

Effect of Different Intracanal Medicaments on Apical Sealing Ability of BioRoot RCS

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ABSTRACT

Aims and objectives: The aim of the present study was to determine the effect of different intracanal medicaments on the apical seal of BioRoot root canal sealer (RCS).

Materials and methods: One hundred permanent single-rooted teeth were used in this study. All the samples were decoronated at the cemento-enamel junction and instrumented in a sequential order from 15 to 50 number k-file. The specimens were randomly divided into five groups containing 20 teeth each. Intracanal medicaments used in this study were Metapex, triple antibiotic paste, Metrogyl DG gel forte (metronidazole gel 1.5% w/w), and curenext gel. For control group following instrumentation, the roots were obturated with laterally compacted gutta-percha with BioRoot RCS. In medicament groups after the period of 14 days, the medicaments were removed. All the four groups were obturated with BioRoot RCS and gutta-percha cones using lateral compaction technique. All the specimens were coated with nail varnish and immersed in 2% methylene blue. Then the specimens were demineralized and diphanized. The cleared teeth were analyzed by means of a stereomicroscope under 10× magnification. All the data were analyzed in SPSS version 18 software (IBM, Chicago, IL, USA).

Result: Among all the intracanal medicaments, triple antibiotic paste showed the highest microleakage. When Metapex and Metrogyl DG gel forte were compared with *Curcuma longa*, differences were not statistically significant.

Conclusion: Among all the intracanal medicaments, triple antibiotic paste showed the highest microleakage and least was Metapex.

Clinical significance: Incomplete removal of medicaments prevents the penetration of sealer into the dentinal tubules and interferes with the normal setting reaction, thus affecting the seal of obturating material leading to microleakage and subsequent treatment failure. Hence, while placing an intracanal medicament, it is important to consider its effect on leakage of the root canal system.

Keywords: BioRoot RCS, *Curcuma longa*, Metapex, Metrogyl DG gel forte, Triple antibiotic paste.

The Journal of Contemporary Dental Practice (2020): 10.5005/jp-journals-10024-2740

INTRODUCTION

The primary goal of endodontic treatment is to make the root canal free of bacteria and their byproducts and to create a tight hermetic seal that prevents reinfection.¹ It is impossible to obtain complete disinfection of root canal system through chemomechanical method due to the complex anatomy of the root canal system.² Intracanal medicaments assist in disinfection of the root canal system.³ Intracanal medicament should be effective throughout its period of application, penetrate dentinal tubules, eliminate bacteria, and act as a physicochemical barrier, preventing root canal reinfection and nutrient supply to the remaining bacteria with little toxicity to periradicular tissue.^{4,5}

Calcium hydroxide is the most commonly used intracanal medicament due to its antibacterial, antiresorptive, and tissue dissolving properties.⁶ Metapex oil-based intracanal medicament containing calcium hydroxide serves as a temporary obturating material in between appointments.⁷ Calcium hydroxide shows limited action against facultative anaerobes and *Candida albicans* species but effective against obligate anaerobes. Removal of calcium hydroxide before obturation is important in obtaining hermetic seal.⁸

Curcumin is the yellow bioactive component of turmeric. It exhibits anti-inflammatory, antioxidants, anticarcinogenic, antiviral, and antimicrobial activities.⁹ Studies have shown that *C. longa* is effective against *Enterococcus faecalis*.¹⁰ The triple antibiotic paste containing metronidazole, ciprofloxacin, and minocycline is very much effective against *E. faecalis* and considered as better root canal medicament than calcium hydroxide. Root canal contains

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How to cite this article: Pradhan PK, Sahoo KC, Dipallini S, *et al.* Effect of Different Intracanal Medicaments on Apical Sealing Ability of BioRoot RCS. *J Contemp Dent Pract* 2020;21(1):47–50.

