**TO EVALUATE THE CLEANING EFFECTIVENESS OF ROOT CANAL PREPARATION USING PROTAPER NEXT, MTWO AND HYFLEX EDM ROTARY SYSTEMS BY SCANNING ELECTRON MICROSCOPE**

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**ARTICLE INFO****Article History:**Received 15<sup>th</sup> July, 2017Received in revised form 19<sup>th</sup>August, 2017 Accepted 25<sup>th</sup> September, 2017Published online 28<sup>th</sup> October, 2017**Key words:**Pro Taper Next, Hyflex EDM,  
scanning electric microscope

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**ABSTRACT**

**Aim:** To evaluate the cleaning effectiveness of root canal preparation using ProTaper Next, Mtwo and Hyflex EDM rotary systems by using Scanning Electron Microscope.

**Materials and Methods:** 36 extracted molars were collected and divided into three groups

Group 1: Pro Taper Next, Group 2: Mtwo and Group 3:Hyflex EDM.

After instrumentation sodium hypochlorite in combination with 17% EDTA was used as an irrigant because of its antibacterial and organic tissue dissolving properties. Root canal of samples was dried with paper points. Then the mesial roots of all the samples was longitudinally split buccolingually for evaluation under SEM to determine canal cleanliness. All teeth were analyzed with the SEM at 20.0 KV and 500X magnification at the coronal, middle and the apical portion of the canal. Debris was defined as dentin chips, pulp remnants and particles loosely attached to the root canal wall.

**Result:** In this study all the systems (Pro Taper Next, Mtwo and Hyflex EDM) performed similar cleaning ability whereas the comparison between the cleaning ability of three portions of the canals coronal, middle and apical is considered there was a significant difference between the coronal and middle, coronal and apical and middle and apical thirds of the root canals.

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**INTRODUCTION**

Success in endodontic treatment depends on adequate biomechanical preparation of the root canal space. Its aim consists of cleaning of root canal and its ramifications, removing most of debris to create an ideal condition which lead to healing and tissue regeneration. The main objective of root canal preparation is to remove vital pulp tissue, residual necrotic materials, debris and infected dentin and thus eliminate most of the micro-organisms from the root canal system.<sup>1</sup>

With the development of various Nickel-Titanium (NiTi) rotary file systems have further ensured more predictable outcomes of the treatment. The cleaning capabilities of different NiTi rotary systems varies because of the different cross-sections and blade designs of each system.<sup>2</sup> One of the most popular single-file systems is ProTaper Next (Dentsply Maillefer, Ballaigues, Switzerland), which incorporates the convergence of 3 significant design features, that is progressive percentage tapers on a single file, M-wire technology and offset design which is used in continuous motion.<sup>3</sup>

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Another newly developed file system is Hyflex EDM (NiTi) files is produced with its unique properties to a breakthrough technology called “Electrical Discharge machining” by an innovative methodology, which uses spark erosion to harden the surface of the NiTi file resulting in superior fracture resistance, improved cutting efficiency and also offer trusted controlled memory effect and regenerative properties.<sup>4</sup>

Recently, a new instrument design has been introduced Mtwo® (VDW, Munich, Germany). These instruments have an S-shaped cross sectional design with a non-cutting tip. The two cutting edges have a positive rake angle to cut dentine effectively. Moreover, the pitch length increases from the tip to the shaft. This design is claimed to eliminate threading and binding in continuous rotation, and to reduce transportation of debris towards the apex.<sup>5</sup>

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**MATERIALS AND METHOD****Materials**

1. 36 extracted mandibular molars.
2. Modeling wax sheets
3. Sodium Hypochlorite 3% (NaOCl)
4. EDTA 17% ( Glyde FILE PREP)
5. Paper points.(Pearl Dent)

