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Original Research Paper

Endodontics

EVALUATION OF ENDODONTIC RETREATMENT ROTARY FILE SYSTEM FOR REMOVAL OF GUTTAPURCHA AND THREE DIFFERENT SEALERS- AN INVITRO STUDY

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ABSTRACT

Objectives: The aim of this study was to compare and evaluate the efficacy of rotary ProTaper retreatment (PTR) files, in the removal of filling materials from the root canal system of extracted human mandibular first premolars. **Materials and methods:** Sixty human mandibular first premolars were collected, stored, and cleaned. Standardization of all specimens was done to 15 mm length. All specimens were prepared upto F2 size using the PTU file system and obturated with F3 gutta-percha using AH 26, Znic oxide and Gutta flow sealer. After coronal sealing, all teeth were stored for 1 week and then divided into three groups of 1. Time taken for retreatment in each group was noted. After retreatment, all teeth were longitudinally sectioned, imaged under stereomicroscope, and scored. Data analysis was done using one-way analysis of variance . **Results:** ProTaper retreatment files showed significantly less residual filling material with respective of sealer used. **Conclusion:** In all groups amount of remaining debrise is proportion on type of sealer used N. In all groups ProTaper retreatment files were most efficient in the coronal third, whereas PTN files were most efficient in the middle and apical third. Clinical significance: Irrespective of the file system used, root filling material is left behind, which may lead to failure of the treatment, and so an efficient retreatment file system is required.

KEYWORDS : Root canal retreatment , NiTi retreatment files seales Guttaflow

INTRODUCTION

Succes in Root canal therapy is not always a guarantee, failure may occur [1, 2]. When conventional root canal therapy fails, retreatment option is preferred as it is the most conservative method, success for retreatment may vary from 40%–100% [3].

In endodontic retreatment the main goal is to regain access to the apical foramen by complete removal of the root canal filling material. Meticulous cleaning and shaping of the root canal system is necessary as necrotic tissue or bacteria, covered by obturating material or sealer, may be responsible for periapical inflammation or pain. Most frequently Enterococcus faecalis, followed by Streptococcus species and Tannerella forsythia are found in poorly root-filled teeth associated with periradicular lesions [4].

Most common cause of failure of root canal treatment is E. faecalis which can invade dentinal tubules and facilitate protection [5]. Balstospores of candida albicans and spirochetes has been found on the microbial biofilms on gutta percha [6].

Now a days Nickel-titanium (NiTi) rotary instruments were used for the removal of filling materials from root canal walls, and various studies have reported their efficacy, cleaning ability, and safety.[7]

More recently, ProTaper nickel-titanium (NiTi) rotary system has been upgraded to the ProTaper Universal rotary system (Tulsa Dental, Tulsa, OK), which offers, in addition to shaping and finishing instruments, retreatment files designed specifically to remove obturation material from root canals.

This system comprises 3 flexible instruments D1, D2, and D3, of tapers and tip diameters equivalent to 0.09/0.30 mm, 0.08/0.25 mm, and 0.07/0.20 mm, respectively. The lengths are 16 mm for D1, 18 mm for D2, and 22 mm for D3. The retreatment files have a convex triangular cross section, which is similar to the ProTaper shaping and finishing files. In addition, D1 has a working tip that facilitates its initial penetration into the filling materials.

Single cone obturation along lateral compaction of gutta-percha is a commonly used method for obturation and is regarded as a reference when considering other obturation techniques. quality of adaptation between the surface of the root canal and gutta-percha is uncertain in fillings using lateral compaction technique.[8]

Thus, efforts have been pursued to find the canal filling material or obturating system that provides three-dimensional sealing that can be removed easily.

Recently, GuttaFlow (Coltène/Whaledent, Langenau, Germany) was introduced into the market as a new material for obturation that includes the combination of gutta-percha in powder form and polydimethylsiloxane-based sealer. Nanometer-sized particles of silver were added to gutta-percha powder, acting as a preservative. It is the first non-heated flowable gutta-percha.

There is limited information about the removability of this new canal filling method and materials for re-treatment purpose [9].

