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Retrievability of calcium hydroxide mixed with different vehicles from root canals with various chelators used in combination with sodium hypochloride: an in vitro cone beam computed tomography volumetric analysis.

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Abstract

Context: Calcium hydroxide is very frequently used as a intracanal medicament. It should be removed from root canals before obturation as it hampers sealing ability of sealers.

Aim: Aim of this study was to check retrievability of calcium hydroxide mixed with different vehicles with chitosan and maleic acid mixed with sodium hypochloride.

Study setting and design: This was an experimental prospective in-vitro study conducted at dental learning institution.

Methods and materials: Biomechanical preparation of root canals of forty mandibular premolar was done and canals were filled either with Metapex or $Ca(OH)_2$. Volumetric analysis was performed utilizing CBCT after seven days of incubation. $Ca(OH)_2$ was removed using either 0.2% Chitosan or 7% maleic acid in combination sodium hypochlorite with sonic agitation.

Statistical analysis: The data was statsically analysed by Kruskal Wallis and Mann–Whitney U-test.

Results: Both of the chelators failed to remove aqueous-based as well as oil-based $Ca(OH)_2$ completely from the root canal. Aqueous-based $Ca(OH)_2$ was easier to be

removed than oil-based $Ca(OH)_2$. 0.2% Chitosan in combination with sonic agitation performed better than 7% of Maleic acid in removal of $Ca(OH)_2$.

Conclusion: Combination of 0.2% Chitosan combined with sodium hypochlorite with sonic agitation results in lower amount of $Ca(OH)_2$ remnants than 7% of Maleic acid irrespective of type of vehicle present in the mix.

Keywords: Calcium Hydroxide, Retrievability, Chitosan, Maleic Acid, Metapex, Volumetric CBCT, Intracanal Medicament.

Introduction

Endodontic treatment aims directed towards the prevention and control of pulpal and periradicular infections. It is clear that the outcome of endodontic therapy depends on reduction or elimination of micro-organisms responsible for these lesions.[1] Elimination of these micro-organisms is mainly achieved by chemomechanical preparation of root canals. However, the eradication of microorganisms from canal irregularities is enhanced by intracanal medicaments that prevent the proliferation of residual strains, as well as recontamination.[2]

Calcium hydroxide is frequently used intracanal medicament as it produces alkaline environment in which most of the micro-organisms don't survive.[3] As a medicament, calcium hydroxide can be placed within the root canal using different vehicles such as water, carboxymethyl cellulose, glycerin and silicone oil. The type of vehicle used affects the physical and chemical properties of calcium hydroxide. Aqueous vehicles cause rapid release of calcium and hydroxyl ions, while oily vehicles prolong the ionic dissociation.[4,5] Out of available vehicles with which calcium hydroxide is mixed, Metapex is silicon oil based calcium hydroxide paste with iodoform which has shown greater anti-microbial properties.[6] Complete removal of calcium hydroxide is recommended before obturation as it limits the penetration of root canal sealers into the dentinal tubules.[7]

Aim of this study was to evaluate retrievability of calcium hydroxide and metapex from the root canal by using 0.2% chitosan and 7% maleic acid mixed with sodium hypochloride with sonic irrigation.

Materials and methodology

Forty extracted single canal human mandibular premolars free from fractures and crack were selected. All teeth were analyzed using digital radiographs to check for single canals. Coronal portion of teeth was flattened to establish working length. Access cavities were prepared and root canals were subjected to chemomechanical preparation with ProTaper files till F3. 2 ml of 5.25% NaOCl was used as irrigant after each instrument and 5 ml of 17% EDTA for final flush. Canals were dried using paper points. Two formulations of $Ca(OH)_2$ with different vehicles were selected.

a) Metapex, a commercially available product composed of $Ca(OH)_2$, silicon oil and iodoform.

b) The a commercially available $Ca(OH)_2$ powder mixed with distilled water in 1:1 ratio.

