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Efficacy of Removal of Iodoform Based Intracanal Medicament from Root Canals Using Peracetic Acid, Sodium Hypochlorite, And Ethylenediaminetetraacetic Acid as Irrigating Solutions in Teeth with Closed Apex – An In-Vitro Stereomicroscopic Study.

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KEYWORDS

Calcium hydroxide, Metapex, peracetic acid, regenerative, sodium hypochlorite

ABSTRACT:

Aim: Removal of intracanal medicament is an ideal requirement for achieving a hermetic seal after obturation. These study aims to compare the efficacy of 0.5% peracetic acid, 3% sodium hypochlorite, and 17% ethylenediaminetetraacetic acid as irrigating solutions to remove calcium hydroxide with iodoform from root canals with closed apex.

Methods: Ninety extracted single-rooted single-canal teeth were selected. All the teeth were decoronated to obtain a standard length of 14 mm. Teeth were prepared using ProTaper Gold rotary files up to F4 and Metapex (calcium hydroxide with iodoform, by MetaBiomed) was placed in them. Teeth were randomly divided into three groups: group 1- sodium hypochlorite, group 2- ethylenediaminetetraacetic acid, and group 3- peracetic acid. Irrigation was done using the above irrigating solution with sonic activation. After the removal of the medicament, the residual medicament was assessed under a stereomicroscope at 20 X magnification using a four-grade scoring system. Data were analysed using a One-way analysis of variance and the Post Hoc Tukey test. ($P<0.05$)

Results: Peracetic acid (group 3) had the least amount of Calcium hydroxide with iodoform (Metapex by Meta-Biomed) remnants, with the lowest mean value of 1.07, followed by sodium hypochlorite (group 1), with a mean value of 1.33, and ethylenediaminetetraacetic acid (group 2), with a mean value of 1.9.

Conclusion: In comparison with sodium hypochlorite, peracetic acid was not significantly more efficient but it was significantly more effective than ethylenediaminetetraacetic acid in removing the Calcium hydroxide with iodoform (Metapex, by Meta-Biomed) from root canals.

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1. Introduction

Endodontic diseases are mainly caused by bacteria and their toxins released in the root canals. The primary objective of root canal treatment is to minimize the bacterial population and their by-products from the root canals. Proper biomechanical preparation and disinfection of the root canals help achieve this. Disinfection of the root canals is considered a significant factor that affects the success of root canal treatments.[1,2] Disinfection can be achieved by using various irrigating solutions and intracanal medicaments in root canals. Intracanal medicaments are used in multi-session endodontic treatments, to reduce the intracanal bacterial population.[3] The intracanal medicament placed in the canals must be removed before obturating the tooth as the residues can hamper the sealing ability and permeability of sealers. [4]

Calcium Hydroxide with iodoform (Metapex, by Meta-Biomed) is a frequently used intracanal medicament in long standing periapical lesions.[5] Hermann in 1936, to improve disinfection of root canal system developed calcium hydroxide intracanal medicament. It is most recommended antimicrobial agent for periapical lesions and disinfection of the canals. However,it is mandatory to remove this dressing from the canals before obturation, as remnants of calcium hydroxide paste on the root canal walls might interact with rootcanal sealers and causes apical leakage after obturation.[6] It also interferes with the penetration of sealers into dentinal tubules and can cause reduction in bond strength specially of resin-based sealers. Metapex is the most commonly used medicament among these combinations and is silicone oil-based calcium hydroxide containing 38% iodoform. Complete removal of calcium hydroxide based iodoform medicament into the canals using various techniques is a challenge, especially in complex root canal system. Re-capitulation with master apical file with copious irrigation using conventional needle irrigation (CNI) is the most common method for removal of iodoform based calcium hydroxide. Balakrishnan R, Dubey S *et al.*. [7] have shown difficulty in removing Ca(OH)2 from root canals using this conventional method.

