The Efficiency Of Physics Forceps In Comparison To The Conventional Dental Extraction Forceps: A randomized Clinical Trial

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ABSTRACT

Background: Tooth extraction is one of the most commonly performed procedures in dentistry. It is usually a traumatic process often resulting in immediate destruction and loss of alveolar bone and surrounding soft tissues. Various instruments have been described to perform atraumatic extractions which can prevent damage to the paradental structures. The physics forceps is one of those innovations in dental extraction technologies that claim to provide an efficient means for atraumatic dental extractions.

Materials and method: A randomized clinical trial was conducted to compare the physics forceps with the conventional forceps for the removal of 28 mandibular single rooted teeth under the following parameters: incidence of crown, root, buccal alveolar bone fracture, the incidence of gingival tear and time needed for extraction. The samples were assigned randomly into two groups according to the computer based randomization software, into a control group (A) and study group (B). The control group was subjected to the surgical extraction procedure using the conventional forceps while the study group was subjected to the surgical extraction procedure using the physics forceps.

Results: results showed that the time required for extraction using the physics forceps was (mean 0.385 min.), which was significantly lesser as compared with that of conventional forceps (mean 3.971 min.) (P=0.011), buccal bone fracture occurred in 4 out of 14 cases (28.57%) using the conventional forceps while it did not occur with the use of the physics forceps (0.00%), crown fracture occurred in 3 cases using the conventional forceps (21.43%), while it did not occur with the use of the physics forceps (0.00%), root fracture occurred in 1 case using the physics forceps (3.57%), while it did not occur with the use of the conventional forceps (0.00%). As for the gingival tear, it occurred in 7 cases using the conventional forceps (50.00%), while it did not occur with the use of the physics forceps (0.00%) which was highly significant (P=0.006).

Conclusions: the use of physics forceps maintains the integrity of gingiva and surrounding periodontium. So extractions using physics forceps are less invasive over conventional forceps and can be considered as a reliable method for extraction requiring significantly less comparative intraoperative time.

Key words: tooth extraction, physics forceps, buccal bone plate. **(Received: 11/10/2017; Accepted: 5/11/2017)**

INTRODUCTION

Dental extraction is one of the most commonly performed procedures in dentistry. According to the UK Local Government Association (LGA), there were 40,970 removal procedures by dentists in 2014-15 compared with 32,457 in 2010-11, and according to Brazilian health ministry, there was 10,674,084 extractions nation wise in 2012 [(1)]. Over the last decade, there has been an increased interest in atraumatic tooth extractions in order to maintain bone for implant insertion [(2,3)].

Physics forceps was developed by the company Golden dental solutions in 2004, it was modified as an extractor that implements the principles of the first-class lever, creep and type of force to provide mechanical advantage to make dental extraction more efficient [(4)].

The physics forceps consists of a handle that connected to a bumper which acts as a fulcrum during extraction and a beak that connects to the other handle which is positioned mostly on the lingual or palatal surface of the root of the tooth.

While the conventional dental extraction forceps relies on bone (tooth socket) expansion for tooth delivery through the use of basic tooth movements against the alveolar bone to the buccal/labial and lingual/palatal with some other extraction movements such as (apical pressure, rotational pressure, and tractional force) [(5)], the physics forceps relies on different approach in both mechanics and procedure.

The wide part of the physics forceps (bumper) is mostly placed on the facial aspect of the alveolus. Unlike the conventional forceps, there is only one point of contact to the tooth to be extracted through the beak of the extractor, also there is no squeezing pressure applied to the handle or the tooth. But the handles (once in position) are rotated by the operators' wrist as one unit for few degrees facially. Approximately after 30 to 60 seconds the internal force or "creep" will build up, allowing the bone to expand slowly and the periodontal ligament to release at which point the tooth will disengage from its socket [(6)].

As the preservation of the paradental tissues is necessary for the functional and esthetic outcome of a dental implant, the use of less invasive

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method for extracting teeth will serve that goal, The aim of the study is to evaluate the efficiency of the physics forceps in single rooted mandibular teeth extractions in comparison to conventional forceps.

