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Influence of Calcium Hydroxide as an Intracanal Medicament on Apical Seal

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

Aim of the Study: Aim of endodontic therapy is to restore the natural tooth functionally as well as esthetically. The success of the treatment depends predominantly on the reduction or complete eradication of pathogens and their byproducts (mechanically and chemically) along with adequate seal. Studies have concluded that chemo mechanical instrumentation alone will only render 50-70% of infected canals free of microorganisms therefore, an effective antimicrobial agent as intracanal medication should be used to improve treatment outcome. Moreover Improper apical seal has been reported as most common cause of endodontic treatment failure in different studies Therefore it is essential to know the effect of most commonly used intracanal medicament Ca (OH) ^{2} on apical seal, in order to reduce the chances of endodontic failure. The aim of this study is to evaluate the effect of intracanal medicament on apical seal.
Study Design: Quasi Experimental study.
Place of the Study: The samples were prepared at Ziauddin University and was analyzed at Karachi University.
Methodology: Mandibular premolars were prepared using step back technique and were divided into two groups. In Group A, no intracanal medicament was placed and in Group B intracanal medicament was placed. Samples were placed in Indian ink dye for 7 days and were then cleaned in running water before sectioning up to 5 mm (1 mm each) using Microtome and analyzed under stereomicroscope. Shapiro-Wilks test and Mann Whitney U test was used for data analysis.

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Results: Group with intracanal medicament showed least amount of dye penetration with mean value 2.30±1.832 as compared to non-medicated group mean value (2.96 ±1.69) but the results were not statically significant p value 0.072.
Conclusion: The results of this study concluded that there is no statistically significant difference in leakage between group A and group B (non-medicated and medicated group).

Keywords: Intracanal medicament; endodontic therapy; apical seal; non-setting calcium hydroxide.

1. INTRODUCTION

In dentistry, lots of advancement has taken place in endodontics directed towards prevention and management of pulpal and per radicular disease. Aim of endodontic therapy is to restore the natural tooth functionally as well as esthetically [1]. The success of the treatment depends predominantly on the reduction or complete eradication of pathogens and their byproducts, as it has been abolished in the Millers report that presence of micro biota is major deterrent for the initiation and perpetuation of pulp and periapical diseases [2,3]. Therefore, the main goal of therapy is to eliminate or reduce amount of causative agent leading to infection of pulpal and periapical tissue [4,5]. Since, complete removal of microorganisms from root canal system is not possible through mechanical cleaning due to complexity of root canal anatomy (Fig. 1), an effective antimicrobial agent as intracanal medication (Table 1) should be used to improve treatment outcome as its proven from different studies that medicaments placed inside the canal could markedly affect the diversity and quantity of cultivable microorganisms in infected canals [6,7].

The antimicrobial substances used as an intracanal medicament are classified into five main groups 1) Antibiotics [2] Calcium hydroxide [3] non-phenolic biocides [4] phenolic biocides [5] Iodine compounds [8]. But, in modern therapy, Calcium hydroxide, introduced by Herman as a pulp capping agent, is the highly recommended and widely used interappointment intracanal medicament based on its antimicrobial, antiresorptive and tissue dissolving property [9]. The bactericidal effects of this intracanal medicament are due to several mechanisms i.e. a) Chemically through: Hydroxyl ions disturbs the bacterial cytoplasmic membrane which leads to disturbance in enzymatic activity and metabolism of bacterial cell and DNA replication inhibition by splitting DNA and b) Physically by: Creating a protective barrier that withholds substrate for bacterial growth and also occupies accessory spaces within the canal, thus preventing ingress and multiplication of bacteria into the root canal system [9,10].

