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Research Article

Comparison Between Physics and Conventional Forceps in Changing Socket Configuration After Tooth Extraction

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Abstract

Aims: The present study aimed to evaluate physics forceps and conventional forceps with regard to their impact on dimensional changes of the tooth socket, specifically buccolingual and mesiodistal dimensional changes, immediately after tooth extraction.

Materials and Methods: A prospective randomized clinical study of 48 patients requiring posterior tooth extractions was undertaken. The patients were randomly divided into two equal groups: one group received extractions using conventional forceps, and the other group received extractions using physics forceps. Immediately after tooth extractions, the buccolingual and mesiodistal dimensional changes of the tooth sockets were measured using calibrated plastic rulers and were compared with the root trunk dimensional changes. Socket dimensional changes were calculated and statistically analyzed using an independent samples t-test with significance set at $P \leq 0.05$.

Results: The results of this study showed that the dimensional changes of the tooth sockets using conventional forceps were greater than those using physics forceps, specifically concerning buccolingual dimensional changes, which were 1.667 ± 0.916 mm for conventional forceps and 1.208 ± 0.414 mm for physics forceps, with a statistically significant difference of $P = 0.031$. On the other hand, there were no statistically significant differences in dimensional changes of tooth sockets using both forceps concerning mesiodistal dimensional changes, which were 0.729 ± 0.389 mm for conventional forceps and 0.750 ± 0.329 mm ($P = 0.842$). Root fractures were only recorded in the conventional forceps group, with no complications recorded for the extractions in both groups.

Conclusion: Physics forceps were associated with significantly lower buccalingual socket expansion compared to conventional forceps, implying better bone preservation. The changes in the mesiodistal direction were comparable for both extraction methods used. The physics forceps could be considered a better alternative for situations where alveolar bone preservation is critical, for example, in preparation for implant placement in the future.

Keywords: Atraumatic extraction; Buccolingual expansion; Conventional forceps; Physics forceps; Socket preservation.

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INTRODUCTION

One of the most common procedures in dental practice is tooth extraction, in which there are dramatic changes in the alveolar processes and shape (1). Although exodontia is considered a routine procedure, it can sometimes cause trauma to the bone and soft tissues due to improper techniques of tooth extraction. Hence, instead of considering exodontia simply as the removal of a tooth, it should be considered a procedure that helps in preserving the anatomical structures around the tooth, which is essential for proper function and rehabilitation (1,2).

Tooth Extractions have been practiced for thousands of years, with evidence showing that they were used as far back as 6000 B.C. The ancient practitioners used primitive techniques because they did not have modern equipment and techniques that could be used for extraction at that time (2). However, with time and the development of dentistry as a medical field, the application of appropriate biomechanical principles and instrumentation is essential in ensuring that extraction is done efficiently and safely. Failure to do so may result in a long and tedious procedure, increased trauma to the patient, and injury to the clinician (3).

Conventional extraction forceps are first-class levers, in which the handles are the long arm, the beaks are the short arm, and the hinge is the fulcrum. Although the force is magnified for tooth gripping, this system does not offer a mechanical advantage for tooth extraction and could be a contributing factor to the excessive stress on the alveolar bone and surrounding tissues (4).

Recent developments in dental instruments have focused on the idea of atraumatic tooth extraction, in which the main objective is to reduce tissue damage and maintain alveolar bone (5). Physics forceps are one of these developments, intended to make atraumatic tooth extraction possible by using a first-class lever system and controlled force delivery (6). The device has a beak placed on the palatolingual surface of the tooth and a buccal bumper that serves as a fulcrum at the mucogingival line. This "beak and bumper" system enables a gradual disruption of the periodontal ligament with minimal lateral forces and excessive socket expansion

(7). The unique feature of physics forceps is its capacity for continuous force delivery, which relies on the principle of mechanical advantage and the creep phenomenon. This ensures tooth extraction with minimal tissue trauma, providing a high degree of comfort for the patient (7). In contemporary dental practice, tooth extraction plays a critical role in complex treatment planning, particularly in implant dentistry and prosthetic rehabilitation. Three-dimensional bone architecture and soft tissue contours significantly influence treatment outcomes and long-term prognosis. Tooth extraction inevitably leads to alveolar bone resorption and gingival contour changes, which may complicate subsequent restorative procedures (8). Consequently, there is an increasing demand for extraction techniques that minimize damage to hard and soft tissues and preserve alveolar ridge morphology (1).

Tooth extraction is a significant procedure in modern dental practice, especially for complex dental procedures such as implant dentistry and prosthetic rehabilitation. The complex three-dimensional arrangement of the bones, as well as the soft tissues, affects dental procedures and the prognosis for dental restorations. Tooth extraction always causes resorption of the alveolar ridge, which affects dental restorative procedures (8). This necessitates the need for extraction procedures with minimal tissue destruction, as well as preservation of the alveolar ridge (1).