Different techniques can be used to evaluate the remaining filling material. Radiographs have been used extensively [18, 19, 10]. Clearing techniques and digitized images[11], Operating microscopes[12] have also been used. Roots have been split longitudinally, and the residual gutta-percha and sealer were measured linearly using evaluation scales: e.g. severe, moderate, mild or no retreatment debris[13]. Halves of the roots can be photographed using a flat-bed scanner and the scanned images can be evaluated using the various image analysis software [14]. More recently micro-CT has been used to evaluate debris [15]. Canal wall cleanliness can also be evaluated through scanning electron microscopic (SEM) analysis and optical stereo microscopy (OSM)[12,16]. Optical microscope can be used along with image analysis software to give the area of the remnant debris in the canal.

Review of the literature revealed that only a few studies investigated the effectiveness of these new ProTaper Universal retreatment instruments in the removal of obturating material during endodontic retreatment and also few studies have evaluated the removability of GuttaFlow during retreatment.

Aims and objective

The aim of this study is to compare the efficacy of ProTaper retreatment files in the removal of root canal fillings with Gutta-percha and AH Plus sealer , Gutta-percha and Zinc oxide eugenol and Guttaflow obturating system ,using optical stereomicroscope.

MATERIAL AND METHODS

After institutional ethical approval, sixty mandibular first premolar extracted for orthodontic/periodontic reason were selected for the study. Single canal and closed apex were confirmed by radiograph. Soft tissue and calculus were mechanically removed from the root surfaces using ultrasonic scalers. Teeth were stored in 0.2% thymol. Decoronation was done at the level of cemento enamel junction to obtain root segments of approximately 13mm in length

Root Canal Preparation

The working length was determined by 10 K-file into the root canal. Root canal preparation was done using ProTaper Universal rotary files (Dentsply Maillefer) as per manufacturer's instructions. A reproducible glide path with hand file was established. Canals were then shaped using S1, S2, F1 and F2 files upto the working length. Irrigation was done after each instrument with 1 ml of 2.5% NaOCl. EDTA was used as a lubricant and final flush was done with 5 ml of saline solution.

Teeth were randomly divided into three experimental groups.
Group 1- Obturation with Gutta-percha and AH Plus sealer using lateral compaction technique
Group 2- Obturation with Gutta-percha and Zinc oxide eugenol sealer using lateral compaction technique
Group 3- Obturation with Guttaflow obturating system

Obturation

In group 1, canals were obturated with gutta-percha master cone, accessory cones and AH plus sealer using Lateral compaction technique.

In group 2, the obturation technique used was same as that of group I except that Zinc- Oxide eugenol sealer .

In group 3, obturation was done using Guttaflow sealer. Post obturation restoration was done using GIC typeII.The samples were stored in 100% humidity for 2 weeks.

Root Canal Re-treatment

Root fillings were removed using the ProTaper Universal NiTi rotary retreatment files as per manufacturer's instructions. A pilot hole was established using a small hand file. The canals were instrumented in a crown-down sequence using ProTaper D1 file to remove filling material from the coronal portion of the root canal. Middle and apical third of the canals were instrumented using ProTaper D2 and ProTaper D3 files, respectively, using a brushing action with lateral pressing movements. Irrigation was done in between with 1 ml of 2.5% NaOCl . Retreatment was deemed complete when the last file reaches the working length, there is no filling material covering the instrument, the canal walls appear smooth and free of debris.

Analysis Of Debris

The roots were grooved longitudinally in a bucco-lingual direction with a diamond disk and split into halves with a chisel. The two halves were then visualized using magnifying loops at 3X magnification. The root half with greater amount of filling debris was taken for examination under an optical stereomicroscope at 10 X magnification.

Images were captured with a digital camera coupled to the microscope and analyzed using AutoCAD 2023 software (Mechanical Desktop Power Pack; Microsoft, Redmond, WA.Canal walls and filling debris were identified based on the difference in the color. A single operator used a specific software

Statistical Analysis

The filling debris /canal area ratio were considered as a unit of analysis and expressed as percentage of filling material left after reinstrumentation.

The analysis was carried out in SPSS 16 using Repeated Measures Analysis of Variance and ANOVA and a p value of 0.05 was considered to be statistically significant.

First the canal thirds (apical, middle and coronal) within each group were compared. Secondly intergroup comparison was done within each canal third. Repeated Measures Analysis of Variance was used for this part of statistical analysis. Finally intergroup comparison using ANOVA considered the total canal area to calculate the filling debris/ canal area ratio.

