# Assessment of Intraoperative Complications Associated with Extraction Technique Using Physics Forceps and the Conventional Method: A Split-mouth Comparative Study

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#### Abstract

Tooth extraction is one of the most frequently performed surgeries, and several instruments were invented throughout history. This study's purpose is to assess the efficacy of physics forceps in comparison to conventional tooth extraction forceps in bilateral dental extraction and their associated intraoperative complications, including crown fracture, root fracture, buccal cortical plate fracture (BCPF), gingival lacerations, and bleeding time. All participants (n = 20) and total extractions (n = 40) were randomly assigned within two groups. Teeth were extracted utilizing physics forceps on one side of the maxillary or mandibular quadrants (n = 20) and conventional forceps on the other side (n = 20). Clinical data were gathered and analyzed. The findings show none of the patients in any of the groups had a crown fracture, however, the occurrence of roots and buccal cortical plate fractures were higher within control group. The incidence of gingival lacerations was seven times (35 %) in the study group and eight times (40 %) in the control group. Bleeding time in control group was longer than that in the study group (P value = 0.022) with a moderate effect size (ES = 0.676). In this study, buccal traumatic ulcer formation was observed in 5 cases (25 %) in study group due to excessive pressure application on the buccal soft tissue. In conclusion, physics forceps provide clinical outcomes comparable to conventional forceps and could be used for routine exodontia.

Key words: Surgical instruments, Atraumatic dental extraction, Physics forceps, Buccal bone plate.

#### 1. Introduction

Exodontia is the procedure of removing the tooth from its socket within the alveolar bone and it's the commonest operation carried out in oral surgery [1, 2]. Even though every effort must be made to preserve the remaining teeth in place, certain teeth still needed to be removed for many reasons. These reasons include major carious lesions, advanced periodontal destruction, purpose, orthodontic malpositioned or fractured teeth, prosthetic extractions, impaction, supernumerary teeth, preradiation treatment, teeth associated with jaw fractures, esthetic, and financial considerations [3]. Conventional exodontia entails grasping the tooth with the forceps, expanding the alveolus, and separating the periodontal connection by utilizing elevators to draw the tooth out. This pulling movement also causes undesirable traumatic events, such as fractured roots or bones, resulting in an inflammatory response, pain, tissue damage, and stressful sequelae for both the operator and the patient. Dental forceps are two firstclass levers joined by a hinge. The forces transmitted to the handle are on the lever's long side, the beaks are the short side, and the hinge serves as a pivot point [4]. As a result, the force applied to the handle is magnified, allowing the forceps to hold the tooth with a

large force but provide no mechanical benefit in removing it. This is comparable to trying to take off a bottle cap with pliers rather than applying the benefit of a lever, as with a conventional bottle cap opener [5] figures 1, and 2.

However, if the practitioner were able to employ two opposing forces, and both actions abolished the need for the third force, the clinician's arm, the chance of tooth fracture would be significantly reduced. Additionally, the patient would also experience substantially lower discomfort. Traumatic destruction of the periodontium during dental extraction can cause visible deformities in the alveolar ridge and impair the healing process as well as compromise. The esthetics of future prostheses, such deformities might prevent the placement of dental implants or even result in sub-pontic food entrapment underneath conventional fixed partial dentures. 'Atraumatic' extraction methods are gaining popularity and might eventually become the standard approach for routine dental extraction because its aims to maintains bone structure and gingival integrity and enables for immediate or future implant insertion. Many techniques and instruments have been invented for minimal invasive tooth extraction including the

physics forceps, piezosurgery, benex extractor, and powered periotomes [6-9].

Richard Golden designed physics forceps in 2004 at Golden Dental Solutions in Michigan. The biomechanics of this tool reduce the likelihood of root fracture and preserve the buccal alveolar cortical bone plate. Physics forceps use a 'beak and bumper' design that allows the practitioner to remove teeth by employing only wrist movement. They function as a first-class lever. The beak of the forceps applies force to the lingual or palatal side of the tooth or root. The plastic covered bumper, which is positioned in the buccal vestibule at the mucogingival junction, acts as pivot point. A constant rotational force is exerted only on both forceps's handles with a minor degree of wrist movement and keeping the same position for about 30 to 60 seconds, allowing the bone and PDL to gradually expand and loosen. The surgeon will shortly notice the tooth snapping out of its socket, at that point he may withdraw the forceps and remove the tooth with a suitable tool such as conventional forceps [12]. The torque force applied to the tooth structure, PDL, and alveolar bone is proportional to the distance between the handle and the bumper, which is eight centimeters.



Figure 1: Conventional forceps give you the ability to "grasp" the bottle cap, however it doesn't provide a mechanical advantage for removing it [9].



**Figure 2**: The mechanical advantage of a first-class lever, comparable to that of a bottle opener, is applied by Physics Forceps

#### [9].

divided by the distance between the bumper and the beak, which is one cm. Therefore, the force applied to the handle attached to the bumper magnifies the force applied to the tooth, PDL, and the alveolar bone about eight times. There is no need to apply force to the beak, which is solely on the lingual portion of the root. As a result, the tooth doesn't crush, or fracture. According to Dym and Weiss, there is no need to raise a mucoperiosteal flap or employ an elevator prior to extraction using physics forceps. This is a significant benefit, particularly in cases requiring atraumatic extraction [13].

