ISSN: 2581-5989
PubMed - National Library of Medicine - ID: 101738774

International Journal of Dental Science and Innovative Research (IJDSIR)

IJDSIR : Dental Publication Service

Available Online at: www.ijdsir.com

Volume – 4, Issue – 4, August - 2021, Page No. : 215 - 221

Comparative evaluation of intracanal calcium hydroxide removal with Hand file Neohybrid Rotary file, Endoactivator & passive ultrasonic Irrigation - An In-vitro study

[1]Dr. Akshay Ankush Gomare**,** Post graduate student, Dept of Conservative Dentistry & Endodontics, ACPM Dental College, Dhule, Maharashtra, India.

[2]Dr. Zinnie Nanda, Professor and Head of the department, Conservative dentistry and Endodontics, ACPM Dental college, Dhule, Maharashtra, India.

[3]Dr. Kavita Rudagi, Professor, Dept of Conservative Dentistry and Endodontics, ACPM Dental college, Dhule, Maharashtra, India.

[4]Dr. Kranthikumar Reddy, Professor, Dept of Conservative Dentistry and Endodontics, ACPM Dental college, Dhule, Maharashtra, India.

[5]Dr Srinidhi SR, Professor, Dept of Conservative Dentistry and Endodontics, ACPM Dental college, Dhule, Maharashtra, India.

[6]Dr Jinet Joseph, Post graduate student, Dept of Conservative Dentistry & Endodontics, ACPM Dental College, Dhule, Maharashtra, India.

[7]Dr Diksha Dubey, Post graduate student, Dept of Conservative Dentistry & Endodontics, ACPM Dental College, Dhule, Maharashtra, India.

Corresponding Author: Dr. Akshay Ankush Gomare**,** Post graduate student, Dept of Conservative Dentistry & Endodontics, ACPM Dental College, Dhule, Maharashtra, India.

Citation of this Article: Dr. Akshay Ankush Gomare, Dr. Zinnie Nanda, Dr. Kavita Rudagi,, Dr. Kranthikumar Reddy, Dr Srinidhi SR, Dr Jinet Joseph, Dr Diksha Dubey, “Comparative evaluation of intracanal calcium hydroxide removal with Hand file Neohybrid Rotary file Endoactivator & passive ultrasonic Irrigation - An In-vitro study”, IJDSIR- August - 2021, Vol. – 4, Issue - 4, P. No. 215 – 221.

Type of Publication: Original Research Article

Conflicts of Interest: Nil

Abstract

Aim: Comparative evaluation of intracanal calcium hydroxide removal with Hand file,Neohybrid Rotary file , Endoactivator & passive ultrasonic Irrigation ,An Invitro study.

Introduction: The main goal of endodontic treatment is complete Elimination of bacteria, their byproducts, pulpal remnants from infected root canals & to achieve perfect sealing. Calcium Hydroxide {$Ca(OH)_2$} is vastly studied & commonly used intracanal medicament to get rid of

microorganism; however the removal of $Ca(OH)_2$ is difficult which in turn adversely effects perfect sealing between obturation material & dentin leading to failure of endodontic treatment. So purpose of this study was to evaluate & compare $Ca(OH)_2$ removal using Hand file, Rotary file, Endoactivator & passive ultrasonic irrigation.

Methodology- 24 single rooted teeth were collected & decoronated to standardize the length to 14mm. Cleaning & shaping was done using Neohybrid File (25-4%). $Ca(OH)_2$ powder was mixed with saline & filled into the canal using lentulospiral. Orifices were sealed with temporary cement. Samples were randomly divided into 4 groups. Group I:HandFile no20k-file(n=6); Group II: Rotaryfiles-no25, 4% Neohybrid Rotary files(n=6); Group III: Endoactivator; Group IV:Passive ultrasonic irrigation (n=6). $Ca(OH)_2$ paste was removed using 2ml of 3% sodium hypochlorite solution followed by 1minute activation of the respective file system. All samples were finally irrigated with 17% ethylenediaminetetraacetic acid & flushed with distilled water. Two longitudinal grooves were made in buccal & lingual aspect of each root & split into two halves. Each section was examined under a stereomicroscope at 20x Magnification.

