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Sahar R. Almashad

Mohammed M. Khalefa

Maha A. Elhousiny

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# Measurement of Remaining Root Canal Filling Materials After Retreatment of Single-rooted Teeth Obturated With Two Techniques by Two Automated File Systems

Sahar R. Almashad<sup>a,\*</sup>, Mohammed M. Khalefa<sup>b</sup>, Maha A. Elhousiny<sup>b</sup>

<sup>a</sup> Dentist at Ministry of Health, Egypt

<sup>b</sup> Department of Endodontic, Faculty of Dental Medicine for Girls, Al-Azhar University, Cairo, Egypt

## Abstract

**Purpose:** The purpose of the study is to evaluate the efficacy of both XP-endo retreatment system versus Reciproc Blue file system in retreatment of single-rooted teeth obturated with single cone endodontic obturation technique and warm vertical compaction technique. **Patient and methods:** Thirty-two extracted single-rooted teeth were prepared with Pro-Taper universal rotary files till file #F3 and then were randomly divided into two equal groups: I and II (16 each) according to the type of obturation technique used with a bioceramic sealer (Neosealer) in both, group I: obturated with single cone technique and group II: obturated with warm vertical compaction technique. Obturated teeth were stored in saline solution 0.09% for 30 days then each group was sub-divided into subgroups: A and B (8 each) according to the type of the automated system used in the retreatment preparation XP-endo retreatment, rotation file system versus Reciproc Blue. All samples were split longitudinally. The residual obturation material was evaluated by software analysis of high-resolution photographic pictures of longitudinal sections of samples. **Results:** Statistical analysis showed a significant difference ( $P < 0.05$ ) between each of the two compared subgroups, where the less amount of residual sealer was in the Reciproc Blue subgroup (IB) and XP-endo R subgroup (IIA). **Conclusion:** Within the limitations of this *in vitro* study, Reciproc Blue was found to be more effective than XP-endo Retreatment in the retreatment of bioceramic sealers using the single-cone technique, while XP-endo Retreatment was more effective than Reciproc Blue in retreatment of bioceramic sealers in single-rooted teeth obturated using the warm vertical compaction technique. Still neither rotation nor reciprocating motion was able to completely remove of gutta-percha and bioceramic sealer.

**Keywords:** Bioceramic sealer, Reciproc blue, Single cone technique, XP-endo retreatment

## 1. Introduction

Endodontic treatment has a good prognosis, provided that the treatment is done in aseptic conditions [1]. Endodontic treatment may fail for several reasons, including poor coronal seal, inadequate root filling, and persistent infection [2]. Re-establishing the health of the periapical tissues is considered as the main objective of nonsurgical root canal retreatment in cases with post treatment disease [3]. However, the removal of filling material from the canal space is the most difficult and challenging step during retreatment, regardless of the technique/

instrument used [4,5]. It has been reported that the presence of root-filling material may act as a source of hidden infection; therefore, several systems was applied to remove root-filling material, including hand, rotary, and reciprocating instruments. Once the clinician could removes the old canal filling material, reestablishes apical patency, sets an adequate working length, and revises the cleaning, shaping, and filling procedures, root canal retreatment will achieve a good outcome in most cases [6].

Specially designed nickel–titanium (NiTi) instruments were manufactured for root-filling material removal. These include, for example, ProTaper

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\* Corresponding author at: Al-Azhar University Girls Branch, Faculty of Dental Medicine for Girls, Nasr City, Egypt.  
E-mail address: [sahar.almashad2017@gmail.com](mailto:sahar.almashad2017@gmail.com) (S.R. Almashad).

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retreatment, D-RaCe, and Mtwo retreatment, which rotate in a continuous motion and are widely used in nonsurgical root canal retreatment [7,8]. Other instruments, despite being originally developed for root canal preparation (shaping instruments), including systems with reciprocating motion (ReciProc, Reciproc Blue, and WaveOne Gold) or continuous motion, such as ProTaper Next and ProTaper Gold, are also suggested for secondary root canal treatment as these instruments are flexible with high resistance to cyclic fatigue and have high cutting efficiency which may enhance root filling removal [9,10].