### Armamentarium

1. High speed micro motor with diamond disk [ Confident, India]
2. Endo-mate-DT rotary system,[N.S.K, Japan]
3. Airotor hand piece,[ N.S.K, Japan]
4. K-FLEX #15 and #30 size files,SS ( MANI, JAPAN)
5. Protaper Next Universal [Dentsply Maillefer]
6. Mtwo®, (VDW, Munich, Germany)
7. Hyflex EDM (Coltene– Whaledent, Allstetten, Switzerland)

### Instrumentation

#### Group 1: (N=12)

Teeth were prepared with ProTaper Next (Dentsply Maillefer, Ballaigues, Switzerland) files in sequential order till x3 at the working length according to the manufacturer's instructions using Endo-mate rotary system (N.S.K, Japan) at 250 rpm.

#### Group 2: (N=12)

The Mtwo system was used according to the manufacturer's instructions. The instrumentation sequence employed six files, as follows: 0.04 taper ISO 10, 0.05 taper ISO 15, 0.06 taper ISO 20, 0.06 taper ISO 25, 0.05 taper ISO 30, and 0.04 taper ISO 35. All six instruments were used to the full length of the canals, employing a cyclical in-out motion. At the point where the instrument rotated freely in the end of canal, it was removed.

#### Group 3: (N=12)

Hyflex EDM One File 25/(Coltene– Whaledent, Allstetten, Switzerland) was used according to the manufacturer's recommendations using Endo-mate rotary system (N.S.K, Japan) at 500 rpm.

After instrumentation Sodium hypochlorite in combination with 17% EDTA was used as an irrigant because of its antibacterial and organic tissue dissolving properties. Root canal of samples was dried with paper points. Then the mesial roots of all the samples was longitudinally split buccolingually for evaluation under SEM to determine canal cleanliness. All teeth were analyzed with the SEM at 20.0 KV and 500X magnification at the coronal, middle and the apical portion of the canal. Debris was defined as dentin chips, pulp remnants and particles loosely attached to the root canal wall. Analysis of the SEM images was performed using the following five score index.

1. Score 1: clean root canal wall, only few small debris particles.
2. Score 2: few small agglomerations of debris.
3. Score 3: many agglomerations of debris covering less than 50% of the root canal wall.
4. Score 4: more than 50% of the root canal wall covered by debris and
5. Score 5: complete or nearly complete root canal wall covered by debris.

### Statistically Analysis

The nonparametric Kruskal-Wallis test ( $p < 0.05$ ) was used to determine whether a statistical difference existed among the

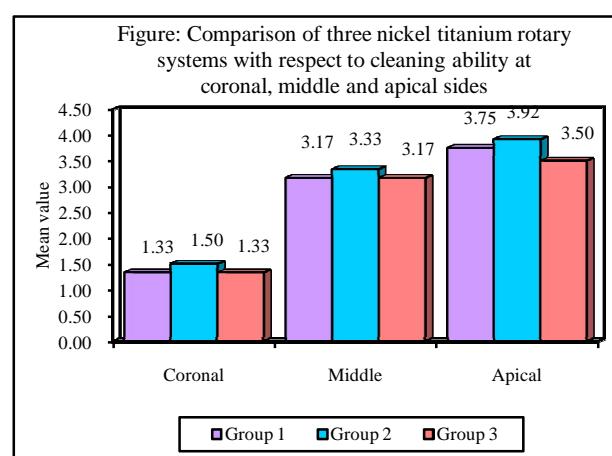
three groups followed by Mann-Whitney U test for pair wise comparison.

### RESULT

Comparison of three nickel-titanium rotary systems with respect to cleaning ability at coronal, middle and apical thirds by Kruskal Wallis one way ANOVA.

Canal Regions	Mean value	Standard deviation	P- value
A1	1.33	0.49	
A2	3.17	1.19	
A3	3.75	0.97	P= 0.8150
B1	1.50	1.50	
B2	3.33	1.15	
B3	3.92	1.00	P= 0.9150
C1	1.33	0.49	
C2	3.17	1.11	
C3	3.50	1.00	P= 0.5790

Bar graph 1: Mean value of cleaning ability at coronal, middle and apical portions.