Sodium hypochlorite (NaOCl), ethylenediaminetetraacetic acid (EDTA), maleic acid, and citric acid are the most commonly used irrigating solutions. [8] Peracetic acid (PAA) is one of the newer irrigating solutions. It is the strongest disinfectant and has antibacterial, antifungal, sporicidal, and antiviral effects. [9]

According to a study by Lottanti et. al., 2.25% PAA solution showed a significant effect as 17% EDTA in smear layer removal. [10] Previously published studies suggest using peracetic acid as a final irrigant in root canal treatment since it showed the capability to remove the smear layer and shows antimicrobial properties. [11] Sagsen et. al. studied the effect of peracetic acid on the removal of calcium hydroxide without iodoform and concluded that 1% peracetic acid is effective in the removal of calcium hydroxide without iodoform. [12]

2. Objectives

There are various studies in the literature where several irrigating solutions have been used to remove calcium hydroxide. However, limited information is available on the removal of calcium hydroxide with iodoform from root canal systems using peracetic acid from the tooth with a closed root end. Hence, the aim of this study was to compare the efficacy of three irrigating solutions: 0.5% peracetic acid, 3% sodium hypochlorite, and 17% EDTA for the removal of calcium hydroxide with iodoform paste using sonic activation in teeth with closed apex.

3. Methods

Specimen preparation

A total of ninety freshly extracted single-rooted single-canal human teeth with the closed apex of similar length and size were selected from lower premolars and upper incisors. The teeth selected were examined for root caries, fractures, or cracks using a dental operating microscope. Preoperative mesiodistal and buccolingual radiographs were taken to check for internal resorption and calcification and check for the presence of a straight single patent canal. The soft tissue debris and calculus were removed from the external surface with an ultrasonic scaler. The teeth were decoronated using a diamond bur with water coolant to standardize the root length of approximately 14mm. (Figure. 1) A 10 K-file was placed into the canal until it was visible from the apical foramen and the length was noted. The working length was determined by subtracting 1mm from the above length. The biomechanical preparation was done

Journal of Chemical Health Risks

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JCHR (2023) 13(6), 1132-1136 | ISSN:2251-6727

using ProTaper Gold rotary files (Dentsply Maillefer, Ballaigues, Switzerland) up to F4 size. The irrigation was performed using a solution of 2.5% sodium hypochlorite after each instrument, followed by 17% ethylenediaminetetraacetic to ensure the removal of the smear layer. After this, saline was used to irrigate the canals and they were dried using paper points. The apical end of the canal was prepared till 2mm from the apex using a diamond bur and the cavity was filled with resin-modified glass ionomer cement.

Application of Iodoform based Calcium hydroxide paste

Commercially available calcium hydroxide paste with iodoform (Metapex, by Meta-Biomed) was placed in the canals directly with the syringe provided by the manufacturer and pushed inside the canals till its pre-determined working length. The canal orifice was packed with cotton and the coronal end of the root was sealed using resin-modified glass ionomer cement to avoid contamination during the splitting of teeth. All the samples were stored at 37% temperature under 100% relative mositure for 3 weeks.

Grouping

The specimens were divided randomly into three groups:

Group 1 (n- 30): Calcium hydroxide paste with iodoform retrieved with 1 ml of 3% sodium hypochlorite (Vishal dentocare, Ahmedabad, India) + sonic agitation for one minute. (Figure. 2)

Group 2 (n- 30): Calcium hydroxide paste with iodoform retrieved with 1 ml of 17% EDTA solution (Prevest DenPro limited, Jammu, India) + sonic agitation for one minute.

Group 3 (n- 30): Calcium hydroxide paste with iodoform retrieved with 1 ml of 0.5% peracetic acid (Prime Laboratory, Pune, India) + sonic agitation for one minute.

Splitting the specimen

Two grooves were made on the lingual and buccal surfaces of the roots using a diamond disk at slow speed with a micromotor handpiece without invading the canals. Then roots were split longitudinally using a chisel and mallet into two halves.

Assessment of remaining calcium hydroxide with iodoform paste:

The specimens were evaluated under a stereomicroscope at 20 X magnification and scored.

