

A Comparative Study of ION Diffusion from Calcium Hydroxide with Various Herbal Pastes through Dentin: An In Vitro Study

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Abstract

Original Research Article

Background: Intracanal medicaments used during root canal treatment comes in direct contact with cells of pulp and periapical tissues. The antimicrobial property of calcium hydroxide [Ca(OH)₂] is broadly utilized. It has the capability to dissolve organic tissues as well as to inactivate bacterial endotoxins. The aim of this in vitro study is ion diffusion from calcium hydroxide with various herbal pastes through dentin. **Materials and Methods:** Twenty one extracted single-rooted premolar were selected. The crown was transversely sectioned at the CEJ level. Paste was prepared by using 1gm of calcium hydroxide powder and 2mL of solution. Group1-(n=7): Calcium hydroxide-saline paste, Group2 (n=7): Calcium hydroxide-coconut water paste. Group3-(n=7): Calcium hydroxide-Ashwagandha paste; the apical foramen were sealed with epoxy resin. The teeth were placed in containers with 50mL of deionized water for 24, 72, and 168 hours, the pH values of the solution were measured using a pH meter. **Results:** Coconut water was alkaline in nature initially and after 168 hours, the medium was still alkaline. Ashwagandha was the only herbal preparation that increased the pH up to 168 hours and made the medium alkaline. Saline water preparations were acidic at the start of experiment, increased the pH up to 72 hours, but could not make the medium alkaline. **Conclusion:** The present study was done with the aim of vehicle used for calcium paste to improve the diffusion capability. Coconut water has a much better composition of minerals like calcium and zinc. The better diffusion ability and marked antimicrobial activity make them the best materials, which can be used as vehicles. Ashwagandha preparations provided additional benefits of diffusion of ions through the dentinal tubules in a sustained manner (up to 168 hours) in comparison with normal saline.

Keywords: Calcium hydroxide, coconut water, Diffusion, herbal intracanal medicament, Normal Saline.

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INTRODUCTION

Calcium hydroxide is the material of choice as intracanal medicament in Endodontics. This material was introduced by Hermann in 1920 and has been largely employed in different clinical situations since then, including the use as intracanal therapeutic agent [1]. Calcium hydroxide [Ca(OH)₂] has long been appreciated for its biological properties. The effects of calcium hydroxide include: antimicrobial activity, capacity to limit root resorption and promotion of repair

of periapical and surrounding [2-4] tissues as well as its ability to dissolve living tissues and weaken the bacterial endotoxin. The bonding capacity is based on Ca(OH)₂ to maintain a proper pH hinge on the distribution of hydroxyl ions [OH] [5, 6].

Hydroxyl ions [OH] free radicals react violently with a wide range of biomolecules. Due to the impeccability of its re-operation, this free radical rarely spread far from its source. The cytoplasmic bacterial membrane is damaged, proteins are released, and

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bacterial deoxyribonucleic acid is damaged, all contributing to the harmful influences of hydroxyl ions on bacterial cells [7].

Studies have demonstrated that the vehicle can exert a great influence on the release of ions [8]. The Ca(OH)₂ powder for root canal dressing has been used with different carriers, such as distilled water, camphorated monochlorophenol, normal saline, cresatin, glycerine, and propylene glycol (PG). Curcumin is a major component of *Curcuma longa* bioactive yellow. "Indian Neem" is another name for *Azadirachta indica*. It acts primarily as an anti-adherence agent. It affects the ability of bacteria to colonize by changing their adhesion. Antioxidant properties are present in it. It has antibacterial activity counter to *Enterococcus faecalis* and *Candida albicans* [9-11].

According to Gomes *et al.*, [8] carrier also should enhance the antimicrobial capacity of the paste. Chlorhexidine may be used as a vehicle in an attempt to increase the antimicrobial capacity of calcium hydroxide pastes, as it is effective against Gram-positive and Gram-negative, aerobic and facultative anaerobic microorganisms, yeasts, and viruses. Considering the antimicrobial potential of a herbal-calcium hydroxide association, it becomes important to determine how well such pastes can promote the diffusion of ions through dentinal tubules, an attribute essential to the therapeutic effect of any calcium hydroxide paste. This trial was conducted with the aim of to evaluate the diffusion ability of ions through dentinal tubules of different calcium hydroxide-containing herbal pastes with the calcium hydroxide paste prepared with saline.

