wjpmr, 2021,7(5), 239 – 243.

SJIF Impact Factor: 5.922

WORLD JOURNAL OF PHARMACEUTICAL AND MEDICAL RESEARCH

www.wjpmr.com

Research Article

ISSN 2455-3301

WJPMR

COMPARATIVE EVALUATION OF THE PRECIPITATE FORMATION ON INTERACTION OF CALCIUM HYPOCHLORITE WITH 17% EDTA, 20% CITRIC ACID AND 2% CHLORHEXIDINE: AN IN VITRO STUDY

[1]Dr. Bharath Makonahalli Jaganath, [2]Dr. Sahadev Chickmagaravalli Krishnegowda, [3]Dr. Sandeep Rudranaik, [4]Dr. Santhosh P Sagar and *[5]Dr. Sekiba K,

[1]Professor, Department of Conservative Dentistry & Endodontics, Sri Hasanamba Dental College and Hospital, Hassan, Karnataka.

[2]Professor and H.O.D, Department of Conservative Dentistry & Endodontics, Sri Hasanamba Dental College and Hospital, Hassan, Karnataka.

[3]Professor, Department of Conservative Dentistry & Endodontics, Sri Hasanamba Dental College and Hospital, Hassan, Karnataka.

[4]Reader, Department of Conservative Dentistry & Endodontics, Sri Hasanamba Dental College and Hospital, Hassan, Karnataka.

[5]Post Graduate Student, Department of Conservative Dentistry & Endodontics, Sri Hasanamba Dental College and Hospital, Hassan, Karnataka.

***Corresponding Author: Dr. Sekiba K**

Post Graduate Student, Department of Conservative Dentistry & Endodontics, Sri Hasanamba Dental College and Hospital, Hassan, Karnataka.

Article Received on 25/03/2021 **Article Revised on 05/04/2021** **Article Accepted on 25/04/2021**

ABSTRACT

Aim- Aim of this study was to assess the interaction between calcium hypochlorite and other commonly used irrigants like 2% chlorhexidine 17%EDTA and 10% citric acid for precipitate formation. **Materials and methodology**-Thirty single rooted tooth were selected for the study and were decoronated 1mm below the CEJ. Working length was determined and tooth were instrumented till F3.After instrumentation samples were devided into 3 group. In group A irrigation was done with 5 ml of CaOCL and 5 ml of 2%CHX. In group B , 5 ml of CaOCL and 5ml of 17% EDTA and in group C 5ml of CaOCL and 10% citric acid. Samples were subjected to stereomicroscopic evaluation for assessment of precipitate formation at coronal, middle and apical third. Data obtained were subjected to statistical analysis. **Results**-Group 1 showed orange brown precipitate which is concentrated on the coronal one third. Group 2 showed least precipitate formation among all the groups. **Conclusion**-Interaction of calcium hypochlorite with chlorhexidine produced orange brown precipitate. Significantly less precipitate formed with 17%EDTA and citric acid.

KEYWORDS: 5% Calcium hypochlorite,17%EDTA,2%Chlorhexidine, Irrigant Interaction, Precipitate.

INTRODUCTION

Chemomechanical preparation plays an important role in the success of endodontic treatment. According to recent reports, 35 to 50% of the root canal anatomy remains untouched after mechanical instrumentation.[1] Endodontic irrigants play an important role in disinfection of these untouched areas which are inaccessible to instrumentation.

Sodium hypochlorite continue to be one of the most commonly used irrigant because of its tissue dissolving and antibacterial property. However, it is recognised that inadvertent periapical extrusion of this irrigant causes tissue irritation, pain, and swelling. When used as an endodontic irrigant, studies have shown that NaOCl has a negative effect on the mechanical properties of dentin, such as flexural strength and modulous of elasticity.[2,3] The bond strength of adhesive restorations is hampered as a result of the loss of strength and modulus of elasticity. As a consequence, an alternative irrigant solution that can resolve these disadvantages while exhibiting tissue dissolution properties comparable to NaOCl might be desirable.

