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# Efficiency of Two Rotary Retreatment Systems with and without XP-Endo Finisher for the Removal of Root Filling Materials.

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**Abstract**

**Aims:** To evaluate the volumetric amount of endodontic obturating materials remains after endodontic retreatment with and without complementary retreatment(XP-Endo Finisher) utilizing two retreatment rotary systems (R-Endo and EdgefileXR).**Materials and Methods:** Twenty human mandibular premolars with single straight root canals were prepared using a 2Shape endodontic rotary system with a file size of 25/0.04. Gutta-percha and T-Seal (Epoxy resin sealer) were used to obtain all the teeth using a single cone technique. Samples were then divided into two groups based on the retreatment system used (n=10). CBCT images of each sample were taken and analyzed in axial, coronal, and sagittal planes to determine the obturating material remnants after retreatment. Then, all samples retreated by two retreatment systems (R-Endo and EdgefileXR) were subjected to supplementary retreatment by the XP-Endo Finisher. Second CBCT evaluation were performed to determine the XP-Endp Finisher effect. The data were statistically analyzed using one-way ANOVA analysis of variance, independent t-test, and Duncan's multiple analysis rang test. **Results:** EdgeFileXR and R-Endo were significantly different, EdgefileXR is more effective and XP-Endo Finisher improved removal of obturating materials in both groups. **Conclusions:** The retreatment system had a significant effect on the amount of endodontic obturating materials remnants, XP-Endo Finisher show a supplementary removal effect.

**الخلاصة**

**الاهداف** : تقييم الكمية الحجمية لبقايا مواد السدادة اللبية بعد اعادة المعالجة اللبية باستخدام نظامين مع او بدون استخدام وحدة الانهاء اللبية اكس بي (EdgefileXR and R-Endo) دوارين في الاسنان المملوءة بواسطة برانتج سيلر. **المواد وطرائق العمل :**استخدمت الدراسة عشرين سن بشري ضاحك سفلي حيث تم تحضير قنوات الجذر وملئها بواسطة الرانتج سيلر , بعدها تم تقسيمها الى مجموعتين كل مجموعة عشرة اسنان حيث تم استعمال نظام اعادة معالجة دوار مختلف مع كل مجموعة .بعدها تم اخذ صورة لكل عينة بواسطة التصوير الشعاعي المخروط المحوسب لاحتساب الكمية الحجمية لبقايا مواد السدادة اللبية وبعد ذلك تم استخدام وحدة الانهاء اللبية اكس بي مع كل العينات في كلتا المجموعتين واحتساب الكمية الحجمية لبقايا مواد السدادة اللبية تم تحليل البيانات باستخدام اختبار تي المستقل وتحليل التباين احادي الاتجاه واختبار دنكن. **النتائج :**نظامين اعادة المعالجة اللبية المستخدمين في البحث يوجد بينهم فرق معنوي حيث ان نظام الاكس ار اكثر فعالية بالإضافة الى ان استخدام وحدة الانهاء اللبية اكس بي سيدعم عملية ازالة بقايا مواد السدادة اللبية في المجموعتين. **الاستنتاجات:** نوعية نظام اعادة المعالجة اللبية له تأثير على كمية بقايا مواد السدادة اللبية ووحدة الانهاء اللبية اكس بي تكون كنظام تكميلي لإعادة المعالجة اللبية.

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## INTRODUCTION

The achievement of the endodontic triad of debridement, disinfection, and three-dimensional obturation is critical to the success of endodontic therapy. Endodontic treatment has a clinical success rate of 50% and 90%. Nonsurgical retreatment is the preferred treatment for failed endodontic cases. This treatment usually yields with positive results [1, 2].

The goal of retreatment is to completely eject the filling material from the root canal, allowing for successful root canal shape, cleaning, and filling. Only after the gutta-percha and sealer have been completely removed and the canal has been reached to the apical foramen can an appropriate retreatment process be performed [3].