This study aimed to evaluate the efficacy of physics forceps in atraumatic tooth extraction, with a focus on the effect on the configuration of the tooth sockets. This was done by comparing the efficacy of physics forceps with conventional forceps, concerning buccolingual and mesiodistal dimensional changes immediately after tooth extraction.

MATERIALS AND METHODS

Study Design

A prospective randomized trial was carried out at the Department of Oral and Maxillofacial Surgery, Hawler Medical University, College of Dentistry, Erbil, Iraq. The trial was conducted over a period of five months, from October 1st, 2024, to

February 6th, 2025. A total of 48 patients who fulfilled the inclusion and exclusion criteria for the trial were consecutively included in the study.

Ethical approval for conducting this research was obtained from the Ethics and Research Committee, Hawler Medical University, College of Dentistry, Erbil, Iraq. This research was conducted in accordance with globally recognized standards for the protection of human subjects, which align with several important guidelines such as the Declaration of Helsinki, among other guidelines. Before the start of the trial, written informed consent was obtained from each participating patient.

Data were collected and analyzed to assess differences in mesiodistal and buccolingual dimensions of the extraction sockets immediately after extraction. Additionally, factors such as difficulty of extraction, complications, and patient-specific characteristics were recorded for a comprehensive evaluation.

Sample Collection

Patient Selection

- Participants were selected based on inclusion and exclusion criteria, ensuring suitability for extraction and standardization of systemic and local conditions.

Inclusion Criteria

- Adult patients requiring tooth extraction due to non-restorable dental caries, periodontal disease, failure of endodontic treatment or orthodontic reasons.
- No contraindications to tooth extraction.
- Sound crown structure.
- No elevators used during the extraction.
- Maxillary and mandibular posterior teeth (except 3rd molars)

Exclusion Criteria

- Patients with severe systemic conditions that contraindicate extraction.
- Badly decayed teeth not allowing proper grasp of the forceps; retained roots.
- 3rd molars.
- Maxillary and mandibular anterior teeth.

Randomization and Intervention

Participants were randomly assigned to two groups:

1. Physics Forceps Group: Extractions performed using the physics forceps technique, which applies a controlled and atraumatic rotational force (Figure 1).

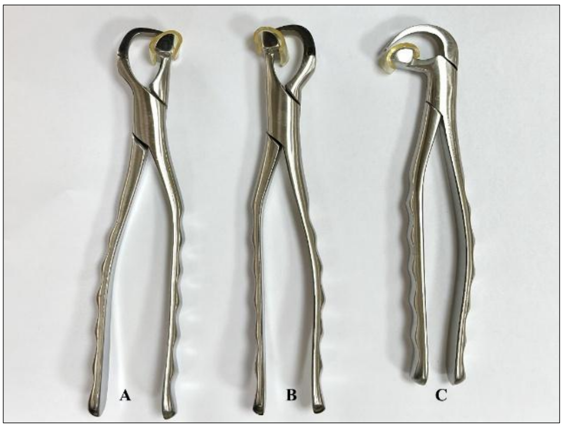

Figure 1: Physics forceps that were used in the study. A) Upper left physics forceps. B) Upper right physics forceps. C) Lower universal physics forceps.

2. Conventional Forceps Group: Extractions performed using conventional forceps, which rely on manual luxation and direct pulling force (Figure 2).
3. Preoperative radiograph (O.P.G.) (Figure 3).

