In vitro Assessment of Calcium Hydroxide Removal from Endo Blocks by Simple Irrigation with NaOCl and the Passive Ultrasonic Irrigation Technique

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Because endodontic pathology is caused due to bacterial contamination of the root canal system, endodontic treatment should focus on eliminating microorganisms in root canals. For more than 70 years Calcium Hydroxide has an important role in antimicrobial endodontic therapy. The use of calcium hydroxide is limited by the incomplete removal thereof, a residue covering 20% to 45% of the ductal wall, even after irrigation with NaOCl or EDTA. This study aims to evaluate the removal of calcium hydroxide in root canals using two different techniques.

Keywords: calcium hydroxide, root canal, NaOCl, endo block

Because endodontic pathology is caused due to bacterial contamination of the root canal system, endodontic treatment should focus on eliminating microorganisms in root canals. A number of materials have historically been used in endodontic treatments, but unfortunately, none of these have been able to satisfy the total requirements of an ideal sealer [1, 2]. For more than 70 years Calcium Hydroxide has an important role in antimicrobial endodontic therapy. It is used both to preserve pulp vitality (direct or indirect pulp capping), root fracture repair, closure of immature apex, root resorption treatment. Calcium hydroxide enhances the formation of a calcified tissue barrier when used as capping material in the canal or can be used in contact with the pulp or healthy periodontal tissue [3]. Many studies indicate the use of calcium hydroxide as an antiseptic in cases where a root canal is infected due to OH ions which can diffuse dentinal tubules in both the infected and the periodontal space directly acting on microorganisms [4] .The use of calcium hydroxide is limited by the incomplete removal thereof, a residue covering 20 to 45% of the ductal wall, even after irrigation with NaOCl or EDTA. As the remaining calcium hydroxide can shorten setting time of sealer-sized zinc oxide eugenol based, can affect root filling quality and increases the risk of micro-infiltrations it is important to remove all residual calcium hydroxide [5].

This study aims to evaluate the removal of calcium hydroxide in root canals using two techniques:

- Irrigation with NaOCl 5.25% associated with manual mechanical instrumentation,
- Passive Ultrasonic Irrigation associated with manual mechanical instrumentation.

Experimental part

For evaluation were used 30 acrylic endo training blocks *Endo 943-100 Training Blocks* DIADENT Group International, each having a tapered root canal 0.65 and two accessories root canals (fig.1).

The channels were filled with injectable Calcium hydroxide respectively Calxyd, SpofaDental, Czech Republic, beyond apex to ensure a full obturation of the root canal (fig 2).

Fig.1 Endo training block

Fig.2 Canal filled with Calcium Hydroxide

- 2 weeks after root canal filling Ca(OH)2 was removed of channels (fig.3) using 2 techniques:

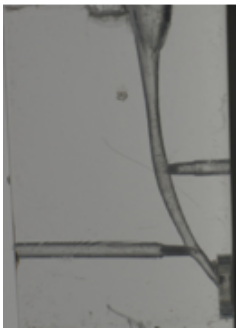

Fig.3 Endo trainer free of Calcium Hydroxide

-I. - 5.25% NaOCl irrigation using special needles, Endo-Eze, Ultradent, USA placed as close to the apex as two-thirds of the working length. Instrumentation with manual master needle, ISO 40, through circumferential drive and withdrawal. At the end of the preparation the channels were dried with paper points.

-II. 5.25% NaOCl irrigation using Passive Ultrasonic Irrigation technique. For irrigation a thin endodontic ultrasonic loop ISO 40 was used. The endodontic ultrasonic loop was placed as close to the apex as two-thirds of the working length and acted 30 s for each irrigation.

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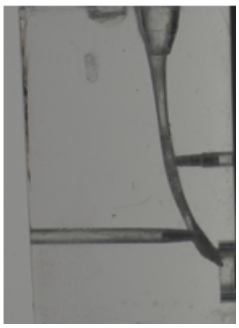