MATERIALS AND METHODS

A randomized clinical trial was conducted in the Department of Oral and Maxillofacial Surgery/ College of Dentistry/ University of Baghdad, 14 patients from whom a total of 28 mandibular teeth were selected; have met the inclusion, were subjected to this study, after obtaining the patients' verbal consents for the surgical procedure, the samples were assigned randomly into two groups according to the computer based randomization software provided through the following link ***(http:/www.raphpad.com/quickcalcs/randomize2/)***, into control group (A) and study group (B). All the extractions were done by the same dentists.

Group A subjected to extraction using conventional forceps (martin, 40-633-09, Germany), and group B subjected to extraction using Golden Misch physics forceps (GMX 200-lower universal, 031015, USA). All patients were anesthetized with 2.2% lidocaine with 1:100000 adrenaline local anesthesia (Septodont, France).

Inclusion criteria:

- Single rooted mandibular teeth from right 2nd to left 2nd premolar.
- Engagable mandibular teeth with or without crowns.

Exclusion criteria:

- Maxillary teeth.
- Mandibular 6th, 7th, 8th molars.
- Teeth with more than grade I mobility.
- Any condition affecting bone density and/or quality like (Osteoporosis, patients on anti-resorptive medications such as bisphosphonates etc).
- Head and neck radiotherapy.

The following parameters were assessed for both groups:

- Duration of extraction.
- The incidence of crown fracture.
- The incidence of root fracture.
- The incidence of labial/buccal alveolar bone fracture.
- The incidence of Gingival tears.

The surgical procedure:

1. Surgical preparations and draping.
2. Local anesthetic injecting of 2% lidocaine with 1:100000 adrenaline using:
   - ✓ Mental n. block technique for the lower 1st, 2nd premolars, lower incisors and canines with lingual n. infiltration.
3. Separation of the attachment of the periodontal and attaching gingival soft tissues using a dental explorer.
4. Extraction:
   A. Conventional forceps (Group A): Tooth extraction is performed in the conventional matter described by the well known letirature.
   B. Physics forceps (Group B): The forceps was positioned with the beak on the lingual root of the tooth and into the gingival sulcus. The bumper was placed on the facial aspect of the dental alveolus at the mucogingival junction. The non-extracting hand of the dentist was placed to support the mandible. No squeezing pressure was applied to the handles or to the tooth and the handles were rotated as one unit for a few degrees. Once the tooth disengaged from the socket, it was delivered using either a tweezer or a root forceps.

Data collection:

- ✓ Time was recorded by a colleague for both groups, where for (group A) it has been registered from the moment of forceps placement till the tooth extracted (pulled) out of the patient's mouth. Whereas for (group B) it has been registered at two time intervals, the 1st was from the moment of forceps placement till the snap motion of the tooth (which is considered the real extraction) and the 2nd time interval represent the time needed to pull the tooth out of the patient's oral cavity by a tweezer or a root forceps.
- ✓ After completion of the extraction, the tooth was examined for any fracture of the crown and/or roots.
- ✓ The buccal cortical plate integrity was assessed by manual palpation along the socket externally and also by running a dental explorer on the lingual aspect of the buccal plate from inside the socket in all direction (from apical to occlusal & from mesial to distal) to check for discontinuity of bone.
- ✓ The gingival tear was assessed by inspection. The data were recorded on the fore mentioned case sheet.

Statistical analysis:

The statistical analyses were performed using a computer controlled program SPSS version 21. Statistical tests adopted for this study and their abnormally distributed sample were: chi square F.E.P.T (Fissure Exact Probability Test), Cliff's

test, Wilcoxon W and Independent sample Mann-Whitney U test.

RESULTS

The sample of the current study consisted of 14 patients (8 males and 4 females) with age range (16-65) years old, mean age 40.714 years, SD= 18.05 (table -1), from whom 28 teeth (lower mandibular single rooted) were extracted (N=28) and randomly assigned into two groups: control group A (n=14) and study group B (n=14).

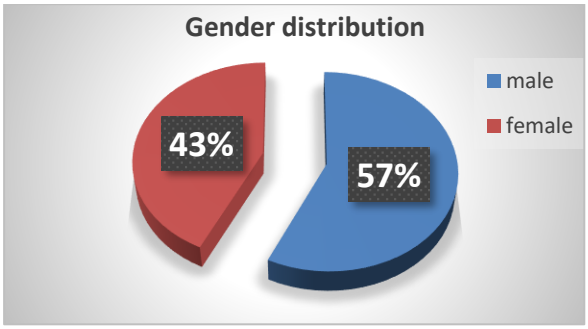

Figure 1: Showing Gender Distribution of the sample patients.

