

Removal of intracanal calcium hydroxide paste with two rotary systems: RaCe and Mtwo

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ABSTRACT

Introduction: The aim of this study was to compare the effectiveness of two rotary systems in calcium hydroxide removal from root canal walls. **Methods:** A total of 44 distobuccal root canals of human maxillary molars with curvatures between 15° – 25° were randomly divided into two groups of 20 canals each and two control groups. Specimens in group A were instrumented with RaCe rotary system and in group B with Mtwo rotary system up to #35 (4%). Canals were rinsed by 5 ml of 2.5% NaOCl between each instrument and #10 K-file was used as patency during filling. Calcium hydroxide paste was placed in the canals and after incubation; it was removed from canals by means of master apical rotary and NaOCl in

each group. Roots were split longitudinally and the remnants were evaluated by stereomicroscope at three levels using a scoring system. Data were statistically analyzed with ANOVA test. **Results:** No significant difference was found in all groups in both RaCe and Mtwo systems ($p>0.05$). Sum of the acceptable scores was found 53.6% in RaCe and 51.3% in Mtwo group, respectively. **Conclusion:** None of the canals was totally free of calcium hydroxide remnants. Although there was no significant difference between groups, there was a slightly better clinical impression of cleanliness with Mtwo system as to calcium hydroxide removal.

Keywords: Calcium hydroxide. Sodium hypochlorite. Root canal preparation.

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Introduction

To achieve the best adaptation of filling material, it is necessary to clean the dentin wall of smear layer and debris as well as intracanal medication. Calcium hydroxide medication is frequently used between sessions because of its well documented antibacterial properties. It is also used to promote apexification.^{1,2,3} If this medication is not completely removed, its presence on the dentinal wall could compromise the cleanliness and permeability achieved by the final flush after root canal instrumentation.^{4,5} Several studies have shown that the presence of calcium hydroxide on root canal walls can affect the physical properties and penetration of sealers into the dentinal tubules.^{6,7}

According to Porkaew et al⁸ residual calcium hydroxide influences the setting mechanism of various types of root canal sealers. The short term clinical implication is a rapid setting reaction of the sealer that may prevent the placement of gutta-percha.

Calcium hydroxide can react to form resorbable calcium carbonate which over time is likely to create voids at the root-filling interface, thus affecting the long term outcome of the root canal treatment. Ricucci and Langeland⁹ reported an endodontic treatment failure due to incomplete elimination of calcium hydroxide. Consequently, several studies have tried to achieve the best protocol to remove all calcium hydroxide medication before root canal filling.

Calt and Serper¹⁰ reported complete removal of calcium hydroxide from the root canal after irrigation with EDTA and NaOCl in comparison with NaOCl alone. However, other studies using the same irrigation regimen could not confirm these results and still found extensive remnants of calcium hydroxide.^{11,12,13} Even the passive use of ultrasonic as the final flush did not result in complete removal of the medication from root canal walls.^{13,14,15} In recent years most of the canal preparation is accomplished by rotary systems. There is no research in hand about their effectiveness in canal wall removal of calcium hydroxide.

The purpose of this *in vitro* study was to compare the cleaning effectiveness of two rotary systems in canal wall removal of calcium hydroxide.

Material and Methods

A total of 44 distobuccal roots of permanent human maxillary molars were subjected to this study.

The inclusion criteria were as follows: No caries, fractures, resorptions and root curvature ranging from 15° – 25° according to Schneider.¹⁶ The selected roots had a working length of 12 mm after decoronation. They were randomly divided into two experimental groups, each containing 20 specimens.

The specimens in group A were prepared with RaCe (FKG Dentaire, La chaux-de-fonds, Switzerland) rotary system according to the manufacturer starting with #15.02 until a # 35.04 master apical rotary (MAR) finalized the preparation. The specimens in group B were prepared with Mtwo (VDW GmbH, Munich, Germany) rotary system according to the instruction manufacturer from #10.04 until a #35.04 taper used as MAR. In order to control speed and torque, the Endo IT Professional electric motor (VDW GmbH, Munich, Germany) was used. Between each rotary instrument, patency was maintained with a #10 K-file (Dentsply, Maillefer, Ballaigues, Switzerland) and canals were irrigated with 2 ml of 5.25% NaOCl. After final irrigation canals were dried with #35 paper points (Gapadent CO, LTD, Korea). A freshly mixed calcium hydroxide paste (Merk, Darmstadt, Germany) was prepared and carried to the canals by means of a #20 lentulo until the paste was detected through the apex. Specimens in control groups were prepared identically to group A. Roots in positive control group were filled with calcium hydroxide while negative control group received no calcium hydroxide treatment. In order to confirm the intermediate filling quality, periapical radiography was performed in buccolingual direction. After temporary restoration with Coltosol (Coltene, Altstätten, Switzerland), all the specimens were incubated in 100% humidity at 37 °C for one week. The temporary filling was removed with an excavator.