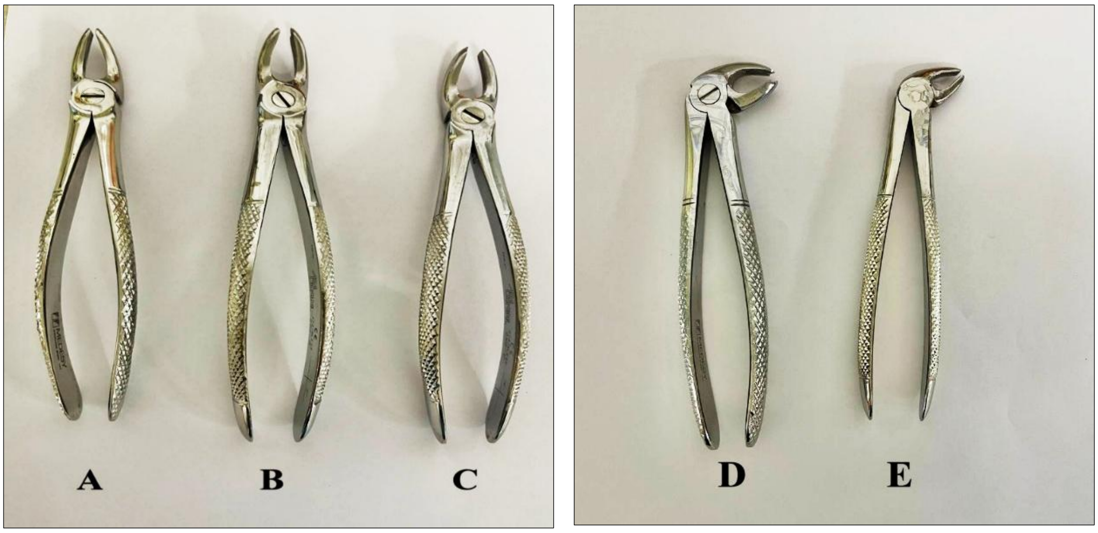

Figure 2: Conventional forceps that were used in the study. A) Maxillary premolar forceps. B) Maxillary left 1st, 2nd molar forceps. C) Maxillary right 1st, 2nd molar forceps. D) Mandibular 1st, 2nd molar forceps. E) Mandibular premolar forceps

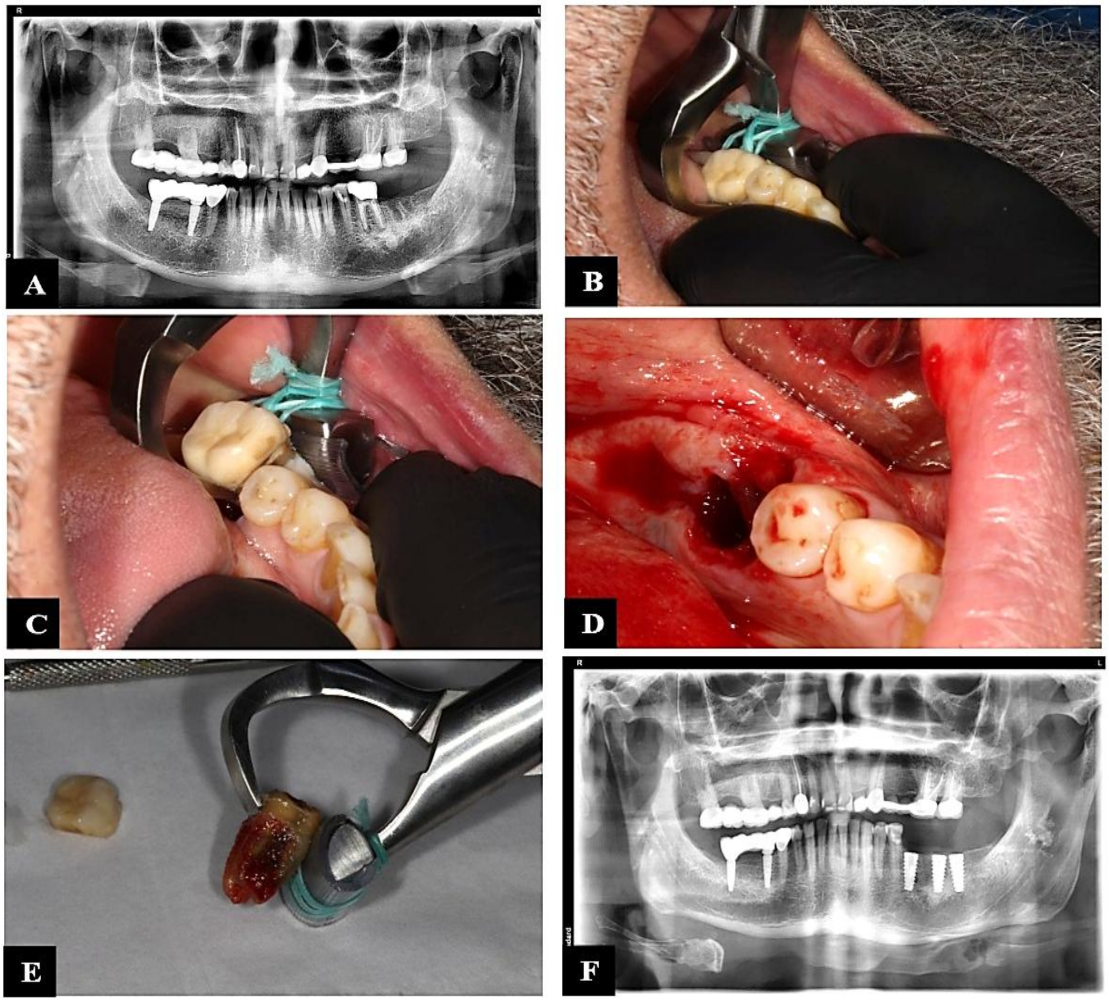

Figure 3: A) Preoperative radiograph (O.P.G.) of mandibular left 1st molar. B) The tooth grasped with physics forceps, with the beak inserted into the lingual gingival sulcus and bumper placed buccally near the mucogingival junction. C) Tooth luxated from the socket. D) Socket immediately after extraction. E) The tooth after extraction. F) Postoperative radiograph (O.P.G.) after implant placement.

