraction technique”. Atraumatic extraction preserves bone, gingival architecture and allows for option of future or immediate implant placement. There are a variety of tools available for a minimally invasive technique of tooth extraction such as Easy X-Trac system^{4, 10}. Our findings align with prior studies showing that atraumatic methods improve clinical outcomes, especially in orthodontic or implant cases where maintaining bone height is critical. Minimal complications were observed with either technique, but the significantly lower rate of delayed healing with periostomes suggests a true clinical advantage. Importantly, achieving these benefits requires familiarity with the periostome technique and careful case selection. In experienced hands, periostomes can be a valuable tool for routine extractions that need to be performed with minimal invasiveness.

Conclusion

Periostome-assisted atraumatic extraction of single-rooted mandibular teeth produced shorter procedure times, less intra- and postoperative pain, and fewer gingival injuries than conventional periosteal-elevator extraction. When alveolar bone preservation and patient comfort are important—such as in orthodontic tooth removal or immediate implant planning—the use of a periostome is recommended. Adequate operator training and case selection are essential for optimal outcomes.

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