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Research Paper: Comparison efficacy of calcium hydroxide removal by Revo-s, Protaper Rotary file from root canal

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ABSTRACT

Introduction: The aim of this study was to evaluate the efficacy of two rotary instrument systems (ProTaper and Revo-s File) in removing calcium hydroxide residues from root canal walls

Materials and Methods: Thirty human maxillary incisors were instrumented with the ProTaper System up to the F2 instrument, irrigated with 2.5% NaOCl,and filled with a calcium hydroxide intracanal dressing. After 7 days, the calcium hydroxide dressing was removed using the following rotary instruments:G1 - NiTi size 25, 0.06 taper, of the Revo-s File System; G 2 - NiTi size 25, 0.06 taper, of the protaper File System. The teeth were longitudinally grooved on the buccal and lingual root surfaces, split along their long axis, and their apical and cervical canal thirds were evaluated by SEM (×1000).

Results: The images were scored and the data were statistically analyzed using the Kruskall Wallis test. None of the instruments removed the calcium hydroxide dressing completely, either in the apical or cervical thirds, and no significant differences were observed among the rotary instruments tested ($p > 0.05$).

Conclusion: To achieve the best adaptation of filling material after root canal treatment, it is crucial to remove intracanal medication from the root canal walls. However, none of the irrigation regimens and different techniques were able to completely remove the CH from the root canal wall.

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Introduction

The placement of an intra canal medicament is necessary when the endodontic treatment cannot be performed in one appointment (1) Further more, intra canal medication is one of the treatment strategies for an infected root canal system(1). A study in 2017 by Siqueira et al.revealed that approximately 10%–50% of the main root canal surface area remain untouched by instruments.

(2) Hence, emphasis has been made on the importance of elimination of bacteria from the root canal system before obturation(3).Calcium hydroxide has been widely used in endodontics. Various biological properties have been attributed to this substance, such as antimicrobial activity(3)high alkalinity,(4)inhibition of tooth resorption, (5)and tissue-dissolving ability(6). To be effective, it has to be adequately placed and condensed in the root canal space(7).However, before the root canal can be filled, the dressing on the canal must first be removed (8). Calcium hydroxide residues on the canal walls interfere negatively in endodontic treatment prognosis(9), influence dentine bond strength(10), affect the adhesion of the endodontic filling material to the root canal walls(11)and the penetration of sealers into dentinal tubules(12).

Several techniques have been proposed to remove the calcium hydroxide dressing from the root canal system, including the use of endodontic hand files(13),sonic activation(14), passive ultrasonic irrigation(15),and nickel-titanium rotary instruments(16).

However, no studies have been published comparing these systems(ProTaper, and revo-s Files) as to their efficacy in removing calcium hydroxide residues from root canal walls.

The aim of this study was to compare the efficacy of the, ProTaper, and revo-s File systems in removing calcium hydroxide residues from root canal walls in the apical and cervical thirds of extracted teeth using scanning electron microscopy (×1000).

Materials and Methods

The present study was approved by the Ethical Committee of Zahedan Medical Science university(Number:6256).Thirty extracted human single-rooted teeth with straight roots were used.The teeth were obtained from specialists who had extracted them for periodontal reasons. The external root surfaces were scaled with ultrasonic instruments to remove any soft tissue or calculus from the root surface. the crowns were removed with a water-cooled diamond bur to obtain approximately 15-mm length root from the apex .Subsequently, the teeth were stored in saline solution until they were used. The roots were measured with a digital caliper (Mitutoyo, Hampshire, UK) to standardize their length. All samples were examined under a stereomicroscope at 30 X magnification to ensure that no root caries, fractures or cracks, and deformities were present on the root surface. Teeth with such findings were excluded from the study and replaced by similar teeth.

After obtaining coronal access with a Diamond bur (KG Sorensen, São Paulo, SP, Brazil), the cervical and middle thirds of each tooth were prepared using S1 and SX instruments (ProTaper System; Dentsply Maillefer, Ballaigues, Switzerland).The working length was established 1.0 mm short of the total tooth length and confirmed radiographically. All canals were prepared by the same operator using the ProTaper System up to the F2 instrument(17).

Irrigation was performed conventionally with 1 mL of 2.5% NaOCl (Vitex, Shamin Chemical Company,Tehran,Iran). disposable syringe with 27-gauge needle(Iran Hilal Medical Equipment Company –Saha) used for canals irrigation.and then,canals were dried with absorbent paper points.

The canals were then filled with a calcium hydroxide(Arvin Chemical Industries Company,Tehran ,Iran) paste using a lentulo spiral No.35 (Dentsply Maillefer,Ballaigues, Switzerland), at a powder-to liquid ratio of 1 g : 1.5 mL(18).Radiographs were taken to confirm their complete filling with calcium hydroxide paste. Cotton pellets were then placed over the canal orifices and the apical

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and coronal roots were sealed with glass ionomer cement (Ionoseal, Cuxhaven, Germany) and light cured . These specimens were stored in distilled water for 1 week at 37 ˚C.

