

Original Article

Efficacy of Various Irrigants in removing Triple Antibiotic Paste (TAP) from the Root Canal: An in-vitro study

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ABSTRACT

Background- Triple antibiotic paste (TAP), a combination of Ciprofloxacin, Metronidazole, and Minocycline is the mainstay in regenerative endodontics. Though combination of the antibiotics may change, it is found to be having some drawbacks when traces are left out in the root canal. Hence, its complete removal from the tooth in the subsequent stages of the treatment becomes very important. **Aim-** The aim of this study is to evaluate competence of various Irrigants in removing TAP from root canals. **Materials and methodology-** 35 Single rooted teeth were taken and decoronated followed by BMP of the root canal. Then root of each tooth was longitudinally cut into two halves and TAP was placed in the grooves and the root segments were reassembled. Based on the irrigant used, the teeth were then randomly assigned to normal saline group, 2% NaOCl group, 3% NaOCl with normal saline group, 17% EDTA group, and 2% CHG group. The roots were then disassembled to test for the remnants of TAP under stereomicroscope. **Results-** Amongst the Irrigants used, 3% NaOCl with normal saline was found to be the most efficient in removing TAP from the root canal. Though normal saline, 2% NaOCl, 17% EDTA, and 2% CHG were also able to remove TAP, they were not as efficacious as the combination in removing TAP from the root canals. **Conclusion-** NaOCl is routinely used for irrigation during endodontic procedures, and increasing its concentration and combining with normal saline can be a better option for irrigation during regenerative endodontic procedures.

Key words- TAP, NaOCl, CHG, EDTA

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INTRODUCTION

Regenerative endodontic procedures are biologically based procedures designed to replace previously damaged pulp-dentin complex by new vital tissue, resulting in restoration of the functional properties of the involved tooth. And this Regenerative Endodontic Therapy (RET) has been playing a distinct role in the treatment of permanent immature teeth that suffer pulpal necrosis as a result of trauma or other insults.¹ The key aspects of revitalization procedures include (i) minimal or no instrumentation of the dentinal walls (ii) disinfection with irrigants, (iii) application of an intracanal medicament, (iv) provocation of bleeding into the canal and creation of a blood clot, (v) capping with a hydraulic silicate cement and (vi) an effective coronal seal.² As the root canal infections are polymicrobial in nature, it is preferred to use a combination of antibiotics as an intra-canal medicament like ledermix paste, double antibiotic paste, triple antibiotic

paste, modified triple antibiotic paste and poly-antibiotic paste etc..Triple Antibiotic Paste (TAP) comprising Metronidazole, Ciprofloxacin and Minocycline was first proposed by Sato³ and its usage in regenerative endodontics has become a common practice. But as Minocycline was found to be having some inherent drawbacks, many other drugs have been tried as its replacement. Regardless of the combination used, complete removal of the TAP from the root canal in the subsequent stages of the treatment is very important as TAP left in the root canal was found to be having certain adverse effects on root canal system such as discoloration, sensitivity to chemicals, cytotoxicity, decreased micro hardness, decreased fracture resistance and decreased bonding efficiency. Though simple as it may seem the human tooth has a complex root anatomy leading to the improper removal of TAP from root canal by mechanical instrumentation alone. The irrigation plays a very significant role in this aspect. Many root canal irrigants

are in existence which are used either alone or in combination. The present study is aimed at evaluating the competence of different irrigants in removing TAP from the root canals.⁴