Table 1: Distribution of subjects by age and gender.

Variables		NO.	%	Total%
Age (Year)	<=30	5	35.7	100%
	30.1+	9	64.3	
Gender	Male	8	57.1	100%
	Female	6	42.9	

Distribution of tooth type by the group and total sample:

The dental sample selected according to the inclusion criteria was the mandibular single rooted teeth from mandibular left 2nd premolar to mandibular right 2nd premolar (tooth No. 20-29), with total sample no. N=28, and 14 teeth in each group. (Table-2) showing the distribution of each tooth type (number) in terms of frequency of extraction; and what percentage value representation to its group and to the total sample.

Table 2: Distribution of tooth type by the group and in the total sample.

Tooth	Group						Total		
	Control A			Study B					
	NO.	%	%T	NO.	%	%T	NO.	%	%T
20	0	.00	.00	1	7.14	3.57	1	3.57	3.57
21	3	21.43	10.71	4	28.57	14.29	7	25.00	25.00
22	2	14.29	7.14	1	7.14	3.57	3	10.71	10.71
23	2	14.29	7.14	1	7.14	3.57	3	10.71	10.71
24	1	7.14	3.57	1	7.14	3.57	2	7.14	7.14
25	2	14.29	7.14	0	.00	.00	2	7.14	7.14
27	0	.00	.00	3	21.43	10.71	3	10.71	10.71
28	2	14.29	7.14	2	14.29	7.14	4	14.29	14.29
29	2	14.29	7.14	1	7.14	3.57	3	10.71	10.71

The most commonly extracted tooth was tooth No.21 (mandibular left 1st premolar). In control group, it was encountered 3 times (21.43% of teeth in group A) and in study group 4 times (28.57% of teeth in group B) which made it account for 25% of the totally extracted teeth in this sample.

The least commonly extracted tooth was tooth No. 27 (mandibular right canine) in group A and tooth No. 25 (mandibular right central incisor) in group B. whereas the overall least extracted teeth were teeth No. 24 &25 (7.14%) of the total sample.

Distribution of tooth condition by groups and in the total sample:

Carious teeth registered the highest frequency of extractions when based on tooth condition, 12 teeth (42.86%) out of 28 teeth were carious.

Sound teeth condition, on the other hand, represents 32.14% (9 teeth) of the total sample which were extracted for space claiming by orthodontists.

Table 3: Distribution of tooth condition by groups and in the total sample.

Tooth condition	Control			Study			Total		
	No.	%	%T	No.	%	%T	No.	%	%T
Carious	7	50.00	25.00	5	35.71	17.86	12	42.86	42.86
Carious+ Mobile	1	7.14	3.57	4	28.57	14.29	5	17.86	17.86
Sound	4	28.57	14.29	5	35.71	17.86	9	32.14	32.14
Sound +Mobile	2	14.29	7.14	0	.00	.00	2	7.14	7.14

Association between intra-operative complications (parameters) and groups:

F.E.P.T. of Chi square test was used to measure the association and the statistical significance between each of the below-listed parameter (table-4) in their respective group.

The buccal bone fracture showed no difference between both groups with ***(F.E.P.T=4.667, P-value = 0.098).*** Although it has no statistical significance, it is worth noting that the incidence of buccal bone fracture occurred 4 times (28.57%) in group A while there was zero occurrence in the study group.

There was no statistical significance ***(F.E.P.T=3.360, P-value=0.222)*** between both groups in regard to crown fracture, where 3 crown fractures (21.43%) was registered in group A versus zero (0.00%) incidence in group B.

Gingival tear, however, was highly significant statistically ***(F.E.P.T=9.333 P-value=0.006)*** between the two groups. Where half (50.00%) of the control group subjects (7 subjects) showed gingival tear incidence in group A; and zero (0.00%) occurrence in group B.

No difference was found between both groups considering root fracture, as the ***(F.E.P.T=1.037, P-value= 1.00)*** which means there was no statistical significance between group A &B (Figure 2).