Fig.4 Image of the endo-trainer

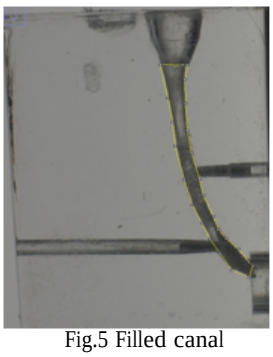

Fig.5 Filled canal

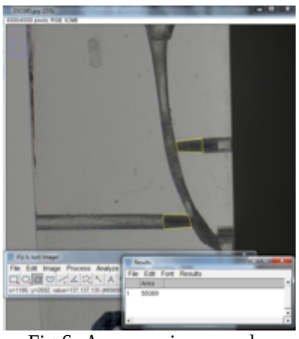

Fig.6. Accessories canals

Fig.7 Remanent Ca(OH)2

Percentage % Remanent $Ca(OH)_2$	Min	Max	Medium
Technique Nr.1	0.521357	15.68941	5.308775
Technique Nr.2	0.803518	14.85413	5.305101

Table 1
AVERAGE RESULTS

After analyzing preparations, they were photographed using a Sony WX500 Compact Camera room, at a resolution of 18 megapixels. To maintain a constant distance and motionless images was used a tripod and an auxiliary shutter. Shutter speed: 1/10 sec; aperture value: f / 3.5; value light sensor sensitivity: ISO 100; Focal Length: 10 mm (fig.4)

Computer analysis of the preparations was performed using ImageJ software, Java, USA, following the surface that remained coated with the calcium hydroxide by free hand selection, in the main canal and in the accessories canals. (fig. 5-7). Digital pictures were analyzed using this program so that each delimited area has a dimension measured as a certain number of pixels, which is a component of very small size, of a graphic image. Data was recorded using the analysis software Microsoft Office Excel, and then was followed by Instat statistical analysis using the GraphPad software. For analysis was used Fisher's exact test, p-value was set at a confidence interval of 95%, p = 0.05.

Table 2
SIMPLE IRRIGATION RESULTS

NaOCl irrigation and manual instrumentation			
Block number	Nr.Pixels filled canal	Nr.Pixels remanent $Ca(OH)_2$	Percentage remanent $Ca(OH)_2$ %
5	217070	34057	**15.68941**
12	236220	32910	13.93193
11	217360	24890	11.45105
4	225811	25144	11.13498
13	221790	11250	5.072366
7	217100	9500	4.375864
6	239055	10175	4.256343
15	234790	9650	4.110056
10	236210	5378	2.276788
8	228506	4200	1.838026
3	237320	4304	1.813585
14	215870	2604	1.206282
1	216949	2090	0.96336
9	216549	2025	0.935123
2	214632	1119	0.521357

Results and discussions

According to tables 1-3 no statistical significant differences were observed between the two techniques. In both lots some canals have been cleaned better, while others have remanent Ca (OH), in different areas of the endo blocks.

The results indicate that none of the techniques used in this study removed the $Ca(OH)_2$ effectively from root canals. In the endodontic literature there is not a well defined irrigation protocol to adopt for the elimination of $Ca(OH)_2$ by mechanical action. For the overall root canal cleanliness the results of this study did not corroborate those of previous reports [6, 7]. To be suitable for clinical application, an intracanal medication must be easy to introduce into the root canal, have proper contact with the tissues, and be easy to remove, to ensure effective sealing of the root filling material [8]. Rodig et al. [9] stated that smaller apical preparation size might affect hydrodynamics and decrease the effectiveness of root canal irrigation solutions. Also, several studies [10-12] have reported that larger apical preparation size increased the mechanical efficacy of root canal irrigation solutions. In the present study, our samples were endo blocks and apical preparation size was large, but none of the solutions could completely remove $Ca(OH)_2$ from the root canals. The improvement of hydrodynamic techniques could add a significant value to treatment results, with more predictable patient outcome.

Passive ultrasonic irrigation and manual instrumentation			
Block Number	**Nr.Pixels filled canal**	**Nr.Pixels remanent $Ca(OH)_2$**	**Percentage %**
19	204704	30407	**14.85413**
18	282147	32670	11.57907
17	215245	42871	10.62557
16	215745	20749	9.617372
22	216480	16730	7.728197
28	217890	9877	4.533021
26	218476	8742	4.001355
25	223456	7540	3.374266
29	237821	6870	2.888727
21	222621	6326	2.841601
30	218731	5891	2.693263
23	205896	4561	2.215196
27	223890	2345	1.047389
24	237891	1972	0.828951
20	227624	1829	0.803518

Table 3
PASSIVE ULTRASONIC IRRIGATION RESULTS

Conclusions

None of the technique used in this study removed the Calcium Hydroxide completely from the entire canal, with no statistical significant difference between. More investigations are recommended on the mechanical means that will effectively remove $Ca(OH)_2$ before final obturation of the canal to reduce side effects and optimize the benefits.

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