Result: Passive Ultrasonic Irrigation had showed the highest ability to remove Ca(OH)2 from the root canal walls followed by Endoactivator , Neohybrid rotary file and hand file system respectively.

Conclusion: Within the limitations of this study, none of the investigated systems were able to completely remove Ca(OH)2 from root canal. Passive Ultrasonic Irrigation had the highest ability to remove Ca(OH)2 from the root canal walls.

Keywords: Calcium Hydroxide, Passive Ultrasonic Irrigation , Neohybrid Rotary File,Endoactivator.

Introduction

The goal of endodontic treatment is complete elimination of bacteria, their by-products and pulpal residues from infected root canals and to achieve perfect sealing of the disinfected root canals(1). The root canal system is a very complex space, which eventually impairs cleaning and disinfection procedures as well as the removal of root canal dressing (2). Calcium hydroxide (CH) was first introduced in Endodontics by Herman in 1920. It is alkaline in nature (pH of 12.5), is extensively used as an intracanal medicament between appointments to render canals free from bacteria because of its antibacterial, biocompatible, therapeutic and regenerative properties (3,4).

Major disadvantage of calcium hydroxide being the residues impede the penetration of sealers into dental tubules as well as increases apical leakage which eventually leads to changes in physical properties and sealing ability of canal sealers and furthermore it alters the setting of zinc-oxide-eugenol based sealers . Hence, it is important to completely remove Ca(OH)2 before root canal filling . The complex anatomy of the root canal may not permit this elimination using conventional materials (5).

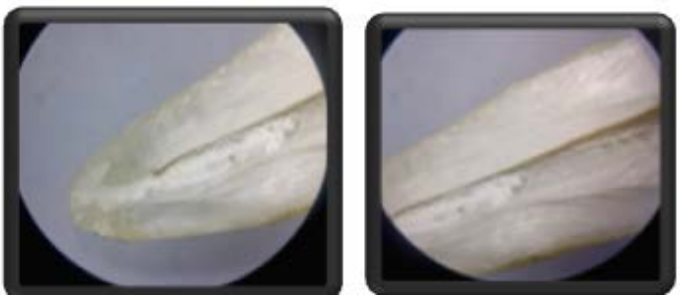
The most common method for elimination of Ca(OH)2 is the use of “master apical file” (MAF) at working length combined with abundant sodium hypochlorite (NaOCl) and ethylenediaminetetraacetic acid (EDTA) solution for irrigating the canals (4). The elimination of Ca(OH)2 with hand files using irrigating solutions may be inadequate; hence, the use of mechanical irrigant activation technique like Passive Ultrasonic irrigation (PUI) ,Sonic activation and rotary NiTi instruments has been Introduced. Passive ultrasonic irrigation (PUI) is based on the circulation of energy from an ultrasonically oscillating instrument to the irrigant inside the root canal. The EndoActivator System

(Dentsply Sirona, Charlotte, USA) was launched as a sonic activated device to enhance the irrigation phase. This system allows activation of various intracanal agents and also give rise to vigorous intracanal fluid movement (6). Neo hybrid Files have a distinctive off-centred rectangular cross Section which helps in Asymmetric or swaggering movement which minimizes the engagement between the file and canal dentin, Enhances loading and augering of debris. So the aim of the study is to evaluate and compare the efficacy of Ca(OH)2 removal from the root canals and canal walls using hand files (K-file), rotary files (neo-hybrid), Endoactivator , and passive ultrasonic irrigation (PUI).

