Research Article

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Comparative Evaluation of Efficacy of Different Irrigants for the Removal of Iodoform Based Calcium Hydroxide Medicament from Root Canals: An In-Vitro Study

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ABSTRACT

Background: Calcium-hydroxide is still the most widely used intra-canal medicament. However, placement of an intra-canal medicament possess a great challenge for the clinicians when it comes to its removal from the canal system prior to obturation, & this removal becomes even more difficult when an oil based Ca(OH)2 formulation is used, regardless of the irrigants & agitation methods used.

Aim: The aim of present in vitro study was to comparatively evaluate the efficacy of different irrigants for the removal of iodoform based calcium hydroxide medicament from root canals.

Methods & material:50 extracted mandibular premolars were selected for the study. Cleaning and shaping was done and teeth were filled with oil based Ca(OH)2 formulation. After 7 days Ca(OH)2 was retrieved using 17% EDTA aqueous solution, 17% EDTA gel & 2.5% NaOCl in combination with sonic agitation. The samples were split longitudinally and scored under stereomicroscope. The results were statistically analyzed using Kruskal-wall is test and Mann-Whitney U test

Results: Among all experimental groups, EDTA gel when used with NaOCl with sonic agitation proved superior significantly.

Conclusion: Under the limitations of present study it can be advocated that neither irrigating solutions removed the medicament from walls of root canals completely.

Keywords: Inter-appointment intra-canal medicament, oil based Ca(OH)2 formulation (Calpex), Endoactivator, Irrigants.

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INTRODUCTION

The main aim of a successful endodontic treatment is to make root canal system sterile.[1] Chemo-mechanical debridement is considered as one of the most important factor to achieve this goal. However, many a times thorough disinfection of root canal system is not possible by chemo-mechanical means (due to the presence of apical deltas, isthmuses),[2] thereby increasing the need an intra-canal medicament.[3]

Intracanal medicaments achieve disinfection by inhibiting proliferation and differentiation of microbes. They are either bactericidal or bacteriostatic.[4] Inter-appointment intra-canal medicaments become even more important in cases of continous pain and in cases of exudates.[5]

Various intra-canal medicaments are used in endodontics. Introduced in 1920 by Hermann, Calcium hydroxide based formulations are one of the most routinely used intra-canal medicaments, as it has an excellent antibacterial activity against most of the endodontic flora (because of its alkalinity, pH = 12-12.5).[6] It also has the ability of forming hard tissue barrier (i.e apexification) and also renders necrotic tissue susceptible to solubilizing action of NaOCl in the coming appointment.[7]

Vehicle used in calcium hydroxide plays a major role.[8] Gautam et.al (2011) documented that oil-based calcium hydroxide are more effective against endodontic flora than water based calcium hydroxide. He proposed that decreased concentrations of oil-based calcium hydroxide (0.022gm/ml) resulted in significantly decreased antimicrobial effects.[9]

Metapex, containing silicone oil as a vehicle, kills Enterococcus faecalis and Candida albicans,[10] This bactericidal & fungicidal effect is not efficiently observed in water- based Ca(OH)2 formulation. Studies also have shown antimicrobial effect of iodoform . Presence of iodoform makes metapex superior to water-based calcium hydroxide, in its anti-microbial action.[11]

Though intracanal medicaments have lot of advantages, they should be removed completely from the root canal system to get fluid impervious seal.[7] Lambrianidis et.al proposed that it is not the concentration of Ca(OH)2 that hinders its complete removal, it is the vehicle.[8] Nandini et al. concluded that Metapex is not easily removed even after using efficient chelators like EDTA.[12] Several methods have been proposed for removal of oil-based Ca(OH)2 from root canals, such as manual dynamic agitation, agitation of irrigants using various devices etc. However. none of the methods proved completely effective.[8,13]

The aim of this study was thus to compare removal of oil-based Ca(OH)2 using different irrigants when agitated using sonic agitation.

MATERIAL AND METHODS

This retrospective in-vitro study was carried out using fifty extracted human permanent mandibular premolars that were collected from the Department of Oral and Maxillofacial surgery, Peoples College of Dental Sciences and Research Centre, Bhopal.

Inclusion criteria:

1. Teeth with closed apex
2. Teeth with single canal

Exclusion criteria:

1. Teeth with open apex.
2. Teeth with caries, cervical abrasion or fracture.
3. Teeth with old restorations or endodontic manipulation.
4. Teeth with internal or external resorption
5. Teeth with dilacerations.