The teeth selected were divided into two groups of twenty teeth each:

1) Group I: Metapex was injected into root canal until material extruded through the apex.

2) Group II: $Ca(OH)_2$ mixed with distilled water was placed into the canals with lentulospiral until material extruded through apex.

Excess material was wiped off with moist cotton. The access cavities were temporarily sealed with a cotton pellet and temporary cement. Later samples were stored at 37°C and 100% relative humidity for 7 days. Subsequently, the teeth were mounted in a modeling wax for the purpose of CBCT. After CBCT imaging, the volume of the filled material in each tooth was estimated.

The teeth in each group were held in the wet sponge and further randomly divided into two subgroups on the basis of irrigant used for removal. Irrigation was done at 2 mm from the working length. Sonic agitation was performed with a sonic activator. The teeth in each group were further randomly divided into two subgroups on the basis of irrigant used for removal.

1. Group IA (n=10): Metapex retrieved with 0.2% Chitosan for 1 min + final rinse with 1 ml of sodium hypochloride
2. Group IB (n=10): Metapex retrieved with 7% Maleic acid for 1 min + final rinse with 1 ml of sodium hypochloride
3. Group IIA (n=10): $Ca(OH)_2$ retrieved with 0.2% Chitosan for 1 min + final rinse with 1 ml of sodium hypochloride
4. Group IIB (n=10): $Ca(OH)_2$ retrieved with 7% Maleic acid for 1 min + final rinse with 1 ml of sodium hypochloride

A second CBCT was done and the volume of remaining material in each tooth was estimated as before.

The calculation of volume measurement of intracanal medicament was done by 3D slicer software as shown in figure 1 (BSD-style license).

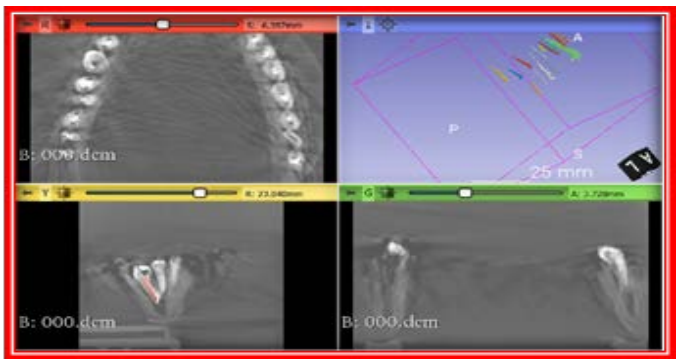

Fig.1: Volumetric CBCT analysis for samples

Volume of intracanal medicament was expressed in terms of cubic mm. Removal efficiency of irrigants were measured in terms of b/a*100, where a is volume of material packed into root canal, b is volume of material after retrieval with irrigation. Lesser the percentage volume remaining greater the efficiency of the irrigation solution. The data was statistically analyzed by Kruskal Wallis and Mann– Whitney U-test.

Results

There was no statistically significant difference in all the groups (P=0.318). Remaining percentage volume of calcium hydroxide with chitosan was least (18.7%) of all the groups followed by maleic acid (20.9%). Remaining percentage volume of metapex retrieved with maleic acid was most (31%) and with chitosan, it was 26.9%. It was also found that removal calcium hydroxide by chitosan was significant (P= 0.046) than removal of metapex by maleic acid as shown in table I.

Table 1: Comparison of percentage of remaining volume of metapex among four groups i.e. after irrigation with chitosan, maleic acid, CA(OH)2 respectively.