MATERIALS AND METHODS

The present study was carried out in the Department of Conservative and Endodontics, Dental College and Hospital, Ahmednagar; Maharashtra, India, anrashtra was approved by the institutional ethical committee. The study was done on 21 extracted single-rooted premolar teeth. Objectives of the study were: To

evaluate Ion diffusion from calcium hydroxide and Saline paste 2)To evaluate Ion diffusion from calcium hydroxide and Coconut water paste 3)To evaluate Ion diffusion from calcium hydroxide and Ashwagandha oil paste and 4)To compare Ion diffusion from all of three group.

Inclusion Criteria

- Single-rooted premolar teeth, Teeth with no gross caries or fracture, Teeth with having patent canals and Teeth with full length of root intact.

Exclusion Criteria

- Teeth with gross deviation in their normal anatomy, Teeth with internal resorption & external resorption.
- Teeth having fractured roots and Teeth with obstruction or calcification within the canal system.

Preparation of the Sample

Twenty one extracted single-rooted premolars were selected. The crown was transversely sectioned at the CEJ level. Root canal length was measured by inserting a #15K-file. Apical preparation was performed up to file#30. The root canal were irrigated with distilled water throughout the instrumentation procedure and the root canal was filled with an ethylenediaminetetraacetic acid solution for 3 minutes. The root canal were rinsed with saline solution and dried with absorbent paper point. Paste was prepared by using 1gm of calcium hydroxide powder and 2mL of solution. Group1- (n=7): Calcium hydroxide-saline paste, Group2 (n=7): Calcium hydroxide-coconut water paste. Group3-(n=7): Calcium hydroxide-Ashwagandha paste; after the complete filling of the root canal with calcium hydroxide paste, their openings were sealed with temporary cement. The apical foramen was sealed with epoxy resin. The teeth were placed in containers with 50mL of deionized water for 24, 72, and 168 hours, the pH values of the solution were measured using a pH meter.



Fig. 1: Specimen of extracted single rooted teeth

RESULTS

In the present study, 21 single-rooted premolar teeth were used and divided into three groups, based on different vehicles used to place calcium hydroxide.

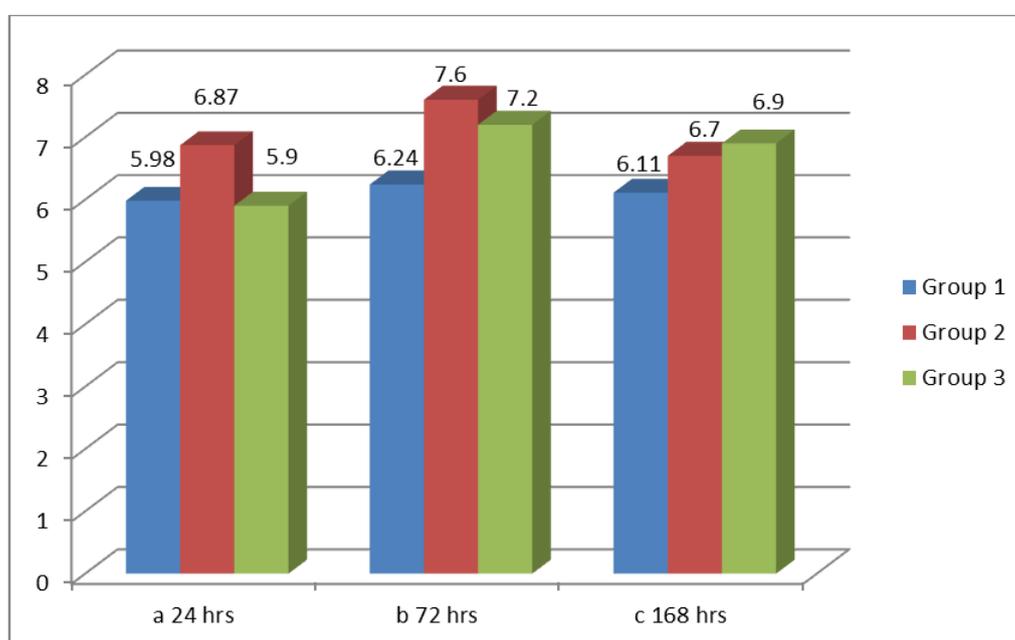
1. **Group I:** Saline was mixed with calcium hydroxide, and showed a pH drift with mean pH of 5.98 for 24 hrs, 6.24 for 72 hrs and 6.11 for 168hrs.
2. **Group II:** Coconut water was mixed with calcium hydroxide, and showed a pH drift with mean pH of 6.87 for 24 hrs, 7.60 for 72 hrs and 6.70 for 168hrs.
3. **Group III:** Ashwagandha preparation was mixed with calcium hydroxide, and showed a pH drift with mean pH of 5.90 for 24 hrs, 7.20 for 72 hrs and 6.90 for 168hrs.

