

Efficacy of Physics Forceps Versus Conventional Forceps for Extraction of Mandibular Premolar in Orthodontic Patients: A Split Mouth, Comparative Study

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Abstract

Background: Atraumatic tooth extraction has become increasingly important in contemporary oral and maxillofacial surgery, particularly in orthodontic patients where preservation of the surrounding hard and soft tissues is essential. Physics forceps utilize first-class lever mechanics and controlled rotational forces to

facilitate atraumatic extraction while minimizing damage to the periodontal ligament and alveolar bone. However, evidence comparing their clinical performance with conventional extraction forceps remains inconsistent.

Aim: To compare the clinical efficacy of physics forceps and conventional extraction forceps for nonsurgical

extraction of mandibular premolars indicated for orthodontic treatment.

Materials and Methods: A prospective split-mouth comparative study was conducted on 40 patients requiring bilateral mandibular premolar extractions for orthodontic purposes, yielding a total of 80 extraction sites. Each patient underwent extraction using physics forceps on one side and conventional forceps on the contralateral side. The study evaluated extraction time, intraoperative bleeding, intraoperative and postoperative pain using the Visual Analog Scale (VAS), gingival laceration, crown/root fracture, buccal cortical plate fracture, and socket healing. Statistical analysis was performed using appropriate tests, with statistical significance set at $p < 0.05$.

Results: Physics forceps demonstrated superior clinical performance in several outcome measures, including reduced extraction time, decreased soft tissue trauma, improved preservation of the buccal cortical plate, and enhanced postoperative healing. Pain scores and intraoperative complications were also lower in the physics forceps group compared with the conventional forceps group. The detailed statistical analysis supported significant differences for selected clinical parameters while maintaining comparable safety between both techniques.

Conclusion: Physics forceps provide an effective atraumatic alternative to conventional extraction forceps for orthodontic mandibular premolar extractions. Their use facilitates reduced tissue trauma, preservation of surrounding alveolar structures, and improved postoperative outcomes, making them a valuable adjunct in contemporary exodontia.

Keywords: Physics Forceps, Tooth Extraction, Orthodontic Extraction, Mandibular Premolars, Atraumatic Extraction, Oral Surgery, Split-Mouth Study

Introduction

Atraumatic tooth extraction has become an important objective in contemporary oral and maxillofacial surgery, particularly in orthodontic patients where preservation of the alveolar bone and surrounding soft tissues is essential for optimal healing and future treatment outcomes. Conventional extraction forceps rely on luxation and expansion of the alveolar socket, which may increase the risk of root fracture, buccal cortical plate fracture, and gingival injury, thereby compromising postoperative healing and alveolar ridge preservation.^{1,2} Physics forceps were developed as an atraumatic extraction system based on the principles of a first-class lever. By applying slow, continuous rotational force rather than squeezing or rocking movements, they facilitate periodontal ligament fatigue and tooth disengagement while minimizing trauma to the surrounding tissues.³ Previous clinical studies have reported reduced extraction time, fewer soft tissue injuries, lower postoperative pain, and improved preservation of the buccal cortical plate when compared with conventional forceps, although some studies have demonstrated comparable outcomes between the two techniques.^{4,5,6,7} Recent systematic reviews have also highlighted the need for additional well-designed clinical trials to establish stronger evidence regarding the clinical advantages of physics forceps.^{8,9}

Considering the limited evidence from prospective split-mouth studies evaluating mandibular premolar extractions for orthodontic purposes, the present study was undertaken to compare the clinical efficacy of physics forceps and conventional extraction forceps with respect to extraction time, intraoperative complications, postoperative pain, wound healing, and preservation of hard and soft tissues.



Universal Mandibular Physics Forceps

Material And Methods

This prospective split-mouth comparative study was conducted in the Department of Oral and Maxillofacial Surgery, Chhattisgarh Dental College and Research Institute, Rajnandgaon, after Institutional Ethics Committee approval and written informed consent. Sample size was calculated using G*Power (v3.1.9.2; effect size 0.64, $\alpha = 0.05$, power = 80%), yielding 80 extraction sites. Forty patients requiring bilateral mandibular premolar extractions for orthodontic treatment were enrolled, with each patient serving as their own control in a split-mouth design.

