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Comparision of Cleaning Efficiency of Rotary Protaper and Self Adjusting File in Oval Shaped Canals – An In- Vitro Study

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Abstract
Background: *Oval shaped canals pose a challenge to endodontists. Self adjusting files have been introduced in the field of endodontics to overcome the deficiencies of rotary protapers in preparing oval canals.*
Aims and Objectives: *To evaluate the cleaning efficiency of rotary protaper along with endoactivator and self adjusting file in oval shaped canals using scanning electron microscope.*
Materials and Methods: *20 single rooted mandibular premolars were divided into 2 groups of 10 in each group. The root canals were instrumented with rotary protaper and self adjusting file. Teeth were sectioned longitudinally in mesiodistal direction and buccal and lingual aspects evaluated by scanning electron microscope.*
Results: *Comparison of mean values among the groups was done using Mann-Whitney U test. SAF performed better in middle third than rotary protaper with significant difference and there was no significant difference between SAF and rotary protaper in the apical third region.*
Conclusion: *SAF is more effective than rotary protaper in cleaning the long oval shaped canals.*
Keywords: *Oval canals, ProTaper, Self-adjusting file, scanning electron microscope, sodium hypochlorite.*

Introduction

The main factor that determines the success of endodontic treatment is effectual cleaning and shaping of root canal. Proper biomechanical preparation of root canals facilitates elimination of bacteria and the removal of debris. One of the chief cause of endodontic failure is residual tissue, bacteria or debris.[1]

Traditionally files have been used for root canal preparation and their effectiveness depends on several factors like file design, surface treatment and the ability to remove debris and smear layer.[2] Recently nickel-titanium (Ni-Ti) rotary file systems have been introduced which resulted in considerable improvement in the bio-mechanical preparation of the root canal space. However,

studies have shown the insufficient quality of bio-mechanical preparation with present Ni-Ti rotary systems. Few studies have revealed that the amount of mechanically prepared root canal surface to be generally less than. Hence, rotary Ni-Ti techniques leave a considerable area of untreated dentin. The rotary action of Ni-Ti files have a tendency to prepare the main root canal space in a circular shape, leaving buccal and lingual extensions unprepared. For successful root canal treatment, correct mechanical instrumentation must homogeneously cover the total perimeter of the root canal, entirely removing the inner layers of heavily contaminated dentin. This, in turn, will warrant the elimination of as much of the residual soft tissue and bacterial biofilm as achievable, since residual soft tissue and bacterial biofilm might stick on to and cover big areas of the inner surface of the canal and might result in failure of root canal treatment. Since there are limitations in current technologies, there is a regular need for successful preparation techniques for better debridement of the root canal space.[1-3]

Recently, the self-adjusting files (SAF) have been introduced in the field of endodontics, with entirely new design. SAF have been introduced, that is a hollow, flexible and compressible instrument made of 120-mm-thick NiTi lattice. Throughout the treatment, the file is designed in such a way that it is compressed when inserted into a narrow root canal and later it regains its original dimensions. In this way, it applies a continuous slight pressure to the canal walls. Hence it adapts to the canals shape when inserted, both longitudinally and also along the perimeter of the canal cross-section. Oval-shaped canals presents a significant challenge for any root canal cleaning and shaping protocol.[4-6]

Metzger et al suggested that SAF has excellent adaptability property to the dentinal walls and due to its abrasive surface removes dentin with a vibrating, back and forth action. Besides, SAF has an exclusive constant irrigation system that pumps irrigant through the hollow cylinder, thus provoding an agitating effect.[7-10]

Studies have shown that when compared to rotary protaper NiTi systems, SAF effectively shape root canals especially challenging oval and C-shaped root canals.[11-15]

We carried our study to evaluate the cleaning efficiency of rotary protaper along with endoacti-vator and self adjusting file in oval shaped canals using scanning electron microscope.

Material and Methods

Our study included 20 single rooted mandibular premolars, which were extracted for periodontal reasons. The extracted teeth were sterilized and stored in saline

Inclusion Criteria

Absence of caries,
Absence of Cracks, restorations and
Absence of surface defects

Exclusion Criteria

Teeth with history of root canal treatment
Teeth with more than one canal
Teeth with immature root apices
Teeth with curved root

Methodology

A coronal access cavity was prepared by using a # 2 round bur in a high speed hand piece. Gates glidden drills #2, #3, and #4 were used in a low speed contrangle hand piece for coronal flaring to a level of 2 to 3 mm below the cementoenamel junction.

The root canals were then negotiated with a #10 k file to obtain apical patency, inserting the file until its tip was visible at the apical foramen, working length was set 0.5 mm short of this length. Subsequently, a glide path was established with #10, #15, #20 k files by using RC Prep as a lubricant. Teeth were randomly divided into two groups (Fig 1):

Group I: where root canals were instrumented with Rotary Protaper and along with Endoactivator.