Sodium hypochlorite and calcium hypochlorite are both bleaching agents and disinfectants that belong to the same chemical family. Calcium hypochlorite as compared to sodium hypochlorite has a more stable pH and more chlorine available (up to 65 percent). According to Dutta and Saunders, an accidental periapical extrusion of calcium hypochlorite may cause less tissue irritation.[4] 5% calcium hypochlorite showed similar cytotoxicity to 0.5% sodium hypochlorite and was more effective than NaOCl in eliminating E. faecalis biofilms.[5] Furthermore, it can produce calcium hydroxide, which can increase the antibacterial efficacy.

Since no single irrigant has all of the ideal properties, it is essential to use a combination of irrigants. to increase antimicrobial activity and organic and inorganic tissue dissolution. Chlorhexidine is commonly used irrigant of bisbiguanide family known for its sustantivity. Adjunctive use of a chelating agent like ethylene-diamine tetra-acetic acid (EDTA) or citric acid (CA) has been proposed in order to remove the smear layer created after root canal preparation.

Till date there are no studies evaluating the interaction of calcium hypochlorite with commonly used irrigants like chlorhexidine,17% EDTA and citric acid. Hence the aim of this study was to assess the interaction between calcium hypochlorite and other commonly used irrigants like 2% chlorhexidine,17%EDTA and 10% citric acid for precipitate formation.

MATERIALS AND METHODS

Thirty single rooted tooth extracted for orthodontic reasons were collected from department of oral and maxillofacial surgery, Sri Hasanamba Dental College And Hospital. Collection, storage, sterilization, and handling of these extracted teeth followed according to the Occupation Safety and Health Administration guidelines The teeth were decoronated 1mm from CEJ to standardize the root length. Decoronated tooth were flared coronally using GG drills.

The working length was established by deducting 1mm from the length recorded when tips of #15 k files were visible at the apical foramen. Specimens were instrumented till F3. The root end of the prepared tooth was inserted into the impression material and allowed to set. This prevented extrusion of irrigant out of the apex and allowed ease of handling during instrumentation.

5% Ca(OCl)2 solution was made up freshly from granules (R & D Laboratories Ltd, Antrim, Northern Ireland, UK) at the time of experiment.

Teeth were divided randomly into three groups of ten teeth each.**In group 1**, the specimens was irrigated with 5ml of 5% calcium hypochlorite and 5ml of 17% EDTA followed by normal saline. **In group 2,** 5ml of 5% calcium hypochlorite and 5ml of 20% citric acid followed by normal saline. **In group 3,** 5ml 5% calcium hypochlorite and 2% CHX followed by normal saline.

The canals were dried immediately with absorbent points. The coronal opening was sealed with softened impression compound.Finally, two longitudinal grooves were prepared on the buccal and lingual surfaces of each root using a diamond disc without penetration into the canals. The roots were then split into two halves with a chisel. One of the two parts of each split tooth was examined under stereomicroscope at the coronal, middle, and apical third levels. The thickness of the precipitate formed was measured from its outer to the inner dentinal wall at a uniplanar level using Image Analysis System. The results were analysed using Analysis of Variance.

RESULTS

Stereomicroscopic examination of the specimens revealed orange-brown precipitate deposited all along the canal wall in Group 1. Group 2 and Group 3 revealed clear precipitate. The precipitate deposition was concentrated in the coronal and middle thirds of the canals in Groups 1. The mean thickness of the precipitate was maximum at the coronal and middle thirds and minimum at the apical levels of all groups. There was statistically significant difference in the thickness of the precipitate formed at the coronal and middle thirds. However, the precipitate formed at the apical third was significantly less than the coronal and middle thirds. The thickness of the precipitate was more in Group 1 compared to Group 2 at all the 3 levels.

Table 1: Comparison of precipitate formation at coronal third.