Procedure

Fifty intact, human mandibular premolar teeth keeping exclusion and inclusion criteria in mind were used in this following study. All the selected teeth were debrided and cleansed using an ultrasonic scaler to remove the soft tissues and calculus flecks followed by examination under stereomicroscope to check for any cracks. Radiographs were taken in mesio-distal and buccolingual directions to rule out more than one canal. Teeth were stored in normal saline until use.All the samples were de-coronated with a diamond disc at high speed under constant water spray to a standard length of 15 mm.

Patency was achieved by placing a size # 10 K file (Dentsply Maillefer, Switzerland). Final working length was determined by placing a size #15 K file (Dentsply Malliefer, Switzerland) into the root canal until it was just visible at the apical foramen, then 1 mm was subtracted from this measurement. ProTaper Universal rotary instruments (Dentsply Maillefer, Switzerland) were used for preparing the canals. Briefly, S1 was used for cleaning and shaping the coronal portion followed by the SX file to increase the taper. S1, S2, F1, F2 and F3 was used in sequence up to the working length. The canals were irrigated with 5 ml 2.5% sodium hypochlorite solution (Prime dental) after each file size using a 30 gauge side-vented endodontic needle (Prime Dent, India). After completion of the instrumentation, final irrigation of the canals was done with 5 ml 17% EDTA solution (Prevest DenPro) followed by 5 mL of 2.5% sodium hypochlorite to eliminate the smear layer. Finally, the root canals were rinsed with normal saline and dried up with paper points (Dentsply Malliefer, Switzerland). Canals of all the samples were filled with iodoform based calcium hydroxide intracanal medicament (Calpex ,Ammdent) and sealed with temporary filling material (Cavitemp, Ammdent, India). Subsequently samples were divided into two groups.

Group 1 samples (n=30) includes the experimental group, which was further divided into three subgroups(n=10) depending upon the irrigation solution used for removal of intracanal medicament.

Group 2 samples (n=20) included the control groups which was further into two subgroups: positive control group(n=10) and negative control group(n=10). Followed by this samples were stored at 37°C in incubator (Tricks Incubator, India) for 7 days offering 100% humidity.After this incubation period temporary filling material from all the samples was removed.

Initially in all the experimental groups, Calpex (Ammdent)was removed by irrigation with 5ml of 2.5% NaOCl (Prime dental) for 1 minute delivered through a 30 gauge side-vented endodontic needle (Prime Dent, India)using endoactivator system (Dentsply Tulsa Dental Specialties, Tulsa) with tip size 25/04. Afterwards the irrigant was left undisturbed in the canal space for 1min in all the samples. Followed by this,

In subgroup A, irrigation with 5ml of 2.5% NaOCl was done using sonic agitation for 1min followed by leaving the same solution in the canal for 1 min. In subgroup B, canals were irrigated with 5ml of 17% EDTA aqueous (Prevest DenPro) for 1min using same agitation protocol and leaving the irrigant in the canal for 1 min.

In subgroup C, irrigation was done using 5ml of 17% EDTA gel (Prevest DenPro) for 1min using sonic agitation and leaving the irrigant in the canal for 1 min. Finally samples in all experimental groups were again irrigated with 5ml of 2.5% NaOCl using sonic activation for 1min and leaving the same inside the canal for 1min. A final flush with 5ml of normal saline was done for all samples saline and dried up with paper points (Dentsply Malliefer, Switzerland).

The samples were then split longitudinally in a mesio-distal direction into two halves and each sample was then scored under stereomicroscope (2X) using 4 grade scoring criteria as suggested by Lambrjanidis et al.(Fig 1) score 1: no visible remnants of medicaments, score 2: scattered remnants of medicaments., score 3: distinct masses of medicaments and score 4: densely packed remnants of medicaments.

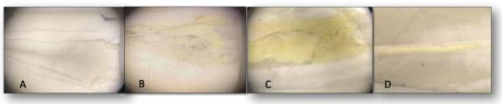


Figure 1: 4 grade scoring criteria as suggested by Lambrjanidis et alScore 1:(A) Score 2: (B) score 3: (C) and score 4: (D)

Statistics:

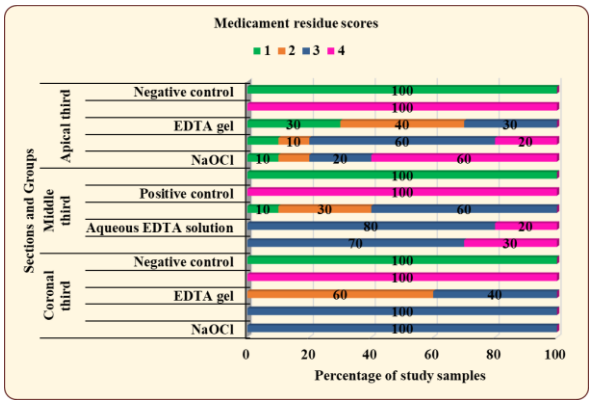
Data obtained were statistically analysed using Kruskal-wallis test and Mann-Whitney U test for pairwise comparison.

