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Original Research Article

Efficacy of four different irrigation systems on the removal of calcium hydroxide from the root canal, *in-vitro* study: Original research

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ABSTRACT

Background/Purpose: Calcium hydroxide (Ca(OH)2) has been used as a root canal medicament due to its antimicrobial activity and organic tissue dissolution capacity. To, increase the efficiency and success of root canal/endodontics treatment calcium hydroxide has to be removed from the canals walls. This study evaluate and compare four different irrigation system i.e. Conventional Irrigation (plastic 30 gauge needle), Sonic Irrigation (Endoactivator), Ultrasonic Continuous Irrigation and Negative pressure with Endo Irrigation plus.

Material and Methods: For carrying out this study we have used 50 extracted premolar roots, preserved in sodium hypochlorite. Then they were randomly allocated five in four groups (n=10) and a control group. Specimen were statistically analysed by Kruskal Wallis test. All Testing was performed at significance level P-values 0.05. The analysis was carried out with social sciences version (SPSS)17.0 for Windows(SPSSInc.,Chicago, IL,USA).

Results: In our present study we have found that None of the techniques used was completely able to remove Ca(OH)2 from the root canals. But the Sonic irrigation system (Endoactivator) has some potential benefit in removal of calcium hydroxide.

1. Introduction

Evidence has overwhelmingly supported the argument that microorganisms have a fundamental role in the pathogenesis of periradicular diseases.[1] Calcium hydroxide, has been widely used as an intracanal medicament after the root canal preparation has been done(chemo-mechanical). It has been postulated that calcium hydroxide has antimicrobial and organic tissue liquefying properties and it also initiates hard tissue formation thereby reducing the possibility and probability of reinfection. Some studies also suggest that this medicament inactive endotoxin thereby delaying the release of cytokines inflammatory mediators hence reducing the periapical inflammation.[2,3] It has been documented in several studies that the presence of calcium hydroxide on root canal, dentin wall can alter the effect of root canal treatment. It has been further explain that the residual of calcium hydroxide interact with Zinc oxide eugenol sealers to produce eugenolate. This could also influence the additional of sealers to the root canal. Thereby, compromising its efficiency and decreasing the success of root canal.[4–7]

However, this medication has to be removed before obturation to prevent any negative effects on the root canal treatment because Ca(OH)2 might lead to apical leakage and reduce sealant adaptation and might react with zinc oxide eugenol and reduce dentinal bond strength.[8] Moreover complete removable of calcium hydroxide is

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quite challenging. For the removal of calcium hydroxide from the root canal different techniques and methods have been proposed like use of endo activator, ultrasonic irrigation, endodontic hand files etc. There has been a lack of evidence to support or describe any one method as best. This study aims to evaluate the effectiveness of different types of irrigation system in removal of calcium hydroxide from the root canals in single rooted tooth. Our results suggested that sonic irrigation system are more efficient as compared to others. This may be explained that limited vibration of in case of endoactivator tends to produce more motion to the calcium hydroxide particles. As, we do believe that as law of motion of uniform rest and motion act more efficiency in sonic irrigation, that might have added potential benefits in cleaning and removal of calcium hydroxide. Many published literature have also suggested the same. Also The combination of rotary instrumentation and passive ultrasonic irrigation lessens the quantity of residual calcium hydroxide in comparison to manual preparation and sonic irrigation. Although the impossibility of full removal of temporary dressings highline that when manual instrumentation and irrigation are supported by rotary instrumentation and ultrasonic irrigation the result is much cleaner root canals. It is important to be mentioned that active ultrasonic irrigation has the potential to alter the root morphology. That is why sonic irrigation is more highly recommended. Several published literature has also supported our study that neither of any methods could complete removal of calcium hydroxide. But Sonic irrigation system has shown positive outcome.[9]

We found that neither irrigation solutions nor ultrasonic activation of the irrigation solutions could completely remove the residual Ca(OH)2 from the root canals of teeth, but use of sonic irrigation system has potential benefit in removal of calcium hydroxide. This study was carried out in Vananchal Dental College & Hospital, Garhwa, Jharkhand and at I.LT Spectra lab, New Delhi.

2. Materials and Methods

For carrying out this study we have used 50 extracted premolar roots, preserved in sodium hypochlorite. Other armamentarium such as distilled water, 0.5% chlorhexidine, Diamond dic, 15, 20 no K-file (Maillefer Le (Maillefer, Dentsply, Ballaigues, Switzerland), AvueCal (Prime Dental Products PVT LTD, EDTA (Prime Dental Products PVT LTD), Endoactivator (Maille Vator (Maillefer, Dentsply, Ballaigues, Switzerland), Endoirrigator Plus (K-DENT, India), Plastic syringe with 30 gauge needle (Fusion 360, Komet, Japan), Ultrasonic tips (ESSENTIAL DENTAL SYSTEMS, USA)

Protaper rotary universal system Universal system Till F5 (50,5%) (Maillefer, Dentsply, Ballaigues, Switzerland) Endomotor (N.S.K. Unicorn Denmart, India), Radiovsiography (RVG) (Acteon PVT LTD, India), Satelec P5 ultrasonic scaler were used.

2.1. Specimen preparation

To remove the organic debris, extracted tooth were immersed in a solution of 3.0% Sodium hypochlorite and left for 48hrs. Subsequently, the external root surface were washed with distilled water and ultrasonic scaling were done and then stored in 0.5% chlorhexidine. The patency of the canals was confirmed by passing a size 15, 20 no. K-file (Dentsply Maillefer) just bind to the apex. The specimens were decorated to obtain a standardized root length of 15mm by using a diamond disk. For the preparation of root canal, Protaper rotatory universal system was used in a crown-down sequence to MAF size F5 (50, 5%). The canal were dried with paper point.

