THE EFFECTIVENESS OF DIFFERENT FINAL IRRIGATION PROTOCOLS FOR REMOVAL OF CALCIUM HYDROXIDE INTRACANAL MEDICATION FROM ROOT CANAL

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ABSTRACT

Abstract: Calcium hydroxide is the most used intracanal medicament between appointments. It should be properly removed before root canal filling because its remnants could compromise the sealing of root obturation. The aim of this study was to compare the effectiveness of two type of irrigation solutions, EDTA and SmearClear in the removal of calcium hydroxide from root canals. Materials and method: twenty human single rooted teeth were prepared using ProTaper Universal instrumentation till F2, .06 taper. The canals were filled with $\text{Ca}(\text{OH})_2$ and after 7 days the $\text{Ca}(\text{OH})_2$ was removed using 3 rinses of 5 ml 15% EDTA and 5 ml 5.25% NaOCl alternately (group 1; n=10) or 3 rinses of 5 ml Smear Clear (SybronEndo) and 5 ml 5.25% NaOCl alternately (group 2; n=10). Results: On the final radiographs the best result was found in group 2 where the cleanliness of the total surface of the root canal wall when SmearClear was used obtained better results comparative to NaOCl – 15% EDTA (91.34% to 71.69%). Conclusions: under the limitation of this study, SmearClear was superior in removing $\text{Ca}(\text{OH})_2$ material compared to NaOCl and 15% EDTA irrigation solution.

Keywords: endodontic irrigation; calcium hydroxide removal

Introduction:

The reduction of microorganism is considered to be the main goal of endodontic therapy. Although many available instrumentation techniques have been advocated, none of them achieved a completely cleaned root canal system. Therefore, an intracanal medicaments are advisable to apply in order to obtain a good disinfection. Calcium hydroxide has the great advantages to inactivate the microorganisms and bacterial products, to change the pH in the root canal due to the diffusion of hydroxyl ions and to induce the formation of mineralized tissues (1).

After the recommended period of 1 or 2 weeks

in the endodontic system, calcium hydroxide must be entirely removed from root canal, because its remnants change the physical properties of sealers, reducing the flow and setting time (2) and altering the penetration of sealers into the dentinal tubules (3). Being a soft paste, $\text{Ca}(\text{OH})_2$ can be firstly removed using K files or master apical file (MAF) in combination with NaOCl and EDTA. Different products and techniques have been investigated to remove this intracanal medication: different solutions, devices for the activation of intracanal irrigants or canal brushes. The manual or mechanical agitation might also enhance the removal of $\text{Ca}(\text{OH})_2$. However, the practitioners and researchers are still searching

the best method to remove the $\text{Ca}(\text{OH})_2$.

The most used and effective method to remove the debris is the combination between NaOCl and EDTA. The addition of tensioactive agents increases the efficacy of endodontic irrigants in removing both smear layer and $\text{Ca}(\text{OH})_2$ (4). A new irrigant solution, SmearClear (SybronEndo, Orange CA) which contain EDTA with tensioactive agent has been recently introduced to the market.

The aim of this study was to compare the effectiveness of two type of irrigation solutions, EDTA and SmearClear in the removal of calcium hydroxide from root canals.

Material and methods:

Twenty human single rooted teeth with closed apices and straight root canals were selected. The teeth were kept in NaOCl 5.25% for 2 days for removing organic debris and were washed using distilled water. Proximal and bucco-lingual radiographs were taken in order to see the internal configuration of endodontic space.

The access cavities were prepared using round diamond bur (no 806 314 012 Komet, Germany). Working length was investigated with 10 or 15 K files from the coronal or incisal point until its tips were seen on apical foramen and the final working length was established by subtracting 1 mm from this length.

All the teeth underwent ProTaper Universal instrumentation till F2, .06 taper. Straight line access was created using Sx instrument and the shaping procedures were done with S1 and S2 instruments in brushing movements on the root canal walls. F1 and F2 were used with pecking movements for finishing the apical part of root canals. A quantity of 2 ml NaOCl 5.25% (Chloraxid, CerKamed, Poland) was used after each file during instrumentation, while a total of 5 ml NaOCl 5.25% was flushed into the root canal at final procedures, after F2 instrument.

Smear layer was removed with EDTA 15% (Endo-Solution, CerKamed, Poland) for 1 minute, followed by 5 ml saline. The irrigating procedures were done using endodontic files (Endo-Top, CerKamed, Poland) with 25 Ga needle and lateral slot. The root canals were then

dried with paper points.

The root canals were filled with Calcium hydroxide (Calcipast + I, CerKamed) using Lentullo spiral file (Paste Carrier, Medin) and the cavities were filled with Citodur Hard (DoriDent, Austria). Another radiographs were taken in mesio-distal incidence for seeing the quality of root canal fillings. The teeth were then put in distilled water at room temperature for 7 days.

After this period the teeth were randomly divided in 2 groups (n=10) according to the solution used for calcium hydroxide removal:

Group 1: root canals were irrigated using 3 rinses of 5 ml 15% EDTA and 5 ml 5.25% NaOCl alternately.