Groups	Mean (%)	S.D	Kruskal Wallis Test	P Value, Significance
Group 1 (Metapex + Chitosan)	26.9	8.79	H =3.519	P =0.318, No Significant Statistical Difference
Group 2 (Metapex + Maleic Acid)	31.0	19.82		
Group 3 ($Ca[Oh]_2$ + Chitosan)	18.7	9.09		
Group 4 ($Ca[Oh]_2$+Maleic Acid)	20.9	9.07		
Mann Whitney U Test Used To Find Individual Pair Wise Comparison				
Group	Comparison	Mean	P Value,	

	Group	Difference	Significance
Group 1 (Metapex + Chitosan)	Group 2 (Metapex + Maleic Acid)	4.10	P= 0.886
	Group 3 ($Ca[Oh]_2$ + Chitosan)	8.20	P = 0.275
	Group 4 ($Ca[Oh]_2$+Maleic Acid)	6.0	P=0.713
Group 2 (Metapex + Maleic Acid)	Group 3 ($Ca[Oh]_2$ + Chitosan)	12.3	P=0.046*
	Group 4 ($Ca[Oh]_2$+Maleic Acid)	10.1	P = 0.294
Group 3 ($Ca[Oh]_2$ + Chitosan)	Group 4 ($Ca[Oh]_2$+Maleic Acid)	2.2	P= 0.980

Discussion

Calcium hydroxide is the widely used intracanal medicament in endodontic treatments because of its antimicrobial effect.[8,9] It also inhibits osteoclasts and neutralizes bacterial toxins.[10] Calcium hydroxide should be combined with a liquid vehicle because the delivery of dry calcium hydroxide powder alone is difficult, and fluid is required for the release of hydroxyl ions. Sterile water or saline are the most commonly used carriers.[7] Metapex is the calcium hydroxide delivered with silicon oil. Oily vehicles have restricted applications as they are difficult to remove and leave a residue on the canal walls affecting the adherence of sealer or other materials used to fill the canal.[11] Thorough debridation of root canal before obturation is necessary as residual calcium hydroxide can negatively effect the treatment outcome.[7] Normally intracanal medicaments are removed with copious irrigation of EDTA or sodium hypochloride with hand instrumentation but these modalities have proven to be insufficient. Studies have observed that type of vehicle also affects retrieval of calcium hydroxide from root canal.[12] In this study the volumetric CBCT was used for assessment of measurement of intracanal medicaments. Some similar kind of studies had been done using longitudinal sectioning of tooth followed by observing under electron microscopy [13] and also digital radiography. Disadvantage of these kind of studies that they couldn't measure volume of intracanal medicament but surface area only. Also there was wastage of material during sectioning of teeth for electron microscopy. Also, volumetric CBCT is superior method according to authors.[14] In the present study none of the irrigant solution was able to retrieve calcium hydroxide completely. In the study irrigant solutions were used in combination with sodium hypochloride, because irrigation solutions as well as sodium hypochloride when used alone did not show favorable outcome.[13,15] Chitosan is bioactive biopolymer of D-glucosamine and N-acetyl-D-glucosamine. Mechanism of action of chelating for chitosan is not well documented yet, however two theories have been put forward to explain how it absorbs heavy metal ions from water producing chelating property. First theory is the bridge model which states that two or more amino group of chitosan bind to the same metal ion. Second theory is the pendant model which states that only one amino group is used for bonding and metal ion sticks to amino group like a pendant. Either of these two mechanisms are responsible for producing chelation of calcium ions by chitosan.[16] In the present study 0.2% chitosan showed the most effective removal of calcium hydroxide from both the main groups. Chitosan more effectively removed calcium hydroxide than metapex,

though there was no significant statistical difference. Maleic acid is the mild organic acid. In dentistry it is used for removing smear layer. Maleic acid has better wettability when mixed with sodium hypochloride.[17] Also it decreses surface tension of maleic acid leading to better removal of smear layer and calcium hydroxide.[17] In the present study maleic acid when combined with sodium hypochloride showed poor retrievability of metapex as well as calcium hydroxide in comparison with chitosan. While it showed statistically significant difference between group IB and group IIA.

