

# COMPARISON OF REMOVAL POTENCY OF DIFFERENT INTRACANAL MEDICAMENTS

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## ABSTRACT

*The aim of this study was to compare the removal potency of calcium hydroxide [Ca(OH)<sub>2</sub>], triple antibiotic paste (TAP) and doxypaste using manual irrigation with sodium hypochlorite (NaOCl). This was an in vitro experimental study conducted at DIDC and DRIBBS, Dow University of Health Sciences and Department of Material Sciences, NED University of Engineering and Technology in December 2015. Thirty extracted single and multirrooted teeth having 45 canals were prepared using k files upto master apical file (MAF). The canals were divided into 3 groups (15 canals in each group) receiving Ca(OH)<sub>2</sub>, triple antibiotic paste and doxypaste respectively. After storing in an incubator for 15 days these medicaments were removed by manual filing followed by irrigation with side vented needle at 1mm from working length using sodium hypochlorite and the sample observed under a stereomicroscope after sectioning. Statistical analysis was performed using SPSS 16.0 to determine the significance of the result by applying kruskal-Wallis test (P-value 0.05).*

*Remnants of medicaments were found in all three of the experimental groups with calcium hydroxide being associated with highest amount of residues (33.3%) which was more than 2 times greater than triple antibiotic paste (11.6%) and 6 times greater than doxypaste (5.72%). This show that failure in completely removing these medicaments from the canal walls may adversely effect the endodontic treatment outcome by compromising the efficacy of the sealer.*

**Key Words:** Root canal therapy, Calcium Hydroxide, root canal irrigants, endodontics.

## INTRODUCTION

Root canal therapy aims to reestablish tooth form and function. One of the goals of endodontic treatment is to reduce or eliminate the infection causing bacteria and their by-products from the root canals in order to preserve the tooth and to create and maintain a functional dento-alveolar complex.<sup>1</sup> This purpose can normally be accomplished by mechanical instrumentation and debridement supported by numerous irrigating agents.

Irrigation has a pivotal role in endodontic treatment. The purpose of irrigants is to disinfect the root canal system, remove the smear layer and provide long term

antibacterial effects. A number of techniques can be used for the delivery of irrigants ranging from manual irrigation with syringe to engine driven systems. The most frequently used of all irrigants is sodium hypochlorite because of their broad antimicrobial spectrum and necrotic tissue dissolving ability.<sup>2</sup> However, in infectious teeth undergoing multi visit root canal therapy intracanal medicaments are used in order to enhance the eradication of bacteria and prevent their multiplication between appointments.<sup>3</sup>

Some of the most commonly used intra canal medicaments are calcium hydroxide (pulpdent), triple antibiotic paste (metronidazole, minocycline and ciprofloxacin) and doxypaste (doxycycline). Herman's introduction of calcium hydroxide in 1930 started a new epoch in the field of dentistry. Because of slow releasing hydroxyl ions calcium hydroxide as a medicament is potentially capable of maintaining it's antibacterial property over a long period of time.<sup>4</sup> When these medicaments are placed in the canals a major concern is to remove them completely from the canal so as to avoid any adverse effects on the treatment outcome.<sup>5</sup> The most frequently described method for this purpose is copious irrigation of the canals with sodium hypochlorite and EDTA along

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with instrumentation. However some medicaments may be more difficult to remove than the others and may leave residues.<sup>6</sup>

These remnants may obstruct the dentinal tubules preventing the penetration of tubules by the sealer and thereby compromising the quality of seal provided by the root canal filling. Calcium hydroxide residues can react chemically with the sealer reducing its working time and flow rate by increasing its viscosity.<sup>7</sup> Moreover, it has the potential to react with zinc oxide eugenol based sealers making them brittle, granular and disorganized.<sup>14</sup> calcium hydroxide being dimensionally instable and potentially soluble in water with resultant dissociation into hydroxide and calcium ions can cause leakage in root fillings in the long run.<sup>2,16</sup> Triple antibiotic paste is shown to be toxic to stem cells at concentrations higher than 0.1g/mL.<sup>8</sup>

Numerous studies have been conducted on the efficacy of different irrigation techniques in removal of specific intra-canal medicaments but limited work is seen on the wash out ability of different intra canal medicaments using a single standard irrigation regimen. The aim of the present study was to compare the removal efficacy of three different intracanal medicaments namely calcium hydroxide, triple antibiotic paste and doxypaste using manual irrigation with sodium hypochlorite.