In removing root-filling material, reciprocating and rotary systems showed the same performance where Wave One gold Reciprocating versus ProTaper Universal Retreatment systems and Reciproc Blue endodontic reciprocating instruments versus the ProTaper Gold endodontic rotary have demonstrated the same effectiveness in root canal filling removal [4,7], while other studies, showed that the reciprocating system was more efficient than the rotary one, where a higher capability of the Reciproc to remove the filling material from the root canal system than the ProTaper Retreatment system [8]. Various studies have reported that endodontic rotary or reciprocating instruments [9,10] remove the root canal filling material more effectively, whereas other studies have reported that hand files are more efficient [11,12]. Although there are a variety of conventional retreatment tools, no one achieves residues clearance of the root canal lumen [13].

Therefore, the aim of this study was to evaluate the retreatment efficacy of anew kit of XP-endo retreatment versus Reciproc Blue in the removal of filling materials of root canal obturated using a single-cone technique and warm vertical compaction, both with bioceramic sealers.

## 2. Patients and methods

Thirty-two anonymous mandibular premolars (single rooted) were extracted for periodontal or prosthodontic reasons and were collected from the clinic of oral and maxillofacial surgery at Faculty of Dental Medicine for Girls, Al-Azhar University. The use of extracted human teeth was ethically approved in accordance with the guidelines of the Research Ethics Committee (REC), Faculty of Dental Medicine for Girls, Al-Azhar University (Code: REC-EN 21-11).

Criteria included were: Teeth with single canal and single apical foremen (anatomically type I) canal curvature of between 0 and 20° (calculated using the Schneider technique), and an apical diameter corresponding to k file#15 (Mani, Inc.

Japan). The buccal cusp tips were flattened using a contra-angle high-speed handpiece (Dentsply Sirona, UK) and a tapered stone with rounded end size 16 (Komet Dental Gebr. Brasseler GmbH and Co.KG) and this served as a reference point (from the flattened occlusal cusp tip to the apex of the root was adjusted to 20 mm). Periapical radiographs were taken before preparation.

### 2.1. Sample size calculation and statistical power

The calculation was made using the CDC Epi Info program version 7.2.0.1 (Atlanta, USA), assuming a power of 80% and  $\alpha = 0.05$  to detect a significant difference in the amount of remaining root canal filling materials after retreatment of single-rooted teeth by two automated file systems, one of them will with one being rotary and the other reciprocating. A total of 32 extracted single-rooted sound human teeth were divided into two equal groups randomly (16 each group), based on an estimated median (range) volume of residual filling material, with a range of 5.553 (0.132–8.507) in samples retreated by the continuous rotation system and will be compared to a range of 0.637 (0.014–3.577) in samples retreated by a reciprocating system [14].

### 2.2. Root canal instrumentation and obturation

The coronal cavities of the selected teeth were prepared using a round bur size 2 (Komet Dental Gebr. Brasseler GmbH and Co.KG) in a high-speed contra-angle. ProTaper Universal Rotary files (Dentsply Maillefer, Switzerland) files were used in cleaning and shaping. ProTaper Universal files were mounted in an E-Connect S electric motor (Eighteen Medical; Tds, China) at 300 rpm and torque 1 N cm according to the manufacturer's instructions. We used the sequence Sx, S1, S2, F1, F2, and F3 to the full working length, respectively. After each file, 2 ml of 2.6% sodium hypochlorite solution (Egyptian Company for household detergents Clorox, Egypt) was irrigated through a 30-gauge side vented irrigating needle (Dia tech Coltene AG., Switzerland) followed by 3 ml of 17% EDTA solution (AmritChem and Min. Ag, Mohali, India) and finally, 5 ml of distilled water (Fipco, Egypt) followed by drying the canals using paper point size #35/0.04. The master cone 35/0.04 (Dentsply Maillefer, Ballaigues, Switzerland) was checked for tug back action in all samples. Radiographic pictures were taken of all teeth with the master cone. All specimens were divided into two main experimental groups: group I and group II (each 16) according to obturation technique was used.

**Group I:** The prepared canals were obturated by using the single-cone technique with Neosealer, a bioceramic root canal sealer (Avalon BioMed; USA). After master cone selection, the Neosealer bioceramic sealer was injected into the canal followed by the insertion of the master cone and the excess gutta-percha was cut using a hot instrument and compacted with a stainless-steel hand plugger to the canal orifices.