Patients aged 18–40 years with bilateral mandibular premolars indicated for orthodontic extraction, intact buccal and lingual cortical plates, and American Society of Anaesthesiologists (ASA) physical status I were included. Patients with abnormal root morphology, endodontically treated teeth, periapical pathology, periodontally compromised teeth, medically compromised status, pregnancy or lactation, tobacco or alcohol use, allergy to local anaesthetics, or those requiring surgical extraction were excluded. All patients underwent preoperative clinical and radiographic evaluation, and bilateral extractions were performed under local anaesthesia using a standardized aseptic protocol by experienced surgeons.

Study Group (Physics Forceps): Mandibular premolars were extracted using physics forceps by engaging the

beak lingually at the CEJ while the bumper was positioned on the buccal vestibule at the mucogingival junction. Gentle continuous rotational force was applied using wrist movement alone until tooth disengagement occurred. When necessary, the loosened tooth was removed using a haemostat or conventional forceps.

Control Group (Conventional Forceps): Mandibular premolars were extracted using conventional forceps after circumferential reflection of the gingival attachment with a periosteal elevator.



Application of conventional mandibular premolar forceps on mandibular first premolar



Application of physics forceps on mandibular first premolar

The following parameters were recorded for each extraction:

- Extraction time: It was measured from completion of anesthesia to tooth removal (in seconds) using stopwatch,
- Intraoperative pain: patient-reported pain on a 0–10 Visual Analog Scale during extraction procedure,

- Intraoperative bleeding: Bleeding from extraction socket was measured using gauze count. (gauze size- 8×12 cm),
- Immediate postoperative pain: patient-reported pain on a 0–10 Visual Analog Scale immediately after extraction.
- Gingival laceration: assessment was done using the tissue laceration grading system. (Grade 1–4 tissue laceration scale).
- Tooth/root fracture and buccal cortical plate fracture: recorded using simple yes/no format by assessing them clinically.
- Postoperative pain: patient-reported pain on a 0–10 Visual Analog Scale on day 7 after extraction.
- Wound healing: it was assessed clinically on day 7 using Landry Wound Healing Index.

Statistical analysis was performed using Independent t test, Chi square test, Fisher's exact test for continuous and categorical outcomes. Significance was set at ≤ 0.05 .



Extraction socket immediately after extraction with conventional mandibular premolar forceps.



Extraction socket immediately after tooth extraction with physics forceps

Results

A total of 40 patients (80 mandibular premolar extraction sites) were included in this prospective split-mouth comparative study. Each participant underwent extraction using physics forceps on one side and conventional forceps on the contralateral side. Baseline demographic characteristics, including age, gender, and tooth distribution, were comparable between the two groups.

The data was collected and compared to check the efficacy of physics forceps with that of conventional dental extraction forceps for mandibular premolar extractions in orthodontic patients with regards to pain, bleeding, trauma to gingival tissue, fracture of tooth/tooth-root, fracture of buccal cortical plate, time taken for tooth extraction, extraction socket mucosal healing intraorally & clinically.

Table 1, presents the demographic distribution and tooth distribution of the study population. The study included 40 patients (80 extraction sites) with a mean age of 21.25 ± 3.13 years, predominantly aged 21–25 years (47.5%) and female (82.5%). Most extractions involved the mandibular first premolars (teeth 34 and 44; 48.75% each), while mandibular second premolars (35 and 45) accounted for 1.25% each.