Measurement of Socket and Root Dimensions

After tooth extraction, the socket was thoroughly dried using cotton. Trimmed plastic rulers with a calibrated length of 3 cm (Figure 4 A) carried into the socket using dental tweezers (Figure 4 B) were used to measure the following:

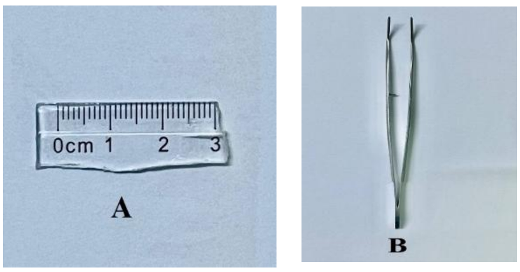

Figure 4: A) Plastic ruler trimmed to 3 cm in length. B) Dental tweezer

Socket Dimensions:

• Buccolingual Dimension: Measured as the maximum distance between the buccal and lingual/palatal socket walls (Figure 5).

• Mesiodistal Dimension: Measured as the maximum distance between the mesial and distal socket walls (Figure 5).

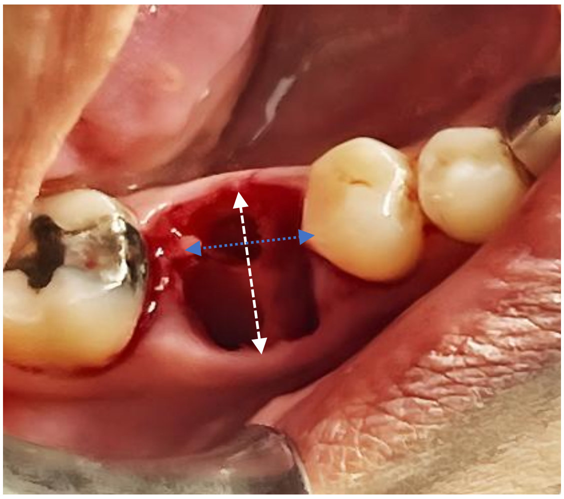

Figure 5: Socket dimensions after extraction by conventional forceps. The blue dashed arrow represents the mesiodistal dimension of the socket. The white dashed arrow represents the buccolingual dimension of the socket.

2. Root Trunk Dimensions:

• Measured at the widest diameter of the extracted root trunk both buccolingual (Figure 6 A) and mesiodistal (Figure 6 B) dimensions to compare with socket dimensions.

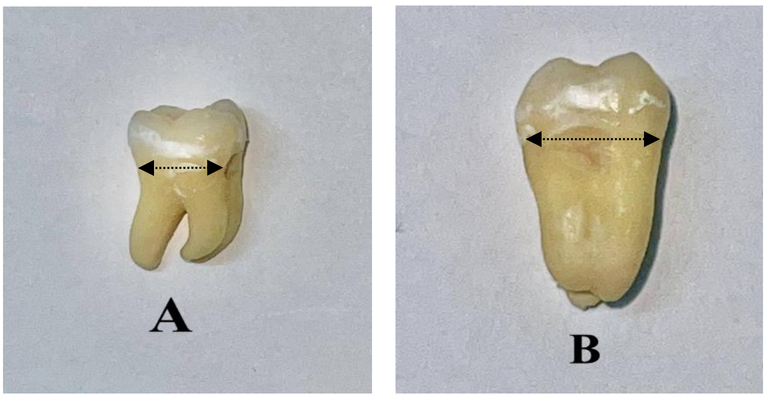

Figure 6: Extracted mandibular right 2nd molar by conventional forceps. A) Buccal view, the black dashed arrow represents the mesiodistal root trunk dimension. B) Mesial view, the black dashed arrow represents the buccolingual root trunk dimension.

All measurements were taken immediately after extraction to ensure consistency and avoid post-extraction dimensional changes due to natural healing. Measurements were recorded to the nearest millimeter.