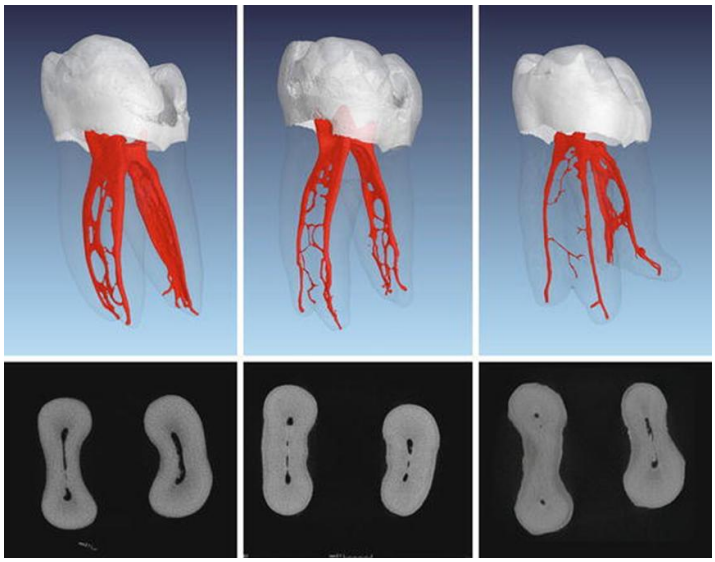

Fig. 1. Micro-computed tomography images of extracted teeth from patients of different ages. Three-dimensional reconstructions and corresponding cross sections from the middle third of the roots are shown

For maximum affect, Intracanal medicament should be filled densely and homogenously to the root apex. Various techniques has been described in literature which includes lentulo spiral bur, injection with a syringe followed by compaction with a plugger, use of the Messing gun, and MacSpadden compactor [11]. Sigurdsson et al reported in 1992 that the use of Lentulo spiral (Fig. 2) resulted in best placement paste in minimally instrumented (size #25 K file) curved canals and is most convenient method for delivering paste into the root canal as stated by Dumsha and Gutmann. This slow-speed instrument is available in a variety of sizes and selected instrument should be placed till working length easily without interference.

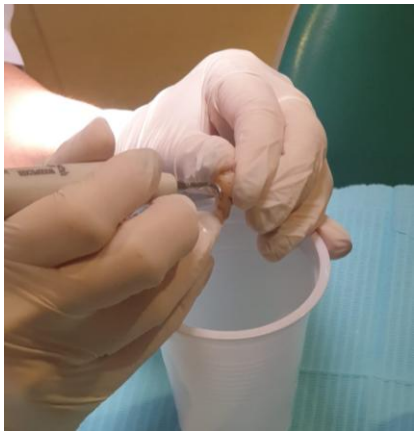

Fig. 2. Clinical picture taken while doing ultrasonic scaling of extracted tooth

Inspite of increase use of Ca (OH) 2 as an intracanal medicament in dentistry, there are a lot of controversial results regarding its effect on apical leakage. Therefore it should be removed before f\obturating the root canal, as any residual medicament on the canal walls will affect the adhesion of the filling material to the root canal wall. None of the method has been proven to remove the intracanal medicament completely from the canal. Assessment of influence of calcium hydroxide on the sealing ability of different sealers is necessary because complete removal of calcium hydroxide from the canal is difficult. Therefore this study will help us to determine its effect on apical micro leakage (AML).

2. MATERIALS AND METHODS

2.1 Research Design

Quasi Experimental study.

2.2 Study Settings

The samples (Extracted teeth) were collected from Oral Maxillofacial and Surgery Department of Ziauddin College Of Dentistry, Ziauddin University.

The sample preparation (Root canal treatment) and demineralization, dehydration and dephanization of each tooth was performed in the Department of Operative Dentistry.

The sectioning and preparation of slides was done in Oral Biology Lab of Ziauddin University.

The prepared slides were then analyzed under stereomicroscope in University of Karachi.

2.3 Sampling Technique

Convenience sampling technique was used for sample recruitment.

2.4 Inclusion Criteria

1. Mandibular premolars extracted due to orthodontic treatment were included in this study.
2. Extracted teeth of patient's age more than 15years were included.

2.5 Exclusion Criteria

Tooth with radiographic features of fracture.

1. Tooth with severe divergent roots were excluded.
2. Tooth with features of internal or external resorption were excluded.
3. Tooth with open apex were excluded.
4. Tooth with blocked or obliterated canals were excluded.
5. Tooth having variation regarding canal morphology were excluded.