**Group II:** The prepared canals were obturated by the warm vertical compaction technique using the Fast Fill-Back fill System for the three-dimensional warm Obturation System (Eighteen Medical, China. Tds) with Neosealer, a bioceramic root canal sealer (Avalon BioMed; USA.). Canal walls were smeared with a sealer using a spreader and then gutta-percha master cone 35/0.04 (Dentsply Maillefer, Ballaigues, Switzerland) was inserted in the canal for precise apical sealing and then the gutta-percha master cone was cut 4 mm before apex using tip #25 of Fast Fill-Back fill system, after which warm gutta-percha was injected into the canal, and a hot stainless-steel plugger was used for condensation filling to the canal orifices.

At the end of the filling procedures of all samples (group I and group II), the coronal cavities were sealed with temporary filling (Coltosol F, Coltene; Altstätten, Switzerland). The obturated canals were assessed by radiographs for obturation quality and then stored in 0.09% saline solution (Al Mottaheedoon pharma, Egypt) for 30 days at 37 °C.

### 2.3. Retreatment step

Both groups (I and II) were divided into two equal subgroups according to the system used in retreatment (8 each) as follows:

**Subgroup A:** The obturated canals were retreated by the XP-endo R (KFG Dentaire, Swiss endo), a new kit of rotary file system which consists of three files: DR1, XP-endo shaper and XP-endo finisher. R. XP-endo R was mounted on an electric motor (E-Connect S) at torque 1 and 800 rpm according to the manufacturer's instructions. At first, DR1 was used as an orifice opener for removal of the coronal third of the root canal filling material, then XP-endo shaper followed by XP-endo finisher were used for full length.

**Subgroup B:** The obturated canals were retreated using the Reciproc Blue system, a reciprocating file system # 40/0.06; at first, gates # 4 was used for the removal of the coronal third of the root canal filling material. Then the Reciproc Blue file# 40/0.06 was mounted on an electric motor (E-Connect S) set to reciprocating motion and was used to the full working length.

**Irrigation protocol:** During retreatment, 2 ml of 2.6% NaOCl was used between each file followed by a 3 ml of 17% EDTA solution and finally 5 ml distilled water was used. Ultra-X device tip #25 (Ultra-X; Eighteen Medical, China) for Passive Ultra Sonic Activation Irrigation was used for 30 s in each canal.

### 2.4. Evaluation method

All teeth were grooved labiolingually and split into two halves by using a diamond disk (Dia Tech, Coltene AG., Switzerland). Imaging of each half was undertaken by using a high-resolution Camera (Canon EOS 750D) at a magnification 10× (Fig. 1), Images were transferred to Mountains Map \_v7 software (Besançon, France and Adobe Photoshop 7.0, Adobe Systems Inc., San Jose, California, USA) for image analysis, which could differentiate between sealer and gutta percha by a coloring effect, and finally images were transferred to ImageJ software (version 1.53a National Institutes of Health, USA). to calculate the mean percent of the remaining root canal filling materials at all sample length and at each third (Fig. 2), which was automatically measured in pixels and then calculated as % of the total third area using the following equation [15]:



Fig. 1. Sample 1 from Group I.