Table 4: Association between intra-operative complications and groups.

Intra-operative complications	Categories	Group						Total		
		Control A			Study B					
		NO.	%	% 50	NO.	%	% 50	NO.	%	% 100
Buccal bone fracture	No	10	71.43	35.71	14	100.00	50.00	24	85.71	96.43
	Yes	4	28.57	14.29	0	.00	.00	4	14.29	14.29
		F.E.P.T=4.667, P-value=0.098(NS).								
Crown fracture	No	11	78.57	39.29	14	100.00	50.00	25	89.29	89.29
	Yes	3	21.43	10.71	0	.00	.00	3	10.71	10.71
		F.E.P.T=3.360,P-value=0.222 (NS)								
Gingival Tearing	No	7	50.00	25.00	14	100.00	50.00	21	75.00	75.00
	Yes	7	50.00	25.00	0	.00	.00	7	25.00	25.00
		F.E.P.T=9.333,P-value=**0.006 (HS)**								
Root fracture	No	14	100.00	50.00	13	92.86	46.43	27	96.43	96.43
	Yes	0	.00	.00	1	7.14	3.57	1	3.57	3.57
		F.E.P.T=1.037,P-value=1.00(NS)								

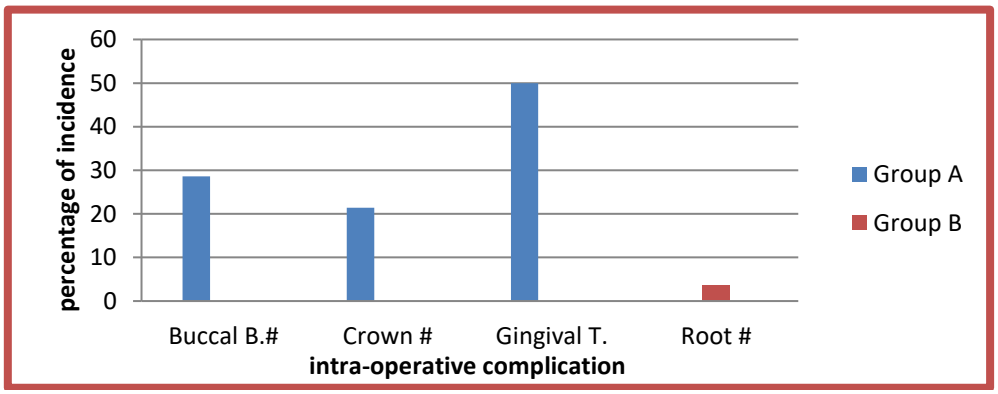

Figure 2: Histogram showing the percentage of all parameters except time comparing both groups

Descriptive and Statistical Test of Time of Extraction between Groups:

Cliff's test method 1997 in Rallfan v-33 was used to assess the statistical relation of time needed for extraction between the two groups.

The test showed a statistical significance **(P-value=0.011)** in favor of group B where the mean time needed for extraction using the physics forceps was 0.38 min. (minutes) and (SD= 0.29 min.), while the mean time for extracting a tooth using the conventional extraction forceps was 3.97 min. (SD=7.60 min.), (figure 3).

The test also found that about 78% of all the teeth extracted by physics forceps needed less time in comparison to those of group A which was faster to extract in about 22% of the cases only, table (5).

Table 5: Descriptive and statistical test of time between groups.

Group	Min.	Max.	Mean	±SD	Median	P-value (Cliff's test)	P(X<Y)	P(X>Y)	P(X=Y)
Control A (X)	0.200	26.490	3.971	7.600	0.990	0.011(Sig.)	0.209	0.776	0.015
Study B (Y)	0.010	1.000	0.385	0.298	0.275				
Total	.010	26.490	2.178	5.585	0.430				