The scoring criteria used to evaluate the remnants of Metapex are as follows:[13]

• score 0: less than 25% of the root canal shows remnants of Metapex. (Figure. 3:A)

• score 1: more than 25% but less than 50% of the root canal shows remnants of Metapex (Figure. 3:B)

• score 2: more than 50% but less than 75% of the root canal shows remnants of Metapex (Figure. 3:C)

• score 3: more than 75% of the root canal shows remnants of Metapex (Figure. 3:D)

Statistical Analysis

Statistical analysis was done using IBM SPSS software version 25.0 (IBM, Armonk, NY, USA). The mean values obtained were analysed using one-way ANOVA as we had to compare three independent groups, while Post Hoc Tukey test was done for intergroup comparison.

4. Results

All the groups showed remnants of Metapex in root canals. Peracetic acid (Group 3) with a mean value of 1.33 showed the least amount of remnants of Metapex followed by NaOCl (Group 2) with a mean value of 1.9 and EDTA (Group 3) with a mean value of 1.07 showed the most amount of Metapex remaining in root canals. (Table 1)

Post Hoc Turkey test was used for intergroup comparison,which showed significant difference between peracetic acid (Group 3) and EDTA (Group 2) ($p<0.05$). However, there was no significant difference between peracetic acid (Group 3) and NaOCl (Group 1). (Table 2)

5. Discussion

Thorough biomechanical preparation and complete irrigation decreases the bacterial counts from the infected root canals.[15] Calcium Hydroxide has been considered till date to be effective against bacterial strains and prevents its proliferation. However, it has been shown that residues of calcium hydroxide in the canals prevents penetration of sealers into dentinal tubules causing apical leakage.[16] The effectiveness of irrigants in removing intracanal medicament depends on their capacity to

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dissolve both inorganic and organic tissues. The organic tissues were no longer a barrier because the canals in the current investigation had already been subjected to sodium hypochlorite, whereas the inorganic tissues, along with the medicament, were the predominant obstacle.

In the present study, the canals were enlarged apically till size F4, as it was found to be necessary to ensure needle placement within 1-2 mm of the working length. [17] According to previous studies, using irrigation activation regimens shows improved removal of calcium hydroxide paste when compared to conventional irrigation from root canals. [18] Sonic activation was used in the study to enhance the clearance of Metapex from the root canals.

From the results of this study, the first observation made was that Metapex was present in all of the groups. When the type of irrigating solution is considered, 0.5% peracetic acid shows the least amount of Metapex remaining. NaOCl showed less removal than peracetic acid but had better results than EDTA.

In the former German Democratic Republic, PAA solutions were employed as an endodontic irrigant. [19] . But over time, it seems as though their promise for application in endodontics has been neglected. PAA is not rendered inactive by organic substances. [20] It does not produce byproducts that are damaging to the environment or leave behind residues. [21] When peracetic acid breaks down into oxygen and acetic acid, free oxygen and hydroxyl radicals can be released. This acetic acid is responsible for dissolving the inorganic materials and removing the calcium hydroxide and iodoform complex, which is insoluble. [22]

It has been shown that PAA is comparatively cytotoxic at high concentrations. [23] However, there is no definitive information about the toxicity of 1% PAA solution in the literature, and more research is required on this subject. We preferred to utilize a 0.5% PAA solution because these investigations demonstrated the negative effects of more concentrated PAA solutions. Despite the fact that there isn't an ideal irrigating solution for totally removing calcium hydroxide with iodoform paste from root canals, favourable results were shown by PAA.

The in vitro analysis model and the clinical situations such as open apex, root resorption, and the periapical lesion can have a negative impact on the findings, to name a few of the study's shortcomings. Additionally, we evaluated a commonly used irrigation strategy, and by employing various other irrigation strategies, the findings may vary. As a result, additional research that takes a variety of aspects into consideration can help advance our existing understanding.

Conclusion

Within the limitations of this study, it was found that neither of the irrigating solutions mentioned herein thoroughly removed calcium hydroxide with iodoform, from the root canal system with a closed end. However, peracetic acid outperformed NaOCl and EDTA in terms of efficacy, and it may be preferred in removing calcium hydroxide with iodoform paste from the root canal system.

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Journal of Chemical Health Risks

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