Heal Talk 🐼 **An In-Vitro Evaluation of Area Increase of Root Canals Through CBCT Using Different File Systems**

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Abstract

Aim: The present study was undertaken to compare and evaluate the area increaseof root canals with ProTaper Gold, Hyflex EDM and Revo-S systems using cone beam computed tomography for analysis.

Materials and Methods: Thirty extracted human mandibular molars having were collected. Teeth were randomly assigned to three groups (n=15). Samples were decoronized by maintaining root length. Pre-instrumentation cone beam computed tomography scan was done after stabilizing the samples on wax blocks. The working length was determined at 1 mm short from the apical foramen by using a ISO 15 K-fi le tip protruding at apical foramen. Preparation was carried out according to the manufacturer's instructions. Finally, canals were instrumented upto apically for each group. After each instrumentation, root canals were irrigated with 2ml of 3% sodium hypochlorite solution followed by 2 ml of 17% EDTA solution. Final irrigation was done with 5ml of saline. Post instrumentation cone beam computed tomography scans of all samples in the 3 groups were acquired.

Result: Hyflex EDM and Revo-Sshowed less area increase than Protaper Gold file system.

Conclusion: Protaper Gold, Hyflex EDM and Revo-S showed statistically significant difference in root canal area increase over the different intervals of root canal length. Therefore, it was concluded that Protaper Gold file system showed more root canal area increase than Hyflex EDM and Revo-S file system.

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Introduction

o achieve a proper root canal treatment the most important factor to be considered is the chemomechamical preparation. It helps in eliminating the tissue and the debris as well as microbes from the root canals. Mechanical preparation of the root canal is carried out by various nickeltitanium (Ni-Ti) instruments have been evolved.1

During preparation of the canal the most important constant is the radicular dentin which should be taken into knowledge to avoid mishaps such as ledges and strip perforations. A tapered preparation and less canal transportation has been shown with Ni-Ti rotary systems.Advanced instrument designs including noncutting tips, radial lands, different cross sections, and varying tapers have been developed to improve working safety, to shorten working time and create a greater flare of preparations.1

For a proper treatmentplanning in endodontics radiographs are a must essential diagnostic tool. Since conventional radiographs offer a two-dimensional representation of the object many digital imaging tools have been used in dentistry,² CBCT is one among them which have been used in this study. CBCT can be used in assessing root fractures, to locate the pulp chamber and analyse the root canal walls, it is also used in preparation of the root canals.³

After accepting the importance of preserving the remaining dentinal thickness through proper usage of various instrument systems, the aim of this study was to compare and evaluate the area increase of root canals using three different Ni-Ti rotary systems ProTaper, Hyflex EDM, and Revo-S systems. Materials & Methodology

Thirty freshly extracted human mandibular molars Samples were stored in normal saline solution until use (Figure 1). They were randomly divided into three groups containing

10 specimens in each of them. Radiographs were taken. After mounting the samples on the wax (Figure 2)blocks Pre-instrumentation CBCT scan was taken(Figure 3).Using an ISO 15 K-file the working length was determined at 1 mm short from the apical foramen (Figure 2). The canals were then widened to an ISO 20 Kfile (Denstply, Maillefer) (Figure 4). After each file irrigation protocol was followed, with a balanced movement and with less apical pressure. According to manufacturer's recommendation, rotary instruments were used.



Figure 1: Thirty extracted human mandibular molars



Figure 2: Stabilization of the sample



Figure 3: Pre-instrumentation CBCT Scan



Figure 4: Canal prepared upto 20K file For ProTaper (DentsplyMaillefer) group, first SX instrument was used up to one-third of the working length and proceeded with S1, S2 instruments at 300 rpm and a torque of about 3 Ncm till two-third of the working length. This was followed by instrumentation with F1, F2, and F3 up to the working length, with less apical pressure with gentle strokes (Figure 5).



Figure 5: Group I- Protaper Gold file system

For Revo-S (Micro-Mega) group, instruments were used with a rotation speed of 400 rpm and a torque of 2 Ncm. Instrument sequence used were: Size 25/0.06 up to twothird the working length, sizes 25/0.04 and 25/0.06 until the apex was reached. This shaping was done in free progressive strokes without pressure. Finally, canals were instrumented up to size 30/0.06 for apical finishing (Figure 6).



Figure 6: Group II- Revo-S file system

For Hyflex EDM group, instruments were used with a rotation speed of 500 rpm and a torque of 2.5 Ncm, except the Glidepath files, which can be used with 300 rpm and at a torque of up to 1.8 Ncm (18 mNm).Depending on the clinical situation, use of HyFlex EDM files reduces the number of files required to 2 or 3 instruments, particularly in straight and larger canals (Figure 7).



Figure 7: Group III- Hyflex EDM file system

After each file, root canals were irrigated with 2 ml of 3% sodium hypochlorite solution followed by 2 ml of 17% EDTA solution. Recapitulation is done after each rinse with an ISO 10 K-file in order to check the apical patency.

Postinstrumentation CBCT was taken for the three groups. The area of each canal was measured at the apical middleand coronal thirds to compare and evaluate the area increase among the three different files after instrumentation (Figure 8).



ANOVA test was done to analyse the data. Comparisons of area measurements before and after instrumentation were carried out by Student's t-test.

Results

Tables 1,2,3 shows the means and standard deviations in root canal area for each pre and postoperative values at different thirds. At apical third, the change in area was highest with Protaper Gold (0.52) followed by Revo-S (0.49) and least with Hyflex EDM (0.45). Similarly, at the middle third and coronal third, the change in area p was highest with Protaper Gold (0.81) and (0.51) followed by Revo-S (0.41) and (0.45) and least withHyflex EDM (0.17) and (0.33) respectively.