Many procedures and materials have been proposed for the proper removal of root canal fillings, including hand files, heat-carrying instruments, chemical solvents, ultrasonic devices, lasers, and engine-driven instruments such as Gates Glidden drills and nickel-titanium (NiTi) rotary instruments. Rotating instruments have recently been developed for retreatment operations. R-Endo, Mtwo R, ProTaper Universal, D-RaCe, and, more recently, EdgefileXR are a few instances of these systems [4].

XP-Endo Finisher has recently been introduced in endodontics as a new concept of anatomical instruments, originally designed to be used following root canal system preparation and retreatment to enhance cleaning. The XP-Endo Finisher has a small core size (ISO 25 in diameter), zero taper (25/.00) and triangular cross section [5].

Tooth sectioning, radiography, the clearing method, micro-computed tomography, and cone beam computed tomography are all methods for evaluating the residual obturation material that remains in the root canal after retreatment [6-8]. In recent years, the cone beam computed tomography (CBCT) technique has been used to assess the residual volume of filling material in the inner walls of root canals following retreatment. The CBCT images produced by this technique are in sagittal, coronal, and axial cross-sections, and they can reduce the superimposition of adjacent tissues. Furthermore, the patient radiation dose with CBCT techniques is lower than that with conventional CT techniques [9-11].

Therefore, this study aimed to evaluate and compare the volumetric amount of endodontically obturating material remnants after endodontic retreatment using two retreatment rotary systems (R-Endo and EdgefileXR) with and without XP-Endo Finisher, in teeth obturated by T-Seal (Epoxy resin-based sealer).

The null hypothesis of this study is that there are no significant differences between the tested systems for the amount of filling remnants in the root canals obturated by T-Seal (Epoxy resin-based sealer). Moreover,

XP-Endo Finisher has no significant effect on the amount of remnants inside the canals.

## MATERIALS AND METHODS

### Ethical Statement:

The present study was approved by Research Ethics Committee board (University of Mosul, College of Dentistry, REC reference No. UoM.Dent/ DM.H.L.50/21).

### Prepared Samples:

Twenty mandibular single straight canal bicuspid teeth with mature root apices, newly extracted for orthodontic purposes, were chosen and preserved at 4 $C^0$ in 0.1 percent thymol solution (BDH Chemical Ltd, England). Preoperative radiographs were taken to ensure that the teeth chosen met the following criteria: No internal resorption, caries; totally formed apices and no calcified canals [(12)]. After that, plaque, calculus, and debris remnants are removed from the teeth by scaler. Then, using a diamond disc bur (KG Sorensen SP, Brazil), all teeth were decoronated to a length of 15mm from the apex, as assessed by digital vernia (China). The access was prepared using a high-speed bur and water spray, and a size 10 K-file (Dentsply Maillefer, Switzerland) was passed to the apex of all canals to assure apical patency. The same file was re-entered into the canal until it was observed at the apical foremen, at which point the working length (WL) was measured [(13-14)]. Then, all teeth fixed in a blocks of acrylic resin material (1.5*1.5*2cm) and these blocks putted in bench vice in order to provide more control and standardization of instrumentation and obturation technique Figure (1)[(15)]. Preparation of root canals was done with the Rotary 2 shape System(MicroMega, Besancon, France) by contra-angled rotary hand piece(E connect, China). The speed and torque of endo motor maintained at 350 (rpm) and 2(N/cm) with single file size TS1 (25/.04). Sodium hypochlorite (2.5%, 5ml/1min) was used as irrigating solution following the use of each file. Each file was discarded after preparation of five specimens. After completion of canal preparation, the canals were rinsed with (17%, 2ml/1min) ethylenediamine tetra-acetic acid (EDTA). A final rinse of 5ml/1min normal saline was used to remove any remnant of the irrigating solution. Then the canal was dried using 2 shape paper points (25/.04) [(16)]. Single cone size TS1 (25/.04) 2 shape gutta percha fitted into the root canal to the full WL and tug-back checked. T-Seal sealer (Nexobio, Korea) was a two component paste put in mixing paper and mixed to reach the desired consistency and inserted into the canal using lentulo spiral. The cone also coated with sealer and introduced into the canal and the excess filling material removed with a heated spoon excavator [(17)]. After obturations, all the samples were sealed coronally with tetric N-ceram composite resin (Ivoclar Vivadent, Liechtenstein) in procedure like direct veneer, and were incubated for one month at 37$C^0$ in 100% humidity by placing them in gauze moisten with distilled water to simulate the clinical procedure as possible[(18)].