Material and Methodology

24single rooted teeth were collected, free of any cracks, caries,restorations, resorption, or open apices were selected for this study. The coronal portions of each tooth were sectioned using diamond disks to standardize the root length at 14 mm. K- file of size 10 was used to establish the patency, and cleaning and shaping were done by crown-down technique using Neohybrid Rotary File (upto 25-4% taper). Calcium hydroxide powder was mixed with normal saline & filled into the canal using lentulospiral & orifice is sealed with zinc oxide eugenol.

Samples were randomly divided into 4 group, Groups I : Hand File –no 20k-file(n=6),Group II-Rotary files-no25,4%,Neohybrid Rotary files(n=6), Group III-Endoactivator (n=6), Group IV: Passive ultrasonic irrigation–no20U File(n=6). Ca(OH)2 paste was removed using 2ml of 3% sodium hypochlorite solution followed by 1minute activation of the respective file system. All samples will be finally irrigated with 17% ethylenediaminetetraacetic acid & flushed with distilled water.Two longitudinal grooves were made in buccal & lingual aspect of each root & split into two halves by a chisel. Each section was examined under a stereomicroscope at 20x Magnification (Figure 1-4) and photographs were taken with a digital camera (Nikon,Japan). The photographs were evaluated by a single person who was not associated with this study. The marked middle & apical portion were evaluated as per the following scores. Score 1=Absence of remnants,Score 2= scattered remnants, Score 3= Densely packed remnants.(Tamil S. et al)

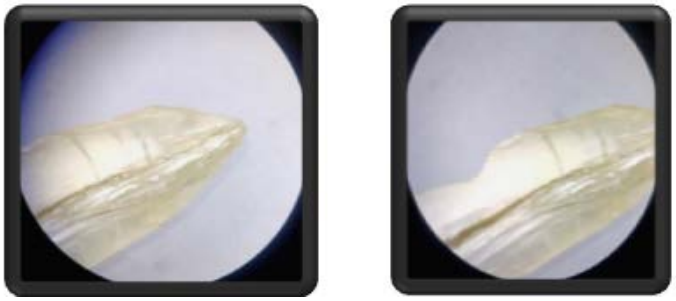


Apical Third Middle Third

Figure 1: Group 1

Apical Third Middle Third

Figure 2: Group 2



Apical Third Middle Third

Figure 2: Group 3

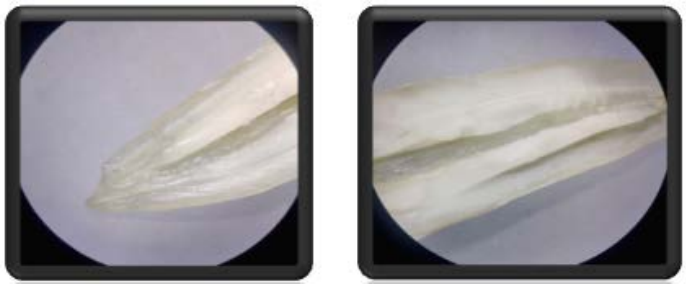


Figure 4: Group 4

Method of data analysis

Statistical analysis was performed using Statistical Product and Service Solution (SPSS) version 16 for Windows (SPSSInc, Chicago, IL). Descriptive quantitative data was expressed in mean and standard deviation respectively. Qualitative data /Categorical data in terms of category of presence of remnants was expressed as percentage. Data normality was checked by using Shapiro – Wilk test. Confidence interval was set at 95% and probability of alpha error (level of significance) set at 5% Power of the study set at 80%. Chi-square test was used to evaluate differences in calcium hydroxide remnants in apical and middle third of root canal among three groups. One –way analysis of variance (ANOVA F test) was used to find difference between mean remnant score between three groups is significant or not. Tukey's post hoc test was used to find pair wise multiple intergroup comparisons between three groups.