Statistical Analysis

The statistical software Statistical Package for the Social Sciences (SPSS) version 29 was used for data entry and analysis. The difference in socket dimension was obtained through the following formulas (Δ Buccolingually = Socket Ø buccolingually after extraction – Tooth root trunk Ø buccolingually) and (Δ Mesiodistally = Socket Ø mesiodistally after extraction – Tooth root trunk Ø mesiodistally). An independent samples t-test was carried out to determine the statistical significance between the 2 forceps groups.

RESULTS

A total of 48 extractions were performed, with 19 extractions for female patients and 29 for male patients (Table 1). The extractions were evenly divided between the two methods, with 24 teeth extracted using conventional forceps and 24 using physics forceps, and all the patients were enrolled in the study randomly.

Table 1: Represents the sex and age distribution of patients in the study.

			Sex		Total
			Female	Male	
Forceps	Conventional	Count	10	14	24
		Percentage	52.6%	48.3%	50.0%
	Physics	Count	9	15	24
		Percentage	47.4%	51.7%	50.0%
	Total	Count	19	29	48
		Percentage	100.0%	100.0%	100.0%

The teeth were extracted using both forceps, clearly summarized in Figures 7 and **8.**

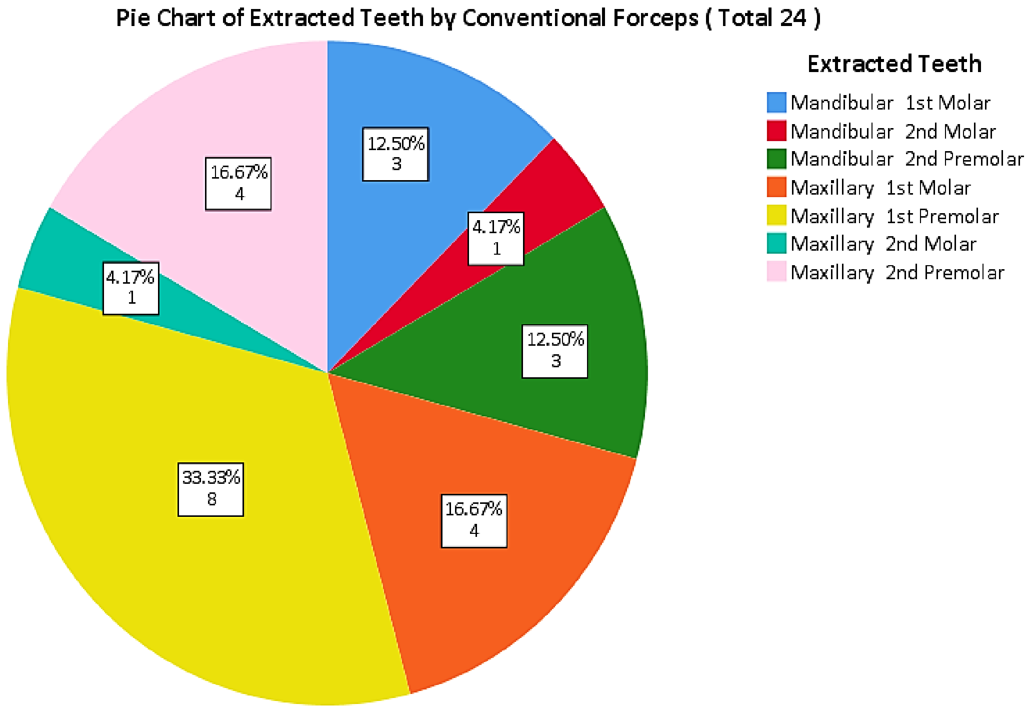

Figure 7: Pie chart that represents the count and percentage of teeth extracted by conventional forceps.