## METHODOLOGY

A total of 30 single and multi rooted permanent extracted teeth with fully formed sound roots and closed apices having a total of 45 canals were collected. This sample was steam autoclaved at 121°C at 15psi for 30 minutes and stored in tap water containing 0.1% thymol. Teeth showing signs of resorption, caries and severe root curvature were excluded from the study. Pulp chambers of the teeth were opened, working length was established for each tooth using stainless steel k-file number 10 which was inserted into the canal till it showed from the apex and then retracted up to 1 mm to mark the working length 1 mm short of the apex. These canals were then prepared manually using step back technique with an MAF upto 30 to 40 using stainless steel k files at the same working length. The canals were irrigated after every file using 1ml sodium hypochlorite (NaOCl) in a 5ml disposable syringe. The sample was divided into three groups each group having 15 canals as follows:

Group 1: Septodont calipulpe [calcium hydroxide], group 2 : triple antibiotic paste [formulated by mixing metronidazole (flagyl), minocycline (minogen) and ciprofloxacin (novidat) in saline as a paste] and group 3: doxypaste [doxycycline (vibramycin) paste in saline].

The respective medicament pastes were then placed in the canals using lentulospiral in a slow speed

handpiece up to the working length till the medicament extruded out of the apex and backfilled to the level of the canal orifice. After removal of excess paste cavity was used to seal the chambers. The sample was stored in an incubator at a temperature of 37°C with 95% humidity and darkness for a period of 15 days. The sample was then taken out of the incubator and in order to standardize the irrigation procedure the coronal portion of all the teeth were cut using diamond disk leaving 18mm length of each root. The medicaments were removed using a standard irrigation technique involving irrigation using 2.5% NaOCl in a 10ml lure lock syringe with a side vent needle (Diadent, Korea) placed 1mm short of the working length for a duration of 1 minute along with instrumentation using the respective MAF in a circumferential filing action. The reason for using this method is that it is the most frequently used method and the irrigant travels only 1mm apically therefore the needle is kept 1mm short of the working length. After copious irrigation the teeth were left to dry out for one day in order to improve the visibility of the canal. A diamond disc was used to make longitudinal grooves on the buccal and lingual aspect along the entire length of the root without breaching the canal space. A chisel was engaged in the groove and rotated splitting the root into two halves.

These sectioned halves were then observed under a stereomicroscope at 5X magnification and analyzed using adobe photoshop. Magnetic lasso tool was used to calculate the percentage of residual medicament in the canal by comparing the pixel proportion of the medicament with the total pixel proportion of the canal. The mean for each respective group was calculated and the statistical significance of the result was determined using spss 16.0. Kruskal-wallis test was applied since data was not following normal distribution taking P-value 0.05 followed by post-hoc comparison using LSD.

## RESULT

In this study it was seen that all three intracanal medicaments left varying amounts of residue with no medicament showing 100% removal from the canal with manual irrigation 1mm from the working length using side vent needle. Out of the three calcium hydroxide was the most difficult to remove showing the highest

TABLE 1: KRUSKAL-WALLIS TEST

CaOH (Group 1)	Triple antibiotic paste (Group 2)	Doxypaste (Group 3)	P- value
(Mean ± S.D)	(Mean ± S.D)	(Mean ± S.D)	<0.001
33.3 ± 20.3	11.6 ± 1.25	5.7 ± 5.05	