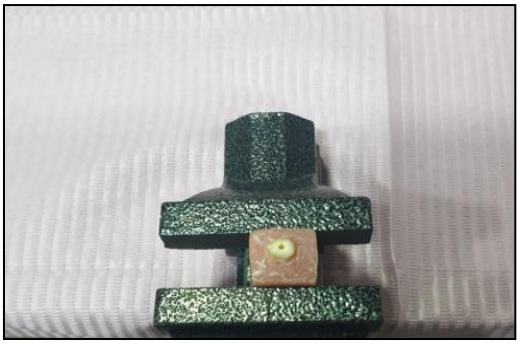

**Figure (1):** Fixation of acrylic block by bench vice.

**Samples Grouping:**

All the samples divided randomly into two groups according to the type of retreatment system used with 10 samples for each as follow:

- **Group A:** R-Endo retreatment files (MicroMega,Besancon,France) . It consists of three files: R1 (25/0.08) till cervical third, R2 (25/0.06) till middle third, R3 (25/0.04) to full working length. Retreatment conducted at a speed of 300 rpm and a torque of 1.2 N/cm by Eighteeth endomotor [19].
- **Group B:** EdgefileXR retreatment files (EdgeEndo, USA). It employed with following sequences R1 (25/0.12), R2 (25/0.08), R3 (25/0.06), and R4 (25/0.04) till reach to full working length. Retreatment performed at speed 400 rpm and a torque of 3 N/cm by Eighteeth endomotor [20].

Sodium hypochlorite (2.5%, 12ml/6min for each sample) used as irrigating solution following the use of each file. After completion of canal retreatment, the canals rinsed with (17%, 2ml/1min) EDTA. A final rinse of 5ml/1min normal saline used to remove any remnant of the irrigating solution [21].

**Cone Beam Computed Tomography Evaluation after Retreatment:**

Samples evaluated by CBCT image had been taken with CS8100 equipment (Carestream, Healthcare, France) at 87 kilo volt (KV), 2.00 millie amber (mA). CBCT images of each sample were taken and evaluated in axial, coronal and sagittal plans to determined obturating material remnant after retreatment as in Figure (2). Moreover, CBCT provided 0.5mm thickness of slice by slice sections for each view. The CS 3D Imaging program was used to inspect each view, which was then saved in DICOM format (Digital Image Communication of Medicine). With the aid of AutoCAD software (Sketchup, Startup company, USA), the volume of filling material was measured Figure (3) [22, 23].

