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RESEARCH ARTICLE

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Cone Beam Computed Tomography Analysis of Post Space in Bifurcated Premolars Using ParaPost and Peeso Reamer Drills

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Abstract:

Introduction: Core buildups are usually maintained by the usage of posts. Even so, in curved and narrow canals, such as bifurcated premolars, excessive dentin removal during post-space preparation can result in a vertical root fracture or perforation. In order to preserve root canal dentin during post-space preparation of bifurcated premolars, this study examined and analyzed the effects of two widely used drills: Peeso Reamer (Dentsply Maillefer, Ballaigues, Switzerland) and ParaPost (Coltene/Whaledent, Inc., Altstätten, Switzerland). We also examined the risks associated with using Cone-beam Computed Tomography (CBCT).

Methods: Three operators with varying levels of experience treated a total of 72 removed bifurcated premolars, dividing them into equal groups. The rotary ProFile system (Dentsply Sirona, Charlotte, NC) was utilized for root canal treatments, and gutta-percha size #30/0.4 was used for obturation. Peeso Reamer #2 and ParaPost #1 were then used to prepare the palatal canals. CBCT was used to assess the total mean intracanal spaces of 3 mm, 5 mm, and 7 mm that were measured both preoperatively and postoperatively. To compare the mean dentin thickness within the canal area across all groups, we used analysis of variance testing. We detected complications, like deviations or perforations, using mesiodistal periapical radiographs.

Results: When utilizing the Peeso Reamer, the mean dentin thickness (0.749 mm) was slightly more than when using the ParaPost (0.736 mm) with p=0.16. There was no significant difference in the mean dentin thickness of the canal area between the Peeso Reamer and the ParaPost drills. The Pesso Reamer drill had fewer complications since it matched the canal configuration, while the Parapost drill removed somewhat more dentin in the canal area. Only seven teeth with minimum deviation from the center of the canal during preparation were produced by the Peeso Reamer drill (20% of teeth having deviation), whereas twenty-one teeth had deviations (72.2% of teeth) and eight had furcal perforations generated by the ParaPost.

Conclusion: Within the limitations of our study, the Pesso Reamer drill caused little more dentin removal than the ParaPost drill. However, the Peeso Reamer had fewer risks and was safer to use in bifurcated premolars. The ParaPost drill is not recommended in bifurcated premolars due to the high risks of deviation and perforation because they have narrow canals. The selection of an appropriate drill for post-space use in bifurcated premolars is essential for successful patient outcomes.

Keywords: Canals, Deviation, Bifurcated premolars, Dentin , Pesso Reamer drill, ParaPost drill.

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1. INTRODUCTION

Posts are commonly utilized in dentistry as a means of retaining core build-up. Maintaining the original canal form with less intrusive procedures leads to better endodontic outcomes [1]. For various post sizes to be accessible, root canals must be enlarged by eliminating intra-radicular dentin obstruction [2]. On the other hand, extensive dentin removal from cervical preflaring may result in concavity perforation in the furcation zone, particularly in curved and narrow canals [3].

Premolars are the teeth most frequently linked to clinical issues and vertical root fractures due to their canals' anatomical structure and thin roots [4]. According to research conducted *in vitro* and clinical studies, the amount of intracanal residual dentin that persists after endodontic treatment directly correlates with the longevity of teeth repaired with posts [5] [6]. Blount *et al*. reported that premolars accounted for 60.4% of vertical fractures, incisors for 22.6% of vertical fractures, and molars for 13.2% of vertical fractures [7]. Mesiobuccal roots of maxillary teeth and mesial roots of mandibular molars and mandibular incisors are more prone to fracture than other teeth when they have flat or thin roots with small mesiodistal and oval diameters in the bucco-lingual direction [8]. According to Testori *et al*., premolars are the teeth with the highest frequency of vertical root fractures after endodontic therapy [9].

It is not necessary to remove more dentin during the post-preparation of the root canal as this can decrease fracture resistance, especially in premolars. Different rotary instruments have been developed in response to the demand for new tools that enable proper cervical preparation.

In this work, the ParaPost (brown) (Coltene/ Whaledent, Inc., Altstätten, Switzerland) size #1 and the Peeso Reamer (Dentsply Maillefer, Ballaigues, Switzerland) drill size #2 were used to measure the intracanal dentin removal in the roots of premolars after preparation. The instruments' designers believe that the application of nanotechnology strengthens the stainless steel and minimizes friction when the environment is dry. The diameters of the ParaPost drill size #1 (brown) and the stainless-steel size #2 Peeso Reamer are 0.90 mm, according to the manufacturer's specifications.

Using large diameters may increase the chance of a striping hole in the root canal by causing substantial dentin loss, specifically at the furcal aspect of the root canal [10]. The purpose of this study was to examine the impact of the two drills on the canal dentin during post-space preparation of bifurcated premolars using Cone-beam Computed Tomography (CBCT), because dentin inside the canals is critical for fracture resistance.

1.1. Objective

CBCT was applied to investigate and assess the benefits and drawbacks of two widely used drills (ParaPost #1 and Peeso Reamer #2) in the post-space preparation of bifurcated premolars concerning root canal dentin preservation.

2. MATERIALS AND METHODS

This study received ethics approval with number KACST, KSA: H-01-R069. A sample of seventy-two human premolars with two separated roots that were previously kept in 10% buffered formalin solution for no more than six weeks after being taken out of the tooth bank was chosen. At first, the roots were examined under a microscope to rule out teeth that had cracks. Each tooth was placed on a tray (Fig. **1**) containing a silicon rubber base (Zetaplus Putty C-Silicone Dental Impression Material, Zhermack GmbH, Marl, Germany).

Fig. (1). An example of how 24 pre-molars from one operator were seated in plastic trays using putty impression material.