At regular intervals of 24, 72, and 168 hours, the pH of the water was recorded for each group.

Coconut water was alkaline in nature initially and after 168 hours, the medium was still alkaline. Ashwagandha was the only herbal preparation that increased the pH up to 168 hours and made the medium alkaline. Saline water preparations were acidic at the start of experiment, increased the pH up to 72 hours, but could not make the medium alkaline. A reduction in pH after 168 hours was seen with all the Saline, coconut water and Ashwagandha preparation (Table 1 and Graph 1).

Table 1: Comparison of mean pH values between groups at different time interval

Groups	a 24 hrs	b 72 hrs	c 168 hrs
1	5.98	6.24	6.11
2	6.87	7.60	6.70
3	5.90	7.20	6.90



Graph 1: pH variation over time

DISCUSSION

The most common root canal dressing utilized in endodontics is calcium hydroxide. The dissociation of calcium hydroxide into ionic forms, such as calcium as well as hydroxyl ions, is the key to its success as a root canal dressing. These hydroxyl ions form an alkaline environment [12, 13] hydroxyl ions must diffuse in dentin for proper functioning at high concentration enough to release the pH needed to destroy the bacteria in the root canal and dentinal tubules. The biological and antimicrobial properties of calcium hydroxide are explained by the activity of these ions in the tissues as well as bacteria Proper intracanal medicine will have the best antibacterial and anti-inflammatory properties and the least number of side effects. *E. faecalis* is a Gram-positive facultative anaerobe. It has a strong link between secondary and chronic diseases. It is found in 24–77%. Because *E. faecalis* begins to grow, there is an urgent need to find

other ways to completely eradicate the virus. Due to its high pH, $\text{Ca}(\text{OH})_2$ converts bacterial lipopolysaccharides into cell wall [14, 15].

The present study was done with the aim of vehicle used for calcium paste to improve the diffusion capability. In similar with the study of Mori GC *et al.*, [16]. Herbal preparations are always welcome in present-day science due to the multitude of benefits due to the phytochemicals present in herbs. Such herbal Ashwagandha preparations provided additional benefits of diffusion of ions through the dentinal tubules in a sustained manner (up to 168 hours) in comparison with normal saline. Coconut water has a much better composition of minerals like calcium and zinc. The better diffusion ability and marked antimicrobial activity make them the best materials, which can be used as vehicles.

CONCLUSION

Ashwagandha as vehicles for calcium hydroxide are suggested as an intracanal medicament. Herbs show promise in *in vitro* experiments, but more preclinical and clinical research is needed to ensure their use. Taking into account the limitations of the *in vitro* trial, it can be speculated that aloe vera is permitted for improved Ca(OH)₂ diffusion via dentinal tubules, boosting its activity, as well as that it should be utilized as a channel for positioning intracanal medicament.

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