

Efficacy of a new retreatment system (R ENDO) in root canals obturated with gutta-percha using two different eugenol free sealers - An *in vitro* comparative study

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Abstract

To compare invitro, the efficacy of a new retreatment system (R Endo-micro mega) versus chemo-mechanical retreatment technique (H file and xylene), in the removal of root canal obturation material that used two different eugenol free sealers (Optura R and Epoxy plus). Forty human, single-rooted premolars were divided into two experimental groups. Group 1 was obturated with gutta-percha and Optura R sealer, Group 2 was obturated with gutta-percha and Epoxy plus sealer. Retreatment was done using the R Endo rotary retreatment files and H files with xylene. Root halves were visualized using magnifying loops at 3X magnification and optical stereomicroscope at 10X magnification. Images were analyzed using AutoCAD 2004 software to calculate area of the remaining debris in the canal. For statistical analysis were used variance test and ANOVA. **Results** obtained from the study showed significant difference in the middle and the apical third using both R Endo and H files in both the groups. **Conclusion:** R Endo retreatment system did not produce completely clean canals in any of the groups. However, it had the best efficacy towards removing Optura R sealer.

Keywords: Optura R, Epoxy plus, R Endo retreatment system.

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INTRODUCTION

The principle objective of endodontic therapy is to retain the tooth in proper form and function. However, Endodontic failure occurs even when the highest standard and the most meticulous treatment procedure is adhered to. *In vitro* studies have demonstrated micro leakage in canals filled with these materials that may allow ingress

and propagation of bacteria resulting in infection. The failure rate of root canal treatment has been reported to be 14 to 16%.¹ For successful retreatment complete removal of root canal sealers, obturating material and shaping of the previously untouched areas of the root canal system is necessary (Uzunoglu, 2015). When conventional root canal treatment fails, endodontic retreatment is the preferred option as it is one of the most conservative methods. Mostly operators emphasized on removal of obturating material only or partial removal of root canal sealers which can jeopardise further 3D obturation in retreatment. The main goal of retreatment is to regain access to the apical foramen by complete removal of the root canal filling material. Biomaterial centered biofilm form in root canal obturating material in failed endodontic cases and necrotic tissue and bacteria, covered by obturating material, may be responsible for periapical inflammation. Sealers along with solid obturating material acts synergistically to create hermetic seal. (Ingle, 2008)

Various techniques are used for removal of root canal sealers and obturating material such as hand instruments, heat pluggers, rotary instruments and ultrasonic devices. Rotary instruments have proved to be effective and time saving in removing the filling materials. (Hulsmann *et al*, 2004). Therefore as much as possible, the obturating material must be removed to reduce the number of micro-organisms within the canal. R-Endo retreatment files have been introduced which are designed specifically to remove obturating material from root canals. It comprises of two steps: coronal conditioning precedes re preparation of the canal, the latter can be achieved with a specific sequence using R-Endo retreatment system. It consists of four instruments: Re to flare the first few millimetres of canal, and three files R1, R and R3 dedicated to each root canal third. An optional finishing file Rs is also available. R-Endo retreatment files allow apical irrigation to aid the disinfection of the apical zone and ideal preparation of the canal for three dimensional filling. Efficiency, flexibility, parietal cleaning of the canal, respect of the canal anatomy, safety and short procedural time are the major advantages. Many obturating materials, techniques have been developed. Lateral compaction of gutta-percha is a commonly used method for obturation and is regarded as a reference when considering other obturation techniques. Different root canal sealers have been used such as zinc oxide based, eugenol containing, resin based sealers, formaldehyde based sealer, iodoform based, calcium hydroxide based, calcium phosphate based sealer, etc. Only few studies have investigated the effectiveness of R-Endo retreatment instruments in the removal of obturating material during endodontic retreatment. Also Several studies have reported that debris is left after root canal retreatment, regardless of the type of instrumentation, type of materials used and use or non-use of solvents.(Barrieshinusair, 2002, Hulsmann *et al*, 2004) Therefore, the aim of this study was to compare the efficacy of a new R Endo retreatment system in the removal of root canal obturated with gutta-percha using two different Eugenol free sealers

MATERIALS AND METHODS

Source of data and Type of study

In vitro study on human premolar teeth with single root canal extracted for orthodontic purpose.