2.6 Sample Preparation

All samples were prepared by a single operator using the following protocol. Calculus and soft debris will be removed with the help of ultrasonic scaler tip (Fig. 2). The instrumentation was done in a single visit. Canal preparation was done using Step back technique. The roots were held in a moist gauze during instrumentation to prevent dehydration. Straight fissure bur was used for Access cavity preparation in a high speed headpiece. Endodontic explorer was used

for canal orifice location. The canal of each tooth was cleaned using #10 K-file and working length was then determined using radiographic technique (Fig. 3). After working length canal preparation was done using step back technique using ISO standardized stainless steel hand files of 25 mm length (Mani). The canal was instrumented up to master apical file size#40 K file (diameter of 0.4mm at Do and 0.72mm at D16) till full working length. Frequent recapitulation was done using #15 K file to maintain the patency of the apical foramen. Step back was done, 3 files above MAF i.e. till #55 K file.

Irrigation with 2ml of 3 % NaOCl solution (Canasol; MK international) (Fig. 4) in between each file was done and 17%EDTA (Meta Biomed CO.LTD.) (Fig. 5) was used as lubricating agent. After preparation, final irrigation was done with 10 ml of 3% sodium hypochlorite.

After completion of this procedure, teeth will be randomly divided into two groups, 50 teeth in each group: (Fig. 6).

Group A (Control group) ---- Teeth included in this group were not medicated with non-setting calcium hydroxide (intracanal medicament).

Group B (Experimental group) --- Teeth included in this group were medicated with non-setting calcium hydroxide paste after preparation and it was placed in the canal with the help of lentulo spiral bur in slow speed hand piece.

A radiograph was taken for each tooth in group B to assess the uniformity of intracanal medicament, and the teeth will then be left for 14days. Canal orifice was covered with dry sterile cotton pellet followed by an Intermediate Restorative Material Cavit (Favodent) in both groups.

Intracanal medicament was removed from teeth in experimental group after 14 days with K file of the same size as the MAF along with sodium hypochlorite as an irrigants. Root surface was covered with nail varnish except for apical 4mm which remained exposed, to allow dye penetration in the canal via apical region before proceeding for obturation. Cold lateral condensation technique was used for canal obturation using Gutta percha as core obturating material along with sealer. The sterile paper points were used to dry the canal before placement of obturating material. Obturation was assessed radio graphically.

(Fig. 7).The teeth were stored in gauze and placed for 72 hours to allow sealer to set. After the procedure, all teeth were immersed in Indian ink. . After one week, the teeth were washed in running water to remove external dye. Nail varnish was removed using scalpel blade. Demineralization of teeth was done in 5% hydrochloric acid, for 24 hours to remove the calcified tissue that may prevent clearing. Dehydration was done in ethanol in ascending order i.e.70%, 80%, 90% and 100 % for 4 hours each, to remove air and water from decalcified tissue and finally methyl salicylate was for 2 hours for dephanization to allow three-dimensional visualization of the gutta-percha filling within the tooth structure. The cleared teeth were dried and sectioned at 1mm up to 5mm using microtome (Figs. 8 & 9) and analyzed by means of a stereomicroscope (x 40 mag) (Fig. 10). Amount of leakage was assessed by the extent of penetration of the dye. The extent of dye penetration was measured in millimeters by an experienced, calibrated examiner, from the apical area to the maximum penetration of the dye (Fig. 11).

Fig. 3. Randomly selected radiographs showing during the preparation of canals for working length confirmation of teeth

2.7 Data Analysis

- Statistical Package for Social Services (SPSS) version 22 was used for data analysis.
- For descriptive statistics percentage and frequency was reported for categorical

variables. For continuous data, mean and standard deviation was calculated.

- Kolmogorov-Smirnov test was used to assess data normality.
- In inferential statistics Mann Whitney U test was used to compare dye penetration among case and control groups.