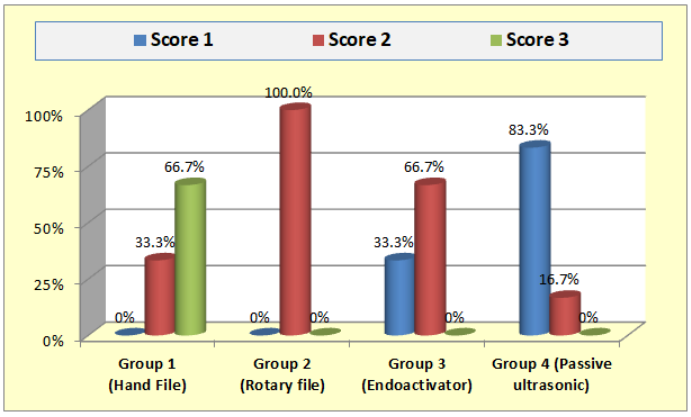
Results

On comparison of residual calcium hydroxide in apical third , best efficacy was seen in Group 4 followed by Group 3 , Group 2 and least in Group 1 . The difference was found to be highly statistical significant mong four groups in relation to efficacy in apical third using Chi square test (Table 1, Figure 5)

Table 1: Comparison of residual calcium hydroxide in apical third

Apical Third	Score 1 n (%)	Score 2 n (%)	Score 3 n (%)
Group 1 (Hand File) (n =6)	0 (0%)	2 (33.3%)	4 (66.7%)
Group 2 (Rotary file) (n =6)	0 (0%)	6 (100%)	0 (0%)
Group 3 (Endoactivator) (n =6)	3 (33.3%)	4 (66.7%)	0 (0%)
Group 4 (Passive ultrasonic) (n =6)	5 (83.3%)	1 (16.7%)	0 (0%)
	Chi square test value = 26.11 , p<0.001**		

Figure 5: Comparison of residual calcium hydroxide in apical third



On comparison of residual calcium hydroxise in middle third , best efficacy was seen in Group 4 followed by Group 3 , Group 2 and least in Group 1 . The difference was found to be highly statistical significant mong four groups in relation to efficacy in middle third using Chi square test (Table 2,Figure 6).

Table 2: Comparison of residual calcium hydroxide in middle third

Apical Third	Score 1 n (%)	Score 2 n (%)	Score 3 n (%)
Group 1 (Hand File) (n =6)	0 (0%)	4 (66.7 %)	2 (33.3 %)
Group 2 (Rotary file) (n =6)	0 (0%)	6 (100%)	0 (0%)
Group 3 (Endo activator) (n =6)	2 (33.3%)	4 (66.7%)	0 (0%)
Group 4 (Passive ultrasonic) (n =6)	4 (66.7%)	2 (33.3 %)	0 (0%)
	Chi square test value = 26.11 , p<0.001**		

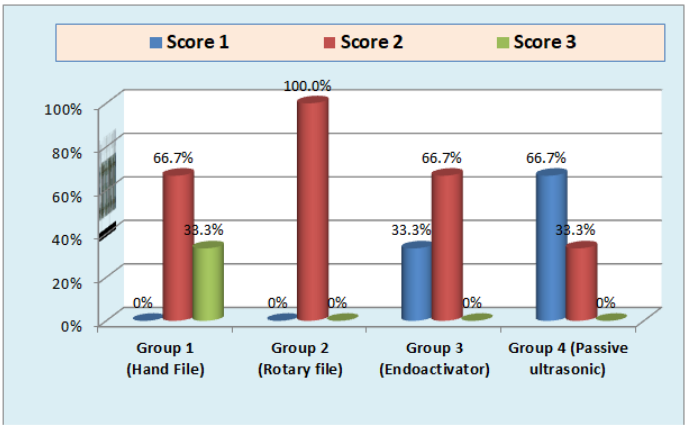


Figure 6: Comparison of residual calcium hydroxide in middle third

On comparison of mean residual calcium hydroxide in apical third among four groups, there was found to be highly statistical significant difference among four groups (p<0.001). 1>2>3>4. (Table 3,Figure 7)