One millimeter above the cementoenamel junction, the crowns of the teeth were sectioned. Weine's 1982 approach was used to calculate the curvature angle of the roots using a digital radiograph with mesial angulation [11]. Teeth that deviated from the canal's center by more than five degrees were excluded. Using an identical rotary file system (ProFile), root canal treatment was performed on all teeth. A patency K-file size #15 (Dentsply Sirona, Charlotte, NC) was passively inserted into the canal until it was visible from the apical foramen. A working length of 0.5 mm was chosen. The palatal canal was obturated with a single cone, utilizing the same master cone (gutta-percha size #30/0.4) to ensure consistency. We selected the palatal canal because numerous studies have shown that the lingual root should be used and the buccal root should be avoided in multirooted premolars when a post is required [12]. The teeth were assigned randomly and categorized into three groups, A, B, and C. Each group was given a stainless steel Peeso Reamer drill size #2 and a ParaPost drill size #1 (brown color) for post-space preparation. An advanced restorative specialist male 36-year-old practitioner working in a public hospital with eleven years of experience prepared group A teeth. A 29-year-old male recent graduate working in a public hospital prepared group B teeth. A 40-year-old male prepared group C teeth with nine years of experience as a general dental practitioner in a private hospital.

CBCT was used to examine the extent of dentin removal within the canal area (Kodak 9000C 3D, Atlanta, GA, USA). To guarantee excellent image quality, three scans were performed at different kilovoltage peaks (kVps) at a constant milliampere (mA). Three scans were performed at various mAs at the kVp with the optimal value after the best kVp was chosen. The optimal readings of 60 kVp and 15 mA were attained. There was a 44.2-second exposure period. Both before and after post-space preparation, we carried out analyses. The intracanal space was measured using CBCTs in axial sections at 3 mm, 5 mm, and 7 mm apically. A single image was captured at every level of the cross-section, which was then magnified to 100%. The photos were modified using three-dimensional dental imaging software (CS 3D Imaging Software, Carestream Dental, Atlanta, GA). The start point for all measurements was 3 mm above the bifurcated area. Subsequently, the calibration tool within the imaging software was used to calculate the mean values of the distances bucco-lingually (B-L axis) and mesio-distally (M-D axis) resulting from the measurements at 3, 5, and 7 mm. The B-L axis was represented by the line connecting the M-D axis line perpendicular to each other within the canal lumen. (Figs. **2** and **3**). To calculate the canal area, the following equation was used:

$$\frac{\text{(The length of B-L axis) X (The length of M-D axis) X } \pi (3.14)}{2} = \text{A (mm}^2\text{)}$$

Mesiodistal periapical radiographs were collected following post-space preparation in order to detect any potential problems.

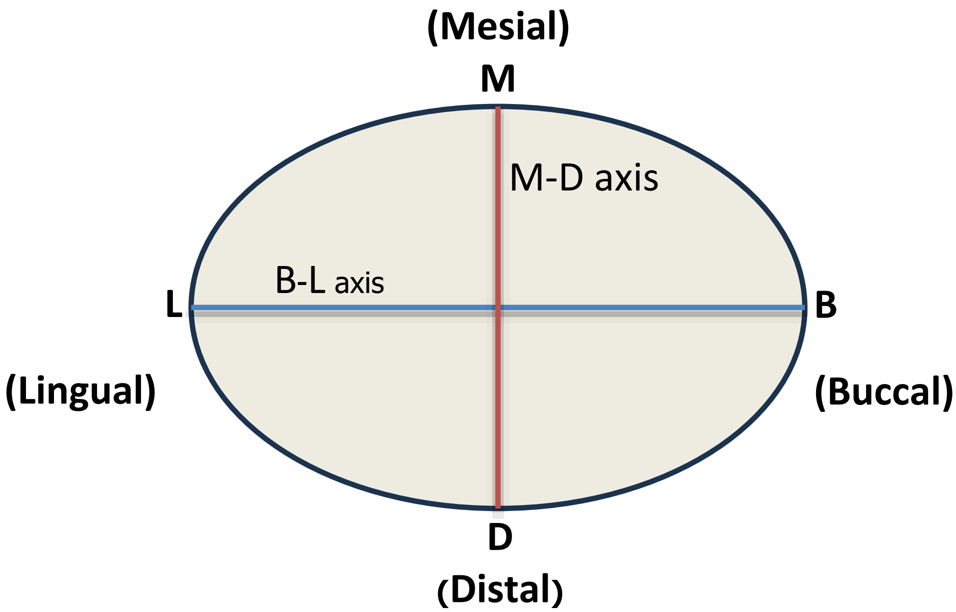

Fig. (2). Diagram representing a canal cross-section, where B-L = buccolingual direction, M-D = mesiodistal direction, and elliptic area represents canal. *(A)= { (B-L axis) X (M-D axis) X (3.14) } ÷2*

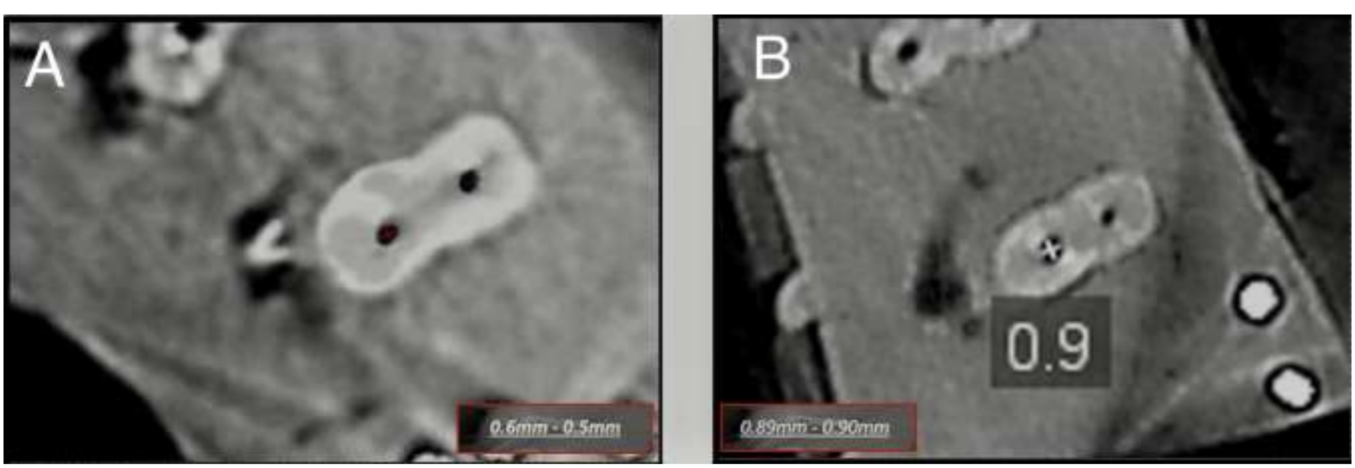

Fig. (3). Cone-beam computed tomography pictures before (**A**) and after (**B**) post space done using a peeso reamer #2 drill.