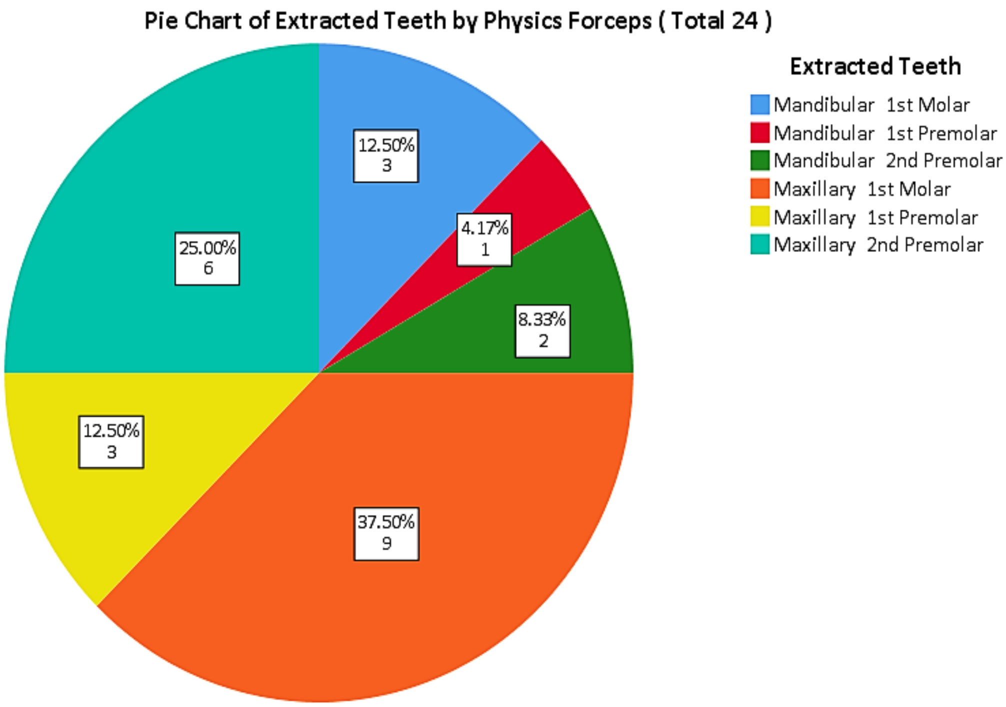

Figure 8: Pie chart that represents the count and percentage of teeth extracted by physics forceps.

Changes in Socket Dimensions

The difference in socket dimension was calculated using the following formulas:

- Δ Buccolingually = Socket Ø buccolingually after extraction – Tooth root trunk Ø buccolingually
- Buccolingual Expansion: Measurements taken after extraction revealed that the buccolingual width of the socket increased in all cases, but the extent of expansion varied between the two methods. The use of conventional forceps resulted in a greater increase in the widening of the socket, with some cases showing an increase of up to 3.5 mm. On the other hand, the use of physics forceps resulted in a smaller increase in socket widening, with the maximum recorded increase being 2.0 mm. The average buccolingual change recorded was 1.667 mm in the use of conventional forceps and 1.208 mm in the use of physics forceps (Table 2), indicating that the use of physics forceps may be beneficial in the preservation of bone structures in this area.
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Table 2: Counts of the calculated Δ buccolingual dimension for each forceps.

		Forceps		Total
		Conventional	Physics	
Δ (Buccolingually)	.5 mm	3	3	6
	1.0 mm	7	10	17
	1.5 mm	4	9	13
	2.0 mm	5	2	7
	2.5 mm	2	0	2
	3.5 mm	3	0	3
Total		24	24	48

The difference in socket dimension mesiodistally was calculated using the following formulas:

- Δ Mesiodistally = Socket Ø mesiodistally after extraction – Tooth root trunk Ø mesiodistally
- Mesiodistal Expansion: The mesiodistal width of the sock*et* also increased post-extraction, but the differences between the two extraction methods were minimal. Most cases (31 out of 48) exhibited a small increase of 0.5 mm, and the average

mesiodistal expansion was nearly identical for both methods—0.729 mm for conventional forceps and 0.750 mm for physics forceps (Table 3).

Table 3: Represents the count of the calculated Δ mesiodistal dimension for each forceps.

		Forceps		Total
		Conventional	Physics	
Δ (Mesiodistally)	.5 mm	17	14	31
	1.0 mm	3	8	11
	1.5 mm	4	2	6
Total		24	24	48

Table 4 shows the descriptive statistics of (buccolingual changes) and (mesiodistal changes) after tooth extraction for each forceps.

Table 4: Descriptive statistics of Δ (buccolingually) and Δ (mesiodistally) for each forceps.

	Forceps	N	Mean (mm)	Std. Deviation	Std. Error Mean
Δ (Buccolingually)	Conventional	24	1.667	.9168	.1871
	Physics	24	1.208	.4149	.0847
Δ (Mesiodistally)	Conventional	24	.729	.3895	.0795
	Physics	24	.750	.3297	.0673

The Shapiro-Wilk test was used to test the normality of the data to determine if the observed data follows a normal distribution or not. Results of the test show a (P-Value = 0.123) in the buccolingual dimension and in the mesiodistal dimension (P-Value = 0.138), which both indicate that the data are normally distributed (Table 5).

Table 5: Demonstrates the result of the Shapiro-Wilk test. The data are considered to have a normal distribution when (P-Value > 0.05).

Test of Normality	Shapiro-Wilk		
	Statistic	df	Sig.
Socket Ø after extraction (Buccolingually)	.962	48	.123
Socket Ø after extraction (Mesiodistally)	.978	48	.138

An independent samples t-test was conducted to determine the statistically significant difference between the two groups of forceps. The results show a significant difference in the buccolingual dimension of the socket (P-Value = 0.031) between conventional and physics forceps, while there is no significant difference in the mesiodistal dimension of the socket (P-Value = 0.842) between conventional and physics forceps (Table 6).