After one week, the access cavity dressing was removed and the calcium hydroxide were removed by the studied files.

According to the method used for Ca(OH)2 removal ,samples were randomly divided into four experimental groups (N=30)

1-G1: Using Revo-s instrument size 25, 0.06 taper (Dentsply Maillefer, Ballaigues,Switzerland)

2-G2: Using ProTaper instrument size 25,0.06 taper (Dentsply Maillefer, Ballaigues,Switzerland)

3-Positive control: Ca(OH)2 was not removed from the root canals These samples were used as positive control(n=5).

4-Negative control: Root canals were not filled with Ca(OH)2.These samples were used as negative control(n=5).

The rotary instruments were applied using an electric motor (X-Smart; Dentsply Maillefer, Ballaigues,Switzerland), driven at 300 rpm and with a torque of 1.8 N/cm. Final irrigation was done with 5 mL of 2.5% NaOCl. The solutions were aspirated and the canals were dried with Absorbent paper points. Next, grooves were made on the buccal and lingual surfaces of the teeth with a water-cooled diamond disc, and the teeth were split along their long axis in a buccolingual direction using a surgical chisel. For SEM analysis, the specimens were dehydrated and fixed on aluminum stubs, sputter-coated with gold, and examined under a scanning electron microscope (JEOL, Tokyo, Japan). Several photomicrographs(×1000) were taken to observe the calcium hydroxide residues at the apical (2-3 mm from the apex) and cervical (10-12 mm from the apex)thirds of each specimen.

Digital images were obtained using a stereomicroscope (Olympus BX43, OlympusCo., Tokyo, Japan) attached to a digital camera (Axiocam ERc 5s, ZE ISS, Oberkochen, Germany)and were transferred to the computer. To evaluate the remnants of Ca (OH)2 on the canal wall, the following Kuga et al (1) classification system was used.

The scoring system was as follows:

score 0: clean root canal wall

score 1:0–9% of the root canal wall covered by Ca(OH)2

score 2: 10–19% of the root canal wall covered by Ca(OH)2

score 3: 20–49% ofthe root canal wall covered by Ca(OH)2

score 4: 50–99% of the root canal wall covered by Ca(OH)2

score 5: root canal wall completely cove red by Ca(OH)2

The amount of residual Ca(OH)2 on the canal walls was measured by three examiner and scored.The images were scored according to the following criteria given by Kuga et al (1):

Absence of remnants (score = 1), scattered remnants (score = 2), mass remnants (score = 3), and densely-packed remnants (score = 4). Having made the longitudinal section and having taken the photo using stereomicroscope by three specialists, each sample was blindly scored. The photos were evaluated. Scores 1 and 2 were considered as acceptable and scores 3 and 4 were regarded as unacceptabl.

Statistical Analysis:

All the data were analyzed by using the SPSS software package (Statistical Package for SocialSciences, version 11.5, SPSS Inc., Chicago, IL).Kruskal–Wallis test and Mann–Whitney U test were used with a level of significance of 0.05 since Kolmogorov–Smirnov test showed no normal distribution.

Results

All specimens in the positive control group (root canals completely filled with Ca(OH)2) showed a score of 5 and all specimens in the negative control group (no Ca(OH)2 residues in the root canals) showed a score of 0.Positive and negative control groups were found to be statistically different from all

other groups ($p < 0.05$)-(table 3).There were no significant differences between the Pro-Taper and Revo-s groups ($p > 0.05$)-(table 1,2).Score 4 was not found and score 1 was more frequent in all experimental groups.

According to the obtained p-valu, it was observed that there was no statistically significant difference between the two groups in the removal of calcium hydroxide in the middle and apical third of the tooth root(table 2).

Table 1-Comparison of the frequency distribution of residual calcium hydroxide in the root canal of control group and Protaper and Revo s groups

STUDY GROUP	Remaining Caoh2 in dentinal wall	Not remaining Caoh2 in dentinal wall	Total	p-value
Revo-s (G1)	3(30%)	7(70%)	10	0/01
PROTAPER (G2)	1(10%)	9(90%)	10	0/01
CONTROL-	0(0%)	5(5%)	5	0/01
CONTROL+	5(5%)	0(0%)	5	0/01
Total	9	21	30	

Table 2 - Comparison of the frequency distribution of residual calcium hydroxide in Apical and cervical of root canal by Revo s and Protaper files

	REVO-S	PRO TAPER	P-value
Apical	10%	20%	0.05
Cervical	30%	30%	0.05

Tabel 3- Distribution of scores of residual calcium hydroxide in the root canal of control Groups and Protaper and Revo s groups