2.1. Statistical Analysis

A paired sample t-test was used to examine the drills' effects. P-values <0.05 were considered statistically significant. ANOVA analysis was used to compare the mean of intra-canal area among all groups. We determined the normality of the data distribution using Kolmogorov-Smirnov and Shapiro-Wilk test. We checked the normality of the three groups before and after the drilling.

An Independent sample t-test was used to determine the significant difference between the two types of drills. We used a paired-sample t-test to determine the effects of the type of drill used (preoperatively and postoperatively) on intracanal dentin removal.

3. RESULTS

Three dental practitioners handled a total of 72 bifurcated premolars with different experiences in dental treatment. After checking the normality of the three groups, it was obvious that the normality condition was satisfied since the significance value was greater than 0.05, as shown in Table 1.

Table 1. Comparison of mean intracanal area and standard deviations based on before and after post-space data.

Tests of Normality							
-	Drill Type	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
Groups		Statistic	df	Sig.	Statistic	df	Sig.
Preoperative A	Peeso	0.132	12	0.200*	0.961	12	0.802
	Para	0.195	12	0.200*	0.922	12	0.299
Postoperative A	Peeso	0.156	12	0.200*	0.967	12	0.874
	Para	0.135	12	0.200*	0.916	12	0.254
Preoperative B	Peeso	0.137	12	0.200*	0.985	12	0.996
	Para	0.157	12	0.200*	0.956	12	0.720
Postoperative B	Peeso	0.187	12	0.200*	0.946	12	0.576
	Para	0.150	12	0.200*	0.954	12	0.701
Preoperative C	Peeso	0.200	12	0.200*	0.961	12	0.793
	Para	0.136	12	0.200*	0.962	12	0.811
Postoperative C	Peeso	0.132	12	0.200*	0.977	12	0.969
	Para	0.097	12	0.200*	0.990	12	1.000

Abbreviations: df, degree of freedom; Sig, significance p-value.

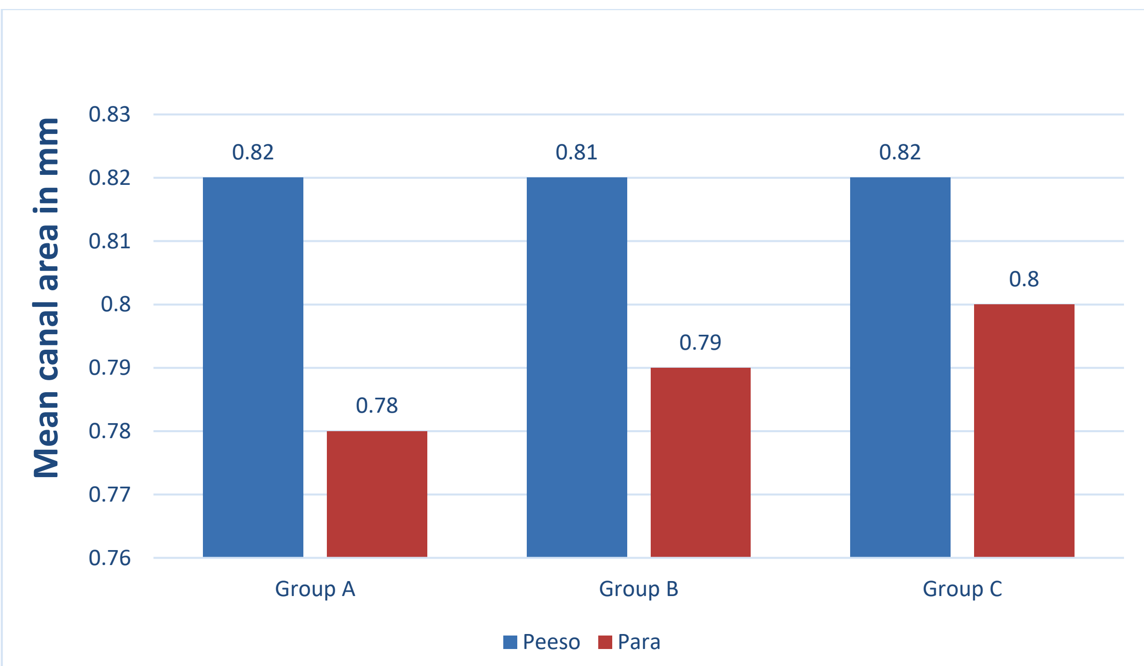

Fig. (4). Mean intracanal area between the groups after post-space.

Table 2. Comparison of mean intracanal area and standard deviations based on before and after drilling.

Drill Type		Period	Mean Canal Area (mm^2)	SD (mm)
Group A	**Peeso**	Before	0.61	0.044
		After	0.82	0.032
	Para	Before	0.62	0.043
		After	0.78	0.049
Group B	**Peeso**	Before	0.58	0.043
		After	0.81	0.042
	Para	Before	0.62	0.046
		After	0.79	0.042
Group C	**Peeso**	Before	0.62	0.051
		After	0.82	0.034
	Para	Before	0.60	0.047
		After	0.79	0.035

Abbreviation: SD, standard deviation.

Table 3. Comparison of the mean intra-canal area between the Peeso Reamer #2 and the ParaPost #1 drill.

Drill Type	Period	Mean Canal Area (mm)	Mean Difference	P-value
Peeso Reamer	Before	0.673	0.012	0.71
ParaPost		0.669		
Peeso Reamer	After	0.749	0.009	0.16
ParaPost		0.736		

We used the mean and standard deviation as descriptive measures for the intracanal area, as shown in Table **2** and Fig. (**4**).