Table 3: Comparison of mean residual calcium hydroxide in apical third , middle third respectively among four groups

	Apical Third Mean (SD)	Middle Third Mean (SD)
Group 1 (Hand File)	2.66 (0.51)	2.33 (0.51)
Group 2 (Rotary file)	2.0 (0.0)	2.0 (0.0)
Group 3 (Endoactivator)	1.66 (0.51)	1.66 (0.51)
Group 4 (Passive ultrasonic)	1.16 (0.40)	1.33 (0.51)
Anova F test	F = 13.571	F = 5.556
p value, Significance	p < 0.001**	p = 0.006*
Tukey's post hoc test to find pairwise comparison		
Groups comparison	p value, Significance	p value, Significance
Group 1 vs Group 2	p =0.054	p =0.579
Group 1 vs Group 3	p =0.003*	p =0.077
Group 1 vs Group 4	p<0.001**	p =0.005*

Group 2 vs Group 3	p =0.526	p =0.579
Group 2 vs Group 4	p =0.012*	p =0.077
Group 3 vs Group 4	p =0.197	p =0.579

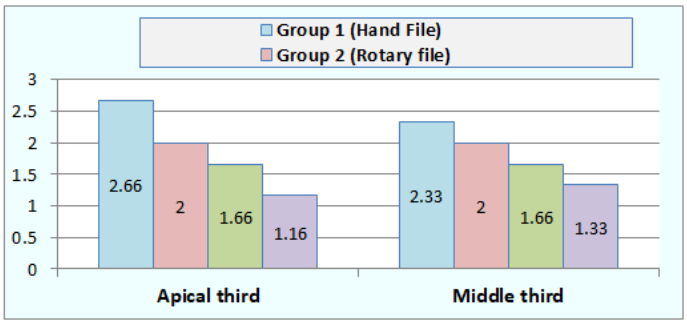


Figure 7 : Comparison of mean residual calcium hydroxide in apical third , middle third respectively among four groups

Discussion

The success of root canal treatment not only depends on instrumentation but also on irrigants and intracanal medicaments which are used during root canal treatment to eradicate microorganisms from root canal system (7). The commonly used intracanal medicament is Ca(OH)2 . Calcium hydroxide is highly alkaline, inorganic intracanal root canal medicament. It is widely used due to its antimicrobial efficacy and favorable biological properties. However, failure to eliminate the remnants of Ca(OH)2 results in the accumulation of its particles on the root canal wall, which leads to increase canal permeability that impedes the sealing ability of endodontic sealer, eventually leading to the failure of treatment (8).

It has also been reported that intracanal Ca(OH)2 remnants has chemical interaction with zinc oxide-eugenol sealers which give rise to brittle calcium eugenolate and might also prevent sealer penetration, thus affecting the bonding of resin sealer adhesion to the dentin. Hence, all intracanal inter-appointment medicaments should be removed completely from the root canals before obturation (9).

In This study passive ultrasonic irrigation is Found to be most effctive in Ca(OH)2 removal followed by Endoactivator, Neohybrid Rotary file and K-file. This could be because of the fact that ultrasonic instruments operate at a greater frequency (40,000 Hz) compared to sonic instruments that use a lower frequency (1000–6000 Hz).The ultrasonic energy has the ability to create multiple nodes and antinodes throughout the length of file which give rise to acoustic waves with the chemical action of the irrigant called as microstreaming and also secondary acoustic streaming along with the formation of cavitation effect. However, the vibration pattern of the sonic energy is unlike than that of ultrasonic energy; it generates a singular node close to the attachment of the file and singular antinode at the tip of the instrument over the total length of the vibrating instrument, hence the streaming velocity is less than the ultrasonic instruments, and during agitation, if the sonic polymer tip comes in contact with the root canal wall, its sideways movement disappears (10). The second most efficient Ca(OH)2 removal in the apical and middle one-third by EndoActivator is attributed due to its flexible polymer tips which on activation produces vigorous fluid movement inside the root canal. It had been suggested that the EndoActivator energize the flow of irrigant into lateral canals as well as apical portion compared with conventional needle irrigation (11).