Cliff's Method 1997 built-in in Rallfan v-33

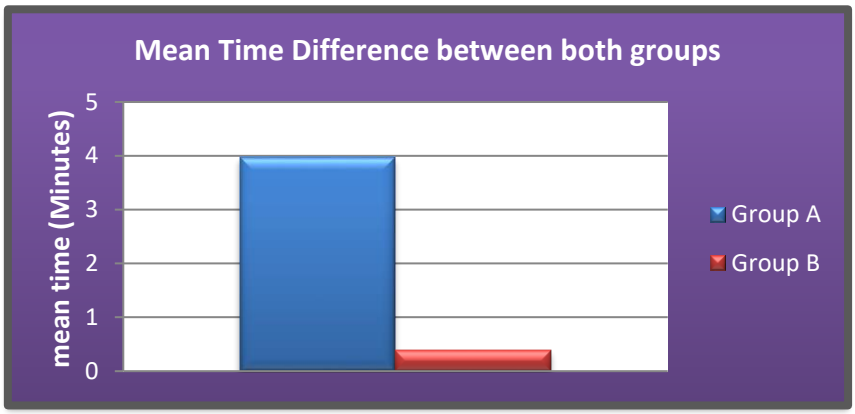

Figure 3: Showing means of time needed for extraction between group A &B.

The data was abnormally which necessitate the use of Mann-Whitney U test for the proper graphic representation of these data as shown in (figure 4) where time is measured in minutes.

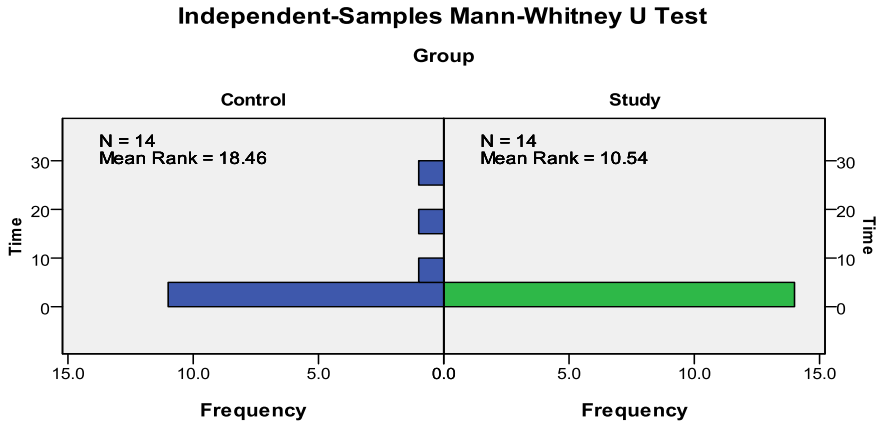

Figure 4: Mann-Whitney U test showing the distribution of no. of teeth extracted (frequency) and the time needed for most of cases measured in min.

Association between tooth condition and time:

The condition of the teeth that were extracted showed no difference in relation to the time of extraction, as shown in (table -6), where the ***(F.E.P.T.=0.686, P-value=1.000)*** which means there is no statistical significance between the condition of the tooth and the time needed for extraction. That's being said, the **sound** teeth took a longer time on average for group A when compared to the time needed for extraction of sound teeth in group B.

Table 6: Association between tooth condition and time.

Tooth condition	Time distribution						F.E.P.T	P-value	Total		
	<=0.340			0.341+							
	NO.	%	% T	NO.	%	% T			NO.	%	% T
Carious	6	42.86	21.43	6	42.86	21.43	0.686	1.000 NS	12	42.86	42.86
Carious+ Mobile	3	21.43	10.71	2	14.29	7.14			5	17.86	17.86
Sound*	4	28.57	14.29	5	35.71	17.86			9	32.14	32.14
Sound+ Mobile	1	7.14	3.57	1	7.14	3.57			2	7.14	7.14

* Mean time of sound teeth extracted via physics forceps was 0.47 min., while the mean time of sound teeth extracted via conventional forceps was 1.085 min.

DISCUSSION

The traditional method of extraction aims to a traumatically loosen and dislodge the tooth without damaging the alveolar bone or supporting tissue. However; It often result in damage ranging from mild gingival tissue laceration to complete loss of the buccal bony plate and interdentally bone crest [7].

The physics forceps which was developed by Golden Misch in 2004, uses the biomechanical advantages of a first class lever, creep and stress distribution without the squeezing, grasping, twisting and pulling forces which make this dental extraction device more efficient [8].