#### 2. Patients and methods

All participants (n = 20) and the teeth (n = 40) were randomly assigned into two groups of 10 patients each and the patient was blind to the type of forceps used during the procedure. Randomization was applied using offered online tool an by https://www.graphpad.com. The control group included extractions performed with conventional forceps, while the study group included extractions performed with the physics forceps. The preoperative evaluation consisted of a thorough patient history and a radiographic assessment (OPG). All patients were anesthetized with lidocaine 2 % E-80 with epinephrine 1:80.000 (New stetic S.A., Colombia). Extractions were performed under rigorous aseptic settings and the teeth were extracted with three days apart as traumatically as possible, and all extractions were carried out by the same surgeon. When the physics forceps was used, the curved beak was positioned on the palatal or lingual side of the root at or just beneath cemento-enamel junction (CEJ), and the forceps' bumper was positioned on the buccal side of the dental alveolus at about the mucogingival junction. An uninterrupted controlled traction force applied until the tooth snapped out from its socket.

In conventional dental forceps, the forceps were pushed apically and aligned to the longitudinal axis of the tooth after severing the fibers that connect the gingival tissue margin to the tooth's neck. Then extracted from the socket using torsional movements mixed with buccolingual rocking for lower teeth and gentle wiggling in a buccopalatal orientation while pulling upper teeth. Postoperatively, the patients were instructed to bite on a gauze pack for about 30 minutes and to avoid gargling and spitting for the first 24 hours, also instructed to maintain soft diet and avoid eating on the extraction site with a gentle rinse for 30 seconds with chlorhexidine mouth wash 0.12 % starting the second day postoperatively. Analgesics were prescribed to the patient as mefenamic acid (500 mg) to be taken as needed. The patients were instructed to attend a follow up visit on the third and seventh post-operative days. Moreover, the following parameters were evaluated after the operation day. Firstly, a crown fracture at or above the CEJ was recorded. A YES or NO format was used for the assessment. Secondly, root

fracture; assessment of root(s) fracture below the CEJ by using the following format (one root fracture = 1, two roots fracture = 2, and / or three roots fracture = 3). Thirdly, the buccal cortical plate integrity was carefully assessed by manual palpation along the extracted tooth socket externally and also by running a dental probe on the lingual aspect of the buccal plate from inside the socket in all directions (from apical to occlusal and from mesial to distal) to check for any discontinuity or step deformity of bone or fenestration or dehiscence-type defects, and also by examining the extracted tooth for adherence of buccal plate to the external root surfaces. Yes/no format was used for the assessment. Fourthly, gingival laceration was assessed by inspection, and any gingival laceration around the extracted tooth area was recorded. A yes/no format was used for the assessment. Finally, the oral bleeding time was assessed by examining the extraction socket for two minutes and subsequently carefully laying a piece of gauze above the site to clean any blood from the region above and around the socket. Then, the alveolus was evaluated every 30 seconds until bleeding is stopped by clot formation, and the total time of bleeding was recorded as oral BT. Data description, analysis, and presentation were performed

using the statistical package for social science (SPSS version 21, Chicago in press, Illinois, USA).

#### 3. Results

This study involved 8 (40 %) males and 12 (60 %) females, that had a mean age of  $20.1 \pm 4.12$ , and the majority of the study sample (16) was accounted with the age group 16-23 years (80 %), and (4) in the age group of 24-31 years (20 %), with no significant difference (P > 0.005). The study sample was limited to first premolar tooth extracted for orthodontic purposes due to the split mouth design. The incidence of crown fracture was zero in both groups. Root fracture occurrence was two times (10 %) within the study group and three times (15%)within the control group with P-value of (0.999). BCPF occurred two times (10 %) in study group, while there was four times (20 %) occurrence in the control group. However, there was no statistically significant difference, P-value (0.661).

Regarding gingival laceration, there was no statistical significance between both groups (P value = 1.00), but the incidence was high in both groups, as it occurred seven times (35 %) within study group and eight times (40 %) within control group. The physics forceps are designed in such a way that forces are transmitted via a bumper placed at the buccal gingiva, which adds to a crushing damage (Figure 3). In this study, ulcer formation was observed in five cases (25 %) in the study group. Whereas, in the control group, no occurrences of postoperative ulcer formation were reported. This was statistically significant with a P value of (0.047) (table1). At each appointment, the time frame of bleeding in 20 individuals was recorded. The physics forceps group had a shorter mean of bleeding time than the conventional forceps group. This distinction was discovered to be statistically significant (P = 0.022), with moderate effect size of (ES = 0.676) table 2, and figure 4.