Neohybrid rotary files has distinctive off-centered rectangular cross section which offers asymmetric or swaggering movement (2 point contact with canal wall) , lesser engagement between files & canal dentin

effectively lowering taperlock & screw-in forces as file moves inside the canal, reduced cross sectional area causes higher flexibility for enhancing loading & augering of debris. These could be the possible reasons for better removal of Ca(OH)2 than Hand K file. Better removal of Ca(OH)2 by Neohybrid rotary file than hand k file could be also because of Biomechanical preparation was done by Neohybrid rotary file.

Conclusion

Within the limitations of this study, none of the investigated systems were able to completely remove Ca(OH)2 from root canal. Passive Ultrasonic Irrigation had the highest ability to remove Ca(OH)2 from the root canal walls when compared to the use of Endoactivator , Neohybrid rotary file and hand file system.

References

1. Kumar A, Tamanna S, Iftekhar H. Intracanal medicaments – Their use in modern endodontics: A narrative review. J Oral Res Rev 2019;11:94-9.
2. Kamath S, Shetty R, Shetty S, Nighot N, Ramnani K, Bhujbal D. Efficacy of XP-Endo finisher in removal of calcium hydroxide from root canal system: A systematic review. J Int Clin Dent Res Organ 2019;11:54-60.
3. Gokturk H, Ozkocak I, Buyukgebiz F, Demir O. Effectiveness of various irrigation protocols for the removal of calcium hydroxide from artificial standardized grooves. J Appl Oral Sci. 2017;25(3):290-298.
4. Tamil S, Andamuthu SA, Vaiyapuri R, Prasad AS,Jambai SS, Chittrarasu M. A comparative evaluation of intracanal calcium hydroxide removal with hand file, rotary file, and passive ultrasonic irrigation: An in vitro study. J Pharm Bioall Sci 2019;11:S442-5.
5. Hamdan R, Michetti J, Pinchon D, Diemer F, Georgelin-Gurgel M. The XP-Endo Finisher for the removal of calcium hydroxide paste from root canals and from the apical third. J Clin Exp Dent. 2017;9(7):e855-e860.
6. Turkaydin D, Basturk F B, Goker S, Tarcin B, Berker Y G, Ovecoglu H S. Efficacy of Endoactivator, CanalBrush, and passive ultrasonic irrigation in the removal of calcium hydroxide paste with iodoform and p-chlorophenol from root canals. Niger J Clin Pract 2020;23:1237-42
7. Bhat R, Hegde MN. Reverse rotary instrumentation in the apical third of the root canal system: An scanning electron microscope analysis. Indian J Dent Res 2018;29:594-9.
8. Kim D, Kim E. Antimicrobial effect of calcium hydroxide as an intracanal medicament in root canal treatment: a literature review - Part I. In vitro studies. Restor Dent Endod. 2014;39(4):241-252. doi:10.5395/rde.2014.39.4.241.
9. Chockattu SJ, Deepak B S, Goud K M. Comparison of efficiency of ethylenediaminetetraacetic acid, citric acid, and etidronate in the removal of calcium hydroxide intracanal medicament using scanning electron microscopic analysis: An in-vitro study. J Conserv Dent 2017;20:6-11
10. Karad KM, Kolhe SJ, Gulve MN, Aher GB,Kolhe PS. Penetration depth of sodium hypochlorite into dentinal tubules influenced by different agitation systems. Endodontology 2021;33:81-5.
11. Gupta R, Sharma H, Kumari R.A, Prakash A, Rai N, Jain L. Effectiveness of Two Techniques in Removal of Calcium Hydroxide Medicament from Root Canals: An in-vitro Assessment. Journal of Clinical and Diagnostic Research. 2018 Jul, 12(7): ZC53-ZC55.