TABLE 2: POST HOC MULTIPLE COMPARISON TEST

Post-Hoc LSD		
Study group	Mean difference	P-value
CaOH with TAP	14.7	<0.001
CaOH with Doxypaste	19.6	<0.001
TAP with Doxypaste	4.9	0.195

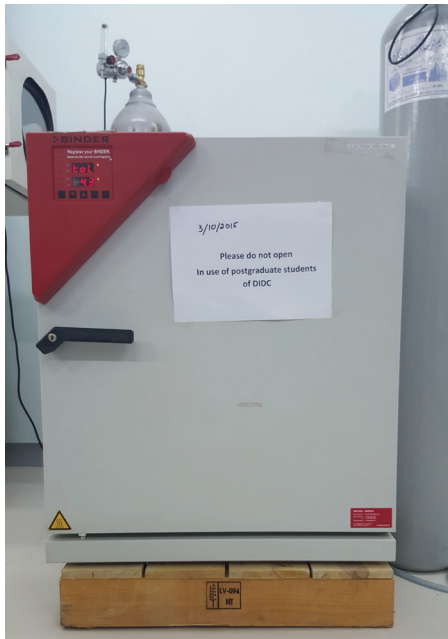


Fig 1: Carbon dioxide incubator



Fig 2: Stereomicroscope



Fig 3: Canal filled with calcium hydroxide showing residues

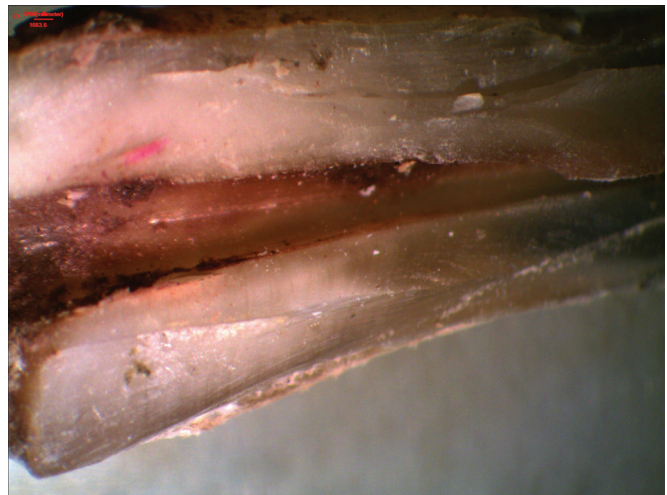


Fig 4: Doxypaste remnants

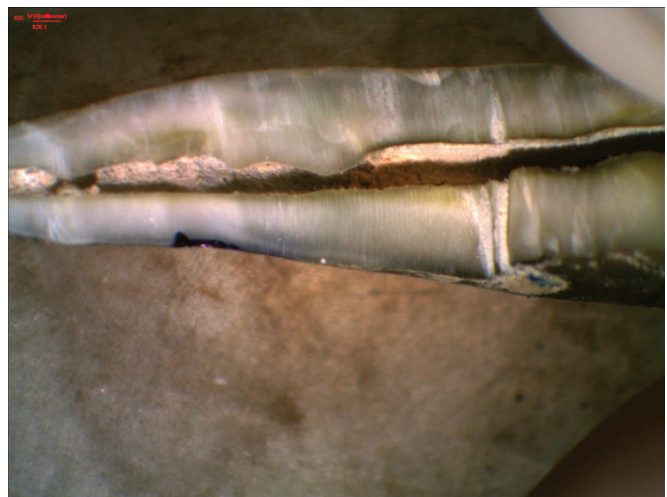


Fig 5: Canal with triple antibiotic paste percentage of residues with an average of 33.3% of the canal area still covered with the medicament. Teeth filled with triple antibiotic paste showed lesser residual medicament of 11.6% whereas the best result was

seen with doxypaste showing near to complete removal with 5.72% of canal covered with medicament. These percentages were calculated using magnetic lasso tool on adobe photoshop by highlighting the covered and total canal areas respectively. The resultant values for areas covered were divided by their respective total canal areas and the percentages were drawn. Post Hoc multiple comparison test showed group 1 with group 2 and group 1 with group 3 having significant results taking the P-value 0.05.