Materials Used

17% EDTA solution (Prevestdentpro)
2.5% sodium hypochlorite solution (Prevestdentpro)
0.2% thymol solution
R –Endo files (Micro Mega, France)
10 K- files (Dentsply)
Guttapercha cones (Dentsply)
Optura R sealer(Xenon)

Epoxy plus sealer(Xenon)

Inclusion Criteria

Freshly extracted Single rooted premolar teeth for orthodontic purpose with straight root canal.

Materials and Methods

Specimen Preparation

Forty extracted humansingle-rooted, single-canal premolars with completely formed apices were selected for the study. Soft tissue and calculus were mechanically removed from the root surfaces using ultrasonic scalers. Teeth were autoclaved and stored in 0.2% thymol. They were then decoronated using diamond disk (Diatech Swiss Dental, Switzerland) to obtain root segments of 13mm length.

Root Canal Preparation And Obturation

Working length was determined by inserting a size 10 K file (Dentsply Maillefer) into the root canal until it was visible at the apical foramen and subtracting 1mm from that length. Rootcanal preparation was done using ProTaper universal rotary files (Dentsply Maillefer, Ballaigues, Switzerland) as per manufacturer's instructions. All canals were prepared uptoF2 ProTaper file. Irrigation was done after each instrument with 10mL of 2.5% NaOCl. When instrumentation of the root canals was completed, 17% ethylene diaminetetraacetic acid was used for 1 minute for smear layer removal, and the canals were again irrigated with 5mL of 2.5% NaOCl. The root Canals were then dried with paper points. Teeth were randomly divided into two experimental groups. Group 1 was divided into subgroup A and B obturated with gutta-percha and Optura R sealer using lateral compaction technique. Group 2 was divided into subgroup A and B was obturated with gutta-percha and Epoxy plus sealer using lateral compaction technique. The access cavities were sealed with glass ionomer cement (GC Corporation, Tokyo, Japan).Teeth were radiographed in buccolingual and mesiodistal direction to confirm the adequacy of root fillings. Thesamples were stored at a temperature of 37°C and 100%humidity for 2 weeks. Group 1 and 2 with subgroup A was removed using R Endo retreatment files and subgroup B using H files with xylene.

Root Canal Retreatment Using R Endo Files

After the canals are obturated R Endo retreatment files (Rm, Re, R1, R2, R3) are used. Rm is placed inside the canal 1/4 turn with the pressure directed towards the apex. Re is placed inside the canal 1 to 3 mm under pulp chamber floor, apical pressure is stopped as soon as the instrument requires force to penetrate. Circumferential filing is done.R1 file is placed, repeated penetration with limited pushing action in apical direction(push and retain) from coronal third to beginning of middle third is prepared.R2 file is placed, repeated penetration with limited pushing action in apical direction(push and retain)

from middle third to beginning of apical third is prepared. R3 file is placed, repeated penetration with limited pushing action in apical direction (push and retain). Inserted till working length.

Method

Forty extracted human single-rooted, single-canal premolars with completely formed apices extracted for orthodontic purpose were selected for the study. Soft tissue and calculus were mechanically removed from the root surfaces using ultrasonic scalers. Teeth were autoclaved and stored in 0.2% thymol. They were then decoronated using diamond disk to obtain root segments of 13mm length. The Working length was determined by inserting a size 10K file (Dentsply Maillefer) into the root canal until it was visible at the apical foramen and subtracting 1mm from that length. The samples were randomly divided into two main groups with subgroups A and B of ten sample each. Sub group B acts as control.