Group II: where root canals were instrumented with SAF.

Canal Preparation with Rotary Protaper

Protaper rotary endodontic files were used up to F3. During the preparation, the root canal was irrigated with 2 ml of 3% sodium hypochlorite solution. After instrumentation, 2 ml of Naocl solution was agitated with endoactivator for 1 minute. A final flush was applied using 5 ml of 17% EDTA for 1 minute, followed by 5 ml of 3% Naocl for 1 minute, followed by the final rinse with 5 ml distilled water

Canal Preparation With Self Adjusting File

The SAF system was used with an in and out vibrating hand piece combined with an RDT3 head. At a frequency of 5000 movements/minute with an amplitude of 0.4 mm. Irrigation with 3% Naocl was applied through the hollow file throughout the 4 minutes of operation. The irrigant was continuously provided by a VATEA peristaltic pump at a rate of 4ml/minute. After instrumentation, a final flush was applied using 5 ml 17% EDTA for one minute and 5 ml 3% Naocl for 1 minute. Followed by the final rinse with 5 ml of distilled water.

Scanning Electron Microscope Evaluation

Decoronation of teeth was done. Teeth were sectioned longitudinally in mesiodistal direction and buccal and lingual aspects evaluated by SEM (Fig 2). Demarcation was done at apical 3rd (3 mm from apex) and middle 3rd (6 mm from apex). Images were taken at 3x (3000) (Fig 3).

Scoring System:

0: None to slight presence of residual debris/filling covering the dentinal tubule or surface.

1: Presence of < 25 % of residual debris/filling on the surface.

2:Moderate presence (25%–50%) of residual debris/ filling covering dentinal tubule or surface.

3: Large amount of (50-75%) residual debris/filling covering the dentinal tubule or surface.

4: The entire or almost the entire surface (75%–100%) is covered with residual debris/filling.

Results

Statistical analysis: The analysis was done using SPSS version 16. A p-value of <0.05 was considered statistically significant. Comparison of mean values among the groups was done using Mann-Whitney U test (Table 1 and Graph 1). SAF performed better in middle third than rotary protaper with significant difference and there was no significant difference between SAF and rotary protaper in the apical third region.

Table 1: Comparison of mean values among the groups

	Group 1		Group 2		P value
	Mean	SD	Mean	SD	
Apical	1.70	0.71	1.2	0.48	0.127 (NS)
Middle	3.05	0.44	0.65	0.67	<0.001 (S)

S-Significant: NS-Not Significant

Fig 01 teeth divided into 2 groups

Fig 02 Scanning Electron Microscope

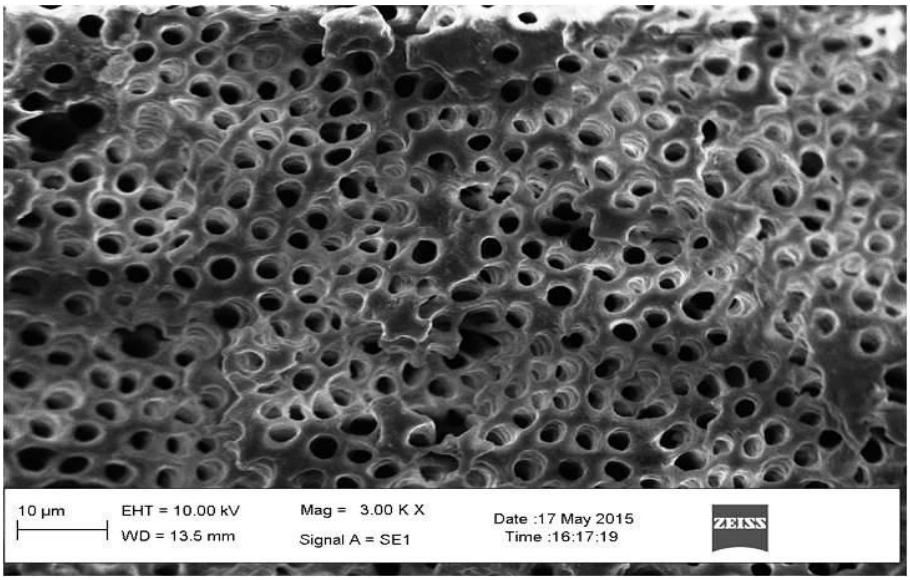
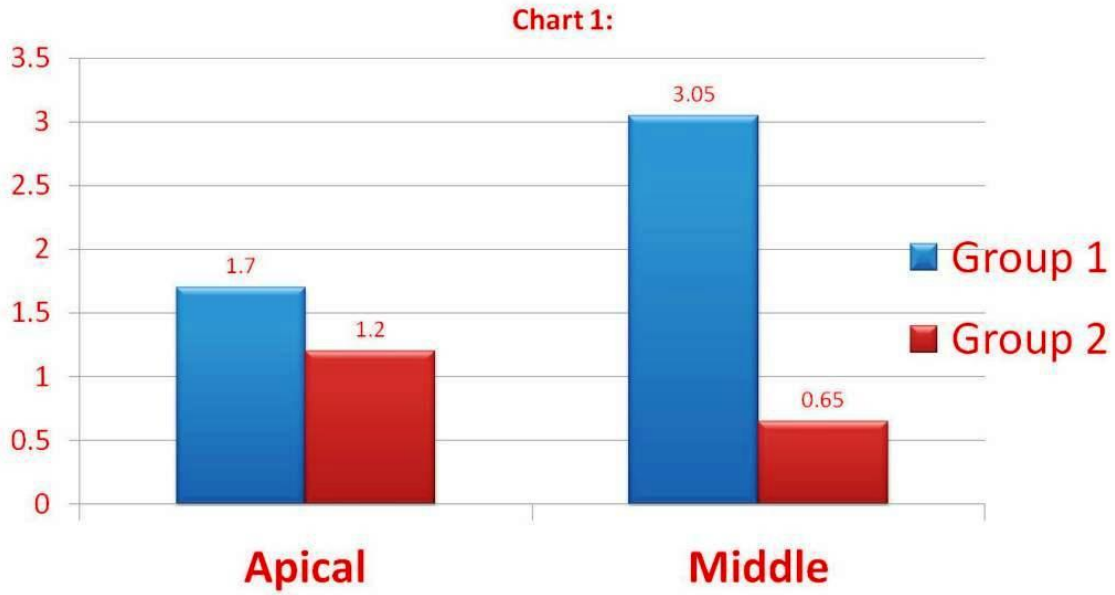