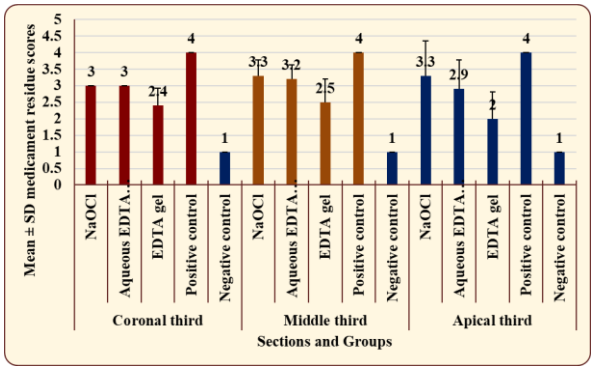
RESULT

The Calpex (Ammdent) removal scores and mean and standard deviation values of each group according to the canal third levels are shown in graphs 1&2: It was concluded from the above graphs that, there was no significant difference

between NaOCl and Aqueous EDTA solution medicament residue scores, also NaOCl and aqueous EDTA solution groups medicament residue scores i.e Sub-Group A &B were significantly higher than EDTA gel. Among all experimental groups, EDTA gel when used with NaOCl with sonic agitation i.e Sub-Group C proved superior.

Graph 1: Distribution of samples according to medicament residue scores in different irrigants at coronal, middle and apical third sections.





Graph 2: Comparison of efficacy of different irrigants for the removal of iodoform based calcium hydroxide medicament from root canals at coronal, middle and apical third sections.

DISCUSSION

Present study aim was to check which irrigant under sonic agitation can remove Calpex from the root canals effectively. The results showed that EDTA gel when used with NaOCl (agitated using endoactivator) is an effective irrigant. EDTA being a chelator has the potential to chelate with calcium hydroxide residues, thereby helping in its removal. However, it does not a good flushing action when compared with NaOCl. Therefore in this particular study NaOCl is was used after flushing the canal with EDTA.

EDTA gel gave significantly better result that EDTA aqueous and 2.5% NaOCl, may be because being viscous in nature it stayed within the canal for longer period of time, which was not the case with liquid irrigants used in this study. EDTA aqueous and NaOCl being liquid in nature spilled out of the canal orifice while irrigating , thereby decreasing their amount within the canal and also the contact time needed during agitation. This is in accordance with a study done by Deepak BS et. al, Deepak BS et. al stated that volume of the irrigant within the canal plays a very important role in the removal of intra-canal medicaments, regardless of the irrigation technique used.

Application time/ contact time of 1min was chosen because it is been very well documented that EDTA has maximum chelating ability at 1-4 min.This is in accordance with the study done by Teixeira et al, in which he concluded that maximum chelating efficiency of EDTA is at 1, 3 and 5 mins. However, there is no standard duration of application of irrigants. It has been proved many a times that instrumentation and irrigation using manual dynamic agitation, rotary brush agitation is not effective in removing intra-canal medicament residues, specifically oil-based formulation of Ca(OH)2.Therefore in the present study, endoactivator was chosen for agitating the irrigant solution because being a machine assisted device it can remove residues of Calpex efficiently. It uses sonic energy for agitation & agitates irrigant using swirling movement & cavitation. This mechanism of activation improve the penetration of irrigants into inaccessible areas of root canals. The battery-operated handpiece activates from 2,000–10,000 cycles/min.

Stereomicroscope was used to quantify the residues scores of the medicament because it has good visibility, is economical and also offers good amount of illumination and magnification needed. Apart from stereomicroscope, there are several other methods used for the same purpose such as SEM, Confocal microscopy, Dental Operating Microscope, CBCT etc. However, regardless of using sonic agitation method, none of the irrigants removed Calpex completely from the canal walls. Apical 1/3rd

showed negligence amount of removal compared to coronal & middle third.

When overall scores were considered EDTA gel form with NaOCl agitation with endoactivator gave significantly better results & thus studies further should be done on the same using advanced methods like CBCT.

CONCLUSION

No technique has completely removed intra-canal medicaments from the canal walls. It is the appropriate use of mechanical instruments combined with chelating agents, followed by final flushing with sodium hypochlorite that enables adequate cleanliness of canal walls. Machine assisted agitation of the irrigants have shown improvement in the removal of intracanal medicaments.

CONFLICTS OF INTEREST

The authors declare they have no potential conflict of interests regarding this article.

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