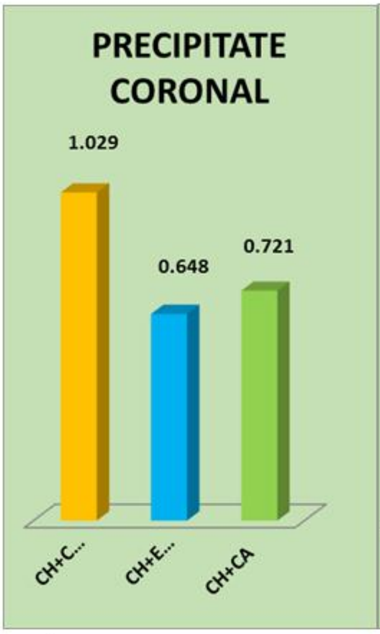
GROUPS		N	Mean	Std. Deviation	p
CORONAL	CH+CHX	10	**1.029**	0.121	<0.001
	CH+EDTA	10	0.648	0.027	
	CH+CA	10	0.721	0.043	

Table 2: Comparison of precipitate formation at middle third.

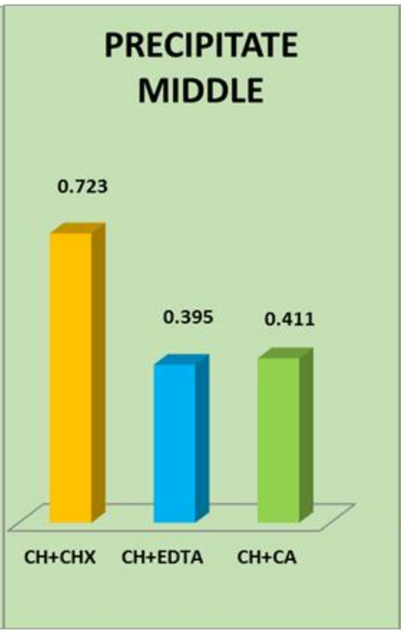
		N	Mean	SD	p
MIDDLE	CH+CHX	10	**0.723**	0.059	<0.001
	CH+EDTA	10	0.315	0.025	
	CH+CA	10	0.319	0.020	

Table 3: Comparison of precipitate formation at coronal third.

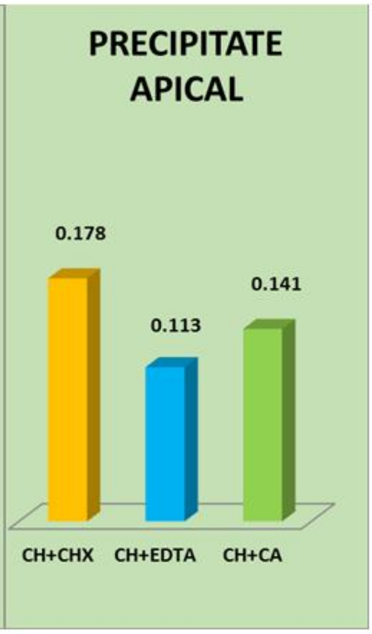
		N	Mean	SD	p
APICAL	CH+CHX	10	**0.178**	0.021	<0.001
	CH+EDTA	10	0.113	0.017	
	CH+CA	10	0.141	0.017	



Graph 1 showing precipitate formation at coronal one third



Graph 2 showing precipitate formation at middle third



Graph 3 showing precipitate formation at apical one third

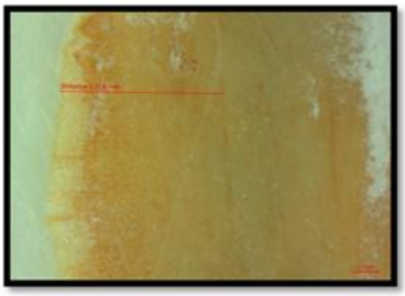


Image 1 showing stereomicroscopic image of Group 1 showing orange brown precipitate