In order to remove calcium hydroxide, MAR instrument was inserted in the canal and worked on all canal walls through brushing action during 30 seconds in each studied group. Also patency of the apical foramen was obtained with #10 k-file. The canals were irrigated with 5 ml of 5.25% NaOCl using a Prorinse probe syringe (Dentsply, Tulsa, USA) with gauge 28 as final flush. Specimens in control groups received no treatment in this phase of the study. All the mentioned processes were accomplished by a fully trained operator.

Longitudinal grooves were obtained through cuts on the buccal and lingual root surfaces of each specimen with a slow speed diamond disc (D&Z, Darmstadt, Germany), taking care to not invade root canal. Roots were split in two halves by a chisel and images of each half of the canals were taken by a digital camera attached to a stereo-zoom microscope (Olympus SZX, Germany) at 10x magnification.

The residual calcium hydroxide was recorded by three trained endodontists unaware of the procedure (double blind observation). A scoring system was defined to assess the quantity of the residue on the canal walls.

Evaluation scores used were: 1 – no visible remnants; 2 – remnants scattered through canal walls; 3 – distinct masses along canal walls; 4 – densely packed remnants along canal walls. Evaluation was carried out at each third (apical, middle, and cervical) and the highest score was considered. Numerical scores of specimens were converted to qualitative scores as “acceptable” for scores 1 and 2, and “unacceptable” for scores 3 and 4.

Data were subjected to statistical interpretation using One Way ANOVA. The level of significance was set at $p < 0.05$.

Results

The results of the study are shown in Table 1.

Positive control group showed complete coverage of dentinal walls with calcium hydroxide, as opposed to negative control group with clean dentinal walls in all thirds.

There were no statistically significant differences between Mtwo and RaCe group in all canal thirds ($p > 0.05$).

The results can be summarized as follows:

1. Acceptable calcium hydroxide removal scores for coronal third were 40% for RaCe and 45% for Mtwo.
2. Acceptable calcium hydroxide removal scores for middle third were 50 % for RaCe and 60% for Mtwo.
3. Acceptable calcium hydroxide removal scores for apical third were 45 % for RaCe and 35% for Mtwo.

Sum of the acceptable scores was found 53.6% in RaCe and 51.3% in Mtwo, respectively.

Discussion

The purpose of this study was to compare the effect of two different master apical rotary instruments on calcium hydroxide removal. The results showed that there was no significant difference on the ability of RaCe and Mtwo system in removal ability of $\text{Ca}(\text{OH})_2$ along canal walls.

Although calcium hydroxide has many benefits as intracanal medication, it should be removed before permanent root canal filling. Several studies tried to achieve the best protocol to remove all calcium hydroxide medication before root canal filling.^{11-15,17-22}

Salgado et al¹⁸ found recapitulation with master apical file (MAF) in combination with irrigants to remove calcium hydroxide from canal walls more efficiently than irrigant alone. On that basis this study was designed to evaluate the effect of final rotary instrument on calcium hydroxide removal. Knee et al¹³ assessed the efficacy of various calcium hydroxide removal techniques and found no technique to remove all the medication, although rotary and ultrasonic were significantly better than irrigation alone.

Table 1. Mean amount of debris found in the apical, middle and coronal third of the experimental groups, in percentage.

System	Coronal		Middle		Apical	
	(1, 2)	(3, 4)	(1, 2)	(3, 4)	(1, 2)	(3, 4)
Mtwo	9 (45)	11 (55)	12 (60)	8 (40)	7 (35)	13 (65)
RaCe	8 (40)	12 (60)	10 (50)	10 (50)	11 (45)	9 (55)

1: Acceptable; 2: Unacceptable; 3: Number (percent).

When a positive blade rake angle is present, the cutting action of the rotary instrument is enhanced.^{22,23} Mtwo instruments have a positive rake angle and they cut dentine along their entire length. These facts might be the reasons for more acceptable percentages in group B in middle and coronal sections, although their differences were not significant. Less acceptable scores were found in the apical section, which is in accordance with previous studies.^{11,18} Since in the mentioned studies the use of patency file had improved the medication removal, this procedure was adopted in this one.

All the studies that have used EDTA as an irrigant for calcium hydroxide removal solely or in combination of NaOCl, found remnants on canal walls.^{11,13,17} There is no evidence that EDTA can completely dissolve calcium hydroxide placed superficially on the canal wall or from deeper layers of the root canal.¹⁴ Similarly to van der Sluis,¹⁴ no EDTA was used in the present study.

The sectioning technique was precise, easy and in

accordance with previous studies.^{15,17,18,20,21} The scoring system used to calculate medicament remnants was reliable and based on previous literature.^{20,21,24,25,26}

In this study two different rotary systems were used for canal preparation and intermediate medication was removed by the MAR of each system along with sodium hypochlorite and patency file. Leaving the most remnants in the apical section emphasizes the importance of increasing master apical size in cases that need intracanal medication between treatment sessions. The authors suggest that in these cases the canal shaping procedure be repeated or carried to a larger size although this needs more research.

Conclusion

Since none of the rotary systems used in this study removed the inter appointment calcium hydroxide from root canal walls, increasing the preparation size in cases with calcium hydroxide therapy is recommended.

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