Thereafter, teeth were randomly allocated to 4 different group and remaining were used as a control.(n=10) Then, all the root canal receive a water based Ca(OH)2 past a size #35. Lentuto Spiral on a contra angle hand piece was used to introduce Calcium hydroxide dressing. Mesio-distal and Bucco-lingual angulation radiograph were taken for the confirmation of calcium hydroxide placements. Zinc oxide eugenol was used as a temporary filling. Finally, all specimen were stored in 35°C with 100% relative humidity for a period of one week. Then, their coronal access was opened and removal of calcium hydroxide was performed using four different techniques:-

1. Conventional Irrigation (plastic 30 gauge needle)
2. Sonic Irrigation (Endoactivator)
3. Ultrasonic Continuous Irrigation
4. Negative pressure with Endo Irrigation plus
5. And the control group in which irrigation was not done.

3. Scanning Electron Microscopic (SEM) Evaluation

SME was done to evaluate the calcium hydroxide removal from root canal by different irrigation system. For scanning Electron Microscopic analysis tooth halves were individually dehydrated, fixed on aluminium stubs.(Silver Paint, Agar Silverpaint; Agar Scientific Ltd, Stansted, Essex, UK), sputter coated with a 20-nm platinum (Polaron Instruments Ltd, Hatfield, UK), and viewed with a scanning electron microscope (ULTRA 55; Carl Zeiss uts Gmbh, Oberkochen, Germany).

To standardize the area examined for each sample, the central beam of the scanning electron microscope directed to the centre of each third of the root canal by the Scanning electron microscope operator under 10_magnification; after which, the magnification was increased to 1000, and the area of the canal wall captured on the screen of the scanning electron microscope was used for evaluating the remained amount of Ca(OH)2 on the canal wall.

The following scoring system was done

Table 1: Indicates significant value, P value (p <=0.05) among the groups. Comparison among coronal, middle and Apical levels.

	Groups	Mean	St Deviation	Median	Chi-Sq	P.value	Inference
	Conventional Irrigation	4.80	0.42	5.00	25.822	0.00	S°
Coronal	Endoactivator	2.00	0.67	2.00			S°
	Endoirrigator plus	3.00	0.00	3.00			S°
	Ultrasonic	4.00	0.00	4.00			S°
Middle	Conventional	4.50	0.53	4.50	21.941	0.000	°S
	Endoactivator	1.80	0.42	2.00			S°
	Endoirrigator plus	2.50	0.53	2.30			S°
	Ultrasonic	3.90	0.57	4.00			S°
Apical	Conventional Irrigation	4.50	0.52	5.00	21.186	0.000	S°
	Endoactivator	1.90	0.57	2.00			S°
	Endoirrigator plus	2.50	0.52	1.00			S°
	Ultrasonic	4.10	0.52	4.00			S°

Table 2: Comparison among different irrigation system.

Group		Mean	St. Deviation	Median	Chi Square	P-Value	Interference
Conventional irrigation	Coronal	4.80	0.42	5.00	1.943	0.379	NS
	Middle	4.50	0.53	4.50			
	Apical	4.60	0.52	5.00			
Endoactivator	Coronal	2.00	0.67	2.00	0.573	0.751	NS
	Middle	1.80	0.42	2.00			
	Apical	1.90	0.57	2.00			
Endoirrigator plus	Coronal	3.00	0.00	3.00	6.444	0.040	S°
	Middle	2.50	0.53	2.50			
	Apical	2.60	0.52	3.00			
Ultrasonic	Coronal	4.00	0.00	4.00	1.450	0.484	NS
	Middle	3.90	0.57	4.00			
	Apical	4.10	0.32	4.00			

*Indicates significant value, P value (p <=0.05) among the groups.

1. Score 1: 80%-100% removal of Ca(OH)2 (total cleanliness)
2. Score 2: 60%-80% removal of Ca(OH)2 (great cleanliness)
3. Score 3: 40%-60% removal of Ca(OH)2 (partial cleanliness)
4. Score 4:20%-40% removal of Ca(OH)2 (light cleanliness)
5. Score 5: 0%-20% removal of Ca(OH)2 (no cleanliness)

4. Statistical Analysis

Btained were statistically analysed by Kruskal Wallis test. All Testing was performed at significance level P-values 0.05. The analysis was carried out with social sciences version (SPSS)17.0 for Windows(SPSSInc.,Chicago, IL,USA).

5. Results

In our study we observed that on taking each coronal, middle and apical third individually. Endoactivator showed the best cleanliness at each third among all the methods, whereas Endoirrigator plus shows better cleanliness as compared to ultrasonic irrigation system at each third. In other hand conventional techniques shows poor or least cleanliness at each third. Control group showed complete coverage of calcium hydroxide on its wall. Details description in Table 1. When considering about each Irrigation system individually, we observed that there was only significant difference in Endoirrigator plus system among coronal, middle and Apical third and others were non significant. Table 2 .

6. Conclusion

In our present study we have found that None of the techniques used was completely able to remove Ca(OH)2 from the root canals. But the Sonic irrigation system (Endoactivator) has some potential benefit in removal of

calcium hydroxide.

7. Source of Funding

None.

8. Conflict of Interest

None.

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