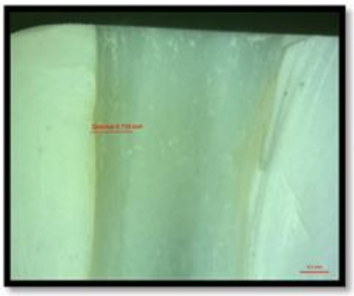


Image 2 showing stereomicroscopic image of Group 2 showing clear precipitate

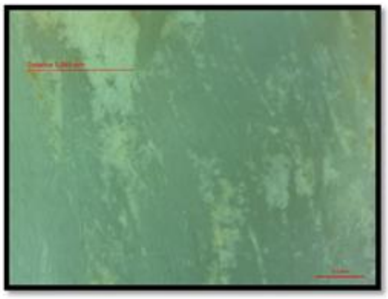


Image 3 showing Stereomicroscopic image of Group 3 showing clear precipitate.

DISCUSSION

Irrigation plays vital role in the disinfection of the root canal system. According to Zender et al an ideal irrigants should have wide antimicrobial spectrum, dissolve necrotic pulp tissue remnants, inactivate endotoxin, prevent smear layer formation during instrumentation or dissolve it once it has formed.[7] None of the available irrigants have all of these characteristics. To achieve this desired property, various irrigants are used sequentially or in combination. Interactions of these irrigants could hamper the effectiveness of root canal therapy.

Because of the ions that are liberated upon dissociation and the high available chlorine content, CaOCl has the potential to be used as a root canal irrigant with superior antimicrobial efficacy. De Almeida et al stated in a recent study that passive ultrasonic irrigation with CaOCl can reduce microbial content within root canals, but the difference was not statistically significant when compared to passive ultrasonic irrigation with NaOCl.[16]

Stereomicroscopy was used to determine the precipitate's existence and differentiates it from debris. It also allows for the most natural colour change without the need for any surface treatment of the specimen, allowing for precise calculation of the undisturbed precipitate.[8]

In the present study all specimens showed precipitate along the walls of dentine. Group 1 showed orange brown precipitate which is more concentrated on the coronal one third.

CHX, a dicationic acid (pH 5.5– 6.0) has the ability to donate protons. CaOCl is alkaline and can accept protons from the dicationic CHX. This proton exchange results in the formation of a neutral and insoluble substance, referred to as the "precipitate.".

The EDTA group had the least amount of precipitate formation. Mixing of chlorine compound with EDTA results in rapid decrease in free available chlorine. When NaOCl is combined with EDTA, the amount of free available chlorine drops dramatically. This combination has been observed to produce gas as well as low-level chlorine gas emissions. This interaction is thought to be triggered by an acid/base neutralisation reaction between NaOCl and EDTA, which results in the formation of HOCl, which then decomposes to release chlorine and oxygen.[9,10,11]

Group 3 developed substantially less precipitate in the current study. Prado et al. discovered that combining sodium hypochlorite with citric acid resulted in the production of chlorine gas. The availability of free chlorine was reduced when chlorine compounds were combined with citric acid. However when citric acid is mixed with a Cl compound, it maintains both its chelating and antimicrobial properties.

The coronal third had the thickest precipitate, while the apical third had the thinnest. This is attributable to the reduced amount of irrigants reaching the apex as a consequence of the irrigation modality's inherent anatomic constraints and limitations. Krishnamurthy and Sudhakaran found similar findings in an in vitro analysis, with the highest precipitate thickness at the coronal third and the least at the apical third.[8]

The precipitate produced as a result of the interaction of irrigants has some drawbacks. They are insoluble substance that is difficult to remove from the canal. It also obstructs the dentinal tubules, making intracanal medication and sealer penetration impossible and jeopardising the three-dimensional seal. It also stains the canal wall and induces tooth discoloration. It would have been interesting if the chemical nature of the precipitate had been determined.

