

COMPARATIVE EVALUATION OF GUTTA-PERCHA REMOVAL USING DIFFERENT KINEMATICS AND SURFACE CHANGES IN RECIPROC BLUE AND PROTAPER ROTARY AS RETREATMENT FILES (IN VITRO STUDY)

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Abstract

Aim of the study: The aim of the present study is to compare between Reciprocating file (Reciproc Blue) and rotating files (Protaper Universal Retreatment System) in retreatment of endodontically treated teeth concerning: 1. Removal of obturating material. 2. Surface changes of the File. **Material and Method:** 32 single-rooted human maxillary central incisors were collected. The specimens were randomly allocated into two groups, 16 teeth decoronated and retreated by ReciprocBlue file, 16 teeth decoronated and retreated by ProTaper Universal Retreatment files. The selected teeth were decoronated using diamond disc to standardize the working length to 15 mm for each specimen. Root canal of each tooth was slightly dried with paper points #40 and obturated with cold lateral. **Technique:** Specimens randomly divided into two experimental groups, with 16 specimens each, retreatment performed using two different Rotary systems without using Gutta-percha solvent. Canals were irrigated in all the specimens with 5.25% sodium hypochlorite during obturation material removal. The obturation removal done using one of the following systems: Group1: Reciproc Blue one file shaping, Group 2: ProTaper Universal Retreatment Ni–Ti rotary. **Results:** No examined retreatment technology can completely remove root canal obturation material, particularly at the apical third. The ProTaper Retreatment Rotary Instruments remove somewhat more obturation material as compared to reciproc blue. Reciproc blue files had a higher percentage of fractures and cracks compared to PTUR files. **Conclusion:** Continuous rotation is somewhat more effective and efficient than reciprocating motion. Instrument failure can be influenced by several parameters such as speed, force, kinematics, and torque values. Reciproc blue files had a higher percentage of fractures and cracks compared to PTUR files.

Keyword: ProTaper, Reciproc Blue, Retreatment, Surface Change, Reciprocation, Rotation.

INTRODUCTION

The main aim of root canal treatment is to shape and disinfect the root canal system and seal it in three dimensions to prevent reinfection of the tooth. The goal of an effective obturation is to eliminate any potential room for bacteria to grow. , It is important to obturate the canal from the apex to the canal orifice with gutta percha, with sealer to fill

any gaps. Endodontic treatment's success is determined by the short-term quality of root-canal therapy and the long-term quality of the ensuing coronal restoration. Endodontic success is predicated on the effective cleaning, shaping, and obturation of the root-canal system. This is because, while endodontic therapy can efficiently eliminate germs from the root-canal area during treatment, preventing recontamination of this region³.

The aim of retreatment is to perform an endodontic treatment that can render the treated tooth functional and comfortable again, allowing complete repair of the supporting structures.

The objectives of nonsurgical retreatment are to eliminate materials from the root canal space and, to cure imperfections or fix iatrogenic or pathologic abnormalities. Confirm any mechanical issues, missed canals in the past, or fractures in the radicular subcrestal area.⁹

Surface changes in Ni-Ti rotary instruments play a significant role in failure or fracture start, Ni-Ti instrument fracture may happen with little to no obvious plastic deformation; this would be impossible to see without magnification.²⁹

Several techniques have been proposed to remove filling materials from root canal system, including the use of endodontic hand files, Nickel Titanium rotary instruments, Gates Glidden burs, heated instrument, ultrasonic instruments, laser, and use of adjunctive solvents. Conventionally, the removal of gutta percha using hand files with or without solvent can be a tedious, time consuming process especially when the root filling material is well compacted¹⁻²

Endodontic practitioners have introduced many generations of rotary Ni-Ti files to enhance their fracture resistance and cutting effectiveness. These generations improve design characteristics, metallurgical properties, and movements³². The ProTaper Universal retreatment system (PTUR) is a rotary system especially designed for retreatment. It consists of 3 instruments that are used in continuous rotation and have a convex triangular cross section.⁷