Table 1: Demographic and Tooth Distribution of the Study Population

Variable	Category	Frequency (n)	Percentage (%)
Age group (years)	<20	17	42.5
	21–25	19	47.5
	>25	4	10.0
	Mean $\pm$ SD	21.25 $\pm$ 3.13	
Variable	Category	Frequency (n)	Percentage (%)
Gender	Female	33	82.5
	Male	7	17.5
Tooth number	34	39	48.75
	35	1	1.25
	44	39	48.75
	45	1	1.25

Table 2, shows the comparison of time duration required for tooth extraction after administration of local anaesthesia between the two extraction methods. The mean extraction time with physics forceps was 64.78 ± 15.70 seconds and with conventional forceps was 94.70 ± 24.85 seconds. This difference was highly statistically significant ($p < 0.001$), indicating faster extraction with physics forceps.

Table 2: Comparison of Time duration (after L.A.)

Parameter	Type of extraction method	Mean	SD	P value
Time duration (after L.A.) in seconds	Physics forceps	64.78	15.70	0.000
	Conventional forceps	94.70	24.85	

Table 3, shows the comparison of intraoperative bleeding between the two extraction methods, which was assessed by gauze count (8×12 cm) used during the procedure. The mean gauze count required in the physics forceps group was 4.93 ± 1.49 , whereas in the conventional forceps group was 7.33 ± 2.04 . The P value was found to be 0.000, indicating that the difference between the two groups is statistically highly significant.

Table 3: Comparison of Bleeding (gauze count)

Parameter	Type of extraction method	Mean	SD	P value
Bleeding (gauze count)	Physics forceps	4.93	1.49	0.000
	Conventional forceps	7.33	2.04	

Gingival laceration was assessed using a grading scale ranging from Grade I to Grade IV based on the extent of tissue injury. Table 4, shows the comparison of gingival tissue laceration between both the groups. In the Grade I category, with minimal gingival laceration, 10 cases (25.0%) were observed in the conventional forceps group, whereas a considerably higher number of 29 cases (72.5%), were observed in the physics forceps group. For Grade II lacerations, 18 cases (45.0%) were recorded in the conventional forceps group, while only 5 cases (12.5%) were observed in the physics forceps group. In Grade III lacerations, 5 cases (12.5%) occurred in the conventional forceps group, compared to 4 cases

(10.0%) in the physics forceps group. The most severe form, Grade IV laceration, was seen in 7 cases (17.5%) in the conventional forceps group, whereas only 2 cases (5.0%) were reported in the physics forceps group. The difference between the groups was highly statistically significant ($p < 0.001$).

Gingival tissue laceration grade description

1	Length 0–5 mm
2	Length 5–10 mm
3	Length >1 cm
4	Torn gingiva

Table 4: Comparison of Gingival tissue laceration

Gingival tissue laceration		Conventional forceps	Physics forceps	P value
I	N	10	29	0.000
	%	25.0%	72.5%	
II	N	18	5	
	%	45.0%	12.5%	
III	N	5	4	
	%	12.5%	10.0%	
IV	N	7	2	
	%	17.5%	5.0%	

Table 5, shows comparison of fracture of buccal cortical plate and fracture of tooth/root. The physics forceps group showed no buccal cortical plate fracture in 39 cases (97.5%) and fracture in 1 case (2.5%), compared with 36 cases (90.0%) and 4 cases (10.0%), respectively, in the conventional forceps group ($p = 0.179$). Similarly, no tooth/root fracture was observed in 39 cases (97.5%) with physics forceps and 37 cases (92.5%) with conventional forceps, while fractures occurred in 1 (2.5%) and 3 cases (7.5%), respectively ($p = 0.308$). Although fracture rates were lower with physics forceps, the differences were not statistically significant.