Score	G1 (NUMBER OF TEETH)	G2 (NUMBER OF TEETH)	Positive Control (NUMBER OF TEETH)	Negative Control (NUMBER OF TEETH)
0	7	9	-	5
1	2	1	-	-
2	1	-	-	-
3	-	-	-	-
4	-	-	-	-
5	-	-	5	-

Figures (1,2)

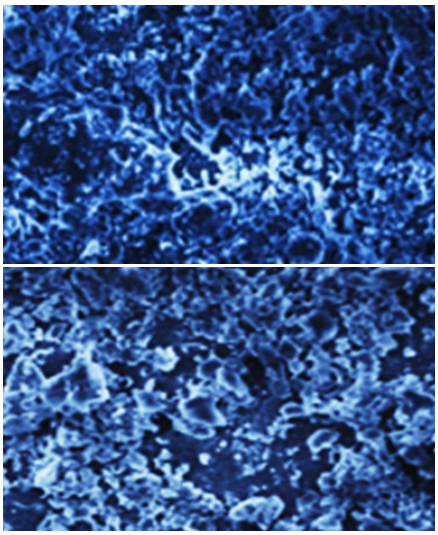

Figure 1 - SEM micrographs (×1000) representative of G1(A = apical third;B= cervical third)

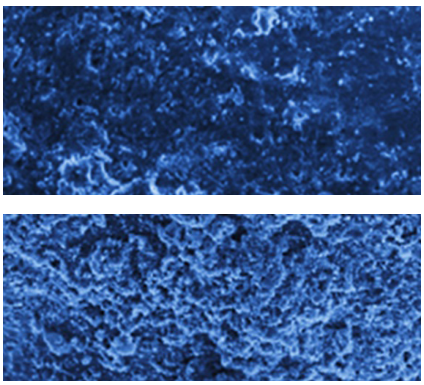

Figure2 - SEM micrographs (×1000) representative of G2 (C=apical third;D = cervical third)

Discussion

Ca(OH)2 is routinely used in root canal treatment,but incomplete removal of Ca(OH)2 remnants on the canal walls could affect the success of the subsequent root canal filling.The important point, however, is that this material should be fully removed before permanent filling of the canal, because the debris of Ca(OH)2 in canal results in the increased ZOE base sealer setting and consequently disturbance in appropriate translocation of gutta percha and reduction of the bonding strength of the filling material when it penetrates into the porosities of the canal wall. In addition, Ca(OH)2 is soluble and if it occupies some space, it can be dissolved over time and presence of an empty space causes microleakage and consequently endodontic treatment failure(11,12).In this study, we compared the effectiveness of two Endodontic instruments in

the removal of Ca(OH)2 from root canal walls.

in previous studies(19,20), different methods have been used to determine residual Ca(OH)2 and other medicaments in root canals. In some of these studies, the amount of residual Ca(OH)2 in the root canal was calculated by measuring the surface area of residues on the canal walls.(Kenee et al., 2006; Balvedi et al., 2010; Tasdemir et al.,2011); however, in other studies, scoring method wasused (van der Sluis et al., 2007; Rodig et al., 2010)

Balvediet al.reported that when the manual technique with NaOCl irrigation was used, the amount of residual Ca(OH)2 on the bovine incisors canal walls was approximately 47% of the total surface area of the canal(21).

few studies have evaluated the influence of rotary instruments on Ca(OH)2 removal from root canals. Kenee et al (16) evaluated the amount of calcium hydroxide remaining in mesial canals of molars after removal with NaOCl and EDTA irrigation, hand files (size 35), rotary instrumentation (Profile System, instrument size 35, 0.04 taper) or ultrasonics (using a size 15 file). They found that rotary and ultrasonic techniques removed significantly more residues than the hand file and irrigating solution techniques

Kuga et al (1) evaluated the efficacy of the F1 instrument of the ProTaper system, and instrument size 25, 0.06 taper of the K3 System, combined with NaOCl or EDTA, in removing calcium hydroxide from root canal dentin walls. They found that, the F1 instrument performed better in the apical and cervical thirds than the K3 instrument, size 25, 0.06 taper, regardless of the final irrigating solution.

Faria et al evaluated the efficacy of Self-Adjusting File (SAF) and ProTaper for removing Ca(OH)2from root canals of mandibular incisor teeth and reported that neither SAF nor ProTaper were able to completely remove calcium hydroxide from the root canals. Similar to the results above, the endodontic instruments used in the present study did not completely remove the Ca(OH)2 medicament(22). Arslan et al. reported that there were nodifferences between ProTaper and Hand instrumentationin terms of removing Ca(OH)2 from root canal(23).

Nevertheless, the results of the present investigation revealed that the efficiency of the two rotary

systems tested was similar, and none guaranteed the complete removal of calcium hydroxide residues.

Conclusion

To achieve the best adaptation of filling material after root canal treatment, it is crucial to remove intracanal medication from the root canal walls. However, none of the irrigation regimens and different techniques were able to completely remove the CH from the root canal wall.

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