The Nickel-Titanium alloy "Ni-Ti" has several benefits over ordinary files, including superior elasticity, form memory, and reduced modulus of elasticity. Reciprocation means mechanical radicular endodontic shaping using unequal bidirectional clockwise/counterclockwise (CW/CCW) directions. Reciproc Blue (RB) (VDW, Munich, Germany) is a single reciprocating file system that shares the same design features as the M-wire Reciproc with an S-shaped horizontal cross-section and 2 cutting edges.³⁷

MATERIALS AND METHODS

Sample selection:

The collected teeth were examined to ensure the absence of caries, root resorption or fractures by periapical x-ray. Before starting the experiment a pre-operative radiograph was taken for each tooth to evaluate the root canal anatomy of the extracted teeth before their inclusion in the study. The teeth with calcified canals, internal or external root

resorption were excluded and replaced with another incisors. The 32 extracted, single-rooted human maxillary incisors were stored in distilled water until further use.

METHODOLOGY

This study was approved by the ethics committee, Faculty of Dentistry, October 6 University, Cairo, Egypt.

Grouping:

Group 1: 16 teeth decoronated and retreated by Reciproc Blue file

Group 2: 16 teeth decoronated and retreated by ProTaper Universal Retreatment files

32 single-rooted human maxillary central incisors were collected

Specimen preparation: The selected teeth were decoronated using diamond disc to standardize the working length to 15 mm for each specimen. A size 10 K-type file was inserted into the canal until its appearance from the apical foramen to ensure the canal patency. The file was retrieved until it was flushed with root apex then the working length was established 1mm shorter than this length. The specimens engaged at their working length (14 mm) by size 25 K file, while the unengaged incisors were replaced by other teeth to standardize the initial file for all specimens. Canal instrumentation was performed using ProTaper Next rotary files system to a final size of 40/0.06. Apical patency maintained with 10 K-file. The canals were irrigated with 10 ml (NaOCl) 5.25% during the root canal preparation and 1 ml of 17% EDTA for 5 min before root canal obturation

Root canal obturation: Root canal of each tooth was slightly dried with paper points #40 and obturated with cold lateral technique. Gutta-percha cone size 40/0.04 and Ceraseal Sealer were used for canal obturation. The master Gutta-percha cone size 40 selected and tug-back was justified, then Ceraseal Sealer was injected inside the canal. The master cone was inserted to the full working length and pumping motion was performed to spread the sealer on the canal walls. A gutta-percha point was inserted, and root canal obturation was performed by using the cold lateral condensation technique. Accessory gutta-percha cones were placed into the space created by the spreader penetrated no more than 1–2 mm from the root canal orifice. The process was repeated until the spreader penetrated only into the coronal one-third of the root canal space. Excess gutta-percha was removed with a heated plugger, the remaining was condensed vertically with a cold plugger and the pulp chamber was cleaned. The obturated teeth were radiographed to confirm the length of root filling. All specimens stored at 37°C for 1 weeks at 100% humidity to allow complete setting of the sealer.

Retreatment

Canals were irrigated in all the specimens with 5.25% sodium hypochlorite during obturation material removal. The obturation removal done using one of the following systems:

Group 1: Reciproc Blue: **one file shaping**, produced with Nickel-Titanium (NiTi) that goes through an innovative heat treatment, modifying its molecular structure to give it increased resistance to cyclic fatigue and additional flexibility as well as its characteristic blue color. Thus, a root canal can be completely prepared with only one Reciprocating instrument – without creating a glide path in the majority of cases.

Group 2: ProTaper Universal Retreatment Ni–Ti rotary instrumentation system: ProTaper Retreatment files will be used in crown-down technique in a brushing motion at constant speed of 500 rpm as per manufacturer's recommendation. D1 (size 30; 9% taper) was used in the coronal third, D2 (size 25; 8% taper) in the middle third, and D3 (size 20; 7% taper) in the apical third as specified by the manufacturer.