Fig. 4. Showing bottle of Canasol (3% sodium hypochloride) used as a root canal irrigant. Along with 3% sodium hypochloride it also contains sodium chloride, sodium carbonate, solute q.s.ad

Fig. 5. EDTA (ethylene diamine tetra acetic acid) cream for root canal cleaning anf smear layer removal

Fig. 6. Randomly divided teeth in group A (control) and B (experimental group)

Fig. 7. Radiographic assessment of obturation

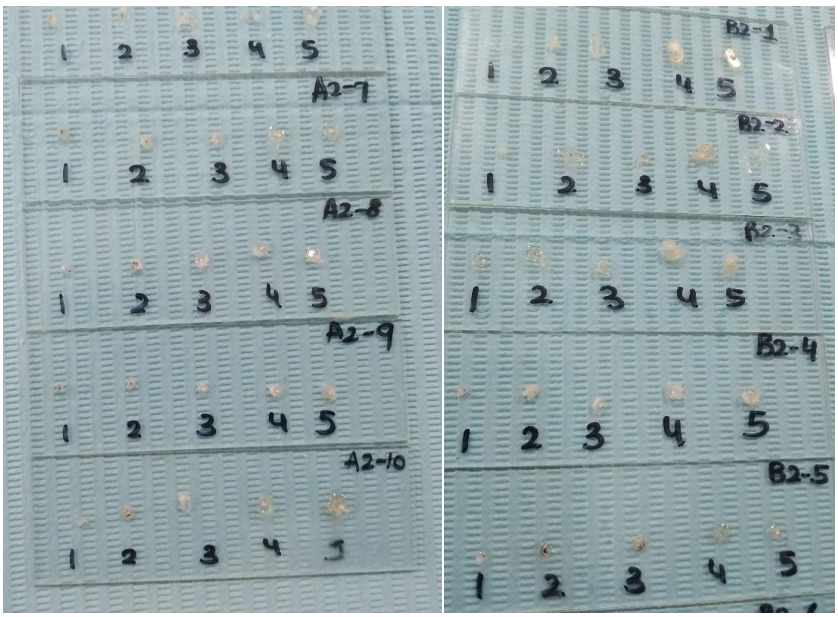

Fig. 8. Picture showing focused image of slides containing apical sections at 1, 2, 3, 4, and 5 mm