### DISCUSSION

The objective of root canal preparation is to clean and shape the root canal system to eliminate necrotic material, microorganisms, and canal irregularities, and to facilitate the placement of a permanent root canal filling.<sup>6</sup> The ability to clean the root canal system effectively depends on both instrumentation and irrigation. A combination of ethylenediaminetetraacetic acid (EDTA) and NaOCl has been reported to be suitable for removing both the inorganic smear layer and organic tissue<sup>7</sup>.

Due to difference in flute and blade design, endodontic instruments vary in their debris removal efficacy and their smear layer production<sup>8</sup>.

With the creation of super elastic nickel-titanium instruments, achieving clean and a correct canal shape, even in curved canals, appears to be more predictable and safe.

In the present study comparison of three portions i.e. coronal, middle and apical with respect to cleaning ability of nickel titanium rotary systems by Kruskal Wallis one way ANOVA was performed with significant difference between the three portions.

In this study all the systems (Protaper next, Mtwo and hyflex EDM) performed similar cleaning ability whereas the comparison between the cleaning ability of three portions of the canals coronal, middle and apical is considered there was

a significant difference between the coronal and middle, coronal and apical and middle and apical thirds of the root canals.

Anne E. Williamson *et al* (2009). Conducted a study to compare cleaning effectiveness using three systems the Profile GT, Protaper Universal and the Endosequence. Analysis of SEM images were performed using 5 score index. They evaluated no difference in cleaning ability of three file systems<sup>9</sup>

E. Schafer, M.Erler *et al* (2006) conducted the study to compare the cleaning effectiveness and shaping of Mtwo, Race, & K3 rotary systems.canals were prepared using low torque control motor, according to the results Mtwo instruments resulted in good cleaning and maintained the original curvature significantly better than K3, and Race files<sup>10</sup>

Devi *et al* (2016) concluded that Hyflex EDM and ProTaper Next systems showed better cleaning ability in the middle and apical third as compared to manual instrumentation (K-file) and the results were statistically significant.<sup>11</sup>

In this study M two shows greater cleaning efficacy than Hyflex EDM and Pro Taper next file system.

M two shows higher efficacy in apical third ( $3.97 \pm 1.09$ ) than Hyflex EDM and Protaper Next file as well as in middle and coronal third. According to the results

1. There was no significant difference between Group A, Group B and Group C (one way ANOVA  $p>0.05$ ).
2. Group 1: There was a significant difference ( $p<0.05$ ) between coronal Vs middle
3. ( $p=0.0003$ ), coronal Vs apical ( $p=0.0001$ ), and middle Vs apical ( $p=0.2145$ )
4. Group 2: coronal Vs middle ( $p=0.0007$ ), coronal Vs apical ( $p=0.0001$ ) and middle Vs apical ( $p=0.2245$ ).
5. Group 3: coronal Vs middle ( $p=0.0002$ ), coronal Vs apical ( $p=0.0001$ ) and middle Vs apical ( $0.4189$ ).

## CONCLUSION

In this study all the systems (Pro Taper NEXT, Mtwo and Hyflex EDM) performed similar cleaning ability whereas the comparison between the cleaning ability of three portions of the canals coronal, middle and apical is considered there was a significant difference between the coronal and middle, coronal and apical and middle and apical thirds of the root canals.

### How to cite this article:

Basavana Gouda *et al* (2017) 'To Evaluate the Cleaning Effectiveness of Root Canal Preparation Using Protaper Next, Mtwo and Hyflex Edm Rotary Systems by Scanning Electron Microscope', *International Journal of Current Advanced Research*, 06(10), pp. 6435-6437. DOI: <http://dx.doi.org/10.24327/ijcar.2017.6437.0942>

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