CONCLUSION

As we expect that combinations of irrigants synergistically increase their properties rather when using only one of the irrigants, it is not always true. Due to the acid-base reaction sometimes the combination of irrigants leads to precipitate formation which shows unfavourable properties. Interaction of calcium hypochlorite with bisbiguanide compound like chlorhexidine resulted in formation of thick orange brown precipitate along the canal wall. These precipitates raises potential concerns with respect to leaching into the surrounding tissues and the seal of the root canal.

REFERENCES

1. Peters OA, Laib A, Göhring TN, Barbakow F. Changes in root canal geometry after preparation assessed by high-resolution computed tomography. J Endod, 2001; 27: 1-6.
2. Zaparolli D, Saquy PC, Cruz-Filho AM. Effect of sodium hypochlorite and EDTA irrigation, individually and in alternation, on dentin microhardness at the furcation area of mandibular molars. Braz Dent J, 2012; 23: 654-658.
3. Grigoratos D, Knowles J, Ng YL, Gulabivala K. Effect of exposing dentin to sodium hypochlorite and calcium hydroxide on its flexural strength and elastic modulus. Int Endod J, 2001; 342: 113-119.
4. Dutta A, Saunders WP. Comparative evaluation of calcium hypochlorite and sodium hypochlorite on soft-tissue dissolution. J Endod, 2012; 38: 1395-1398.
5. Sedigh-Shams M, Gholami A, Abbaszadegan A, Yazdanparast R, Saberi Nejad M, Safari A et al . Antimicrobial Efficacy and Cytocompatibility of Calcium Hypochlorite Solution as a Root Canal Irrigant: An in Vitro Investigation. Iran Endod J., 2016; 11: 169-74.
6. Kim HS, Zhu Q, Baek SH, Jung IY, Son WJ, Chang SW et al . Chemical Interaction of Alexidine and Sodium Hypochlorite. J Endod, 2012; 38: 112-6.
7. Zehnder M. Root Canal Irrigants. J Endod, 2006; 32: 389-98.
8. Krishnamurthy S, Sudhakaran S. Evaluation and Prevention of the Precipitate Formed on Interaction between Sodium Hypochlorite and Chlorhexidine. J Endod, 2012; 36: 1155-57.
9. O'Connell MS, Morgan LA, Beeler WJ, Baumgartner JC. A comparative study of smear layer removal using different salts of EDTA. J Endod, 2000; 26: 739-43.
10. Zehnder M., Schmidlin P., Sener B., Waltimo T. Chelation in root canal therapy reconsidered. *J. Endod*, 2005; 31: 817–820.
11. Clarkson RM, Podlich HM, Moule AJ. Influence of ethylenediaminetetraacetic acid on the active chlorine content of sodium hypochlorite solutions when mixed in various proportions J Endod, 2011; 37: 538-43.
12. Grawehr M., Sener B., Waltimo T., Zehnder M. Interactions of ethylenediamine tetraacetic acid with sodium hypochlorite in aqueous solutions. *Int. Endod. J.*, 2003; 36: 411–415.
13. Prado M., Júnior H.M.S., Rezende C.M., Pinto A.C., Faria R.B., Simão R.A et al . Interactions between irrigants commonly used in endodontic practice: A chemical analysis. *J. Endod*, 2013; 39: 505–510
14. Baumgartner J.C., Ibay A.C. The chemical reactions of irrigants used for root canal debridement. *J. Endod*, 1987; 13: 47–51.
15. Maíra Prado, Helvécio M. Santos Júnior, Claudia M. Rezende, Angelo C et al. Gomes. Interactions between Irrigants Commonly Used in Endodontic

Practice: A Chemical Analysis.J Endod, 2012; 39: 426-32.
16. De Almeida AP, Souza MA, Miyagaki DC, Dal Bello Y, Cecchin D, Farina AP. Comparative evaluation of calcium hypochlorite and sodium hypochlorite associated with passive ultrasonic irrigation on antimicrobial activity of a root canal system infected with Enterococcus faecalis: an in vitro study. J Endod, 2014; 40: 1953-1957.