#### 4. Discussion

A split-mouth trial design was used because it reduces the chance of bias, as numerous variables such as nutritional status, dental hygiene, and bone condition are similar on each side and the compliance of the participants is consistent. Since both patient's quadrants had been operated on by the same surgeon, there was no operator bias. The study sample was limited to orthodontic extraction of first premolar extracted to address Angle's class I malocclusion, which is the prevalent type of malocclusion in Iraqi

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population [10]. There was zero incidence of crown fracture in both groups. This could be due to the study sample, which was limited to sound first premolar teeth only, with a single and straight root in most cases, which reduced the incidence of crown fracture. These results are like Patel et al. results [11], who also reported zero incidence of crown fracture in both groups. Hasan [13] also reported no statistical significance in regard to crown fracture, where three crown fractures (21.43 %) were registered in conventional forceps group versus zero incidence in physics forceps group. Being the most usually documented consequence after tooth extraction, having a prevalence ranging from 5 to 7 %. Yet reaching as high as 30 % in teeth with dilacerated and divergent roots [14]. Therefore, it is not unexpected that most of the research examined and studied root fracture. Results of this study is in accordance with the findings of most other investigations that found no differences in tooth fracture (irrespective of the tooth region) including Hariharan et al. [15], Patel et al. [11], Madathanapalli et al. [16], and Hasan [13].

In this study, BCPF occurred two times (10 %) in the study group, and four times (20 %) in the control group, Although the incidence was lower in study group, there

was no statistically significance difference. Physics forceps apply consistent and steady force using the wrist only, which reduces the likelihood of buccal cortical plate fracture [16]. Furthermore, as it is placed on the buccal side of the ridge, the bumper produces a compressive force at the buccal cortical plate, so retaining and maintaining the bone in position. This study results agree with Kosinski [18], who noted that the slow buccal.

		Groups						<b>T</b> 1	
Vars.		Study		Contro 1		Statistic	P value	Total	
		N	%	N	%			N	%
Crown fracture <sup>a</sup>	No	20	100	20	100			40	100
Root fracture <sup>a</sup>	Yes	2	10	3	15	0.220	0.999 NS	5	12.5
	No	18	90	17	85	0.229		35	87.5
BCBF <sup>a</sup>	No	18	90	16	80	0.784	0.661 NS	34	85.0
	Yes	2	10	4	20	0.784		6	15.0
Gingival tear <sup>b</sup>	No	13	65	12	60	0.107	1.00 NS	25	62.5
	Yes	7	35	8	40	0.107		15	37.5
Buccal traumatic ulcer <sup>a</sup>	No	15	75	20	100	5 714	0.047 5:~	35	87.5
	Yes	5	25	0	.00	5./14	0.04 / SIg.	5	12.5

**Table 1**: Distribution of intraoperative complication among groups.

a: Fisher exact, b: Chi square, Sig: significant, NS: non-significant.

movement performed by physics forceps was generally not sufficient to fracture the buccal alveolar bone plate. Abdelwahab et al. [11], reported that the force required to extract a tooth may be dependent on the size and shape of the roots. Therefore, it could be speculated that BCPF will be more common in extraction of multirooted premolars and molars than single-rooted premolars and incisors. It is well known that a patient's anticipation of pain may compromise dental treatment [19]. In this study, ulcers on the buccal side of the socket were observed on the 3<sup>rd</sup> postoperative day in 5 cases of the study group and it was due to excessive pressure applied by the bumper on the buccal aspect, while there were none in control group. During tooth extraction, the bumper of the physics relies on the buccal side of the tooth socket, which could obscure the surgeon's viewpoint, thereby leading to laceration propagation, and the bumper is convex throughout the full forceps span, while the BCP concavity differs at various positions of the lower and upper arches. As a result, severe pressure was linked to a crushing trauma and gingival ulceration. In addition, physics forceps rely exclusively on buccal horizontal rotation to extract the tooth, that could raise the risk of BCPF and gingival laceration when used

with significant forces and a large amount of buccal rotation [20]. These results are in accordance with the results of Lingaraj et al. [21], and Kapila et al.[22] who reported a gingival laceration on the buccal aspect of the extracted tooth socket that was attributed to the pressure applied by the physics forceps bumper on the injured site during extraction.

#### **5.**Conclusion

Physics forceps are a novel type of extraction forceps. The extraction procedure is relatively easy to master. and offer a comparable outcome to the conventional forceps, it requires significantly less force to extract teeth of comparable conditions and root configurations. Because the current investigation was limited to orthodontic extraction, bigger multicentric prospective trials with a greater number of participants, covering molars, root stumps, and extensively carious teeth, are essential to be carried out.



Figure 3: Positioning of the physics forceps in the oral cavity and tooth disengagement from its socket using physics forceps.

**Table 2**: Descriptive and statistical test ofbleeding time among groups.

Groups	Ble Tim	T test	P value	Effect size Cohen's D			
Study group	Minimum	3.370					
	Maximum	6.450					
	Mean	5.110		0.022 Sig.			
	±SD	0.799					
Control group	Minimum	4.200	2 390		0.676		
	Maximum	6.550	2.390				
	Mean	5.650					
	±SD	0.619					





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