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Evaluation of Gutta Percha removal from different NITI rotary file system: An *in vitro* study

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Abstract

The main goal of endodontic retreatment is cleaning and shaping of the root canal with removal of old root filling material. Hand instruments and rotary instruments are mainly used for removing this filling material; as hand instruments are time consuming and tedious so we used rotary instrumentation for removal of gutta percha. The main aim of this study is to compare the relative efficacy of three different NI TI rotary instrumentation systems for removal of gutta-percha from root canal during endodontic retreatment.

Materials and Methods: Sixty freshly extracted, single-rooted human anterior teeth were instrumented with K-files, and each root canal was filled with gutta-percha and AH Plus (Dentsply Detrey, Konstanz, Germany) sealer using lateral compaction. Specimens were then divided into three experimental groups with ten specimens each. The removal of gutta-percha was performed using Pro-Taper retreatment files, Mtwo retreatment files, and Edge file XR. The amount of root canal filling material remnant in the coronal, middle and apical thirds was measured using stereomicroscope.

Result: The data was evaluated statistically using analysis of variance. Pro-Taper group was found to have less remnant filling material as compared to the other groups in coronal and middle thirds, but a significant difference was observed between edge file XR and Mtwo.

Conclusions: It was concluded that EDGE FILE XR, rotary retreatment system proved to be the most efficient method of removing gutta-percha and sealer in comparison to the other two retreatment files and M-TWO retreatment files required less time to remove root filling material than the other instruments.

Keywords: Gutta percha removal, Edge file XR, M Two, retreatment files

1. Introduction

The vast increase in endodontics can be described as the “good news- bad news dilemma”. The “good” news is that hundreds of millions of teeth are salvaged through the combination of endodontics, periodontics, and restorative dentistry. The “bad” news is that tens of millions of endodontically treated teeth are failing each year for a variety of reasons. Therefore, the future of endodontics will include dealing with the treatment of its failures. Root canal treatment enjoys a high success rate all over the world and has saved billions of teeth from extraction. However, there are instances of failure, the main causes being insufficient cleaning and inadequate obturation. In such cases the most conservative treatment option would be non-surgical retreatment. It requires regaining access to the entire root canal system through removal of the original root canal filling thus permitting further cleaning and re- obturation. Removal of gutta-percha and sealer becomes a critical step to gain access to the root canal system, remove necrotic tissue debris, bacteria and infected dentin.

It is necessary to identify the optimum file system that will allow most effective removal of obturation material from the root canal. Several techniques can be used to remove the gutta-percha, including the use of stainless steel hand files nickel-titanium (NiTi) rotary instruments heat-bearing instruments, ultrasonic instruments and lasers. The usage of rotary instruments in the retreatment process presents advantages concerning clinical time reduction. Two new NiTi systems have recently been designed for gutta-percha removal.

They are the Edge file xr, Pro-Taper Universal retreatment files (Dentsply Maillefer, Ballaigues, Switzerland) and Mtwo retreatment rotary files (Sweden and Martina, Padova, Italy). Maximum removal of gutta percha and sealer followed by re-instrumentation is very crucial for successful re-treatment. As the bacteria or fungi surviving and thriving under the gutta percha and sealer have to be removed. Gutta percha can be removed using K or H files along with chemical solvents. Alternatively, it can also be removed from the coronal portion using gates glidden drills or heated pluggers followed by the use of ultrasonics, lasers or NiTi rotary files for the remaining part of the canal. Pro-Taper instruments (Dentsply-Maillefer Ballaigues, Switzerland) have a convex triangular cross-sectional design with different shafts. A new NiTi rotary system, Pro-Taper Universal Tulsa (Dentsply Tulsa, Tulsa,) is introduced. This new system is integrated with 3 Pro-Taper retreatment files, D1, D2, D3. The 3 Pro-Taper Universal System retreatment files (PTUS) are designed to facilitate the removal of filling material. Each file has different lengths, tapers, and apical tip diameters. Mtwo Retreatment Files consist of two instruments of 21mm length with active cutting tip: R1 (size 15, 0.05 taper) and R2 (size 25, 0.05 taper). They have S- shaped cross-section but a shorter pitch length to enhance the advancement of the file into the filling material. They are used at a speed of 250-350rpm and a torque of 120gcm. These instruments are characterized by two cutting edges, which cut dentine effectively. Thus, the purpose of this in vitro study was to evaluate and compare the efficacy of three rotary retreatment file systems: Pro-Taper universal retreatment files, Mtwo retreatment files and hand files (Hedstrom Files) in the removal of root canal filling material during root canal retreatment.