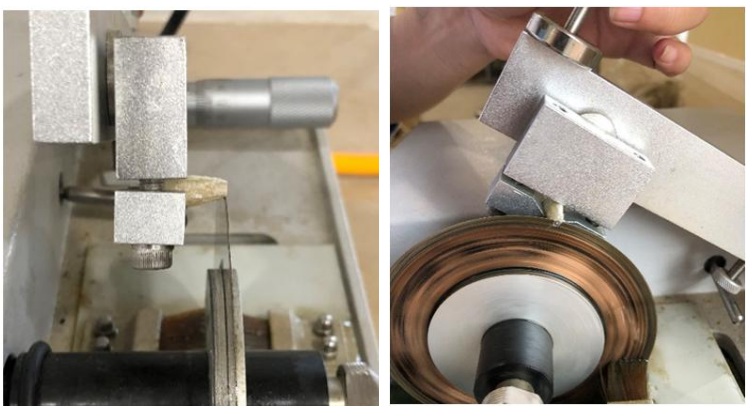

Fig. 9. Showing sectioning of tooth at 3 mm

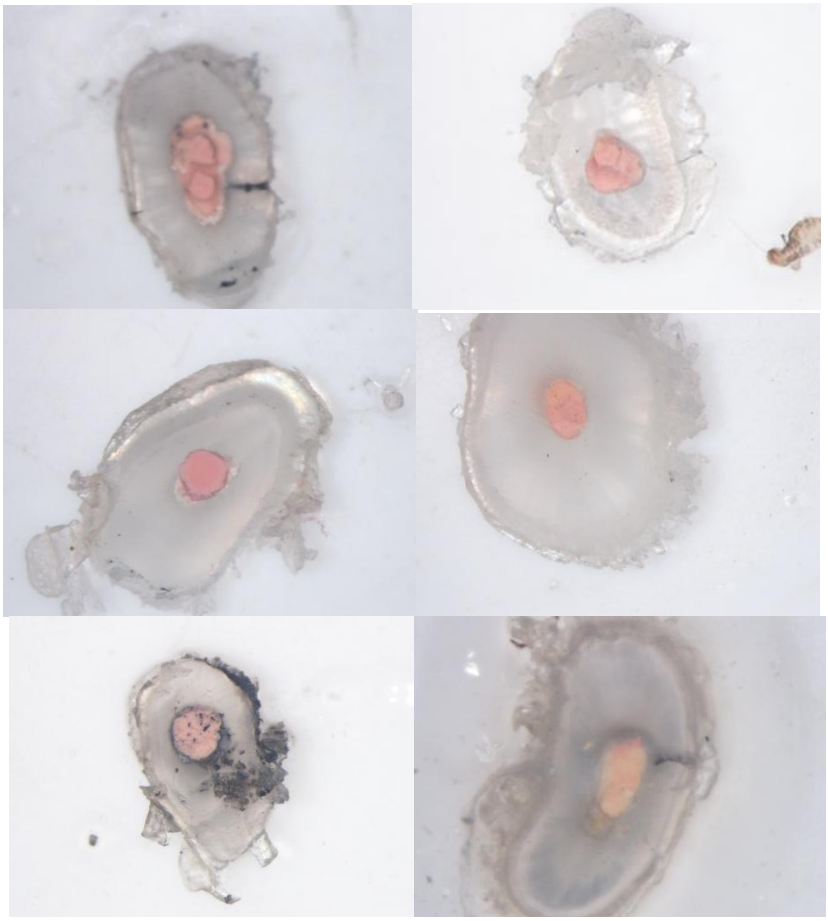

Fig. 10. Stereomicroscope images showing apical micro leakage via Indianinkdye penetration

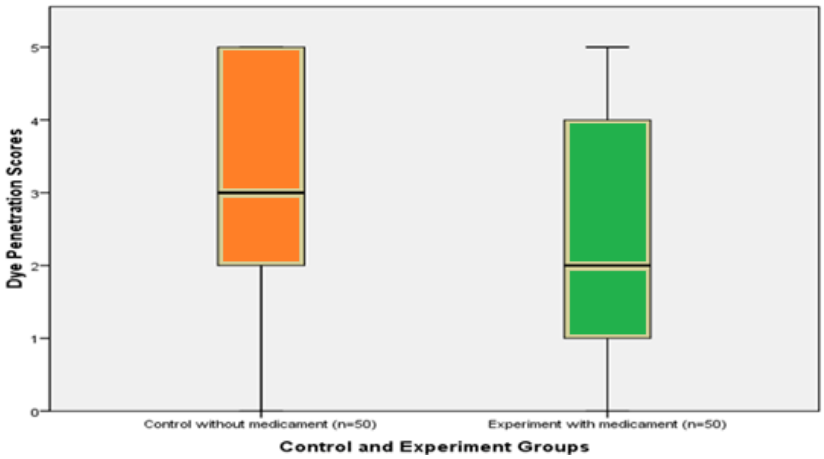

Fig. 11. Box-plot representing apical leakage scores between control and experiment group

3. RESULTS

The 100 teeth were divided into two groups A and B with 50 samples each. In Group A (control) no intracanal medicament was placed and in Group B (experiment group) intracanal medicament was placed for 14 days. Teeth were assessed via Stereomicroscope to evaluate apical sealing ability using dye penetration method. The study results showed no statistical difference between the control and experiment group in apical leakage but medicated group showed least amount of leakage comparatively (Table 2, Fig. 11).

Table 1. Indications of intracanal medicament

	Indications of intracanal medicament
1.	To dry weeping or canal with persistence exudation.
2.	To eliminate any remaining pathogens in the pulp space
3.	To create an infection free environment in root canal system
4.	To neutralize acid pH created by pathogens and debris
5.	To act as a barrier against leakage from the temporary filling

Table 2. Apical leakages of control (GROUP A) and experiment groups (GROUP B)

S.no	Study Group	Apical leakage		P value
		Mean ± SD	Median (IQR)	
1.	**A** Control (without medicament) n=50	2.96 ±1.69	3(3)	0.072
2.	**B** Experiment (with medicament) n=50	2.30±1.832	2(3.25)	

P-value < 0.05 is considered significant
Mann-Whitney U test was applied

4. DISCUSSION

Calcium hydroxide is the most routinely used intracanal medicament in the dental practice. Calcium hydroxide has antibacterial properties; it enhances hard tissue formation, dissolves tissue, and inhibits tooth resorption. Due to many clinical effects its use in clinical practice is enhanced now days [12]. Also, it is difficult to completely remove this intracanal medicament from canal therefore it is essential to assess its effect on apical seal in order to reduce endodontic failure. Moreover, several techniques have been proposed to remove Ca (OH) 2 from the canal including, using rotary files, sonic, endodontic hand files, Canal brush technique and ultrasonic activated tips along with irrigation, but none has been proved to remove this completely [13]. Moreover, the most commonly practiced method is through instrumentation with master apical file at working length along with sodium hypochloride and EDTA. Therefore this method was used in this present study [14-17].