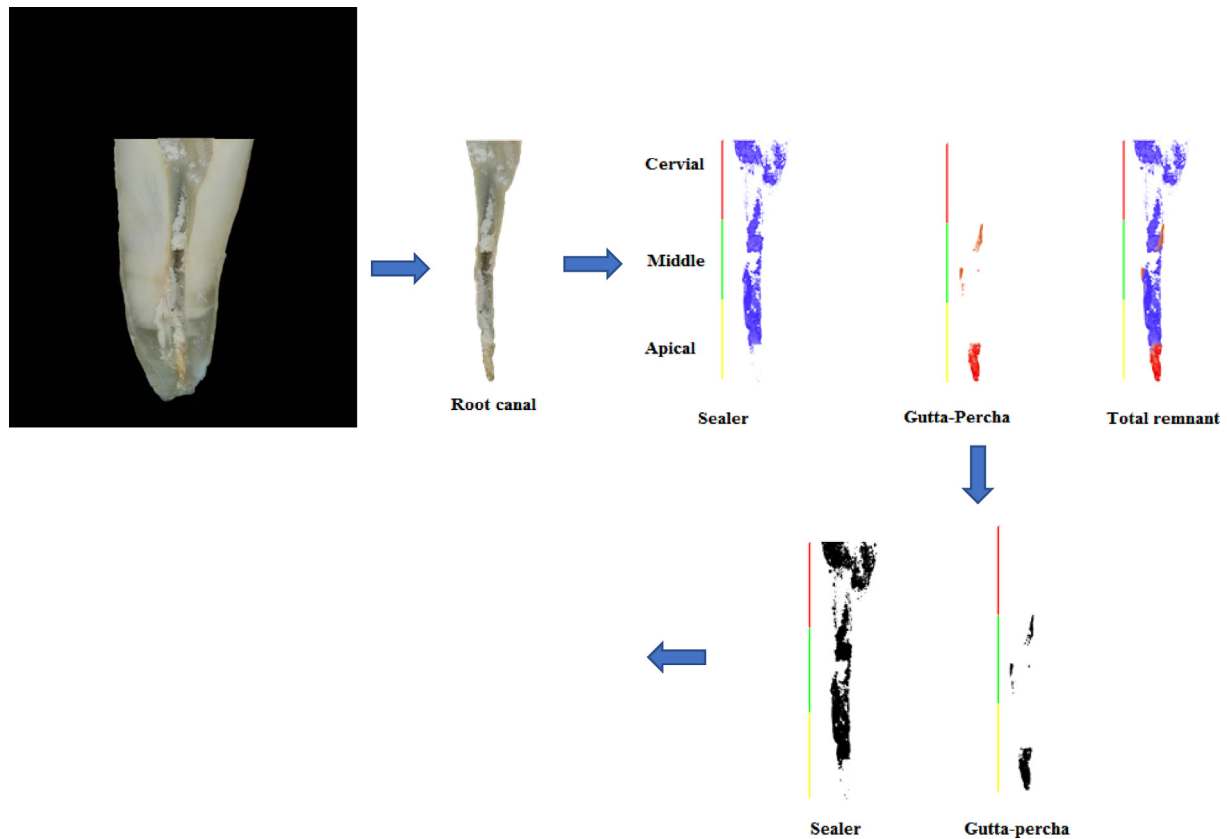


Fig. 2. Measurement procedure scheme sample 1 from Group I.

$$\text{Sealer \%} = \frac{\text{Sum. of blue stained area (pixels)}}{\text{Total third area (pixels)}} \times 100$$

$$\text{Gutta - percha \%} = \frac{\text{Sum. of red stained area (pixels)}}{\text{Total third area (pixels)}} \times 100$$

The less the remaining root canal filling, the more effective the file system.

### 2.5. Statistical analysis

Statistical analysis for results was performed by applying the ANOVA test (one- and two-way) and after that the post hoc test, and  $P$  less than 0.05 was considered statistically significant (95% significance level). Levene's test was used to test the normality of data. Data were analyzed using the statistical software SPSS (version 23, IBM Co. USA).

	Cervical	Middle	Apical
Third area (Pixels)	179288	90388	58764
Sealer area (Pixels)	60131	48378	37643
Sealer %	33.54	53.52	64.06
Gutta-percha area (Pixels)	0	7925	18484
Gutta-percha %	0.00	8.77	31.45

## 3. Results

The test of normality (Levene test) revealed that all data of remaining filling material on the root canal walls were parametric.

### 3.1. Group I: single-cone technique (Xp-endo R. Versus Reciproc Blue)

The mean values (percentage) of the remaining bioceramic sealer on the root canal walls and standard deviation at the cervical, middle and apical thirds of subgroup IA (Xp-endo R.) and subgroup IB (Reciproc Blue) ( $70.16 \pm 15.07$ ,  $75.01 \pm 14.50$ ,  $56.40 \pm 12.11$ ) and ( $52.90 \pm 12.12$ ,  $45.33 \pm 9.29$ ,  $33.51 \pm 5.92$ ), respectively. The ANOVA test showed that there was a difference between tested subgroups in the mean values (percentage) of the remaining bioceramic sealer on the root canal walls. The post hoc test found a statistically significant difference between the tested subgroups in the mean values (percentage) of the remaining bioceramic sealer on the root canal walls. ( $P < 0.05$ ) where the mean values percentage of residual bioceramic sealer area was recorded higher value with Xp-endo R. (Subgroup IA) in all thirds cervical, middle, and apical

compared with the Reciproc Blue (Subgroup IB) [Table 1: Fig. 3](#).