Materials and Method

A total of thirty extracted permanent maxillary and mandibular anterior teeth, verified radio-graphically to have single canal were collected. To achieve a certain degree of uniformity, the teeth were carefully distributed into three groups of ten teeth each, according to canal length and width. The teeth were wrapped with saline saturated cotton wool and stored at 370 C between each experimental stage of the study to simulate oral conditions.

Root canal preparation was done by a step back technique using K-flex files apically to master apical file size 55. During cleaning and shaping the root canals were irrigated with 5% Sodium hypochlorite. Lateral condensation technique was used for obturation. The canals were obturated using size 55 master gutta percha cones. AH plus was used as a sealer. The access cavities were temporized to serve as barrier to the ingress of fluids. Teeth were radiographed to confirm the adequacy of the root canal obturation. The teeth were restored at 370 C, in saline saturated cotton wools.

RETREATMENT TECHNIQUE: The temporary restorations were removed. For all teeth, the cervical middle and apical two thirds of the gutta percha/ sealer were retreated according

to one of the three methods described. All the rotary instruments were used at a constant speed of 300 rpm and torque recommended by the manufacturers. Rotary instrumentation of the Pro-Taper Edge file XR and Mtwo retreatment files was performed using a 16:1 reduction gear handpiece with an electric motor (X-Smart; Dentsply, Ballaigues, Switzerland)

Group 1: Pro Taper retreatment system

All the 3 Pro-Taper Universal System retreatment files were used sequentially with crown down technique, until the working length was reached using a brushing action with lateral pressing movements. The D1 Pro-Taper file was used to remove the filling material from the cervical third of the root canal. A D2 Pro-Taper file was used in the coronal two thirds of the root canal. The D3 Pro-Taper file was used with light apical pressure until the working length was reached and no further filling material could be removed.

Group II: Mtwo retreatment system

The Mtwo retreatment file was used according to the manufacturer’s instructions. Retreatment was initiated by placing tip of R2 size 25, 0.05 taper retreatment file on the gutta-percha. The canals were instrumented to the working length using Mtwo R2 file with circumferential filing and a lateral pressing movement. Progression of the rotary files was performed by applying slight apical pressure and frequently removing the files to inspect the blade and clean the debris from the flutes

Group III : EdgeFileXR

R1 (25/0.12), R2 (25/0.08), R3 (25/0.06) and R4 (25/0.04) files were used in crown- down manner with light to medium pressure in apical way, respectively. The sequence was repeated until R4 reaches to WL. Final apical preparation was then performed using the Edge File X3- C4 file (size 40/0.06 taper). As a safety feature the files are designed to unwind. They may be used until the files unwind backward

Result

All instruments left filling material inside the root canal. The specimens retreated with the EdgeFile XR left less filling material inside the root canals than other groups but significance difference was found between EdgeFile XR and M-Two. The amount of remaining gutta-percha and sealer were evaluated. The roots were grooved and split longitudinally using a chisel after which the coronal, middle and apical thirds of the specimens were examined under stereo microscope 20 X magnification (Lieca MS 5, Germany). The specimens were photographed with a camera which was attached to stereomicroscope after which the images were evaluated using AUTOCAD software using a formula:

$$\text{Volume \% of remaining filling material} = \frac{\text{Volume of remaining filling material}}{\text{Volume of original filling material}} \times 100$$