Source of support: Nil

Conflict of interest: None

multiple microorganisms, and single antibiotic may not be effective in eliminating all the bacteria. Patients with triple antibiotic paste do not develop interappointment flare-up.¹¹ Combinations of metronidazole and chlorhexidine have shown synergistic effect against many bacteria. Metronidazole is effective against obligate and facultative anaerobes. Chlorhexidine exhibits protein binding and substantivity effect, leading to prolonged antibacterial activity and low toxicity.¹²

Residual intracanal medicament on the canal wall might interfere with sealing ability of sealer and prognosis of treatment. There are fewer studies on *C. longa* and the effect of intracanal medicament on BioRoot root canal sealer (RCS). The aim of the

present study was to determine the effect of different intracanal medicaments on the apical seal of BioRoot RCS.

MATERIALS AND METHODS

One hundred permanent single rooted, noncarious human teeth with intact apices and curvature of less than 10° were used in this study. Teeth with cracks, root caries, immature root apices, curvatures, fracture, and internal or external resorptive defects were excluded. Samples were disinfected in 0.5% sodium hypochlorite solution, washed in tap water, and stored in normal saline until further use. All the samples were decoronated at the cemento-enamel junction. To standardize the length, all specimens were resected 16 mm from the apex using a diamond disc with water coolant. Contents of the canal were debrided and irrigated with 3% sodium hypochlorite (Septodont Healthcare, India). Working length was determined by penetrating the 10 no. k-file (Dentsply, Maillefer, Switzerland) until it appears at the apex and subtracting 1 mm from that. Apices of all the teeth were sealed with sticky wax.

All the samples were instrumented in a sequential order from 15 to 50 no. k-file (Dentsply, Maillefer, Switzerland). Root canals were irrigated with 3% hypochlorite in between instrumentation. Canals were enlarged using step back technique till 70. Smear layer was removed using 1 mL of 17% EDTA (Smear clear, [Sybron endo], Kerr dental) using passive ultrasonic irrigation (Satelec/Acteon, India). Finally the canals were irrigated with 3 mL of normal saline. The sticky wax was then removed from the apex and canals were dried using absorbent points. The specimens were randomly divided into five groups containing 20 teeth each.

Intracanal medicaments used in this study were Metapex (Meta Biomed, PDP, India), triple antibiotic paste, Metrogyl DG gel forte (Lekar Pharma Ltd, India) containing metronidazole and chlorhexidine, and curenex gel (Abbott Healthcare, India) containing *C. longa*. In Metapex group following instrumentation, medicament was placed with the help of lentulo spiral. Both Metrogyl DG gel forte and curenex were placed with the help of finger plugger. Triple antibiotic paste was prepared by taking equal amounts of ciprofloxacin, minocycline, and metronidazole and mixed with distilled water and was placed with the help of finger plugger (Dentsply, Maillefer, Switzerland). The quality of medicament placement was confirmed with a radiograph and the canals were sealed with cotton pellet and intermediate restorative material and stored in isotonic saline for 14 days.

For control group (no medicament) following instrumentation, the roots were obturated with laterally compacted gutta-percha with BioRoot RCS (Septodont, USA) sealer and the access cavities were sealed with glass ionomer cement (GC Corporation, Tokyo, Japan). In medicament groups after the period of 14 days, temporary was removed and canals were irrigated with 3% sodium hypochlorite and 17% EDTA, using passive ultrasonic irrigation. At the end, the canals were irrigated with 5 mL normal saline and dried with paper points. All the four groups were obturated with BioRoot RCS and gutta-percha cones using lateral compaction technique and sealed with glass ionomer cement. Sealer was mixed according to the manufacturer instruction. Teeth were stored for 24 hours at 37°C and 100% relative humidity in an incubator to allow the sealer to set.

All the specimens were coated with two layers of nail varnish except at the apical 2 mm. The teeth were immersed in 2% methylene blue for 24 hours under normal atmospheric pressure.

After removal from the methylene blue, the roots were thoroughly washed in tap water to remove the dye from all external surfaces of the teeth. The nail varnish was removed from the root surface. The roots were then demineralized in 5% nitric acid (Merck Specialities Pvt. Ltd, India) for 3 days. The teeth were washed in running tap water, dehydrated in ascending concentrations of ethanol, and finally placed in methyl salicylate (Merck Specialities Pvt. Ltd, India) for 2 hours for diaphanization. The cleared teeth were analyzed by means of a stereomicroscope (Olympus Opto System, India) under $10\times$ magnification. The amount of apical leakage was assessed by extent of dye penetration in each group and expressed in millimeter.