Table 6: Represents the result of the independent samples t-test. The mean difference between the two groups is significant when (P-Value ≤ 0.05).

Independent Samples Test

		t-test for Equality of Means		
		Std. Error Difference	95% Confidence Interval of the Difference	
			Lower	Upper
Δ (Buccolingually)	Equal variances assumed	.2054	.0449	.8718
	Equal variances not assumed	.2054	.0399	.8767
Δ (Mesiodistally)	Equal variances assumed	.1042	-.2305	.1888
	Equal variances not assumed	.1042	-.2307	.1890

The complications were evaluated for extraction cases using both forceps; Table 7 shows the details of complications.

Table 7: Complications during extractions using conventional and physics forceps.

		Forceps		Total
		Conventional	Physics	
Complication	Crown Fracture	1	2	3
	Root Fracture	4	0	4
	No Complication	19	22	41
	Total	24	24	48

DISCUSSION

Maintenance of the integrity of the alveolar socket following tooth extraction is a key factor that determines healing and future successful procedures for tooth restoration, especially dental implants. It has been established that tooth extraction results in dimensional changes in the alveolar ridge (1). The maximum resorption is usually in the horizontal direction or buccolingually (1,9,10,12). Thus, tooth extraction techniques that minimize damage to the surrounding bone are of considerable clinical significance. The present randomized clinical study was conducted to assess the effect of physics forceps as opposed to conventional forceps on immediate post-extraction socket configuration with reference to buccolingual and mesiodistal dimensions.

The outcome of this study showed a statistically significant decrease in buccolingual socket widening when physics forceps were employed compared to conventional forceps (P = 0.031). This outcome verifies the hypothesis that conventional extraction methods, relying on squeezing, rocking, and lateral force, may impose excessive lateral pressure on the alveolar bone, especially the buccal cortical plate. The buccal plate is usually thin and consists mostly of bundle bone, which is more prone to deformation and fracture during the extraction process (3,9). Therefore, the increased buccolingual widening in the conventional forceps group may be attributed to micro-fractures or elastic deformation of the alveolar walls due to uncontrolled lateral forces.

In contrast, physics forceps have been specifically designed to provide a constant and controlled force through a first-class lever system with a buccal bumper as a fulcrum and a tooth beak that contacts the lingual or palatal aspect of the tooth (7). The gradual disruption of the periodontal ligament is facilitated by the creep phenomenon as opposed to a sudden force (13,14). Misch and Perez stressed that a constant force over a long period results in fatigue and enzymatic disruption of the periodontal ligament, facilitating tooth removal with minimal lateral socket expansion (6). The marked difference in buccolingual dimensional change in the physics forceps group in our study is consistent with this mechanism and supports previous clinical studies that endorse the use of physics forceps as an atraumatic method for tooth removal (13,14). The mesiodistal socket expansion was not significantly different between the two techniques of tooth extraction (P = 0.842). Such results can be justified by the natural anatomical characteristics of the mesial and distal socket walls, which are usually thicker and more stable against deformation compared to the buccal plate. Several studies have demonstrated that dimensional changes following tooth extraction are usually confined to the buccolingual dimension, while changes in the mesiodistal dimension are minimal regardless of the technique used in the extraction procedure (10,18). Such results are in accordance with those of the current study.

Another interesting finding was that root fracture was present only in the conventional forceps group. Root fracture is a well-documented problem that can be caused by excessive gripping and rotational forces applied during extraction. This problem is most common in posterior teeth with multiple roots (3, 11). The lack of root fracture in the physics forceps group could be attributed to the gradual application of forces, which would minimize the concentration of stresses on the root surface and, therefore, minimize the chances of root fracture. While crown fracture was present in both groups, the low prevalence could imply that factors such as tooth structure and degree of destruction could be more important than the extraction method.

From a clinical perspective, the maintenance of buccolingual socket dimensions is a critical factor in the practice of implant dentistry (15,16,17). Resorption of the alveolar ridge after tooth extraction can result in the need for additional surgical procedures to augment the ridge, making the procedure more complex and expensive (1,13,18). Physics forceps can be seen to reduce the need for ridge preservation surgeries by minimizing buccolingual socket dimension. This is particularly critical in posterior regions.