RESULTS

All the three groups used in the study had some filling material left inside the root canal after reinstrumentation with protaper rotary retreatment files.

Table 1 presents the Mean (SD) filling debris area/ canal area ratio obtained in the coronal, middle & apical third and also in the total canal of the studied groups.

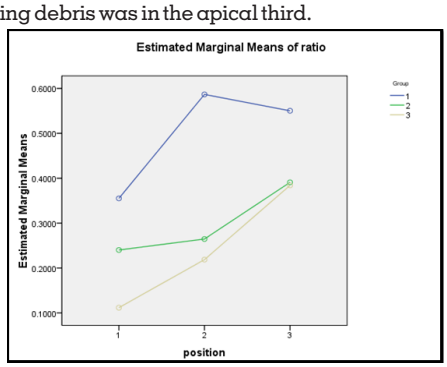
Groups	Coronal third	Middle third	Apical third	Total canal
G1	**0.35 (0.18)**	**0.59 (0.20)**	**0.55 (0.45)**	**0.45 (0.16)**
G2	**0.24 (0.14)**	**0.26 (0.24)**	**0.039 (0.22)**	**0.27 (0.13)**
G3	**0.11 (0.05)**	**0.21 (0.19)**	**0.38 (0.28)**	**0.18 (0.08)**

Group (i)	Group (j)	Mean difference	95% confidence interval		p value
1	2	.1837529	0.066	0.30	.001
2	3	-.0847673	0.03	-0.20	.197
1	3	-.2685202	0.15	0.38	.000

Significant at 5% level

The **graph 1** shows that the maximum percentage of remaining debris was in group 1 followed by group 2. Least amount of remaining debris was in group 3.

In group 1, the middle third of the canal had maximum amount of debris remaining whereas in groups 2 & 3, maximun remaining debris was in the apical third.



However, when the debris ratio was compared at each position (coronal, apical & middle) across the three groups there was no statistically significant difference (p=0.272).

One way analysis of variance was used to test whether the total debris /canal area ratio differs between the three groups. There was a statistically significant difference with p<0

DISCUSSION

A growing interest in endodontic retreatment has been seen as a result of an increasing demand to restore failed teeth. Whenever feasible, nonsurgical retreatment should be performed over surgery[3].

Complete removal of pre-existing filling material from canals is a prerequisite for successful nonsurgical root canal retreatment11. This procedure uncovers residual necrotic tissues or bacteria that may be responsible for persistent periapical inflammation, and allow further cleaning and refilling of the root canal system [17,11].

A variety of different techniques have been used for removing filling materials such as manual use of endodontic hand files and automated rotary files. Advantages of rotary files include less tedious and shorter working time, whereas disadvantages include higher incidence of file fracture and more remaining filling material after retreatment[11,18].

The present study aimed at evaluating the efficacy of Protaper retreatment files in removing different obturating materials. All three obturating materials selected for the study were gutta-percha based. The difference was present between the types of sealer used in each group. Group 1 was an epoxy-resin based sealer, Group 2 was zinc oxide eugenol based sealer and group 3 contained a silicone based sealer, poly dimethylsiloxane.

For all groups, none of the Protaper rotary retreatment files showed intracanal failure. This may be because the active tip of the D1 facilitates easy penetration of the files as opposed to the shaping files (S1–S2) of the original ProTaper System that cannot penetrate the gutta-percha easily causing file tip fracture.

Furthermore, no perforations, blockages, or ledging were recorded. Working length was regained in all canals. This may be because of the nonactive tips of D2 and D3 which reduce the incidence of ledging, perforation, and stripping during the removal of filling material.

In the present study an operating microscope was used after re-instrumentation to visualize the cleanliness of the canal walls. After splitting the roots longitudinally first a magnifying loop at 3X magnification was used to visualize the two halves. The root half with greater amount of filling debris was taken for examination under an optical stereomicroscope.. Visualizing the halves under magnifying loops gave a clearer picture of the remaining debris and selecting that half for further analysis was easier.

The AutoCAD 2023 software used in this study gave the exact area of the amount of remaining debris in the entire root canal and also in the coronal, middle & apical third of the canal.

Accordingly, we see that all three groups had some amount of remaining debris. This is in accordance to all previous studies in which completely clean canal walls were not produced by any of the techniques investigated[10,12,19].