RESULT

The mean and standard deviation for all the five groups were calculated (Fig. 1). Values were statistically analyzed by Kruskal-Wallis test (Table 1) and Dunn's *post hoc* test (Table 2) for intergroup comparison. Control group exhibited the least amount of leakage, and triple antibiotic paste showed highest amount of leakage. When Metapex and Metrogyl DG gel forte were compared with *C. longa*, the difference was not statistically significant ($p = 0.288$).

DISCUSSION

Successful root canal therapy requires three-dimensional seal of the root canals in order to prevent possible microleakage that may be the cause of future failure of the root filling. Leakage of the root canal system is an important consideration when placing an intracanal medication. Leakage at the apex occurs between the root canal wall and the sealer, between the sealer and the gutta-percha, or within the sealer itself.²

BioRoot RCS, a new tricalcium silicate-based sealer, was used in this study as it released high levels of calcium, i.e., almost double

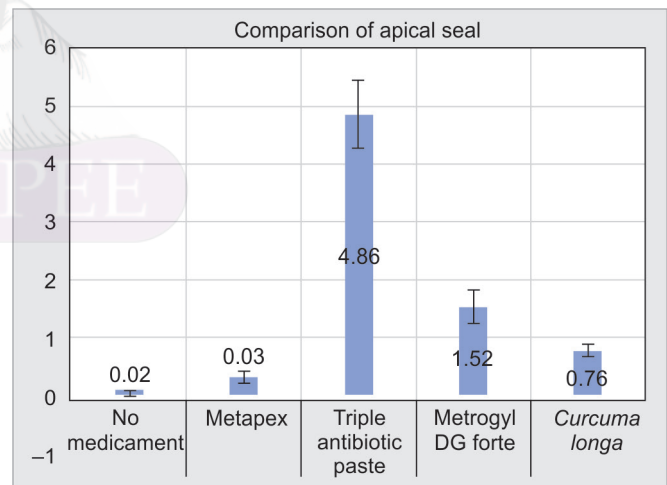


Fig. 1: Mean apical leakage in different groups

Table 1: Mean rank obtained by Kruskal-Wallis test

Group	Mean rank	Chi-square	p
No medicament	10.50	95.597	<0.001
Metapex	30.50		
Triple antibiotic paste	90.50		
Metrogyl DG forte	70.50		
Curcuma longa	50.50		

Table 2: Dunn's *post hoc* test showing the level of significance

Group	Comparison	Test statistic	Standard test statistic	p value
No medicament	Metapex	-20.00	-2.18	0.288
	Triple antibiotic paste	-80.00	-8.74	<0.001
	Metrogyl DG forte	-60.00	-6.55	<0.001
	<i>Curcuma longa</i>	-40.00	-4.37	<0.001
Metapex	Triple antibiotic paste	-60.00	-6.55	<0.001
	Metrogyl DG forte	-40.00	-4.37	<0.001
	<i>Curcuma longa</i>	-20.00	-2.18	0.288
Triple antibiotic paste	Metrogyl DG forte	20.00	2.18	0.288
	<i>Curcuma longa</i>	40.00	4.37	<0.001
Metrogyl DG forte	<i>Curcuma longa</i>	20.00	2.18	0.288

as compared to the other sealer. It is a water-based sealer and consists of powder and liquid. The powder contains tricalcium silicate, zirconium oxide, and povidone. Liquid contains water, calcium chloride, and polycarboxylate. It has a working time of 10 minutes and setting time of 4 hours.¹³ When it comes in contact with tissue fluids, it forms a calcium phosphate paste.^{14,15} It releases osteogenic and angiogenic growth factor, indicating higher bioactivity.¹⁶⁻²¹ It interacts with dentinal fluids with the formation of mineral plugs within the dentinal tubules, thus enhancing the biological activity within the root canal. The mineral tags were formed where the BioRoot RCS penetrated the dentinal tubules. This zone has been termed the mineral infiltration zone.¹⁴ No studies have compared effect of medicament on sealing ability of BioRoot RCS.