The use of this forceps as a lever type 1 however, made the researcher wonder about the tissues under the fulcrum area and whether the gingival tissues have sustained damage or not?, since this study did not measure any post-operative complications and/or follow up, therefore, the preservation of tissue integrity under the fulcrum of the forceps might be attributed to four main factors from the author's proposed point of view: (Compression versus shear and tensile force) where Materials, in general, are weakest to shear forces and strongest to compressive loads [9]. So when a rotating force is applied to the Physics forceps on a tooth, the stress to the tooth and the periodontal complex is a shear component of force lingually, while the force applied to the gingiva and bone by the bumper is a compressive force. (Greater surface area) the wide area of the bumper (17*7.5*8 mm.) helped to distribute the force applied to the gingiva over a larger surface area (even in the corner of the mandible such as a canine extraction) which reduced the pressure per unit area on the oral mucosa. In addition to the silicon cover of the bumper which provided a cushioning effect interphase between the rigid metal bumper and oral mucosa (although the exact composition of the silicon cover had not released by the manufacturer). Finally, a faster extraction time (as shown by results) meant that the tissues were subjected to compression for a relatively short time which would not result in ischemia and necrosis later on. Thus, those factors might provide a sensible explanation for the soft tissue trauma-free nature of the physics forceps.

Dym and Weiss **[10]** stated that, "there is no need to raise a mucoperiosteal flap or use an elevator before attempting extraction with the physics forceps. This is a major advantage, particularly in cases that require atraumatic extraction."

In the current study, it was found that the time required for extraction using the physics forceps was (mean 0.385 min.), which was significantly lesser as compared with that of conventional forceps (mean 3.971 min.), and that came in accordance with the results reported by Mandal S. et al. in his studies, where he found that the mean extraction time was 2.33 min. using the physics forceps and 3.94 min. using the conventional forceps [11]. In his other study, he found that the mean extraction time was 1.868 ±1.503 min. using physics forceps and 2.584±1.831 min. using conventional forceps [12].

Madathanapalli S. et al, in his comparative study, found that there was a significant difference pertaining to the time taken (P=0.006) [13]. Patel HS. et al, also reported that the physics forceps was more efficient in reducing operating time (mean time taken for extraction using Physics forceps was 58.8 sec. while that with conventional forceps was 88.33 sec.) [14]. Whereas Hariharan S. et al., did not find a significant difference in time taken [15].

Conservation of the buccal bone plate following tooth extraction is very important in recent era of Implantology, where more bone in implant bed means higher primary stability and a better osseointegration later on, let alone an enhanced soft tissue contour and more esthetic emergence profile [16]. Physics forceps was claimed to prevent the marginal bone loss by its developer Golden Misch [4].

This study assessed buccal bone fracture which occurred in 4 cases out of 14 (28.57%) using the conventional forceps, while (0.00%) incidence was registered using the physics forceps, even though the results was of no statistical significance (Probably due to small sample size n=28); it was worth noting that a sizable percentage of this complication was observed.

This came in agreement with Madathanapalli S. et al., in his comparative study. He found that there was no significant difference in buccal bone fracture. While our results disagreed with Al-Kenawy MH. et al. They found that buccal bone fracture occurred in 3 out of 100 cases (3%) using the physics forceps and in 7 out of 100 cases (7%) using the conventional forceps [17].

It also disagreed with Mandal S. et al. They found that buccal bone fracture occurred in 12 teeth out of 25 using the conventional forceps and 4 out of 25 using the physics forceps. The results showed that there was a significant difference (P=0.05) [11]. It also contradicted with Patel HS. et

al results (buccal bone fracture occurred in 2 teeth 4.76% using the physics forceps which was significantly lesser than with the conventional forceps) [(14)].

Crown fracture parameter results showed that there was no significant difference (21.43% using the conventional forceps and 0.00% using the physics forceps). This came in accordance with the results reported by Madathanapalli S. et al [13], while it disagreed with Al-Kenawy MH. et al. In his study, crown fracture occurred more frequently with the use of the conventional forceps (10%) and it occurred less frequently with the use of the physics forceps (3 %) [(17)].

There was no significant difference pertaining to root fracture (0.00% using the conventional forceps and 7.14% using the physics forceps). This came in accordance with Madathanapalli S. et al, and disagree with El-Kenawy MH. et al (8.5 % using the physics forceps and 16.6% using the conventional forceps), which could be because the sample included was restricted to mandibular single rooted teeth that logically represents a more predictably uneventful extraction.