The purpose of this study was to evaluate the effect on calcium hydroxide when used as an intracanal medicament on the apical seal and different studies have been conducted to evaluate the same with controversial results. As Calcium hydroxide is most commonly used intracanal medicament also its difficult to remove from the root canal there is a need to determine whether the remaining calcium hydroxide paste has any beneficial or adverse effect on the apical seal [18]. The results of current study concluded that there is no statically significant difference between Group A with no intracanal medicament and Group B with intracanal medicament. But there are different studies with controversial results to our study. Porkaew et al. [19] conducted a study to evaluate the effect of calcium hydroxide as an intracanal medicament and concluded that the application of Ca (OH) 2 as an intracanal medicament prior to obturation reduces the apical leakage effectively. This result was also supported by Holland R et al. [20]. Kim SK et al. [18] and Hamidi, M.R. et al. [21] several explanations were formulated for the described effect. One possibility may be that the Ca (OH) 2 has been mechanically forced into the dentinal tubules during obturation thereby reducing the dentinal permeability, this would decrease the ability of the dye to penetrate into the canal walls [19]. Another possibility proposed by Weisenseel et al was plugs at the apical area formed may reduce the ability of dye to penetrate [22]. Wu et al. has described the possibility of false results occurring with previous dye leakage studies using methylene blue dye, because it may lose its color in contact with calcium hydroxide [23]. However results of study by Shahi, S. and Hanareh, F. showed opposite results and observed that the leakage was least in non-medicated group [24]. Which was also supported by Tandan M, et al. [25]. A study by Adel M et al, concluded that use of intracanal medicament increases the apical leakage of resilon filled root canals [26]. The results of these studies were different from the result of present study. Also, further studies should be conducted to assess

the clinical performance of Calcium hydroxide on apical seal as this is laboratory based study and does not replicate clinical condition.

5. CONCLUSION

The results of this study concluded that there is no statistically significant difference in leakage between group A and group B (i-e non-medicated and medicated group).

6. RECOMMENDATION

- This laboratory based study does not replicate clinical conditions therefore further studies should be conducted to assess the clinical performance of Calcium hydroxide on apical seal.
- Different techniques of leakage assessment should be compared together for accuracy of results.

CONSENT

As per international standard or university standard, patients' written consent has been collected and preserved by the author(s).

ETHICAL APPROVAL

Approval was obtained from Ethics Review Committee of Ziauddin University (Ref: 0820219PBOM.)