## DISCUSSION

The results of present study show that none of the medicaments were removed completely from the canals with calcium hydroxide leaving the most residues which may interact with the sealer effecting its penetration into the dentinal tubules and hence effecting its sealing ability by giving it a thick non homogenous appearance. These residues may also react chemically with sealer reducing its flow and working time.<sup>9</sup> Doxypaste was removed most effectively coming closest to the ideal results. Approximately 33% of the area of the canals was seen to be covered by calcium hydroxide. This is in agreement with the general hypothesis generated by the results of previous studies. Similar findings were shown in a study conducted by Kenny Chou et al in the University of Queensland and Griffith University, Queensland, Australia, comparing the effectiveness of different irrigation techniques using open-ended irrigation needle at working length, at 5mm from canal orifice, Max-I-Probe and EndoActivator on the removal of calcium hydroxide (pulpdent), doxypaste, odontopaste and ledermix. According to the study all four techniques cleared an average of 95% of doxypaste, odontopaste and ledermix whereas calcium hydroxide was the most difficult to remove with approximately 27% of the pulp dent material remaining within the canals.<sup>4</sup> A research was conducted to compare the ability of manual and passive ultrasonic irrigation on removing calcium hydroxide. Canals of 92 extracted bovine incisors were prepared using step-back technique and assigned into two groups. Remnants of medicaments were found in both the experimental groups regardless of the irrigation technique used.<sup>1</sup> Another study was conducted to compare the efficacy of removal of calcium hydroxide/chlorhexidine (CHX) gel, Ca(OH)<sub>2</sub>/CHX solution and Ca(OH)<sub>2</sub>/saline paste using irrigation with sodium hypochlorite and EDTA solution. Residues of medicaments were found in all the teeth with Ca(OH)<sub>2</sub>/CHX gel leaving larger amount of residues than the others.<sup>11</sup> A similar study was conducted on triple antibiotic paste (TAP) placed in human root segments and irrigated with endoactivator, passive ultrasonic irrigation, EndoVac or a syringe/Max-i-Probe needle. Almost 88% of TAP was seen to be retained in the canals and almost 50% of the radiolabeled TAP was

seen circumferentially within the dentin up to 350µm.<sup>7</sup> Similarly many other studies have been conducted using different irrigants to remove a particular medication but very few studies comparing the wash out ability of different medicaments have been done.

This poor removal efficacy of calcium hydroxide may result in part due to its thick viscosity and cellulose or oil based vehicle and also because the flushing action of the syringe in the classical approach that is manual irrigation is weak and not wholly effective in the most apical part of the canal. Moreover, it depends on the root canal morphology, the placement of irrigation needle, its closeness to the apex and diameter of the needle. However, there exists a limitation that the irrigation technique applied though is the most frequently used but not as effective in removing the medicament completely. With time more advanced methods have been introduced to overcome this shortcoming and may help in achieving better results. Therefore, the results may vary depending upon the different technique used and the placement of the irrigation device.<sup>12</sup> Moreover, the formulation of calcium hydroxide used in this study is cellulose based and the results could be improved using calcium hydroxide powder mixed with saline.

This finding is similar to the results of previous studies that showed significant amounts of calcium hydroxide left on the canal walls. As triple antibiotic paste and doxypaste were prepared using saline they were more easily removed because of the presence of water based vehicle as compared to calcium hydroxide which is based on a cellulose or oil based vehicle.

## CONCLUSION

In the present study calcium hydroxide showed poor results therefore measures should be taken to counteract this shortcoming by using a different medicament, replacing the oil/cellulose derivative by water based filler or using more advanced irrigation techniques for example passive ultrasonic irrigation, EndoActivator or Max-I-Probe etc.