ROOT CANAL FILLING REMOVAL

After the canals are obturated R Endo retreatment files (Rm, Re, R1, R2, R3) are used. Rm is placed inside the canal 1/4 turn with pressure directed towards the apex Re is placed inside the canal 1 to 3 mm under pulp chamber floor, apical pressure is stopped as soon as the instrument requires force to penetrate. Circumferential filing is done. R1 file is placed, repeated penetration with limited pushing action in apical direction (push and retain). from coronal third to beginning of middle third is prepared. R2 file is placed, repeated penetration with limited pushing action in apical direction (push and retain), from middle third to beginning of apical third is prepared. R3 file is placed, repeated penetration with limited pushing action in apical direction (push and retain). Inserted till working length



Figure 1: Root canal area with filling debris

Analysis of Filling Debris

The roots are grooved longitudinally in the buccolingual direction with a diamond disk and split into halves with a chisel. The two halves are visualized using magnifying loops at 3X magnification. The segment with a greater amount of filling debris is then taken for examination under an optical stereomicroscope at 10 X magnification. Images are captured with a digital camera coupled to the stereomicroscope and analyzed using AutoCAD 2004 software (Mechanical Desktop Power Pack; Microsoft, Redmond, Wash, USA). Canal walls and filling debris are identified based on the difference in the color. A single operator uses the software tool to outline the canal area and the filling debris area in each third (cervical, middle, and apical), as well as the total canal area. The filling debris/canal area ratios are considered as a unit of analysis and expressed as a percentage of filling material left after reinstrumentation.

Statistical Analysis

The analysis is carried out in SPSS 20 using t test. A p value of 0.05 is considered to be statistically significant.



Figure 2: Armamentarium



RESULTS

Both the groups in the study had some filling material left in the root canal after retreatment with R Endo

retreatment files. The maximum percentage of remaining debris was in the H file group with Epoxy plus sealer followed by the H file group with Optura R sealer. In both groups, the apical third had maximum remaining debris. There was a statistical significant difference found in the percentage of remaining debris between the R endo and H file using optura R ($p < 0.05$). There was a statistical difference found in the percentage of remaining debris between the R endo and H file using Epoxy plus sealer ($p < 0.001$).

Table 1: Mean value and standard deviation of remaining debris on canal surface in Coronal third

Coronal Third	N	Mean	Sd
R Endo and optura R sealer	10	0.31	0.04
H file and optura R sealer	10	0.35	0.02
R Endo and Epoxy plus sealer	10	0.32	0.02
H file and Epoxy plus sealer	10	0.34	0.02

Table 2: T value and p value of remaining debris on canal surface in Coronal third

Coronal Third	T Value	P Value
R Endo and H file using Optura R	1.94	0.06
R Endo and H file using Epoxy plus	1.69	0.108

Table 3: Mean value and standard deviation of remaining debris on canal surface in Middle third

Middle Third	N	Mean	Sd
R Endo and optura R sealer	10	0.49	0.04
H file and optura R sealer	10	0.52	0.02
R Endo and Epoxy plus sealer	10	0.48	0.04
H file and Epoxy plus sealer	10	0.56	0.03

Table 4: t value and p value of remaining debris on canal surface in middle third

MIDDLE THIRD	t VALUE	P VALUE
R Endo and H file using Optura R	3.01	0.03
R Endo and H file using Epoxy plus	2.09	0.00**

Table 5: Mean value and standard deviation of remaining debris on canal surface in Middle third

APICAL THIRD	N	MEAN	SD
R Endo and optura R sealer	10	0.51	0.04
H file and optura R sealer	10	0.54	0.01
R Endo and Epoxy plus sealer	10	0.52	0.04
H file and Epoxy plus sealer	10	0.57	0.03

Table 6: t value and p value of remaining debris on canal surface in apical third

Apical third	t value	P value
R Endo and H file using Optura R	3.02	0.02*
R Endo and H file using Epoxy plus	2.12	0.00**

DISCUSSION

Endodontic nonsurgical retreatment is a comprehensive field with its own science, literature, specific technologies, best materials, and escalating range of