In group 2 & Group 3 the apical third had a mean percentage of remaining filling material greater than the middle and the cervical third. This may be due to increased anatomical variability and difficulty of instrumentation of the apical third. This finding is consistent with previous studies done by Valentina Giuliani et al and Francesco Somma et al [20]. The existence of curvatures in many planes of deep grooves and depressions on dentine walls in the apical third may well explain the presence of these less instrumented areas.

Moreover the master apical file size was F2 which has a tip diameter of 0.25 whereas the tip diameter of D3 file, used to clean the apical portion of the root canal was 0.20, which means the D3 file tip did not bind to the canal walls and permit a complete cleaning action. This indicates that further root canal filing with files of larger diameter may be necessary to completely remove the obturating material from the apical part of the root canal.

In group 1 the middle third had a greater mean percentage of remaining debris. Similar finding was as reported by Zmener et al that is more filling debris was left in the middle third of canals re-instrumented with rotary instruments [12]. Kosti et al also observed a greater amount of resin-based sealer (AH 26) in the middle third using rotary instrument [10]. He speculated that it could be because resin-based sealers have better adhesion to dentin walls; their removal from root canals with rotary instruments is more difficult.

Similarly for the present study it can be speculated that more debris was present in the middle third of Group 1 because epoxy resin based sealer adhere better to the dentin walls and the middle third of the root canal has greater compaction of gutta-percha and sealer making removal of obturating material difficult.

It was demonstrated that significantly less debris was present in the coronal third in all group, a finding consistent with other reports (Imura et al. 2000, Sae-Lim et al. 2000)

When the total canal debris in each group was compared group 1 had significantly more debris as compared to group 2 and group 3. The sealer used in each group was different. As each sealer had different constituents and adhesive behaviour it is not surprising that varying amounts of materials remained.

In a study conducted by Economides et al it was seen that AH26 is denser and more compact compared with a zinc oxide-based sealer [21]. Mamootil K, demonstrated that epoxy resin-based sealer AH26 displayed deeper and more consistent penetration compared with the ZnOE based sealer Pulp Canal Sealer[22].

Silicone-based sealers are inert and biocompatible, yet no information is available on their adhesion to dentine. However, Kosti et al reported that RoekoSeal, which is considered as the initial form of GuttaFlow, was removed more easily from the canals than AH 26 sealer [10].

In the present study the sealer used in group 1 is an epoxy resin-based sealer. Hence greater amount of remaining debris in group 1 could be due to adhesion and greater penetration of epoxy resin based sealer as compared to zinc oxide eugenol based and silocone based sealer.

The GuttaFlow group had less remaining filling material when compared with the other groups. That might be due to the fact that teeth filled by lateral compaction, does not create a homogeneous mass of gutta-percha and tends to entrap pools of sealer between the gutta-percha cones. It also tends to result in better condensation of obturating material. (Nguyen 1994)[23]. This type of obturation is more difficult to remove as compared to the cold flowable GuttaFlow which gave a consistent homogeneous filling.

We observed that ProTaper Universal Tulsa retreatment files could remove gutta-percha from the canals in large pieces around the spirals of instruments. The specific flute design and rotary motion of the ProTaper Universal retreatment instruments tend to pull gutta-percha into the file flutes and direct it towards the orifice. Furthermore, it is possible that the rotary movements of engine-driven files produce a certain degree of frictional heat which might plasticize gutta-percha. The plasticized gutta-percha would thus present less resistance and be easier to remove (Betti & Bramante 2001) [24].

The results of the present study show abnormal distribution of the percentages of total area of remaining filling material. In some specimens it was distributed along the entire root canal wall, resulting in a significantly greater percentage of debris as compared to other specimen which showed significantly very less percentage of remaining debris.

This abnormal distribution could be because of the extent of the anatomical variations that are generally present in human

teeth. Variations in original root canal morphology greatly influence the changes that occur after root canal preparation (Peters et al. 2001)[25] and as a logical extension, after retreatment procedures.

It should be considered that hand files can be precurved and directed to the regions in which the tactile sensation indicates the presence of filling material.

Therefore, the combined use of hand and rotary instruments would be a good option to improve canal cleanliness. Considering the limitations of removing root-filling materials from canal walls, extensive canal re-preparation is also required for complete cleaning of the root canal.

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