$P<0.05$ was considered significant. The mean intra-canal area among the study groups was compared using ANOVA analysis.

Table **3** shows no significant difference in the mean of the intracanal area between the Peeso Reamer #2 and the ParaPost #1 ($p=0.16$).

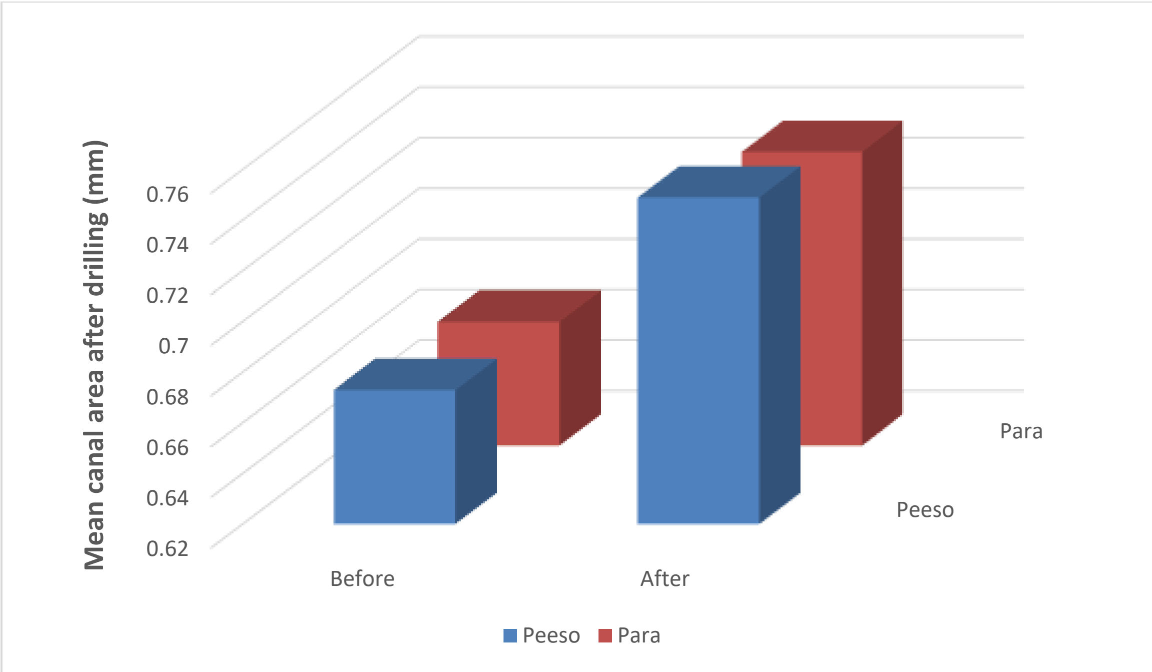

Fig. (5). Mean canal area before and after using Peeso and ParaPost drills.

The mean intracanal area when using the Peeso Reamer #2 (0.749 mm) was a little higher than when using the ParaPost #1 (0.736mm). There was no significant difference in the intracanal area before using the Peeso Reamer and ParaPost drill (p=0.71), and using the Peeso Reamer drill resulted in a little more dentin removal in the canal lumen compared to using the ParaPost drill (Fig. 5).

The advanced restorative specialist who prepared the teeth in group A achieved a significantly smaller mean intracanal area postoperatively than preoperatively with both types of drill ($p<0.05$; Table 4). The recently graduated resident who prepared the teeth in group B achieved a significantly larger mean intracanal area postoperatively than preoperatively with both types of drill ($p<0.05$; Table 5). The resident with nine years of experience who prepared the teeth in group C achieved a total significantly larger mean intracanal area postoperatively with both the ParaPost and the Peeso drill with preoperative thicknesses ($p<0.05$; Table 6).

Table 4. Group A comparison of the intracanal area using peeso reamer #2 and parapost #1 drill.

Drill Type	Period	Mean Canal Area (mm^2)	Mean Canal Area Difference	SD (mm)	95% CI	P-value
Peeso (before-after)	Before	0.6125	-0.20500	0.0550	(-0.2310, -0.1700)	p≤.05
	After	0.8175				
ParaPost (before-after)	Before	0.6250	-0.15750	0.0614	(-0.1965, -0.1185)	p≤.05
	After	0.7825				

Abbreviations: SD, standard deviation; CI, confidence interval.

Table 5. Group B comparison of the intracanal area using peeso reamer #2 and parapost #1 drill.

Drill Type	Period	Mean Canal Area (mm^2)	Mean Canal Area Difference	SD (mm)	95% CI	P-value
Peeso (before-after)	Before	0.5850	-0.23417	0.0558	(-0.2696, -0 .1987)	p≤.05
	After	0.8192				
Para (before-after)	Before	0.6192	-0.17250	0.0465	(-0.2021, -0.1429)	p≤.05
	After	0.7917				

Table 6. Group C comparison of the intracanal area using peeso reamer #2 and parapost #1 drill.

Drill Type	Period	Mean Canal Area (mm^2)	Mean Canal Area Difference	SD (mm)	95% CI	P-value
Peeso	Before	0.6167	-0.1992	0.0569	(-0.2354, -0.1629)	p≤.05
	After	0.8158				
Para	Before	0.6042	-0.1875	0.0379	(-0.2116, -0.1634)	p≤.05
	After	0.7917				

Table 7. Comparison of the intracanal area between peeso reamer#2 and parapost#1 drill.

Drill Type	Period	Mean Canal Area (mm^2)	Mean Difference	95% CI	P-value
Peeso Reamer	Before	0.67	-0.85	(-0.147, -0.005)	0.036
	After	0.75			
ParaPost	Before	0.67	-0.72	(-0.124, -0.010)	0.022
	After	0.74			

Abbreviations: SD, standard deviation; CI, confidence interval.

Table 8. Mean difference between the results of dental practitioners for the peeso reamer#2 and parapost #1.