Gutta-percha removal evaluation

Roots grooved longitudinally, in buccolingual direction, into two halves with diamond disc such that the groove done in proximity of the root canal wall but not cutting through the wall of the canal. The root split using a chisel and mallet. After tooth splitting, each half of every specimen separately imaged. Amount of Gutta-percha and sealer on canal walls was imaged in standardized way in both sections of the tooth and measured in square millimeters using the feature of image analyzer software (imageJ 1,6,0_20, image software, USA) connected to Stereomicroscope at 150x magnification (Technival 2 Carl Zeiss, Jena, Germany) Figure (1) ProTaper, Figure (2) ReciprocBlue.

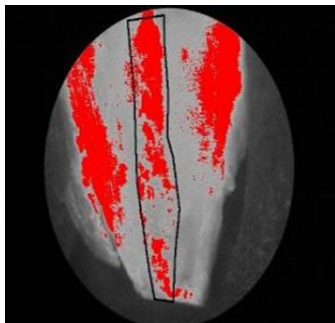


Figure 1

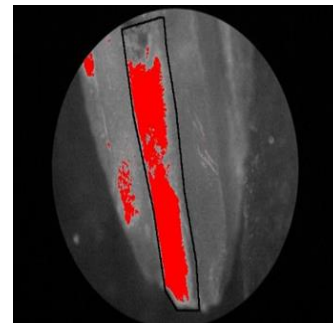


Figure 2

Determination of the files surface changes

Analyzing the surface changes of the Reciproc Blue Figure (3) and the D3 Figure(4) (size 20; 7% taper)

We took the last file of every system and analyze the surface change of the master file of ProTaper Retreatment kit after use it in 4 canals as manufacture instructions in Dentsply paper or fracture happened (<https://www.dentsplysirona.com>)

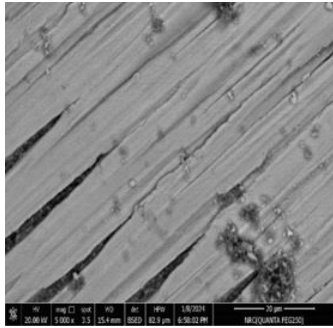


Figure 3

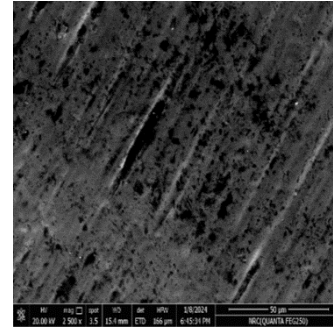


Figure 4

Table 1: Mean and standard deviation of group 1 and 2 and comparison between them using Independent t test:

Section	Group 1		Group 2		Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference		P value
	Mean	Std. Deviation	Mean	Std. Deviation			Lower	Upper	
Apical	3.56	0.18	4.23	0.21	-0.671	0.069	-0.81	-0.53	0.0001*
Middle	3.77	0.19	5.03	0.25	-1.261	0.078	-1.42	-1.10	0.0001*
Coronal	8.45	0.42	5.33	0.27	3.120	0.124	2.86	3.37	0.0001*

*Significant difference as $P < 0.05$.

Means with the same superscript letters were insignificantly different as $P > 0.05$. Means with different superscript letters were significantly different as $P < 0.05$.