Notwithstanding the positive findings, there are a number of limitations that must be considered. The measurement of socket size was performed using calibrated plastic rulers, which, although useful and easily replicable in a clinical environment, do not have the same degree of accuracy as three-dimensional imaging modalities such as cone beam computed tomography. Moreover, the measurements were recorded immediately post-extraction, and the long-term changes that occur with bone remodeling were not evaluated. It has been demonstrated in previous studies that considerable alveolar resorption persists during the healing phase post-extraction

(9,10). Hence, it would be advisable to conduct future studies that include radiographic evaluation and longer-term follow-up to evaluate whether the immediate socket preservation effect of physics forceps has a long-term impact on dimensional stability.

CONCLUSIONS

Within the limitations of the current study, it is possible to conclude that:

- Based on the prospective randomized clinical trial, the application of physics forceps resulted in significantly less buccolingual socket expansion compared to conventional forceps extraction of the posterior tooth. This shows the superiority of the physics forceps in the preservation of the alveolar bone when a controlled and continuous application of force is utilized compared to the conventional method of extraction.
- Based on the results of the study, physics forceps may be considered a reliable and atraumatic extraction method compared to the conventional extraction method, especially when the preservation of the alveolar bone is critical for the application of implant therapy. Physics forceps may be recommended for further studies to assess the long-term effect of the extraction method on the remodeling of the alveolar ridge and the success of the implant procedure.

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Authors' Contribution

The author Muhamadami HM designed the study, conducted the experiments, collected data, performed the data analysis, and wrote the manuscript.

Ethical statement: This study was reviewed and approved by the Research Ethics Committee of Hawler Medical University, College of Dentistry, Erbil, Iraq.

Conflict of interest

The author declares that there are no conflicts of interest regarding the publication of this manuscript.

Availability of data and materials: All data generated or analyzed during this study are included in this published article and its supplementary information files.

Declaration of Generative AI and AI-assisted technologies

We acknowledge the use of ChatGPT (OpenAI) to assist in language polishing and grammar correction of this manuscript. The intellectual content, data interpretation, and conclusions were entirely prepared and verified by the authors.

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مقارنة بين ملقط الفيزياء والملقط التقليدي في تغيير شكل تجويف السن بعد خلع الأسنان

هندرين محمد علي

قسم جراحة الفم والوجه والفكين، كلية طب الأسنان، جامعة هولير الطبية، أربيل، العراق

الملخص

الأهداف: الهدف من هذه الدراسة هو مقارنة الملاقط الفيزيائية والملاقط التقليدية من حيث تأثيرهما على شكل جوف القلع، مع التركيز على التغيرات البعدية الدهليزية اللسانية والأنسية الوحشية مباشرة بعد قلع السن. **المواد وطرائق العمل**: أُجريت دراسة سريرية عشوائية مستقبلية على 48 مريضًا بحاجة إلى قلع أسنان خلفية. قُسِّم المرضى عشوائيًا إلى مجموعتين: مجموعة القلع باستخدام الملاقط التقليدية (24 حالة) ومجموعة القلع باستخدام الملاقط الفيزيائية (24 حالة). بعد القلع مباشرة، تم قياس أبعاد الجوف الدهليزية اللسانية والأنسية الوحشية باستخدام مساطر بلاستيكية مدرجة، ومقارنتها بأبعاد جذع الجذر المقابل. حُللت التغيرات البعدية إحصائيًا باستخدام اختبار العينات المستقلة (Independent samples t-test) مع اعتماد مستوى دلالة. ($P \leq 0.05$) **النتائج**:أظهرت النتائج أن متوسط التوسع الدهليزي اللساني كان أعلى بشكل معنوي في مجموعة الملاقط التقليدية (1.667 ± 0.916 ملم) مقارنة بمجموعة الملاقط الفيزيائية (1.208 ± 0.414 ملم) مع قيمة دلالة .($P = 0.031$) في المقابل، لم يُلاحظ فرق ذو دلالة إحصائية في التوسع الأنسي الوحشي بين المجموعتين .($P = 0.842$) سُجلت كسور الجذور فقط في مجموعة الملاقط التقليدية، في حين أُجريت معظم حالات القلع في كلا المجموعتين دون مضاعفات. **الاستنتاجات**: تؤدي الملاقط الفيزيائية إلى توسع دهليزي لساني أقل مقارنة بالملاقط التقليدية، مما يدل على قدرة أفضل في المحافظة على العظم السنخي. لم تُظهر الطريقتان اختلافًا يُذكر في التغيرات الأنسية الوحشية. وعليه، يمكن اعتبار الملاقط الفيزيائية خيارًا مفضلاً في الحالات التي تتطلب المحافظة على العظم السنخي، خاصة عند التخطيط لزرع الأسنان مستقبلًا.

الكلمات المفتاحية: خلع غير رضّي؛ ملقط فيزيائي؛ ملقط تقليدي؛ الحفاظ على تجويف السن؛ توسع تجويف السن من الجهة الشفوية اللسانية