Group	Peeso Reamer			ParaPost		
	Mean canal area (mm^2)	F-test	P-value	Mean Canal Area (mm^2)	F-test	P-value
A) Advanced restorative specialist	0.817	9.967	0.003	0. 782	8.963	0.006
B) Recently graduated resident	0.819	-	-	0.792	-	-
C) Resident with nine years of experience	0.816	-	-	0.792	-	-

It can be concluded from Tables **4**-**6** that the difference in the standard deviation is small, which indicates the standard deviation to be statistically very similar before and after the drilling.

We found a significant increase in the mean canal area after the operation than before when using the Peeso Reamer ($p \leq 0.036$) and ParaPost drill ($p \leq 0.022$) (Table **7**).

The changes in the mean canal area between groups A, B, and C were significant for the Preeso Reamer #2 ($p=0.003$) and ParaPost #1 drill ($p=0.006$) (Table **8**, Figs. (**6** and **7**).

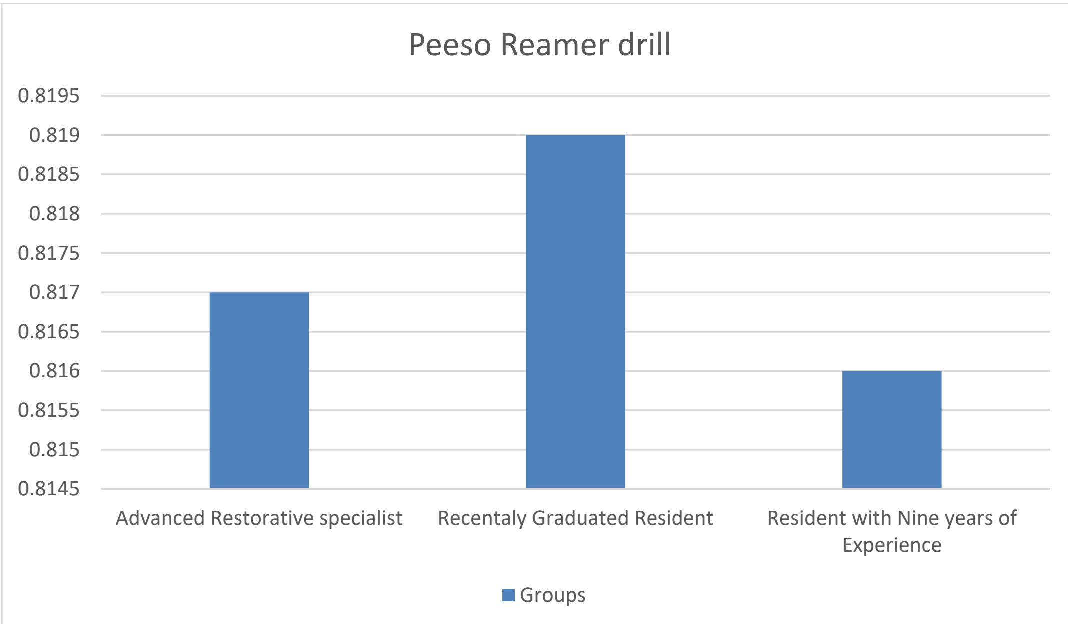

Fig. (6). Mean difference between dental practitioner groups for the peeso reamer #2 drill.

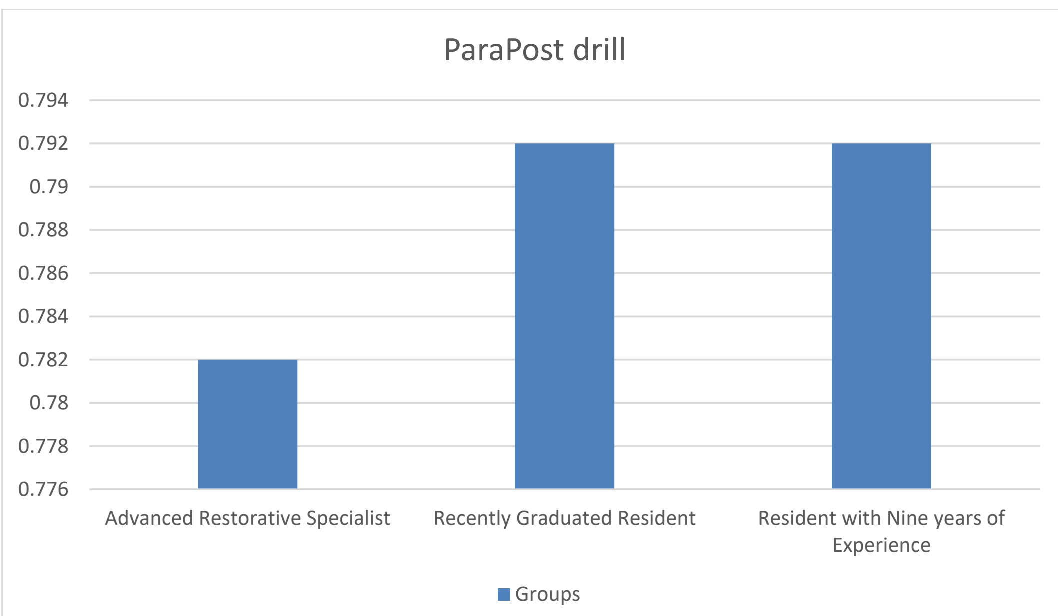

Fig. (7). Mean difference between dental practitioner groups for parapost #1 drill.

The correlation between drill type and complication has been obtained as a positive and moderate correlation, showing the drill type to affect the deviation, as illustrated in Table 9.

Table 9. The correlation (R) between the type of drilling and complications.

Model	R	R-square	Adjusted R square	Std. Error of the Estimate
1	0.653	0.427	0.419	1.469

Table 10. Association between drill type and complication crosstabulation for all groups.