After the Instrumentation & Post CBCT Scan:

Table 1: mean and standard deviation of preoperative and postoperative values of root canal area by protaper gold file system

Table 2: mean and standard deviation of preoperative and

		Pre Operative	Post-Operative	Change in Area
	At Apical Third	0.77±0.29	0.25±0.19	0.52±0.17
	At Middle Third	1.23 ±0.42	0.78±0.21	0.81±0.18
	At Coronal Third	1.72±0.44	1.21±0.24	0.51±0.27

postoperative values of root canal area by Revo-S file system

Table 3: mean and standard deviation of preoperative and

	Pre Operative	Post-Operative	Change in Area
At Apical Third	1.31±0.46	0.82±0.29	0.49±0.19
At Middle Third	1.77 ±0.33	1.36.±0.31	0.41±0.24
At Coronal Third	1.97±0.46	1.52±0.29	0.45±0.27

postoperative values of root canal area by Hyflex EDM file system

Table 4: comparison of percentage increase in root canal

		Pre Operative	Post-Operative	Change in Area
	At Apical Third	1.10±0.18	0.65±0.19	0.45±0.21
	At Middle Third	1.27±0.21	1.11±0.15	0.17±0.09
	At Coronal Third	0.92±0.17	0.59±0.18	0.33±0.17

area in different thirds of canal between three different fiile system

	Pre Operative (Protaper Gold)	Post-Operative (Revo-S)	Change in Area (Hyflex EDM)	P Value	Significance
At Apical Third	0.52±0.17	0.49±0.19	0.45±0.21	0.003	Significant
At Middle Third	0.81±0.18	0.41±0.24	0.17±0.09	0.002	Significant
At Coronal Third	0.51±0.27	0.45±0.27	0.33±0.17	0.000	Significant

One Way ANOVA at p 0.05

Graph 1. The mean and standard deviation of preoperative and post operative values of dentin thickness by Protaper Gold file system



Graph 2: The mean and standard deviation of preoperative andpost operative values of dentin thickness by Revo-S file system



preoperative and post operative values of dentin thickness by Hyflex EDM file system Graph 4: comparison of percentage increase in root canal

1.5 - 1.27 1 - 0.022 0.65 0.022 0.65 - 0.33At Apical Third



area in different thirds of canal between three different file system

Discussion



Complete disinfection of the root canal space and the eradication of the periapical lesions is the utmost important factor an Endodontist must obtain. The major goal of endodontic therapy is to reduce the microorganisms from the root canal space. With a proper chemo-mechanical preparation a successful endodontic treatment is achieved. Achieving these objectives is often failed by traditional hand instruments. Since canals are curved and the hand metals are manufactured from straight metals, hence they have a tendency to straighten itself inside the canal.⁴

In the present study, three Ni-Ti rotary

systems namely ProTaper, Hyflex EDM, and Revo-S were used to investigate the canal area increase before and after instrumentation.

Preserving the radicular dentin is of utmost important for preventing root fractures. There is a possibility of weakening of root structure if much of radicular dentin is removed. Although no definitive minimal radicular thickness has been established, 0.2 mm is considered critical.⁵ In the present study, in order to prevent the instrument separation due to intracanalfriction, a crown down technique is recommended by the manufacturers for the three rotary systems.According to Schafer et al., this technique is mandatory.

In the present study, ProTaper showed a greater amount of dentin removal compared to Hyflex EDMand Revo-s especially for the middle and coronal thirds. The greater cutting ability of ProTaper can be due tothe sharp cutting edges of the convex triangular crosssectional design and its flute design that combines multiple tapers within the shaft up to 19%.⁶

HyFlex EDM offers the dental practitioner enhanced ease of mechanical preparation of the root canal so that even newcomers to endodontics can achieve reliable results quickly and easily.HyFlex EDM files are produced using an innovative manufacturing process called Electrical Discharge Machining. The EDM process results in a file that is extremely flexible and fracture resistant. In fact, HyFlex EDM files are up to 700% more resistant to cyclic fatigue compared to traditional NiTi files. HyFlex EDM files follow the anatomy of the canal, which can significantly reduce the risk of ledging, transportation and perforation. The combination of flexibility, fracture resistance and cutting efficiency of the HyFlex EDM make it possible to reduce the number of files required for cleaning while preserving anatomy.⁷

In the present study, Revo-S and Hyflex EDM seemed to remove the less dentin from both middle and coronal portions compared to ProTaper, which is statistically significant and in accordance with previous studies.

Revo-S (Micro-Mega, France), another Ni-Ti rotary system was developed with the asymmetrical cross-section provides less stress on the instrument. The canal axis has 3 cutting edges located on 3 different radiuses: R1, R2 and R3. nThe smaller section allows more flexibility and offers a better ability to negotiate curves. n The asymmetrical cross-section increases the available volume for upward debris elimination. In the present study there were no file separations occurred.⁸

In the present study, we have used CBCT, which provided a practical and nondestructive technique for assessment of canal morphology before and after shaping according to Gluskin et al.

After the pre and post instrumentation cone beam computed tomography, we conclude that ProTaper showed maximum canal area increase in middle and coronal thirds of the root canal compared to Hyflex EDM and Revo-S systems which were statistically significant.On the other hand, Hyflex EDM had removed the least dentin compared to ProTaper and Revo-S systems. Moreover, the mean percentage of area increase showed that ProTaper achieved the most followed by Revo-S and Hyflex EDM systems.⁹ Conclusion

Protaper Gold, Hyflex EDM and Revo-S showed statistically significant difference in root canal area increase over the different intervals of root canal length. Therefore, it was concluded that Protaper Gold file system showed more root canal area increase than Hyflex EDM and Revo-S file system.

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