Comparative Evaluation of Cleaning Ability of Reciproc and Waveonegold Reciprocating File Systems – A Scanning Electron Microscopic Study

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Abstract

Objective: The aim of this study was to evaluate the canal cleaning ability of two reciprocating single file systems: Reciproc (VDW, Munich, Germany) and WaveOne gold (Dentsply Maillefer, Ballaigues, Switzerland) using scanning electron microscopy (SEM).

Materials and Methods: Forty freshly extracted human mandibular premolar teeth with single root and canal were selected. The samples were randomly divided into two experimental groups (n = 15 each). Control group (n = 10) has non-instrumented teeth. Working length was determined using #10/15 K files. All the teeth were prepared to a # 25 final apical size following the manufacturer’s instructions using crown-down technique. Teeth were sectioned buccolingually and examined under SEM at 20.0 kV and ×700 magnification. SEM images of the coronal, middle and apical third of the canal were taken and then analyzed using a five-score index.

Results: The WaveOne Gold group presented a larger amount of debris than the Reciproc Group, however, without a statistically significant difference (P > 0.05). A larger amount of debris in the control group was observed, with the statistically significant difference between Reciproc and WaveOne Gold groups (P < 0.05).

Conclusion: The two reciprocating single-file instrumentation systems presented similar effectiveness for root canal cleaning.

Keywords: Apical debris, canal cleaning ability, reciproc, reciprocating single file systems, Waveone Gold

INTRODUCTION

The successful endodontic therapy depends on the complete elimination and debridement of the microorganisms within the root canal system, thereby preventing the reinfection of the canal. In the modern era, several technological advances have been developed in the nickel-titanium rotary file systems which have further ensured the predictable clinical outcome. The important properties of these rotary files are their superelasticity, flexibility, and shape memory effect which result in cleaner root canals thereby facilitates subsequent three-dimensional filling.[1] Rotary files with different tapers, cross-section, and longitudinal design have led to faster and predictable canal preparation when compared to manual instrumentation.[2,3]

Majority of the commercially available NiTi systems are mechanically driven in continuous motion. In the present era, rotary files driven by reciprocating motion based on balanced force technique concept introduced by Ghassan Yared, are used for root canal instrumentation.[4] These files use oscillatory movement where the instrument turns in the clockwise direction and then counter clockwise before completing a full 360° rotation cycle.[4,5] Thereby, with reciprocating motion, the stress created on file during the canal instrumentation is minimized which helps in reducing the risk of fracture and increases the lifespan of the file.[6,7]

In 2010, Reciproc (RC, VDW, Munich, Germany) was commercially introduced into the market. It has an S-shaped cross-sectional design with a regressive taper. It is made of M-wire technology. Recently, in 2015, WaveoneGold (WOG, Dentsply Maillefer) was launched with a unique parallelogram cross-sectional design and improved cyclic resistance. These for root canal instrumentation.[4] These files use oscillatory movement where the instrument turns in the clockwise direction and then counter clockwise before completing a full 360° rotation cycle.[4,5] Thereby, with reciprocating motion, the stress created on file during the canal instrumentation is minimized which helps in reducing the risk of fracture and increases the lifespan of the file.[6,7]

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How to cite this article: Surakanti JR, Punna R, Vanapatla A, Vemisetti H, Poojitha N, Nidumukkala TP. Comparative evaluation of cleaning ability of reciproc and waveonegold reciprocating file systems – A scanning electron microscopic study. Indian J Dent Sci 2018;10:98-101.
files are made of advanced metallurgy and manufactured using heat treatment technology. The thermal cycling procedure (heated and cooled slowly many times) imparts gold color to these files. The manufacturer claims that with this gold technology, the flexibility of the file is improved.

These reciprocating file systems were designed to complete the cleaning and shaping procedure with single file instrumentation. These files are marketed in a presterilized condition and are discarded after single use, thereby preventing cross-contamination and instrument fracture. There is less risk of file separation with these files, thereby ensuring patient safety. To date, a few studies have investigated, and there is limited information about the cleaning ability of wave one gold reciprocating file system. Therefore, the aim of this study was to compare the canal cleaning ability of Reciproc and Waveone Gold file systems, using scanning electron microscopy (SEM).

**Materials and Methods**

In the present study, forty freshly extracted single-rooted permanent mandibular premolars with a single root canal and straight roots were selected. Teeth with double canals, fractures, calcification, and internal resorption are excluded from the study. The teeth were randomly divided into two groups (n = 15 for each group). Group A: Reciproc, Group B: Waveone gold and a control group (n = 10) had Non-instrumented teeth. Standardized access cavities were prepared in each of the samples used for the study. The working length was then determined using an electronic apex locator with (#10/15 K files) and confirmed with radiographs. The samples were then randomly divided into the following groups depending on the file system used.

Group – A (n = 15) Reciproc (RC) - The samples in this group were instrumented with primary file R25 (0.08 taper) Reciproc (RC, VDW, Munich, Germany) using x-smart plus endodontic motor (Dentsply Maillefer, Switzerland), according to the manufacturer’s recommendations.

Group – B - (n = 15) WaveOne Gold (WOG) (Dentsply maillefer-Tulsa dental) - The samples in this group were instrumented with primary file WOG 25 (0.07 taper) using x-smart plus endodontic motor (Dentsply maillefer Switzerland), according to the manufacturer’s recommendations.

Group – C-(n = 10) - the samples in this group were left uninstrumented.