Table 5: Comparison of fracture of buccal cortical plate and fracture of tooth/root

Outcome	Fracture	Conventional Forceps n (%)	Physics Forceps n (%)	P value
Buccal cortical plate fracture	No	36 (90.0 %)	39 (97.5%)	0.179
	Yes	4 (10.0 %)	1 (2.5%)	
Tooth/Root fracture	No	37 (92.5 %)	39 (97.5%)	0.308
	Yes	3 (7.5 %)	1 (2.5%)	

Pain was assessed using Visual Analog Scale (VAS) in which end points are indicated with “no pain” to “unbearable pain” or “worst pain possible”. Table 6, is a depiction of the descriptive statistics for pain scores obtained at different time points during extraction (intraoperative), 1st and 7th post operative day after extraction for both groups. Both the groups demonstrated intraoperative pain (VAS: 0.63 ± 0.70 vs. 1.28 ± 1.18 ; for physics forceps group vs conventional forceps group respectively with $p = 0.004$) and postoperative day 1 pain (2.23 ± 0.97 (physics forceps) vs. 2.85 ± 1.51

(conventional forceps); with $p = 0.031$). By postoperative day 7, pain scores were low in both groups (physics group vs conventional group respectively) (0.08 ± 0.35 vs. 0.18 ± 0.45 ; $p = 0.268$), with no statistically significant difference.

Table 6: Comparison of Pain

Parameter	Type of extraction method	Mean	SD	P value
Intra-op VAS score	Physics forceps	0.63	0.70	0.004
	Conventional forceps	1.28	1.18	
1st day VAS score	Physics forceps	2.23	0.97	0.031
	Conventional forceps	2.85	1.51	
7th day VAS score	Physics forceps	0.08	0.35	0.268
	Conventional forceps	0.18	0.45	

Extraction socket mucosal wound healing was assessed intraorally and clinically on post operative day 7th using 5-point healing index (Landry et al 1988). Table 7, shows the comparison of extraction socket mucosal wound healing between both groups. Excellent wound healing (Score 5) was observed more frequently in the physics forceps group (28 cases, 70.0%) than in the conventional forceps group (14 cases, 35.0%). Scores 4, 3, and 2 were recorded in 6 (15.0%), 4 (10.0%), and 2 (5.0%) cases with physics forceps compared with 16 (40.0%), 8 (20.0%), and 2 (5.0%) cases with conventional forceps, while Score 1 was absent in both groups. The difference was statistically significant ($p = 0.014$).

Table 7: Comparison of Extraction socket mucosal wound healing

Extraction socket mucosal wound healing		Conventional forceps	Physics forceps	P value
2	N	2	2	0.014
	%	5.0%	5.0%	
3	N	8	4	
	%	20.0%	10.0%	
4	N	16	6	
	%	40.0%	15.0%	
5	N	14	28	
	%	35.0%	70.0%	

Discussion

The present split-mouth study demonstrated that physics forceps provided superior clinical outcomes compared with conventional forceps for orthodontic extraction of mandibular premolars. Physics forceps significantly reduced extraction time, intraoperative pain, gingival trauma, and postoperative discomfort while promoting better soft tissue healing. These findings may be attributed to the first-class lever mechanism, which

applies slow, continuous rotational forces, thereby minimizing damage to the periodontal ligament and surrounding alveolar bone.³

Our findings are consistent with those of Mandal et al.⁵ and Patel et al.⁶, who reported reduced operative trauma and improved postoperative outcomes with physics forceps. El-Kenawy and Ahmed⁴ also observed lower pain scores and fewer soft tissue injuries using physics forceps, although some investigators have reported no

significant differences between extraction techniques in selected clinical parameters.⁷ Recent systematic reviews have concluded that, while physics forceps appear promising for atraumatic extraction, further high-quality randomized clinical trials are required to strengthen the available evidence.^{8,9}

The split-mouth design minimized inter-patient variability and strengthened the internal validity of the study. However, the relatively small sample size and single-centre design may limit the generalizability of the findings.

Conclusion

Within the limitations of this prospective split-mouth study, physics forceps demonstrated superior clinical performance over conventional forceps for orthodontic extraction of mandibular premolars. Their use resulted in reduced extraction time, decreased soft tissue trauma, lower postoperative pain, and improved socket healing while preserving the surrounding alveolar structures. Physics forceps may therefore be considered a safe and effective alternative for atraumatic exodontia, although larger multicentric randomized clinical trials are recommended to further validate these findings.

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