-		Complication						Total
		None	Minute Deviation from the Canal Center	Slight Deviation from the Canal Center	Moderate Deviation from the Canal Center	Total Deviation from the Canal Center	Furcal Perforation	-
Drill type	Peeso	29	2	5	0	0	0	36
		80.6%	5.6%	13.9%	0.0%	0.0%	0.0%	100.0%
	Para	10	0	2	6	10	8	36
		27.8%	0.0%	5.6%	16.7%	27.8%	22.2%	100.0%
Total		39	2	7	6	10	8	72
		54.2%	2.8%	9.7%	8.3%	13.9%	11.1%	100.0%

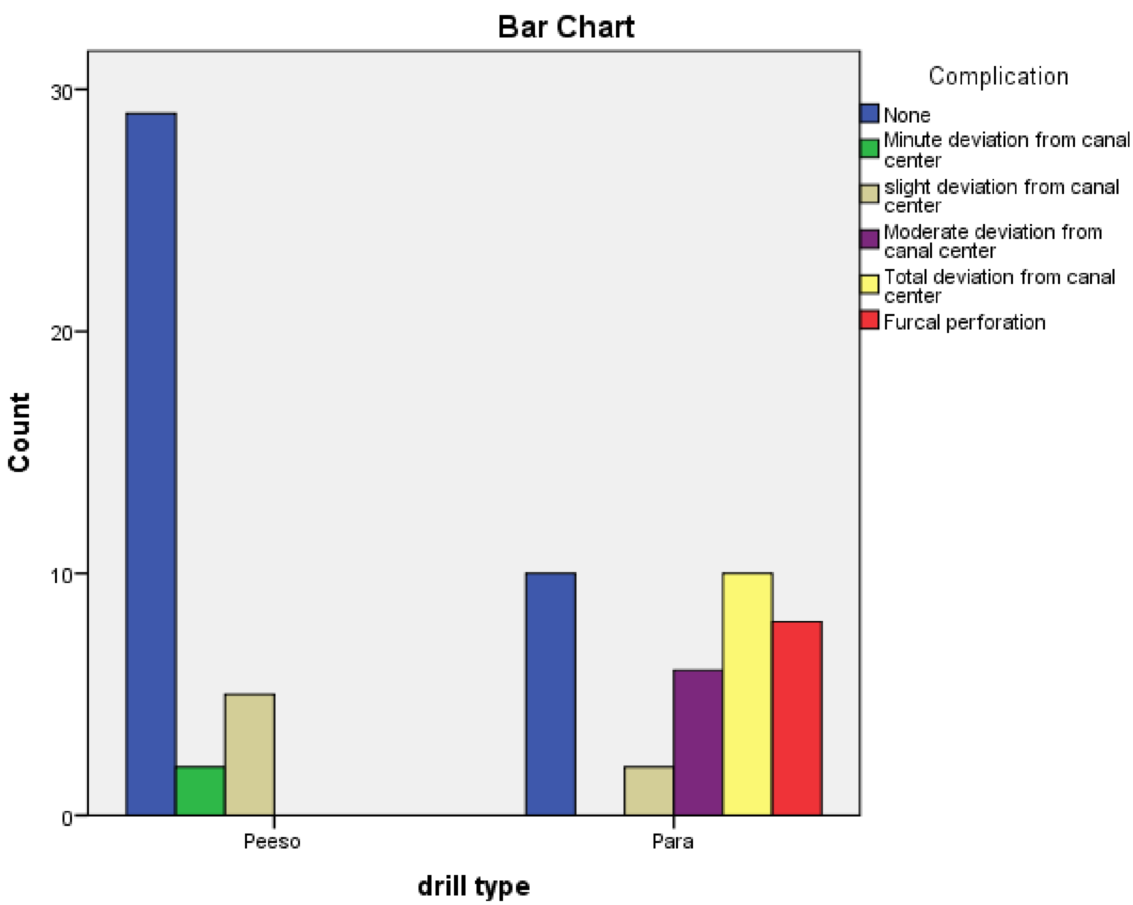

Fig. (8). Comparison between the Peeso Reamer #2 and the ParaPost #1 drill deviation degree for all groups.

The deviation from the center of the canal was classified into four categories, namely minute deviation, slight deviation, moderate deviation, and total deviation. We considered it minute if one-fourth of the post space shifted laterally from the center of the canal pathway. If two-fourths shifted, it was taken as a slight deviation. If three-quarters of the post space has shifted, it was observed to be a moderate deviation. Lastly, total deviation meant that the whole post space was away from the canal center pathway. It was considered important to test the association between the drill type and the complications for all groups using crosstabs, as shown in Table **10**.

From Table **10**, it can be concluded that the Peeso Reamer #2 proved to be better than the ParaPost #1 in drilling since using Peeso Reamer prevented 80% deviation, but using the ParaPost prevented only 27.8% deviation. The types of drilling *versus* the type of deviation are illustrated in Fig. (**8**).

The chi-square value of 0.000 less than 0.05 shows that the relationship between the drill type and deviation was statistically significant (Table **11**).

Twenty-one teeth showed various degrees of deviation from the center of the canal, and the ParaPost drill caused eight furcal perforations. The Peeso Reamer drill resulted in only seven teeth with minimal deviation from the center of the canal during the preparation (Tables **12**-**14**, and Fig. **9**).

Using the Pesso Reamer drill resulted in a little more dentin removal in the canal area during the post-space preparation than using the ParaPost drill. However, the Peeso Reamer had fewer complications because it followed the canal configuration. The ParaPost was associated with a higher risk of causing deviation or perforation than the Peeso Reamer drill (Fig. **9**).

Table 11. CHI square test for drilling types and deviation of the canal for all groups.

-	Value	Df	Asymp. sig. (2-sided)
Pearson Chi-square	36.542	5	0.000
Likelihood ratio	47.034	5	0.000
Linear-by-linear association	30.313	1	0.000
N of valid cases	72	-	-

Table 12. Group A preoperative and postoperative mean canal area and outcomes.