Both the file systems were used in the traditional crown-down technique. All the canals were prepared by the same operator. Each instrument was used for four samples after that it was discarded. After each file instrumentation, 3 ml of 3.0% sodium hypochlorite (NaOCl) was used for intracanal irrigation followed by a 1 min 17% EDTA rinse. After a complete cleaning and shaping NaOCl was used as a final rinse. The teeth were dried with paper points. All samples were decoronated and sectioned buccolingually for evaluation. Later, the samples were gold sputtered and examined under SEM to determine canal cleanliness. The samples were analyzed with the SEM at 30.0 kV and ×700 magnification in the coronal, middle, and apical third of the canals. Debris was defined as dentin chips, pulp remnants, and particles loosely attached to the root canal wall. The SEM images were analyzed using the following 5 score index. Score 1: Clean root canal wall, only a few small debris particles. Score 2: Few agglomerations of debris; Score 3: Many agglomerations of debris covering <50% of the root canal wall; Score 4: More than 50% of the root canal wall covered by debris; and Score 5: Complete or nearly complete root canal wall covered by debris. The debris score of all the samples was analyzed using Mann–Whitney U-test [Figure 1a-e].

**Results**

The results were analyzed using Mann–Whitney U-test. Statistical analysis for two groups are listed in Table 1, and the mean values are represented in a bar diagram (Graph 1). Samples in control group were given score 5; therefore, statistical analysis did not include the control group.

The analysis of the results revealed that there is no statistically significant difference between Reciproc and Waveone Gold.
The mean debris score for Reciproc is 1.5333, and Waveone gold is 1.7111. Both the reciprocating file systems showed highest cleaning efficacy in the coronal third followed by middle thirds with maximum debris remaining in the apical thirds of the root canals.

**DISCUSSION**

In the modern era, the field of endodontics has seen many technological advancements and materials used for the manufacture of rotary file systems. With the newer modifications, the endodontic treatment has become easier to perform with reduced fatigue and time for the clinician. The advantages of reciprocating files are reduced working time, shorter learning curve, number of instruments is reduced thereby reduction in steps for instrumentation and ensured safety with regard to instrument separation and procedural errors.

In the present study, the canal cleaning ability of Reciproc R25 primary file (0.08 taper) and Waveone Gold WOG 25 primary file (0.07 taper) were evaluated. Both the files are single file systems and work in reciprocating motion with unequal clockwise or counterclockwise motion which travels a shorter angular distance than a rotary instrument causing low-stress levels, more safer when compared to that of the multiple rotary file systems.\[^{3, 13, 14}\] There was no instrument fracture reported throughout the study.

Reciproc is one of the most popular reciprocating file systems. It has an S-shaped cross-section with two cutting edges, made of M-wire technology,\[^{15}\] also has a regressive taper (0.08) and are slimmer at the end of working part which prevents unnecessary loss of tooth structure in the coronal part. These files when bind in the canal, will not fracture as they never rotate past its specific angle of fracture thereby eliminates the guide path creation.

Another file system used was Waveone Gold WOG 25 (0.07 taper) has a parallelogram cross-section with 2 cutting edges. It also features the off-center design of protaper next (Dentsply Malleifer) files and is manufactured with advanced gold heat treatment technique. This newer manufacturing technique improves the elasticity of the file.\[^{10}\]

During instrumentation, a standardized irrigation protocol using 3% NaOCl followed by 17% EDTA was used. Several SEM studies have shown that rotary files in association with NaOCl and EDTA irrigation exhibited dentinal walls free of smear layer thereby reducing the bacterial count. The major goal of the study was to assess the cleaning efficacy of these files for which the amount of debris was used as the criteria. Studies have revealed that debris comprises dentin chips, residual vital or necrotic pulpal remnants which get attached to the root canal wall, is infected and has to be removed as its presence can cause reinfection of the root canal.\[^{16, 17}\]

In this study, images were taken using SEM, as it offers high definition three-dimensional images with superior magnification and resolution.\[^{18}\] The ×700 magnification was employed since it offered a wider view and gave accurate information. The SEM images were scored using debris index.

The results have shown that the cleaning ability of Reciproc (mean = 1.5333) was shown to be better when compared to Waveone Gold (mean = 1.7111) file system. This may be attributed to the difference in cross-sectional design of the files.\[^{19}\]

The present study has shown results in accordance with previous studies evaluating the canal cleanliness of the root canal system using reciprocating rotary files.\[^{20-22}\] Both the file systems have demonstrated relatively cleaner root canals. However, the other clinical aspect like decreased instrumentation duration may be attributed to reduced time available for irrigation and chemical debridement of the root canal. To overcome the minimal irrigation time while using these reciprocating files, additional activation of the irrigant is advisable which may improve chemical dissolution of the residual debris which ensures complete disinfection of the canal.\[^{17}\]

**CONCLUSION**

Within the limitations of the study, both the systems have shown better canal cleaning ability. It may be concluded that the innovative reciprocating file systems showed significant cleaning efficacy in the coronal and middle third of the root canals and reciproc showed better cleaning ability in the apical third. However, further studies need to be conducted to corroborate the findings of this study.

| Table 1: Mean and standard deviation of the samples |
|-----------------------------------------------|
| Group A (Reciproc) | Group B (WaveOne Gold) |
| Mean             | 1.5333 | 1.7111 |
| Median           | 1.0000 | 2.0000 |
| SD               | 0.62523 | 0.72683 |

\[P=0.261. SD: Standard deviation\]
**Financial support and sponsorship**
Nil.

**Conflicts of interest**
There are no conflicts of interest.

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