techniques that are, at times, required to achieve clinical success¹⁰. Complete removal of preexisting filling material from canals is prerequisite for successful nonsurgical root canal retreatment. R-Endo retreatment files allow apical irrigation to aid the disinfection of the apical zone and ideal preparation of the canal for three dimensional filling. Efficiency, flexibility, parietal cleaning of the canal, respect of the canal anatomy, safety and short procedural time are the major advantages. R Endo retreatment files has Rm, Re, R1, R2, R3 files.. Rm is placed inside the canal 1/4 turn with the pressure directed towards the apex. Re is placed inside the canal 1 to 3 mm under pulp chamber floor, apical pressure is stopped as soon as the instrument requires force to penetrate. Circumferential filing is done. R1 file is placed, repeated penetration with limited pushing action in apical direction (push and retain) from coronal third to beginning of middle third is prepared. R2 file is placed, repeated penetration with limited pushing action in apical direction (push and retain) from middle third to beginning of apical third is prepared. R3 file is placed, repeated penetration with limited pushing action in apical direction (push and retain). Inserted till working length Different techniques have been used to evaluate there maining filling material: radiographs¹¹, clearing techniques and digitized images¹², operating microscopes¹³, and scanning electron microscopy (SEM)¹⁴. Residual gutta-percha and sealer have been measured using evaluationscales, for example, mild, moderate, and severe¹⁵. More recently micro-CT has been used¹⁶. In the current study, an optical stereomicroscope issued to visualize the remaining filling material. The roots were visualized using magnifying loops at 3X magnification before selecting the half for stereomicroscopic analysis. This gave a clearer picture of the remaining debris as compared to naked eye visualization and helped in selecting the appropriate root half for further analysis. The AutoCAD 2004 software gave the exact area of the remaining debris in the root canal. This method is more precise as compared to the evaluation scale which is a subjective procedure and is bound to have subjective errors. Two obturating materials selected for the study are eugenol free, non resorbable. Group 1 is optura R an epoxy, eugenol free sealer, it is non resorbable and does not shrink on setting. It makes the canal alkaline while setting due to the inherent chemical reaction. Once mixed it makes for a fine creamy paste that can be easily inserted inside the canal. Gives hermetic seal and highly radiopaque. Group 2 is Epoxy plus sealer, it is non resorbable and does not shrink on setting. it makes the canal alkaline while setting due to the inherent chemical reaction. Once mixed it makes for a fine creamy paste that can be easily inserted inside the

canal and contains only titanium dioxide as a radio opaque material. Due to this it does not stain tooth much and gives a hermetic seal. In the current study, all groups had some amount of remaining debris. Studies have shown that the depth of penetration of root canal sealers into dentinal tubules using the lateral compaction technique is influenced by the root canal level, with penetration decreasing apically¹⁹. Obturation done using lateral compaction technique tends to result in better condensation of obturating material²³, and this type of obturation is more difficult to remove as compared to the cold flowable Gutta Flow. In this study lateral compaction technique is used. The two groups in the study have some amount of obturating material left within the root canal after retreatment with R Endo and H files using Optura R and Epoxy plus sealer. But R endo is more efficient compared to H files as it has three equally spaced cutting edges and it works with circumferential filing action. In the coronal third there is no significant difference found between R Endo and H files group using Optura R. Also there was no significant difference observed between R Endo and H files group using epoxy plus. Only a least amount of debris remaining found in the coronal third in both the groups. In the middle third there was a significant difference found between R Endo and H files using Optura R with a $p < 0.05$. Also there was a significant difference observed between R endo and H file using Epoxy plus with $p < 0.001$. It can be inferred that higher debris was found in the H files using Epoxy plus. In the apical third there was a significant difference found between R endo and H files group using Optura R with $p < 0.05$. Also there was significant difference observed between R endo and H files group using Epoxy plus with $p < 0.001$. It can be inferred that higher debris was found in the H files using Epoxy plus. In both the groups, the apical third had a mean percentage of remaining filling materials that is greater than the middle and the coronal. This has been attributed to increased anatomical variability and difficulty of instrumentation of the apical third. Group 2 using epoxy plus had significantly greater total debris compared to Group 1 using Optura R sealer, this is probably due to the higher setting time and low shrinkage stress hence that gives better sealing ability of epoxy plus²⁴.

CONCLUSION

It can be concluded that¹ R Endo retreatment files did not produce completely clean canals in both the groups but more efficient than H files and xylene² it showed better efficacy towards removing Optura R when compared to Epoxy plus sealer. In both the groups maximum amount of filling debris was found in the apical third. Therefore

further research is necessary to check the efficacy of R Endo retreatment files in different type of canals.

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