Tooth Number and Drill Type	Mean Canal Area (mm^2)		Complications (Perforations or Deviation)
	Preoperative	Postoperative	
Peeso Reamer 1	0.63	0.81	None
Peeso Reamer 2	0.61	0.84	None
Peeso Reamer 3	0.65	0.80	None
Peeso Reamer 4	0.59	0.78	None
Peeso Reamer 5	0.64	0.85	None
Peeso Reamer 6	0.59	0.77	None
Peeso Reamer 7	0.66	0.83	Minute deviation from the canal center
Peeso Reamer 8	0.54	0.81	None
Peeso Reamer 9	0.58	0.87	None
Peeso Reamer 10	0.55	0.82	None
Peeso Reamer 11	0.63	0.85	Slight deviation from the canal center
Peeso Reamer 12	0.68	0.78	None
ParaPost 1	0.59	0.79	None
ParaPost 2	0.67	0.82	Total deviation from the canal center
ParaPost 3	0.60	0.84	Total deviation from the canal center
ParaPost 4	0.59	0.77	Slight deviation from the canal center
ParaPost 5	0.57	0.78	Total deviation from the canal center
ParaPost 6	0.61	0.72	None
ParaPost 7	0.68	0.85	Moderate deviation from the canal center
ParaPost 8	0.64	0.82	None
ParaPost 9	0.68	0.72	Moderate deviation from the canal center
ParaPost 10	0.66	0.71	Total deviation from the canal center
ParaPost 11	0.56	0.75	None
ParaPost 12	0.65	0.82	Total deviation from the canal center

Table 13. Group B preoperative and postoperative mean canal area and outcomes.

Tooth Number and Drill Type	Mean Canal Area (mm^2)		Complications (Perforations or Deviation)
	Preoperative	Postoperative	
Peeso Reamer 1	0.60	0.85	None
Peeso Reamer 2	0.58	0.75	None
Peeso Reamer 3	0.57	0.85	Slight deviation from the canal center
Peeso Reamer 4	0.60	0.82	None
Peeso Reamer 5	0.51	0.83	None
Peeso Reamer 6	0.54	0.85	None
Peeso Reamer 7	0.63	0.79	None
Peeso Reamer 8	0.55	0.76	Slight deviation from the canal center
Peeso Reamer 9	0.55	0.78	None
Peeso Reamer 10	0.61	0.88	None
Peeso Reamer 11	0.66	0.81	Minute deviation from the canal center
Peeso Reamer 12	0.62	0.86	None
ParaPost 1	0.55	0.72	Furcal perforation
ParaPost 2	0.63	0.73	Total deviation from the canal center
ParaPost 3	0.70	0.82	Furcal perforation
ParaPost 4	0.62	0.81	Moderate deviation from the canal center
ParaPost 5	0.60	0.85	None
ParaPost 6	0.59	0.78	Furcal perforation
ParaPost 7	0.63	0.81	Total deviation from the canal center
ParaPost 8	0.56	0.79	Moderate deviation from the canal center
ParaPost 9	0.65	0.76	Furcal perforation
ParaPost 10	0.62	0.79	Total deviation from the canal center
ParaPost 11	0.59	0.80	Furcal perforation
ParaPost 12	0.69	0.84	Total deviation from the canal center

Table 14. Group C preoperative and postoperative mean canal area and outcomes.

Tooth Number and Drill Type	Mean Canal Area (mm^2)		Complications (Perforations or Deviation)
	Preoperative	Postoperative	
Peeso Reamer 1	0.59	0.83	None
Peeso Reamer 2	0.63	0.82	Slight deviation from the canal center
Peeso Reamer 3	0.56	0.79	None
Peeso Reamer 4	0.67	0.81	None
Peeso Reamer 5	0.64	0.88	None
Peeso Reamer 6	0.59	0.76	None
Peeso Reamer 7	0.66	0.84	None
Peeso Reamer 8	0.58	0.85	None
Peeso Reamer 9	0.53	0.83	None
Peeso Reamer 10	0.66	0.79	None
Peeso Reamer 11	0.59	0.77	Slight deviation from the canal center
Peeso Reamer 12	0.70	0.82	None
ParaPost 1	0.61	0.80	Furcal perforation
ParaPost 2	0.59	0.73	Total deviation from the canal center
ParaPost 3	0.69	0.82	Total deviation from the canal center
ParaPost 4	0.63	0.85	Slight deviation from the canal center
ParaPost 5	0.64	0.81	Moderate deviation from the canal center
ParaPost 6	0.56	0.76	None
ParaPost 7	0.62	0.80	Moderate deviation from the canal center
ParaPost 8	0.57	0.79	Furcal perforation
ParaPost 9	0.61	0.83	None
ParaPost 10	0.54	0.78	Total deviation from the canal center

(Table 14) contd.....

Tooth Number and Drill Type	Mean Canal Area (mm^2)		Complications (Perforations or Deviation)
	Preoperative	Postoperative	
ParaPost 11	0.64	0.77	Furcal perforation
ParaPost 12	0.55	0.76	Total deviation from the canal center