The mean values (percentage) of the remaining gutta-percha on the root canal walls and standard deviation at the cervical, middle, and apical thirds of subgroup IA (Xp-endo R.) and subgroup IB (Reciproc Blue) ( $10.93 \pm 4.84$ ,  $5.83 \pm 1.50$ ,  $10.51 \pm 3.74$ ) and ( $18.92 \pm 5.66$ ,  $9.94 \pm 1.73$ ,  $15.39 \pm 4.01$ ) respectively. ANOVA test showed that there was a difference between tested subgroups in the mean percentage values of remaining gutta-percha on the root canal walls. Post hoc test found that a statistically significant difference between tested subgroups at cervical area only ( $P < 0.05$ ) where the mean values percentage of residual gutta-percha was recorded higher when using Reciproc Blue (Subgroup IB) than Xp-endo R. (Subgroup IA) cervical third only. [Table 1: Fig. 3](#).

IA (Xp-endo R. with Single cone tech.) IB (Reciproc Blue with Single cone tech.)

IA (Xp-endo R. with Single cone tech) IB (Reciproc Blue with Single cone tech).

### 3.2. Group II: warm vertical compaction tech. (Xp-endo R. vs. Reciproc Blue).

The mean values percentage of remaining bioceramic sealer on the root canal walls and standard

deviation at (cervical, middle, and apical) thirds of subgroup IIA (Xp-endo R.) and subgroup IIB (Reciproc Blue) ( $39.37 \pm 9.98$ ,  $29.53 \pm 6.43$ ,  $38.10 \pm 8.94$ ) and ( $51.82 \pm 11.11$ ,  $49.30 \pm 13.87$ ,  $36.41 \pm 9.24$ ), respectively. The ANOVA test showed that there was a difference between tested subgroups in the mean values percentage of the remaining bioceramic sealer on the root canal walls. Post hoc test found that a statistically significant difference between tested subgroups in the mean values percentage of remaining bioceramic sealer on the root canal walls ( $P < 0.05$ ) where the mean values percentage of residual bioceramic sealer area was recorded higher value with Reciproc Blue (Subgroup IIB) in cervical and middle thirds than Xp-endo R. (Subgroup IIA) while apical third was recorded nonsignificant difference. [Table 2: Fig. 4](#).

The mean values percentage of the remaining gutta-percha on the root canal walls and standard deviation at the cervical, middle, and apical thirds of subgroup IIA (Xp-endo R.) and subgroup IIB (Reciproc Blue) were ( $6.64 \pm 2.19$ ,  $9.70 \pm 5.77$ ,  $8.10 \pm 3.43$ ) and ( $9.01 \pm 4.24$ ,  $12.51 \pm 5.10$ ,  $29.38 \pm 8.58$ ), respectively. The ANOVA test showed a difference between the tested subgroups in the mean values percentage of the remaining gutta-percha on the root canal walls. Post hoc test found

Table 1. Comparative evaluation of mean values percentage of residual filling (bioceramic sealer and gutta-percha) in different thirds between Xp-endo R and Reciproc Blue in the retreatment of single-rooted teeth were obturated using the single-cone technique.

Subgroups	Cervical	Middle	Apical	Mean of every group
Subgroup IA sealer	$70.16 \pm 15.07$	$75.01 \pm 14.50$	$56.40 \pm 12.11$	67.19
Subgroup IB sealer	$52.90 \pm 12.12$	$45.33 \pm 9.29$	$33.51 \pm 5.92$	43.91
P value	0	0	0	
Subgroup IA gutta-percha	$10.93 \pm 4.84$	$5.83 \pm 1.50$	$10.51 \pm 3.74$	9.09
Subgroup IB gutta-percha	$18.92 \pm 5.66$	$9.94 \pm 1.73$	$15.39 \pm 4.01$	14.75
P value	0.006	0.240 <sup>ns</sup>	0.318 <sup>ns</sup>	

ns: non-significant ( $P > 0.05$ ), P value significant at P less than or equal to 0.05.