## REFERENCES

- 1 Arslan H, Topcuoglu HS, Saygili G, Tuncay O & Altintop Y. Effect of various intracanal medicaments on the bond strength of self-adhesive resin cement to root canal dentin. *Acta Biomaterialia Odontologica Scandinavica*, 1.1, 2015.
- 2 Kim D, Kim E. Antimicrobial effect of calcium hydroxide as an intracanal medicament in root canal treatment: A literature review – part 1. In vitro studies. *Restor Dent Endod*. 2014 Nov;39(4): 241-52.
- 3 Pai S, Vivekananda Pai AR, Thomas MS, Bhat V. Effect of calcium hydroxide and triple antibiotic paste as intracanal medicaments on the incidence of inter-appointment flare-up in diabetic patients: An in vivo study. *J Conserv Dent: JCD*. 2014 May;17(3):208-11.
- 4 Sathyaprasad S, Jose BK, Chandra HS. Antimicrobial and antifungal efficacy of *Spilanthes acmella* as an intracanal

- medicament in comparison to calcium hydroxide: An in vitro study. Indian Journal of dental research. 2015; 26(5):528-32.
- 5 Chou K, George R, Walsh LJ. Effectiveness of different intracanal irrigation techniques in removing intracanal paste medicaments. Aust Endod J. 2014 Apr;40(1):21-25.
- 6 Capar ID, Ozcan E, Arslan H, Ertas H, Aydinbelge H. Effect of different final irrigation methods on the removal of calcium hydroxide from an artificial standardized groove in the apical third of root canals. J Endod: JOE. 2014 Mar;40(3): 451-54.
- 7 Silva LJ, Pessoa OF, Teixeira MBG, Gouveia CH, Braga RR. Micro-CT evaluation of calcium hydroxide removal through passive ultrasonic irrigation associated with or without an additional instrument. Int endod Journal. 2015 Aug;48(8):768-73.
- 8 R. P. A. Balvedi, M. A. Versiani, F. F. Manna, & J. C. G. Biffi. A comparison of two techniques for the removal of calcium hydroxide from root canals. International endodontic journal, 43.9, (2010): 763-68.
- 9 Alturaiki S, Lamphon H, Edrees H, Ahlquist M. Efficacy of 3 different irrigation systems on removal of calcium hydroxide from the root canal: A scanning electron microscopy study. JOE (Journal of Endodontics). 2015 Jan;41(1): 97-101.
- 10 Masudi SM, Azhar L, Awang RAR, Alam MK. Removal Efficiency of Calcium Hydroxide Intracanal Medicament Using Two Irrigation Solutions. Int Med Journal. 2014;21(1): 106-09.
- 11 Marcus Haapasalo, Ya Shen, Wei Qian & Yuan Gao. Irrigation in endodontics. Dental clinics of north America 54.2 (2010): 291-312.
- 12 Jain P, Nilker V, Mandke L. An in vitro evaluation of calcium hydroxide medication removal using various irrigants and methods. SRM Journal of Research in Dental Sciences. 2015 Jan; 6(1):17-21.
- 13 Sokhi R, Sumanthini MV, Shenoy VU, Bodhwani M. Effect of Calcium hydroxide based intracanal medicaments on the apical sealing ability of resin based sealer and gutta-percha obturated root canals. J Clin Diagn Res. 2017;11(1): 75-79.

#### CONTRIBUTIONS BY AUTHORS

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|--------------------------------|--|
| <b>1 Muhammad Adeel Ahmed:</b> | Acquisition of data, Clinically performing procedures on patients, Drafting of manuscript, Drafting of abstract.           |
| <b>2 Zainab Sharif:</b>        | Topic selection, Study conception and design, Analysis and interpretation of data, Discussion write up, Critical revision. |
| <b>3 Almass Aafreen:</b>       | Critical revision, Referencing, Input of references into endnote, Literature review.                                       |