Fig 03 SEM image



Graph 1 Comparison of mean values among the groups

Discussion

Cross-sectional root canal configurations are categorized as round, oval, long oval, flattened, or irregular. Variations in configuration of canals prior to bio-mechanical preparation procedure appear to have more influence on the changes that arise throughout preparation than the instrumentation methods themselves.[11, 12]

The effectiveness of bio-mechanical preparation depends on many factors like cross-sectional file design, the surface treatment of the file and its capacity to remove debris and smear layer. The introduction of current rotary file systems has revolutionized the field of endodontics and increased the success rates of root canals enormously. However these rotary systems have two main disadvantages: ineffective cleaning and shaping of oval canals and may result in needless, unwarranted removal of sound dentin and creation of micro-cracks in the remaining root dentin, thereby compromising the long term success. Studies reported that bio-mechanical preparation with rotary instruments produced a smear layer in the root canal space which will result in poor quality of obturation and in infected root canals, can harbour bacteria thereby serving as a probable source of persistent infection. Hence, adequate cleaning of the canal space is believed to be vital for successful endodontic treatment. In order to achieve this, pulpal remnants, debris and the smear layer produced by instrumentation should be removed from the root canal system.[12-14]

Hence to overcome the disadvantages of rotary systems, SAF have been introduced which has a hollow, compressible Ni-Ti file, with no central metal core. SAF has been shown to effectively clean all types of root canals including oval canals. The back-and-forth grinding motion of SAF system removes dentin effectively and the most important parameter in this system is its vibrating effect. Here uniform layer of dentin is removed thereby preventing unnecessary excessive removal of sound dentin as well as creation of micro cracks in the remaining root dentin. Hence SAF technology is included in the field of Minimally Invasive 3D Endodontics.[4-6]

In the present study, the SAF performed better in middle third than rotary protaper with significant difference. The possible reason might be the ability of the SAF to expand within the root canal system may have been responsible for the superior results in this segment.[5, 10, 11]

In the present study, there was no significant difference between SAF and rotary protaper in the apical third region. The possible reason might be the lack of difference to the roundness of the apical anatomy and the minute difference may be because of long oval canals are more common in the apical 5 mm.[1, 4, 5]

The SAF preparation was reported to result in significantly less untreated surface throughout the length of long oval canals when compared to the rotary protaper. SAF system was significantly more affective in disinfecting long oval canals. The possible reason might be the continuous irrigation feature of the system and the agitation created by the in and out movements of the file.[10, 11]

Our finding of SAF being more superior to rotary protaper in oval root canal preparation is in accordance with few other studies. Siqueira et al also found that SAF system was significantly more effective than rotary NiTi instrumentation in disinfecting long oval root canals in vitro.[10] Solomonov et al found that SAF was more effective than the pro Taper file system in shaping the walls of C-shaped root canals.[11]

One limitation of our study is the small size of the sample i.e. 20 teeth. We recomend to carry studies with larger sample size and using various parameters.

Conclusion

Ours is the first such study conducted to compare the efficacy of SAF and protaper rotary systems analyzed by SEM. Within limitations of this study, it can be concluded that the SAF is more effective than rotary protaper in cleaning the long oval shaped canals. Endoactivator does not show

any significant difference in cleaning efficiency when compared with SAF.

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