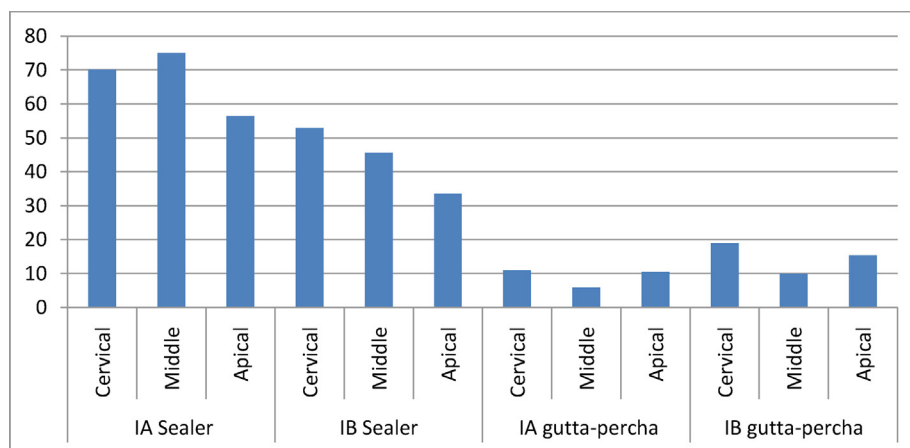


Fig. 3. Column chart representing mean values percentage of bioceramic sealer and gutta-percha in different thirds between Xp-endo R and Reciproc Blue using the single-cone technique.

Table 2. Comparative evaluation of mean values percentage of bioceramic sealer and gutta-percha in different thirds between Xp-endo R and Reciproc Blue with warm vertical comp. tech.

Subgroups	Cervical	Middle	Apical	Mean of every group
Subgroup IIA sealer	39.37 ± 9.98	29.53 ± 6.43	38.10 ± 8.94	35.67
Subgroup IIB sealer	51.82 ± 11.11	49.30 ± 13.87	36.41 ± 9.24	45.84
<i>P</i> value	0.001	0	0.936 <sup>ns</sup>	
Subgroup IIA gutta-percha	6.64 ± 2.19	9.70 ± 5.77	8.10 ± 3.43	8.15
Subgroup IIB gutta-percha	9.01 ± 4.24	12.51 ± 5.10	29.38 ± 8.58	16.97
<i>P</i> value	0.454 <sup>ns</sup>	0.483 <sup>ns</sup>	0	

ns: nonsignificant ( $P > 0.05$ ),  $P$  value significant at  $P$  less than or equal to 0.05.

ns: nonsignificant ( $P > 0.05$ ),  $P$  value significant at  $P \leq$  less than or equal to 0.05.

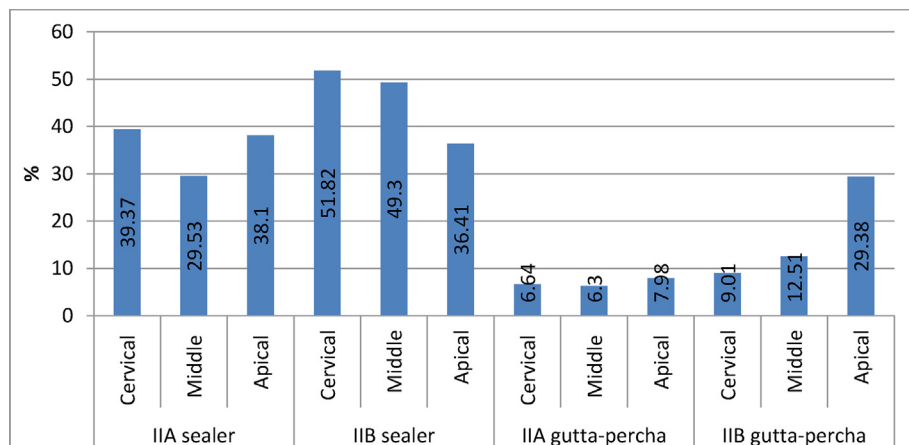


Fig. 4. Column chart representing mean values percentage of bioceramic sealer and gutta-percha in different thirds between Xp-endo R and Reciproc Blue using the warm vertical comp. tech.

that a statistically significant difference between the tested subgroups in apical area only ( $P < 0.05$ ) where the mean percentage values of residual gutta-percha was recorded higher when using Reciproc Blue (Subgroup IIB) in apical third than Xp-endo R. (Subgroup IIA). Table 2: Fig. 4.

IIA (Xp-endo R. warm vertical comp. tech) IIB (Reciproc Blue warm vertical comp. tech).

#### 4. Discussion

Root canal filling materials should be completely removed to disinfect the root canal system which is essential requirement for success of retreatment [16], the persistent infection is hidden by residual filling jeopardizing the outcome of retreatment as a result to achieve long-term success cleanliness processes should be updated on a regular basis [17].