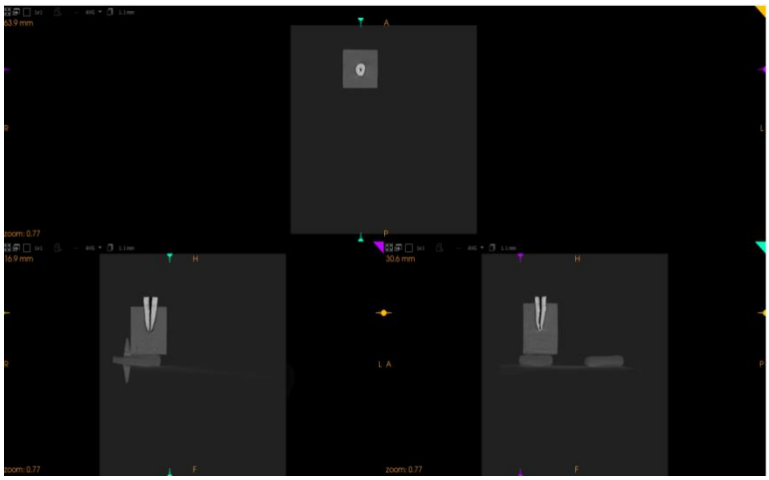

**Figure (2):** CBCT image of sample after retreatment with EdgefileXR files.

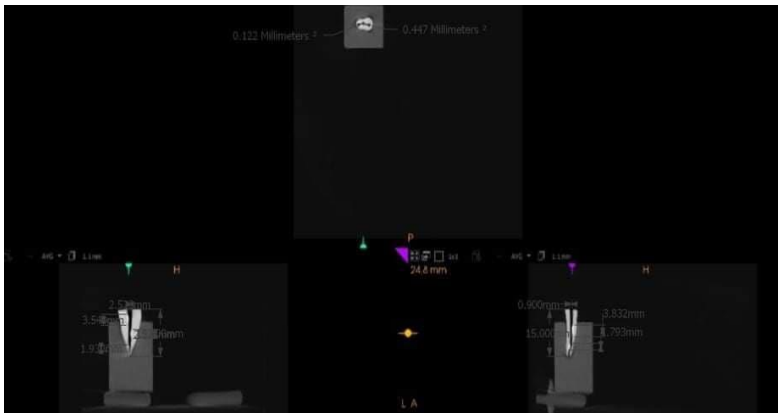

**Figure (3):** Volumetric measurement of remaining filling material after retreatment with R-Endo files.

**Supplementary Retreatment with XP-Endo Finisher:**

All samples retreated by two retreatment systems (R-Endo and EdgefileXR) undergo supplementary retreatment by XP-Endo Finisher (FKG Dentaire, Switzerland). The XP-Endo Finisher has a 25 ISO size, zero taper, and triangular cross section. It operated at 800 rpm and 1 N/cm torque. In order to hold the XP-Endo Finisher straight when setting the WL measurement, it cooled with Endo-Ice spray [24]. The XP-endo Finisher instrument was placed in a contra-angle hand piece (E connect, China), cooled by ice spray, removed from the plastic tube, and inserted without rotation into the canal. The rotation was then initiated (800 rpm and 1 Ncm), and the instrument was activated for 1 minute by making slow and gentle movements up to the WL. During the instrumentation, the instrument was brushed against the canal sidewalls. This cycle was carried out three times. After each cycle, the canal was irrigated with 5 mL of 2.5 percent NaOCl. Then rinsing the canal with 2 mL of 17% EDTA for 3 min followed by 5 mL of 2.5% NaOCl. Finally, a 3 mL rinse with by distilled water was

used in the final irrigation to flush out the NaOCl[25].Second CBCT images for each sample was taken and the volume of the remnant material inside the canal walls was analyze as mentioned before as in Figure (4).

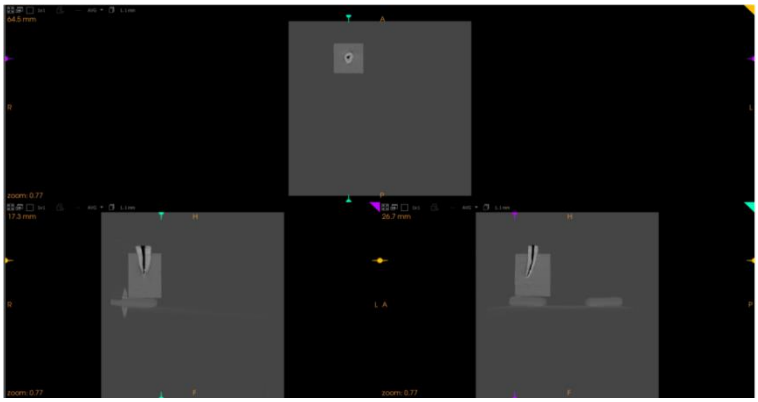

**Figure (4):** CBCT image of sample retreated with R-Endo after supplementary retreatment with XP-Endo Finisher.

### Statistical analysis:

The data were collected and analyzed using SPSS version 25 (IBM,USA) using normality test that detect data parametric and then using descriptive statistic, independent t-test, one way ANOVA and Duncan's multiple analysis rang test . *P* value ≤0.05 was considered statistically significant.