Group 2: root canals were irrigated using 3 rinses of 5 ml Smear Clear (SybronEndo) and 5 ml 5.25% NaOCl alternately.

The irrigation solution were placed in 5 ml syringes with 25 Ga needle, calibrated at 1 mm less then working length with rubber stop. For each canal, a total of 15 ml were used, divided in 3 rinses of 5 ml. After each rinse, a K file 25 was introduced into the canal and slightly file movements on the canal walls were applied. Finally, the root canals were flushed with 5 ml distilled water and dried with paper points.

After irrigation protocols, final radiographs were taken in mesio-distal incidence. The radiographs were standardized at 50x140 pixels and were analyzed using ImageJ 1.50 and Java 1.8.0 _77 programmes (5). On the mesio-distal radiographs we selected manually the total area of root canal filled with calcium hydroxide and the data were calculated using ImageJ 1.50 programme. After the irrigating protocols, on the final radiographs the new areas representing the calcium hydroxide remnants were selected and calculated in the same manner. The data were introduced in Microsoft Excel programme for comparative analyze.

Results

The best results was found in group 2 where the maximum cleaning percentage of a tooth was 96.07%. In group 1 the maximum cleaning percentage of a tooth was 79.49%. The most areas of $\text{Ca}(\text{OH})_2$ remnants were found in the apical part of the canal (31.13% in group 1 to 13.85%

in group 2), while in the medium part were found the less remnants of Ca(OH)_2 (25.82% in group 1 to 3.52% in group 2). Comparing the cleanliness of the total surface of the root canal wall when SmearClear was used, one can see a better results comparative to NaOCl – 15% EDTA (91.34% to 71.69%) (tabel 1).

Table 1. Percentage of Ca(OH)_2 remnants and clean areas after specific irrigating protocols in the experimental groups

Group		Group I	Group II
Coronal part	Ca(OH)_2 remnants(%)	28.1	9.37
	Clean areas(%)	71.9	90.63
Medium part	Ca(OH)_2 remnants(%)	25.82	3.52
	Clean areas(%)	74.18	96.48
Apical part	Ca(OH)_2 remnants(%)	31.13	13.85
	Clean areas(%)	68.87	86.15
Total	Ca(OH)_2 remnants(%)	28.31	8.66
	Clean areas(%)	71.69	91.34

According to these results, both irrigation protocols left some Ca(OH)_2 covering the canal walls at different areas. Representative radiographs of the presence of Ca(OH)_2 at coronal , medium and apical parts of the two groups are shown in Figure 1 and Figure 2.

Figure 1 a, b, c Inferior canine, EDTA/NaOCl group; before preparation (a), after Ca(OH)_2 filling (b) and after Ca(OH)_2 removal (c)

Figure 2 a, b, c Inferior incisor, Smear Clear group; before preparation (a), after Ca(OH)_2 filling (b) and after Ca(OH)_2 removal (c)

Discussion

Calcium hydroxide is the most used intracanal medicament between appointments due to its antimicrobial activity. However, it should be removed prior to root canal filling because its remnants could interfere with the sealing ability of endodontic sealers and compromise the sealing of root obturation (6,7). Sodium hypochlorite represents the most chosen irrigant to remove Ca(OH)_2 .

This experimental study revealed that

none of the chosen irrigant solutions completely removed $\text{Ca}(\text{OH})_2$ material from the canal walls. There was better results between the use of 15% EDTA and SmearClear at the three regions of the root canals comparative to NaOCl and 15% EDTA. Although in the apical part more $\text{Ca}(\text{OH})_2$ material was found in all groups, even there 15% EDTA and SmearClear managed to clean better the root walls. These findings are in disagreement with Lui et al, Da Silva et al, Masudi et al who concluded that SmearClear did not result in better smear layer removal comparative to EDTA (8, 9, 10).

It is stated that addition of surfactants and tensioactive agents to EDTA reduces surface tension of irrigation solutions and improves the cleaning efficacy, but other authors (Zender et al) showed that reducing surface tension of root canal irrigant did not improve their calcium hydroxide chelating performance (11).

The results of this study are in agreement with those found by Uzunoglu et al who revealed that EDTA with surfactants can remove $\text{Ca}(\text{OH})_2$ from root canals more effective as EDTA alone. This effect is due to the combination of a chelating agent and a detergent which improved the efficacy of SmearClear in calcium ion elimination. Furthermore the type and sequence of irrigants play a more important role than the total volume solutions in removal $\text{Ca}(\text{OH})_2$ (12).

The experimental study revealed that apical part presented more remnants than the other parts of the canal. It is known that the apical region of the canal is the most difficult area to be cleaned due to its anatomical complexities, lateral and accessory canals. Other factor such as instrumentation in combination with irrigants improves the removal of calcium hydroxide medication better than an irrigant alone (Salgado et al) (13).

Conclusions

Under the limitation of this study, SmearClear was superior in removing $\text{Ca}(\text{OH})_2$ material in all parts of the root canal compared to NaOCl and 15% EDTA irrigation solution. However, both solutions produced less effective cleanliness at the apical region of the root canal.

Acknowledgements:

For this article all the authors have equal contributions.

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