In the study group in which no medicament was placed, the micro leakage was least. This suggests that in the medicament groups the remnant of intracanal medicaments might have interfered with the penetration of sealer into dentinal tubules. Calcium hydroxide is available in several formulations. The most common form is calcium hydroxide paste mixed with distilled water. The problem associated with it is its incomplete removal resulting in calcium hydroxide remnants on the canal walls. The oil-based calcium hydroxide, i.e., the Metapex group, showed least microleakage among all medicament groups. This is in accordance with the study conducted by Hamidi et al.,⁶ and they proposed that the residual calcium hydroxide may get incorporated into the sealer during obturation, which will decrease the permeability of sealer. Calcium hydroxide blocks the dentinal tubules by penetrating inside, decreasing the permeability.^{6,22} This in contrast to the study by Kim and Kim²³ who proposed more leakage with calcium hydroxide dressing. Metapex being an oil-based calcium hydroxide medicament have larger contact angle with root canal dentin. So it will not contact the root canal walls and can be easily removed from the canal wall.²⁴ Leakage in Metrogyl DG gel medicated group can be explained due to the substantivity effect of chlorhexidine. This is in accordance with other studies.^{6,10,24} Chlorhexidine gluconate is a broad-spectrum antibacterial agent. It acts by getting adsorbed onto the cell wall of the microorganism and causing leakage of intracellular components. The adsorption of chlorhexidine onto the canal wall may interfere with the sealing ability of the sealers. In the present study, triple antibiotic paste showed the highest leakage; this may be attributed to the chelation of minocycline to calcium ion and forms an insoluble complex of tooth matrix which is difficult to remove.^{25,26} Previous studies proved that more than 80% triple antibiotic paste retained in the root canal wall, regardless

of irrigation technique used.²⁷ *Curcuma longa* medicated group showed less leakage as compared to the triple antibiotic paste and the difference is significant ($p < 0.001$). *Curcuma longa*, Metapex, and Metrogyl DG forte all exhibited equal amount of leakage ($p = 0.288$).

Laterally condensed gutta-percha filling technique was used instead of warm vertical compaction technique as application of heat during warm vertical compaction technique may change the property of the sealer, resulting in reduced flow and setting time of the sealer.^{14,28} Three percent sodium hypochlorite was used as an irrigant followed by 17% EDTA to remove the intracanal medicament, as this is very much effective in removing the residual sealer.²⁹

Flow is an important property of endodontic sealer responsible for penetration of sealer into dentinal tubules and accessory canals of root canal system. Presence of residual medicament may have decreased the flow and also the setting time of BioRoot RCS, resulting in microleakage. BioRoot RCS exhibited the formation of calcium hydroxide early in the setting process, promoting bioactivity.^{15,17-19} Solubility of it may be related to the release of hydroxyl and calcium ion.

Dye penetration technique is the most frequently used method to evaluate the sealing ability of dental materials. Methylene blue dye is widely used for convenience and its small molecular weight provides it with a high degree of penetrability. Despite their popularity, dye leakage studies have several disadvantages; molecular size of most dye particles is smaller than bacteria. Most studies measure the penetration in one plane rather than the total leakage.³⁰ Dye penetration recorded by clearing technique makes it easier to observe the lateral and accessory canals, it allows easier view of leakage area thereby providing three-dimensional view of the internal structure of root canal, which clearly reflects the relation between sealing material and apical foramen.³¹ Among all the intracanal medicaments, triple antibiotic paste medicated group showed the highest microleakage and the least was shown by Metapex medicated group. Based on the study findings, *C. longa* can be used as intracanal medicament with less effect on the sealing ability of root canal sealers.

CONCLUSION

Control group exhibited the least amount of leakage. No significant difference was found when *C. longa* was compared with Metapex and Metrogyl DG gel forte. Metrogyl DG gel forte exhibited more leakage than Metapex and the difference was statistically significant. Triple antibiotic paste showed the highest leakage.

Further studies have to be done to see the effect of *C. longa* on other sealers and also interaction of BioRoot RCS with intracanal medicaments.

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