## RESULTS

Descriptive statistic for the volume of residual obturating material that remained inside the canal after using two rotary retreatment systems for Epoxy resin root canal sealers used for obturation are seen in Table (1). It was shown that the samples retreated by EdgefileXR retreatment files had less mean volume of remaining filling materials in root canal than samples retreated by R-Endo retreatment files. Moreover, Independent t-test was used to compare the volume of remnant filling material for each retreatment system in same obturating sealer. Results showed that there was significant difference for the same sealer retreated by two retreatment systems as in Table (2).

**Table (1):** Descriptive statistics of volume of remaining obturating material after using two retreatment systems.

| | Retreatment Systems | No. | Minimum $mm^3$ | Maximum $mm^3$ | Mean $mm^3$ | Std. Deviation |
|---|---|---|---|---|---|---|
| T-Seal | R-Endo | 10 | 1.83 | 1.93 | 1.8878 | 0.03455 |
| | EdgefileXR | 10 | 1.41 | 1.53 | 1.4769 | 0.04916 |

**Table (2):** Independent t-test for volume of remnant filling material for each retreatment system.

| | Retreatment systems | Mean($mm^3$)±SD+ | *P*-value** |
|---|---|---|---|
| T-Seal | R-Endo | 1.8878±0.03455 | |
| | EdgefileXR | 1.4769±0.04916 | 0.000 |

+ Standard deviation. ***P*≤0.05 mean significant variation exist. Highly sig ≤ 0.01

Descriptive statistic for the volume of remaining obturating material that remain after supplementary retreatment with XP-Endo Finisher are seen in Table (3). It was shown that the samples retreated by EdgefileXR retreatment files and underwent supplementary retreatment by XP-Endo Finisher had less mean volume of remaining filling materials in root canal than samples retreated by R-Endo retreatment files and underwent supplementary retreatment by XP-Endo Finisher. Statistically, with same sealer and different previous retreatment systems. Results showed Moreover, Independent t-test was used to compare the volume of remnant filling material after supplementary retreatment that there was no significant difference for the T-Seal sealer retreated by different retreatment systems as in Table (4).

**Table (3):** Descriptive statistics of volume of remaining obturating material after supplementary retreatment with XP-Endo Finisher.

| | Retreatment Systems+ supplementary | No. | Minimum $mm^3$ | Maximum $mm^3$ | Mean $mm^3$ | Std. Deviation |
|---|---|---|---|---|---|---|
| T-Seal | R-Endo+XP-Endo | 10 | 0.00 | 0.14 | 0.0700 | 0.06110 |
| | EdgefileXR+XP-Endo | 10 | 0.00 | 0.12 | 0.0441 | 0.05495 |

**Table (4):** Independent t-test for volume of remnant filling material for each retreatment system in same obturating sealer after supplementary retreatment.

| | Retreatment systems + Supplementary | Mean($mm^3$)±SD | *P*-value** |
|---|---|---|---|
| T-Seal | R-Endo+XP-Endo | 0.0700±0.06110 | |
| | EdgefileXR+XP-Endo | 0.0441±0.05495 | 0.332 |

***P*≤0.05 mean significant variation exist.

To investigate if there is any difference exist in the mean volume of remnant filling material. ANOVA and Duncan Multiple Analysis Rang were performed. Result showed a significant difference (P-value≤ 0.05) among groups that retreated by two retreatment systems before and after supplementary retreatment

by XP-Endo Finisher. It was found ANOVA showed that there was significant difference among retreatment files that used in canals obturated by single cone with and without supplementary retreatment as in Table (5). Duncan Multiple Analysis Rang revealed that there was significant difference between groups before and after using of XP-Endo Finisher but after supplementary retreatment there was no significant difference as in Table (6).