Most of the invitro studies evaluating the efficiency of root canal re-treatment techniques have used straight root canals [18,19] as in current study, mandibular premolars with straight roots and oval canal cross-sections were selected to facilitate the standardization of the specimens, the canals in the present study were originally prepared to working

length with an F3 Protaper universal instrument with size 30 tip. Therefore, instruments with size 40 tip Reciproc Blue versus XP-endo R kit were used in the re-treatment procedure.

In past research, dental crown removal was widespread, with the goal of improving the consistency of the working length and root canal filling removal, as well as removing the access cavity limitation to root canals [20], many teeth undergoing retreatments, however, have crowns in clinical practice. As a result, the effectiveness of retreatment tools is hampered by the existence of crowns, which restrict access to root canals. As a result, teeth in this study were not decoronated and length uniformity was maintained at 20 mm from the flattened buccal cusp to the root canal apex.

Bio-ceramic sealer (calcium silicate bioceramic sealer) is a recently developed substance, setting calcium phosphate bond chemically with radicular dentin which makes a serious problem in re-treatment [21]. Single cone obturation technique, the concept of more sealer and less gutta-percha, this technique is the most used with bio-ceramic sealers [22], what show increase difficulty in the re-treatment cases [23]. A warm vertical compaction technique was reported to provide a more homogenous

filling with significantly less voids when compared with single cone and cold lateral compaction techniques [24]. However, as reported in the literature, all the filling techniques investigated are never 'void-free' regardless of the type of sealer used [25].

Calcium silicates -based sealers classified into water-based sealers and non-water-based sealers, the water-based sealers like BioRoot RCS which is a powder mixed with water are susceptible to desiccation due to the heat applied during warm vertical compaction of gutta-percha [5], although this does not compromise the quality of fill. Non-water-based sealers (premixed sealers) are less susceptible to changes in temperature, since they have an alternative vehicle [6] which includes all premixed sealers like TotalFill BC Sealer HiFlow which have been developed specifically by the manufacturer to be used in procedures employing heat so the selection of (Neosealer) which is one of the new premixed bioactive bioceramic (single past) endodontic sealers to be used in this study.

Ni Ti max wire alloy is an Xp-endo shaper file alloy (XPS, Dentaire SA, La Chaux-de-Fonds, Switzerland) that provides a high expansion capacity from a size #15 to #30 at body temperature allowing for complete canal preparation with a single file [26]. A previous study demonstrated its ability to improve mandibular incisor retreatment [27]. Aggregation of three files (DR1, XP-endo Shaper R, XP-endo finisher R) forming a retreatment kit, DR1 contains a triangular cross-section of cutting edges, shaper characterized by its snack shape and finisher to promote root canal retreatment efficacy due to its shape memory and design [17]. The XP-endo shaper R followed by XP-finisher R more efficient in retreatment of mandibular molars in mesial roots rather than the distal ones, even though both rotary retreatment files removed the majority of old filling materials, the apical section is still a critical part [28].

Reciproc Blue (RB; VDW, Munich, Germany) is a single file system designed to be used with reciprocating motion. Its design (S-shaped cross section, two cutting edges, and a noncutting tip) It is manufactured from an M-wire alloy with special heat treatment.) is technology shows increased file flexibility and improved cyclic fatigue resistance. Reciproc Blue file is intended for use in initial treatment and retreatment [29].

There was a great difference in the percentage of residual materials between studies due to differences in obturation techniques used, types of sealer, canal size, and systems used in retreatment procedure. The type of obturating technique used for initial root canal treatment was a factor affecting

the amount of remaining filling material and retreatment time where thermoplastic zed technique had the higher amount of filling material, and the longest time taken for removal in compare with teeth obturated with cold lateral condensation and warm vertical compaction techniques regardless type of sealer [30] Also, another study proved that the type of obturating technique used for initial root canal treatment affect the retreatment time rather than the amount of root canal filling materials where teeth obturated with GuttaCore pink were retreated in shorter time in compared with the canals obturated using Thermafil and warm vertically compacted gutta-percha [31]. While another study concluded that the efficiency of retreatment in the oval-shaped canal was closely related to the storage time i.e., aging of root canal filling material rather than obturation technique used with tricalcium silicate sealer [32]. This study showed conflicting results where the efficacy of XP-endo R file system in retreatment of teeth were obturated by warm vertical compaction technique was better than its retreatment efficacy with the teeth were obturated by single cone technique while Reciproc Blue system had the same performance in retreatment regardless of the type of obturation technique used.