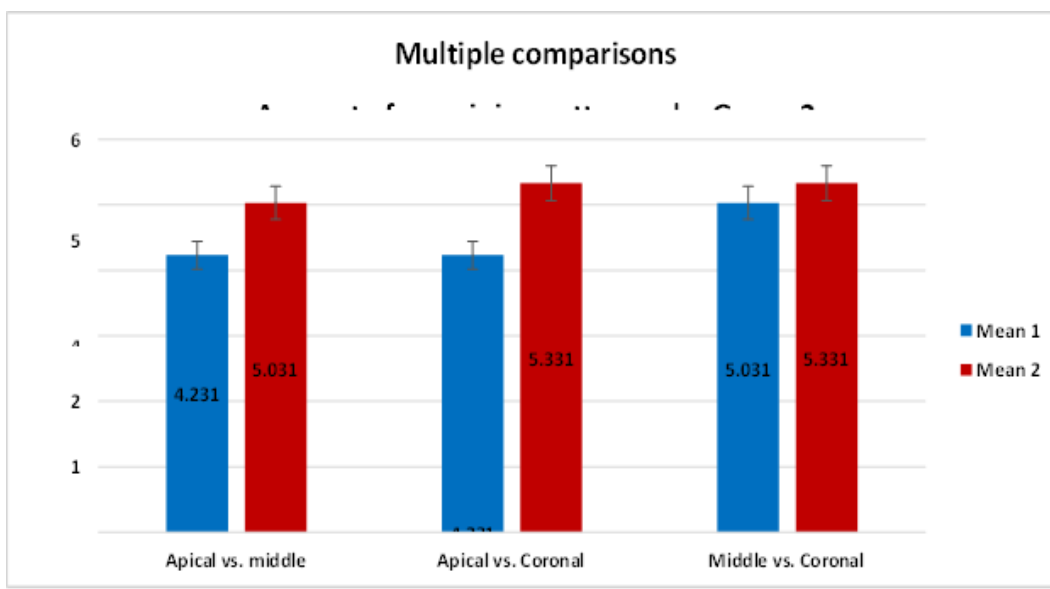


Figure 5: Multiple comparisons of amount of remaining gutta percha between group 1,2

DISCUSSION

The main aim of root canal treatment is to disinfect and shape the root canal system and seal it in three dimensions to prevent reinfection of the tooth. Lack of healing is due to persistent intraradicular infection residing in previously instrumented canals, dentinal tubules or in the complex irregularities of the root canal system. The present study evaluated the effectiveness of different systems with two type of kinematic movements, continuous rotation (ProTaper Universal retreatment system, and reciprocation (Reciproc Blue, WaveOne Gold) in removing gutta-percha. The main advantage of using engine-driven file systems over hand files is the reduction in the time required for filling removal (4,8,9).

Previous studies have suggested that continuous rotation provides a more suitable cutting motion for retreatment cases (1,2) . Moreover, the single-file reciprocating WO files are meant to be used with proprietary kinematics software that requires a specific motor. According to a recent and past reviews (5), no existing retreatment protocol can completely remove root filling materials. With the current investigation, the ProTaper Universal rotary instruments left a lower proportion of the area covered with GP/sealer remains than those treated with other procedures. The improved performance of ProTaper Universal retreatment equipment might be related to their design. D1, D2, and D3 have escalating tapers and lengths. These qualities may allow the retreatment tools to remove not only the GP but also the superficial layer of dentine during root filling extraction. Furthermore, the ProTaper Universal retreatment instruments' unique flute shape and rotating motion tend to draw GP into the file flutes and send it toward the crown, this result agreed with (2,9,14,15).

In this investigation, results showed that reciprocating motions showed less fatigue resistance than continuous rotation agreed with (15) .but there was a fracture in the tip of last file of protaper universal after using in three teeth. There was no significant variation in the mean length of the broken pieces across the equipment evaluated.(34,43).

CONCLUSION

- 1) No examined retreatment technology can completely remove root canal obturation material, particularly at the apical third.
- 2) The ProTaper Retreatment Rotary Instruments remove somewhat more obturation material as compared to reciproc blue.
- 3) Continuous rotation is somewhat more effective and efficient than reciprocating motion. Single file retreatment is cost-effective, and time-saving method for retreatment.
- 4) Instrument failure can be influenced by several parameters such as speed, force, kinematics, and torque values.
- 5) Reciproc blue files had a higher percentage of fractures and cracks compared to PTUR files.

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