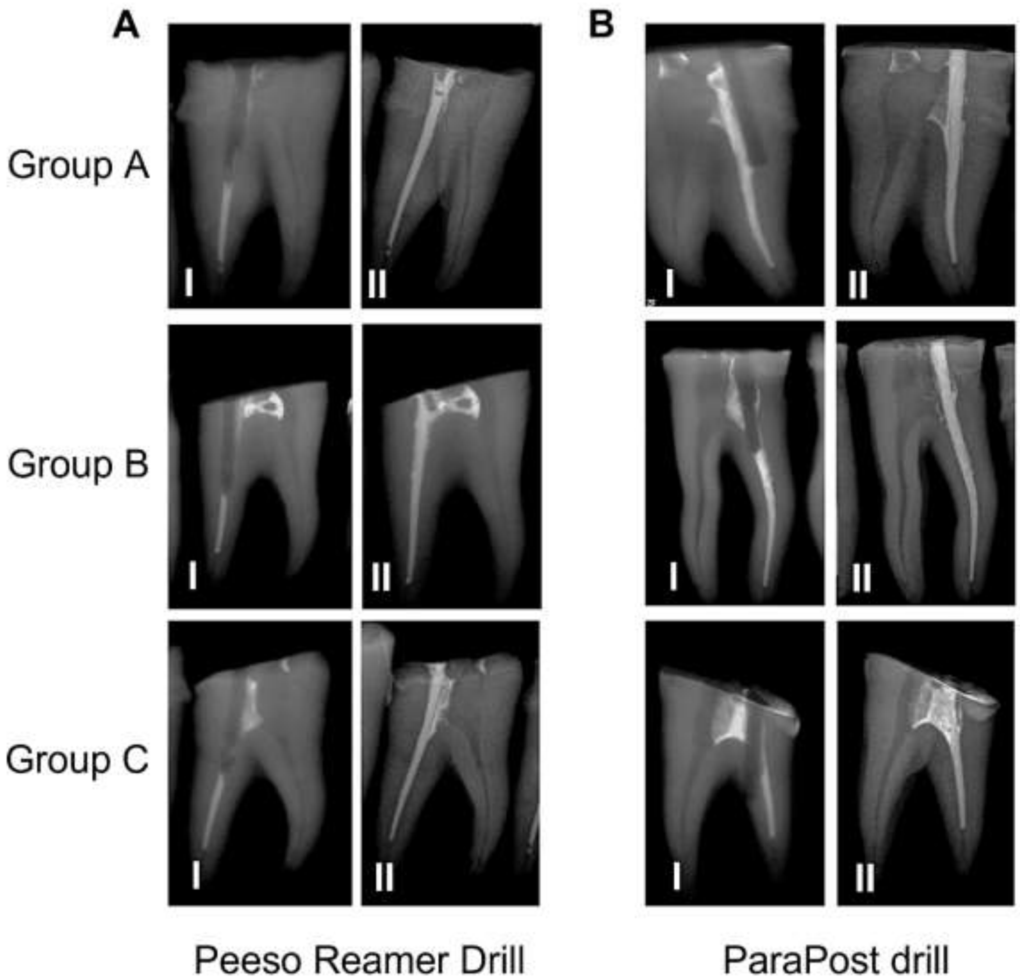

Fig. (9). Peeso Reamer drill (**A**) and ParaPost drill (**B**) preoperative (II) and postoperative (I) periapical radiographs from the mesiodistal view to reveal the complications.

4. DISCUSSION

The primary aim of this study was to develop a better understanding of how the selection of an appropriate drill for post-space use in bifurcated premolars is essential for successful patient outcomes. By preserving the intracanal dentin, we can maintain the integrity of the tooth structure and reduce the potential for further damage. Consequently, a crucial component of teeth's fracture resistance is dentin thickness. Premolars have a narrow canal and variable post-space configurations, making strip perforation during post-space preparation extremely risky [13]. The tooth wall's thickness directly correlates with a tooth's ability to tolerate lateral forces [14]. Trope *et al*. found that creating an access opening without a post space was more effective in strengthening endodontically treated teeth than creating a post space [15].

As a result of these factors, certain researchers have given a high priority to maintaining dentin, while others have shown that post-preparations need at least 1 mm of residual thickness [16]. A tooth may become weaker and develop root fractures as a result of an excessive or improper dentin removal procedure if the original canal is not followed [17]. Five drills were compared by Fisher *et al*. utilizing artificial roots rather than teeth that were taken from humans. They discovered that the ParaPost and Parkell's C-I drills (a system for amalgam and composite cores) exhibited the highest degree of deviation from the canal center, while the Peeso Reamer and Kurer drills demonstrated the least [18]. This is similar to our findings, as more deviations in our study occurred in canals prepared using the ParaPost drill. With the exception of Peeso Reamer and Kurer drills, Fisher *et al*. similarly observed a noticeably higher variation in preparation dimensions in the faciolingual surface compared to the mesiodistal directions [18].

Pilo and colleagues reported that using parallel-sided drills, like ParaPost, during post-space preparations endangers root integrity due to the risks involved during preparation [12], and our research has confirmed their findings.

Our method involved post-space preparation for all groups under standardized conditions to get more reliable results and then using CBCT imaging to measure the dentine thickness canal area without destroying the teeth by sectioning. This approach guaranteed no loss of intracanal dentin during the cutting of teeth, providing more accurate results, unlike the Muffle technique, which has certain drawbacks, including its invasive nature and its requirement of physically reassembling sections. In addition, it involves destructive sectioning of specimens, which is another limitation to consider [16, 19].

Hartmann *et al.* demonstrated the reliability of this method without the need for destructive sectioning of the specimens in their research [20]. Meanwhile, Ozgur Uyanik and his team found CT scans to enable simple measurement of canal changes and that they can reduce the risk of radiographic or photographic transfer errors [21].

The risk of root perforation increases when the drill is moved farther from the middle of a canal that has been properly endodontically treated. The radiograph presented in Fig. (**9**) illustrates how much more easily deviations can be noticed using the mesiodistal view than with the buccolingual view. It is crucial to understand the diameter and deviation linked to a specific drill type. Post-space preparation appears to depend on the root configuration, the operator, and the design of the cutting side of an instrument. Our experiment has demonstrated the operator's experience to be a significant factor, as evidenced by the results of group A, which had fewer complications compared to the other groups.

There are some limitations associated with our study as there is a lack of prior research studies on the same comparison of post-drills. Therefore, to provide stronger evidence for our findings, we need further studies that are similar in nature.

CONCLUSION

Within the limitations of our study, the Pesso Reamer drill caused a little more dentin removal than the ParaPost drill. However, the Peeso Reamer had fewer risks and was safer to use than the ParaPost drill in bifurcated premolars. Given their narrow canals and significant deviation and perforation risk, bifurcated premolars are not advised to be drilled using a ParaPost drill.

LIST OF ABBREVIATIONS

CBCT	=	Cone-beam Computed Tomography
kVps	=	kilovoltage peaks
mA	=	milliampere

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

This study received ethical approval with the number KACST, KSA: H-01-R069.

HUMAN AND ANIMAL RIGHTS

No animals were used in this research. All procedures performed in studies involving human participants were in accordance with the ethical standards of institutional and/or research committee, and with the 1975 Declaration of Helsinki, as revised in 2013.

CONSENT FOR PUBLICATION

Informed consent was obtained from all participants.

STANDARDS OF REPORTING

STROBE guidelines were followed.

AVAILABILITY OF DATA AND MATERIALS

The authors confirm that the data supporting the findings of this study are available within the article.

FUNDING

None.

CONFLICT OF INTEREST

The authors declare no conflict of interest, financial or otherwise.

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