**Table (5):** ANOVA test for volume of remaining obturating material before and after supplementary retreatment.

| | Sum of Squares | Df[+] | Mean Squares | F-value | *P*-value** |
|---|---|---|---|---|---|
| Between Groups | 27.264 | 3 | 9.088 | 3507.942 | 0.000 |
| Within Groups | 0.093 | 36 | 0.003 | | |
| Total | 27.357 | 39 | | | |

[+]df= degree of freedom. ***P*≤0.05 mean significant variation exist. Highly sig ≤ 0.01

**Table (6):** Duncan Multiple Analysis Rang for mean of remaining obturating material before and after supplementary retreatment.

| | Retreatment systems with and without Supplementary | Mean($mm^3$)±SD | Duncan Grouping |
|---|---|---|---|
| T-Seal | R-Endo | 1.8878±0.03455 | C |
| | EdgefileXR | 1.4769±0.04916 | B |
| | R-Endo+XP-Endo | 0.0700±0.06110 | A |
| | EdgefileXR+XP-Endo | 0.0441±0.05495 | A |

The variable letters mean significant difference exist.

## DISCUSSION

As a result, this study was conducted to test and compare the performance of two rotary retreatment systems (Edgefile-XR and R-Endo) for retrieval of canals obturated by T-Seal (Epoxy resin-based sealer) with and without extra cleaning by XP-Endo Finisher, as measured by CBCT.

According to some studies, using solvents to remove filling material (gutta-percha and sealer) may make root filling material removal more difficult, as it may make the structure of material viscous and highly adhesive, resulting in the formation of films of softened gutta-percha on the root canal surface. As a result, using instrumentation techniques (manual or mechanical) in retreatment is more effective and convenient than using a solvent [26, 27].

In endodontic retreatment, NiTi rotary files are becoming increasingly common. Working with NiTi rotary instruments has several benefits, including reduced working time and fatigue [28]. As a result, this research utilised NiTi rotary retreatment devices.

The volume of the remaining filling material was measured using cone beam computed tomography in this study. Given the importance of precisely determining the exact location and volume of residual filling material during retreatment procedures, the use of CBCT images may provide useful information for clinicians in the volumetric assessment of the amount of residual filling material in root canals [29].

Because of the complexity of the apical area of the root canal (intracanal isthmuses, constriction, and apical delta), which was observed in the majority of cases, the results of this study revealed that two rotary retreatment systems (R-Endo and EdgefileXR) left filling materials in the canal after retreatment for canals previously obturated by epoxy resin sealer (T-Seal)[30]. The current study found that the EdgefileXR retreatment system for T-Seal sealer was more effective than the R-Endo retreatment system in removing obturating materials. The superior effectiveness of Edgefile XR may be attributed to the fact that it is made of an annealed heat-treated nickel titanium alloy known as Fire-Wire TM, the heat treatment of which may improve the files' strength and mechanical qualities. Furthermore, because the cutting edges R-Endo instruments lack radial land and the tip is inactive, its cutting efficiency is reduced. In addition, the number of files in the Edgefile XR system is four, while R-Endo system has three files that effected on the efficacy of system in removal of obturating materials [31]. The results revealed that the samples obturated by Epoxy resin sealer and previously retreated by EdgefileXR files and then underwent supplementary retreatment by XP-Endo Finisher had volume of remaining filling material less than volume of remaining filling material in samples obturated by epoxy resin sealer and previously retreated by R-Endo files and then underwent supplementary retreatment by XP-Endo Finisher, this explained due to the effectiveness of EdgefileXR file in removing of filling material reinforced by using of XP-Endo Finisher.

According to the current study, we confirmed that the retreatment was reinforced by using of XP-Endo Finisher in the samples obtained by epoxy resin sealer and retreated by two retreatment systems (R-Endo and EdgefileXR). Therefore, it is advisable to use of a supplementary XP-Endo finisher after retreatment systems in failure endodontic treatments.

## CONCLUSION

None of the investigated systems have ability for complete elimination of the obturating materials. Better removal efficiency was evident when these systems followed by supplementary XP-Endo Finisher.

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