As for the gingival tear, results showed that it was highly significant (0.00% using the physics forceps and 50% using the conventional forceps). This came in accordance with Mandal S. et al. In both of his studies, he found there was a significant difference (P=0.05) [11] and (P=0.032) [12]. While it disagreed with Madathanapalli S. et al [13].

Nine sound teeth (32.14%) were extracted using the physics forceps and this condition is of paramount importance; as the researcher suggests; because this condition exposes and discloses the full mechanical advantage potential that the physics forceps has to offer as claimed by the manufacturer.

Within the limitations of this study, it was concluded that:

- The physics forceps was easy to use compared to the other traditional instruments, it required significantly less force to extract teeth of comparable conditions and root configurations.
- The physics forceps provided significant less operating time.
- It maintains the integrity of gingiva and surrounding periodontium. So extractions using physics forceps are less invasive over conventional forceps and can be considered as a reliable method for extraction.
- Preserves the buccal bone and cortical plate from fracture which is an important factor for implant success and survival.

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المستخلص:

خلفية: يمثل قلع الاسنان واحداً من اكثر الاجراءات شيوعاً في طب الاسنان, وعادةً ماتكون عملية رضّية منتجةً تحطيم وفقدان مباشر للعظم السنخي والانسجة الرخوة المجاورة. وُصفَت العديد من الادوات لقلع الاسنان بطريقة غير رضّية مما يمنع او يقلل الضرر عن الانسجة ماحول سنية. احدى تلك الادوات المخترعة المقدمة للاستعمال في تقنيات قلع الاسنان هي الكلّاب الفيزيائي واللتي يدّعي مصنعوها توفير وسيلة فاعلة وكفؤ في قلع الاسنان دون ضرر كبير.

المواد وطريقة العمل: أُجريت دراسة سريرية عشوائية لمقارنة الكلّاب الفيزيائي بالكلّاب التقليدي لقلع (28) سن سفلي احادي الجذر، وقد تم قياس المعلمات التالية: حدوث كسر في التاج، الجذر، الصفيحة الشدقية السنخية، التمزق اللثوي والمدة الزمنية المطلوبة لإتمام القلع. وُزعت الحلات عشوائياً الى مجموعتين: مجموعة ضابطة (أ) ومجموعة تجريبية (ب). تم تحقيق العشوائية باستعمال برنامج حاسوبي متخصص للتوزيع العشوائي. أُخضعت المجموعة الضابطة للقلع باستعمال الكلّاب التقليدي في حين أُخضعت المجموعة التجريبية للقلع باستعمال الكلّاب الفيزيائي.

النتائج: أظهرت النتائج بأن الوقت اللازم للقلع باستعمال الكلّاب الفيزيائي (متوسط 0.385 دقيقة) كان اقل منه للمجموعة (أ) (متوسط 3.971 دقيقة) وذو دلالة احصائية (P=0.01). حدث كسر العظم السنخي الشدقي في 4 حالات من اصل 14 حالة (28.57%) باستعمال الكلاب التقليدي في حين لم تسجل اي حالة في المجموعة (ب). كسر التاج حدث في 3 حالات في المجموعة (أ) (21.43%) ولم تحدث في اي حالة في المجموعة (ب) (0.00%). كسر الجذر سُجل في حالة واحدة باستعمال الكلّاب الفيزيائي (3.57%) في حين لم تسجل اي حالة في المجموعة الضابطة. أما التمزق اللثوي فقد سُجل في 7 حالات في المجموعة (أ) (50.00%) ولم تسجل اي حالة في مجموعة الكلّاب الفيزيائي وكانت النتيجة ذات دلالة احصائية عالية (P=0.006).

الاستنتاجات: ان استعمال الكلّاب الفيزيائي حافظ على سلامة اللثة والانسجة المحيطة وبهذا فالقلع باستعمال الكلّاب الفيزيائي أقل اجتياحاً وضرراً مقارنةً بالكلّاب السني التقليدي ويمكن عدّها اداةً موثوقةً للقلع، كما ومكنّت اتمام القلع السني خلال وقتاً اجرائياً ضئيلاً مقارنةً بالكلّاب التقليدي.