Many studies compared the efficiency of (rotation motion versus reciprocating motion) in removal of root canal filling materials. Madarati *et al.* [33] reported that reciprocation systems were more effective but needed longer times than rotary systems in removing calcium silicate based-sealers flings as in current study where Reciproc Blue system was more efficient than XP-endo R system in retreatment of single rooted teeth obturated by single cone technique with Bioceramic sealer.

The superiority of XP-endo Shaper rotary instruments versus Reciproc Blue #25/0.05 in retreatment oval shaped canal of mandibular incisors which were obturated by using the continuous wave of condensation technique was reported by De-Deus *et al.* in 2019 [34] which means less untouched areas than Reciproc Blue #25/0.05 and rendered to the expandable feature of the instrument in body temperature from #15/0.01 to #30/0.04 which allows the instrument to reach inaccessible areas by using it at high speed reaching about 1000 rpm but in this study Reciproc Blue system #40/0.06 was more efficient than XP-endo R system in retreatment of single rooted teeth of mandibular premolars (medium canals) obturated with single cone technique. The superiority of Reciproc Blue system #40/0.06 versus XP-endo R was due to incompatible sizes and tapers for comparison, although XP-endo shaper can

expand within canal, but maximum expansion reach to size #30/0.04 which indicated the presence of a great areas of untouched radicular dentinal walls in XP endo R subgroup and that was the cause of the highest percentage of Bioceramic residual amount among the whole subgroups.

Reciprocating systems appear to be equally effective as those working in continuous rotation for retreatment where the Reciproc and WaveOne reciprocating systems were as effective as the Pro-Taper Universal retreatment system for root canal filling material removal [35] Also, protaper gold and Reciproc blue files had the similar capabilities in terms of obturation material removal and mean retreatment times, the more recent review reported that the collected studies showed no effect of motion (either reciprocation or full rotary motion) on the remnant of root canal filling materials [3], and this study agreed with this review that although Reciproc Blue system was more efficient than XP-endo R system in retreatment of single rooted teeth obturated with single cone technique, but this efficiency rendered to larger size and taper of Reciproc Blue # 40/0.06 than XP-endo Shaper # 35/0.04 which are not compatible sizes for comparison, so this study showed no real effect of motion either reciprocation or full rotary motion on residual filling and the great effect on the percentage of residual materials depend on the proper selection of the retreatment file size and taper providing that suitable for canal size want to retreat and this determined by the initial size should be taken after glide path to the apex to be ensure proper toughing of radicular dentinal walls especially in retrievability of calcium silicate bioceramic sealer which bond chemically with radicular dentin what make retreatment a great challenge what agreed with Hassanloo and colleagues reported that the remnants of root canal filling material are reduced when the last file used in retreatment is larger than the last file used during canal shaping [36].

There were various imaging methods available for analyzing and calculating the amount of residual root canal filling after retreatment, including conventional and digital radiography [37], scanning electron microscopy [38], cone-beam computed tomography, and photographic imaging [39]. The vertical split tooth technique and imaging was used in this research. While this procedure is destructive but enables direct inspection and proper detection of remaining filling materials, particularly when employing high magnification and resolution photographs. Although some remaining filling materials may be lost during tooth splitting procedures; this can be avoided by cutting carefully without dislodging the filling ingredients [16] as shown in this study.

#### 4.1. Conclusion

Within the limitations of this invitro study, Reciproc Blue was more effective than XP-endo Retreatment in retreatability of bioceramic with single cone technique while XP-endo Retreatment was more effective than Reciproc Blue in retreatability of bioceramic sealer in single rooted teeth obturated with warm vertical compaction technique. Still not rotation or reciprocating motion enable to completely remove of gutta percha and bioceramic sealer.

#### 4.2. Recommendation

It is recommended that XP-endo retreatment kit may be used in retreatment small size canals only, it may be more effective rather than in medium canals like this study, although XP-endo shaper can expand within canal, but maximum expansion reach to size #30/0.04. XP-endo shaper characterizes by snake shape which is the more benefit in quick glide path by rolling gutta percha around its long axis rather than accomplish retreatment.

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#### Conflicts of interest

Authors have no conflict of interest.

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