Conclusion

In the limitations of present study, it can be concluded that, None of the irrigation solutions were able to remove calcium hydroxide completely from root canals. Calcium hydroxide is difficult to remove from root canal when mixed with oil vehicle than that of aqueous vehicle. 0.2% chitosan mixed with sodium hypochoride showed better retrieval of calcium hydroxide irrespective of vehicle used when compared to 7% maleic acid. Further studies are required for more efficient retrieval calcium hydroxide from root canal by use of different irrigation system.

References

1. Sathorn C, Parashos P, Messer H. Antibacterial efficacy of calcium hydroxide intracanal dressing: A systematic review and meta- analysis. Int Endod J 2007;40:2-10.
2. Vineeta N, Gupta S, Chandra A. Retrievabilty of calcium hydroxide intracanal medicament with chitosan from root canals: An in vitro CBCTvolumetric analysis. J Conserv Dent 2014;17:454-7.
3. Siqueira JF Jr., Lopes HP. Mechanisms of antimicrobial activity of calcium hydroxide: A critical review. Int Endod J 1999;32:361-9.
4. Teoh, Y.-Y.; Athanassiadis, B.; Walsh, L.J. The influence of aqueous and PEG 400 solvent vehicles on hydroxyl ion release from calcium hydroxide medicaments. Int. Dent. 2016, 11, 44–56.
5. Cai, M.; Abbott, P.V.; Salgado, J.C. Hydroxyl ion diffusion through radicular dentine when calcium hydroxide is used under different conditions. Materials 2018, 11, 152.
6. Çalt S.,Serper A. Dentinal tubule penetration of root canal sealers after root canal dressing with calcium hydroxide. Journal of Endodontics, 1999;25:431–3.
7. Mohammadi Z, Dummer PMH. Properties and applications of calcium hydroxide in endodontics and dental traumatology. Int Endod J. 2011;44:697-730.
8. Han GY, Park SH, Yoon TC. Antimicrobial activity of Ca (OH) 2 containing pastes with Enterococcus faecalis in vitro. J Endod 2001;27:328-32.
9. Athanassiadis B, Abbott PV, Walsh LJ. The use of calcium hydroxide, antibiotics and biocides as antimicrobial medicaments in endodontics. Aust Dent J 2007;52:S64-82.
10. Tanomaru JM, Leonardo MR, Tanomaru Filho M, Bonetti Uzunoglu, et al. CH removal efficiency of chelates Sadifferent irrigation solutions and calcium hydroxide on bacterial LPS. Int Endod J 2003;36:733-9.
11. Fava LRG, Saunders WP. Calcium hydroxide pastes: classification and clinical indications: review, Int Endod J 1999;32:257-82.
12. Lambrianidis T, Margelos J, Beltes P. Removal efficiency of calcium hydroxide dressing from the root canal. J Endod 1999;25:85-8.
13. Uzunoglu E, Turker SA, Ozcelik B. The effectiveness of various chelates used alone or in combination with sodium hypochlorite in the removal of calcium

hydroxide from root canals. Saudi Endod j, 2015:5;161-5.

14. Suzuki S, Masuda Y, Morisaki H, Yamada Y, Kuwata H, Miyazaki T. The study of chitosan-citrate solution as a root canal irrigant: A preliminary report. Oral Hyg Health 2014;2:142.
15. Wiseman A, Cox TC, Paranjpe A, Flake NM, Cohenca N, Johnson JD. Efficacy of sonic and ultrasonic activation for removal of calcium hydroxide from mesial canals of mandibular molars: A microtomographic study. J Endod 2011;37:235-8.
16. Ballal NV, Ferrer-Luque CM,Sona M, Prabhu KN, Arias-Moliz T, Baca P, Evaluation of final irrigation regimens with maleic acid for smear layer removal and wettability of root canal sealer, Acta Odont Scand.
17. Nainan MT, Nirupama DN, Benjamin S. Comparison of the efficacy of ethylene diamine tetraacetic acid and maleic acid in the removal of three calcium hydroxide intra-canal dressings:A spiral computerized tomography volumetric analysis. J cons dent 2013;16:56-60.