Table 1: Time Taken For Complete Procedures in Different Groups

S.NO	Group	No. of Samples	Mean Time Taken	Minimum	Maximum	S.D
Group I	Edge File Xr	10	5.41	3.49	7.04	1/02
Group II	Pro-Taper Universal	10	6.09	4.06	8.85	1.24
Group III	M -Two	10	5.06	3.03	5.23	0.65

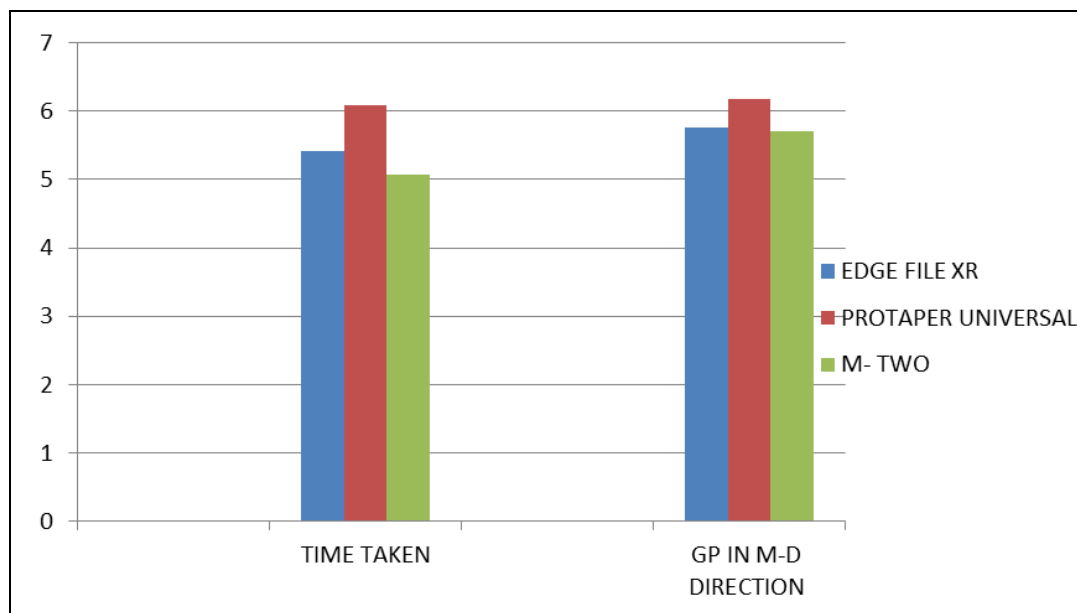


Fig 1: Bar Digramatic Representation of Stastical Analysis

Discussion

We had no broken rotary instruments, probably due to the utilization of low-torque motor with constant speed. In addition, each set of instruments only prepared five root canals and the application of solvent xylene also helped to prevent iatrogenic errors like broken instruments.

Efficacy of the Pro-Taper Universal rotary retreatment system for gutta-percha removal from root canals was evaluated by Gu *et al* [2]. It was concluded that all techniques left gutta-percha/sealer remnants on root canal walls. The Pro-Taper Universal rotary retreatment system removed gutta-percha more efficiently compared with other traditional techniques with Hedstrom files and K-files. The better performance of Pro-Taper Universal retreatment instruments was attributed to the three progressive tapers and length design of D1, D2 and D3 files. Our study concurs with Gu *et al*. Efficacy of two rotary NiTi instruments in the removal of gutta-percha during root canal retreatment in comparison with hand Hedstrom files was evaluated by Saad *et al*. It was concluded that Pro-Taper and K3 required significantly less time for filling material removal than hand instruments. This finding could probably be due to the inherent characteristic design of Pro-Taper and K3 rotary files. Our study agrees with study by Saad *et al*. Effectiveness of the Mtwo R, Pro-Taper retreatment files and a Hedstrom manual technique in the removing gutta-percha, Resilon and EndoRez was compared by Somma *et al*. It was found that all instruments left remnants of all the filling material and debris on the root canal walls irrespective of the root filling material used. Both the engine-driven NiTi rotary systems proved to be safe and fast devices for the removal of endodontic filling material; confirmed by our study.