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Peters OA, Barbakow F, Peters CI. An analysis of endodontic treatment with three nickel-titanium rotary root canal preparation techniques. International Endodontic Journal. 2004 Dec;37(12):849-59.
2. Gaikwad B, Banga KS, Thakore AJ. Effect of calcium hydroxide as an intracanal dressing on apical seal: An in vitro study. J Endod. 2000;12:7-12.
3. Möller ÅJ, Fabricius L, Dahlén G, Sundqvist G, Happonen RP. Apical periodontitis development and bacterial response to endodontic treatment. Experimental root canal infections in monkeys with selected bacterial strains. European journal of oral sciences. 2004 Jun;112(3):207-15.
4. Tsesis I, Taschieri S, Slutzky-Goldberg I. Contemporary endodontic treatment. International Journal of Dentistry. 2012 Nov 6;2012.
5. Tabassum S, Khan FR. Failure of endodontic treatment: The usual suspects. European journal of dentistry. 2016 Jan;10(01):144-7.
6. Trope M. Treatment of immature teeth with non-vital pulps and apical periodontitis. Endodontic topics. 2006 Jul;14(1):51-9.
7. Orstavik D, editor. Essential endodontology: Prevention and treatment of apical periodontitis. John Wiley & Sons; 2020 Jan 21.
8. Athanassiadis B, Abbott PV, Walsh LJ. The use of calcium hydroxide, antibiotics and biocides as antimicrobial medicaments in endodontics. Australian Dental Journal. 2007 Mar;52:S64-82.
9. Mohammadi Z, Shalavi S, Yazdizadeh M. Antimicrobial activity of calcium hydroxide in endodontics: A review. Chonnam Medical Journal. 2012 Dec 1;48(3):133-40.
10. Estrela C, Bammann LL, Pimenta FC, Pécora JD. Control of microorganisms in vitro by calcium hydroxide pastes. International Endodontic Journal. 2001 Jul;34(5):341-5.
11. Bhalla VK, Chockattu SJ. Intracanal delivery of calcium hydroxide: a literature review. Saudi Endodontic Journal. 2021;11(1):1.
12. Kawashima N, Wadachi R, Suda H, Yeng T, Parashos P. Root canal medicaments. International dental journal. 2009 Feb;59(1):5-11.
13. Khatod SS, Ikhar AD, Nikhade PP, Chandak M, Motwani NM, Chandak MS, Rathi CK, Jaiswal AS. Removal Techniques for Intracanal Medicament-A Review.
14. Chung HA, Titley K, Torneck CD, Lawrence HP, Friedman S. Adhesion of glass-ionomer cement sealers to bovine dentin conditioned with intracanal medications. Journal of Endodontics. 2001 Feb 1;27(2):85-8.
15. Taşdemir T, Celik D, Er K, Yildirim T, Ceyhanli KT, Yeşilyurt C. Efficacy of several techniques for the removal of calcium hydroxide medicament from root canals. International endodontic journal. 2011 Jun;44(6):505-9.

16. Salgado RJ, Moura-Netto C, Yamazaki AK, Cardoso LN, de Moura AA, Prokopowitsch I. Comparison of different irrigants on calcium hydroxide medication removal: Microscopic cleanliness evaluation. Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology. 2009 Apr 1;107(4): 580-4.
17. Bhuyan AC, Seal M, Pendharkar K. Effectiveness of four different techniques in removing intracanal medicament from the root canals: An *in vitro* study. Contemporary Clinical Dentistry. 2015 Jul;6(3):309.
18. Kim SK, Kim YO. Influence of calcium hydroxide intracanal medication on apical seal. International endodontic journal. 2002 Jul 1;35(7):623-8.
19. Yildirim T, Oruçoğlu H, Çobankara FK. Long-term evaluation of the influence of smear layer on the apical sealing ability of MTA. Journal of endodontics. 2008 Dec 1;34(12):1537-40.
20. Holland R, Alexandre AC, Murata SS, Dos Santos CA, Junior ED. Apical leakage following root canal dressing with calcium hydroxide. Dental Traumatology. 1995 Dec;11(6):261-3.
21. Hamidi MR, Mahmoudi E, Moghadamnia AA, Zahedpasha S. Effect of calcium hydroxide and chlorhexidine medicaments on the apical seal. Iranian Endodontic Journal. 2012;7(1):15.
22. Willershausen I, Callaway A, Briseño B, Willershausen B. In vitro analysis of the cytotoxicity and the antimicrobial effect of four endodontic sealers. Head & Face Medicine. 2011 Dec;7(1):1-9.
23. Wu MK, Kontakiotis EG, Wesselink PR. Decoloration of 1% methylene blue solution in contact with dental filling materials. Journal of Dentistry. 1998 Sep 1;26(7):585-9.
24. Shahi S, Hanareh F. Effect of Using Calcium Hydroxide as an Intra-canal Medicament on Apical Seal. Journal of Dentistry. 2008 Sep 1;9(3):271-7.
25. Tandan M, Hegde MN, Hegde P. Effect of four different intracanal medicaments on the apical seal of the root canal system: A dye extraction study. Indian Journal of Dental Research. 2014 Sep 1;25(5):607.
26. Adel M, Foroozia M, Rezaei MH, Mahboobi N. Effect of calcium hydroxide on the apical leakage of Resilon-filled root canals: An in vitro study. Gen Dent. 2012 May 1;60(3):e136-40.

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