Efficacy of the R-Endo rotary NiTi instrumentation system and hand instrumentation to remove gutta-percha or Resilon from root canals was evaluated by Fenoul *et al*. It was concluded that time to reach the working length and for removal of filling was lower with R-Endo than with Hedstrom files³. This is probably due to instrument design of R-Endo; the results of present study confirm these findings. Overall NiTi rotary instruments were more effective than stainless steel H-files in the removal of root filling material.

In this study, Mtwo retreatment files left less gutta-percha followed by Pro-Taper retreatment files and Hedstrom files.

Among all the systems, better performance of M two retreatment files is attributed to the design of the instrument. The M two retreatment files have an S-shaped cross-section, an increasing pitch length in the apical-coronal direction and a cutting tip. Therefore, these instruments are characterized by a positive rake angle with two cutting edges. The cutting blades form long, vertical spirals ensuring better control of instrument progression through the canal. As they have sharp blades, it is possible to cut through the canal and reach the apical end-point whilst by passing obturation material. Also, unlike some of the NiTi instruments, Mtwo rotary instruments do not require a crown-down instrumentation sequence.

The major goal of root canal treatment is to clean and shape the root canal system and seal it in three dimensions to prevent reinfection and retain the tooth with durable outcome. Although initial endodontic therapy has been shown with a high degree of predictable success, failures can also occur often due to various procedural and non procedural errors.

Compared to primary root canal therapy non-surgical retreatment procedure leads to more extrusion apically. When endodontic retreatment is performed, irritants in the form of filling materials, necrotic pulp tissues, bacteria or irrigants are introduced into the apical region. This leads to post-operative pain and discomfort due to post-operative inflammation and flare ups leading to failure of periapical healing.

An epidemiological study was done by Kvist T *et al.*, to know the success of non-surgical retreatment and surgical retreatment. There was no statistically significant difference between the success rate of surgical and for non-surgical retreatment; the preferred treatment for failed endodontic cases is non-surgical retreatment as surgical retreatment resulted in more postoperative discomfort, trauma to the normal oral tissues, post-surgical complications.

In the present study samples were decoronated with a diamond disk to standardize the length 16 mm to minimize variations by eliminating some variables, such as crown anatomy and root length, thus proving a reliable comparison of the proposed retreatment system [4]. The teeth were mounted in an acrylic tube to simulate the periodontal ligament space and stability. Dentin removal and micro cracks formation in dentin during retreatment procedure will weaken the tooth structure. Non-surgical retreatment is a less traumatic procedure to treat endodontic failures and

ultrasonics proved to be an efficient method for the removal of gutta-percha.

Conclusion

Endodontic retreatment does differ from the initial therapy. The clinician is faced with additional criteria for case selection and removal of the present obturating material can be most challenging. However, the necessity of endodontic retreatment is being seen with greater frequency. Proper case selection, patient education, and use of the techniques presented may reduce the fatigue and frustration experienced during the treatment of such cases. This study was undertaken to compare which rotary instrumentation is best and efficient for retreatment which could be a help in day to day practice. Edge File-XR re-treatment files and Pro-Taper universal retreatment files removed significantly more gutta-percha and sealer compared to M-two system files. Re-treatment with M-two system Ni-Ti rotary systems was significantly faster compared to other two file systems in the removal of gutta-percha sealer.

. Nevertheless, further evaluation will be needed before routine usage could be recommended. It should be kept in mind that removal of the material is only a step in the overall objective of successful treatment and retention of the tooth.

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