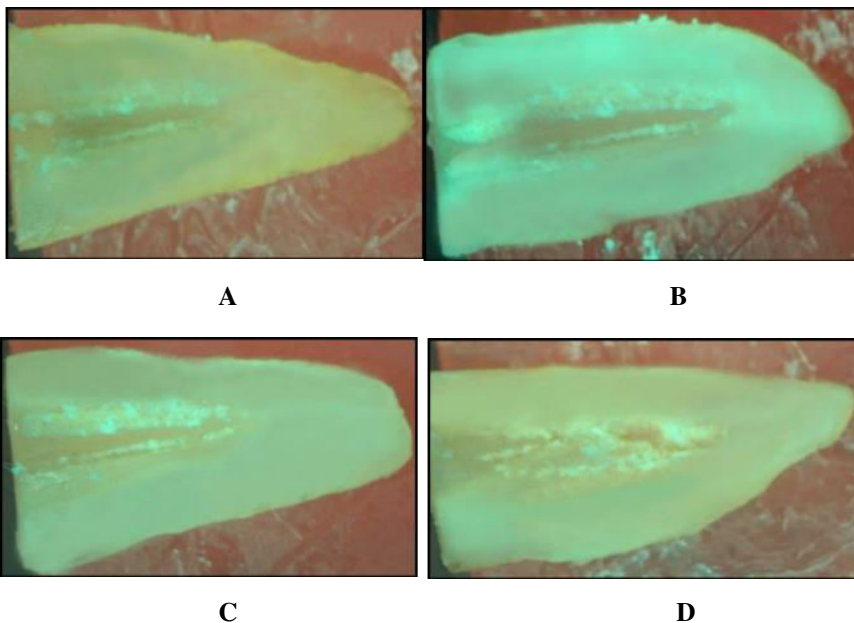
MATERIAL AND METHOD

35 single rooted extracted teeth were collected from the department of pedodontics and orthodontics of GITAM dental college & hospital, Visakhapatnam. The tooth samples were decoronated using a diamond disc under water coolant in order to obtain a standardized root length of 13 mm from root apex. The root canals were cleaned and shaped up to 50 size k-file and between the instrumentation, irrigation was done with 2% NaOCl, followed by 5 ml of sterile physiological saline and were dried with paper points. The samples were then irrigated with 17% EDTA followed by saline irrigation and drying with paper points.⁵ They were then placed in epsilon vials with silicon material to get the impression of the teeth. After the silicon material gets set, the tooth samples were taken out and were longitudinally sectioned into two equal halves with a diamond disc under water coolant. The sections were then irrigated with 17% EDTA and 5 ml of 2.5% NaOCl for a

duration of 1 minute, after which Triple Antibiotic Paste prepared by combining Metronidazole, Ciprofloxacin, and Amoxicillin in the ratio of 1:1:1 by weight was placed with the help of a spreader in one half of the sections. Then the two halves were reassembled and kept back in the epsilon vials. The vials were then transferred to an incubator maintained at 37°C and 100% humidity and kept for 1 week. The teeth were then divided into 5 groups based on the irrigant used with 7 teeth in each group. The irrigants used in the study were Normal Saline (Group 1), 2% NaOCl (Group 2), 3% NaOCl and Normal saline combination (Group 3), 17% EDTA (Group 4), and 2% Chlorhexidine gluconate (Group 5). The samples were then irrigated with the agent allotted to that group and dried with paper points. They were then taken out of the epsilon vials and disassembled and observed under stereomicroscope.

The scoring of the images was done based on the scoring system given by Lambrianidis.⁶

- Score 1- when no visible remains of TAP were present
- Score 2- remnants of TAP dispersed in small quantities on the walls of the canals
- Score 3- masses of TAP in different areas of canal
- Score 4- dense masses of TAP present across the canal



(A- Score 1, B- score 2, C- score3, D- score4)

Scoring sheet

Tooth sample	Normal saline group	2% Naocl Group	3% Naocl with normal saline group	17% EDTA group	2% CHG Group
Sample 1					
Sample 2					
Sample 3					
Sample 4					
Sample 5					
Sample 6					
Sample 7					

RESULTS:

To minimize the error, the obtained images were scored by three examiners. Statistical evaluation was done using kappa statistics and Kruskal-wallis & Mann-whitney test were performed to check the difference in the TAP scores among different groups. The inter examiner reproducibility was found to be 85.7% with the kappa value of 0.78. The mean scores and standard deviations were found to be 3.29 & 0.95, 2.43 & 0.79, 2.14 & 0.69, 2.71 & 0.76, and 3.43 & 0.53 for normal saline, 2%

NaOCl, 3% NaOCl and normal saline combination, EDTA, and CHG respectively. The results have shown that 3% NaOCl and normal saline combination was the most efficient in removing TAP from the canal, followed by 2% NaOCl, normal saline, and 17% EDTA. And it has been found that Chlorhexidine gluconate was the least efficient of all. 3% NaOCl & normal saline combination has shown a statistically significant difference with normal saline group and 2% CHG group.

Table 1 (Kruskal - Wallis test)

Examiner 2	Mean	Median	SD
Normal saline group	3.29	4.00	0.95
2% Naocl group	2.43	2.00	0.79
Normal + 3% Naocl group	2.14	2.00	0.69
17% EDTA group	2.71	3.00	0.76
2% CHG group	3.43	3.00	0.53
P-value<0.01		HS	

Table 2 (Mann – Whitney test)

Examiner 2	Normal saline group	2% Naocl group	Normal saline + 3% Naocl group	17% EDTA group	2% CHG group
Normal saline group	-				
2% Naocl group	0.24				
Normal + 3% Naocl group	<0.05	0.95			
17% EDTA group	0.62	0.95	0.62		
2% CHG group	0.99	0.12	<0.05	0.41	-

DISCUSSION-

The objective of regenerative endodontic procedures is to regenerate pulp-like tissue, ideally the pulp-dentin complex. This consists of three important stages, elimination of bacteria from the root canal system, creation of a scaffold for the ingrowth of new tissue, and prevention of reinfection by creating a bacteria-tight seal. Because infection of the root canal is polymicrobial consisting of both aerobic and anaerobic bacteria, disinfection of infected root canal is best done using a mixture of antibacterial drugs. Triple antibiotic paste (TAP), which is the mixture of ciprofloxacin, metronidazole, and minocycline is a routinely used combination for this purpose. However, this combination is found to be having disadvantages of causing cytotoxicity, sensitivity, drug resistance, difficulty in removal and discoloration. Many studies have shown that the tooth discoloration occurs mainly because of the presence of minocycline TAP.^{7, 8,9,10} Therefore, many efforts have been made to reduce tooth discoloration by substituting minocycline with alternative antibiotics such as Amoxicillin, Cefaclor, Cefroxadine, Fosfomycin, Rokitamycin, Clindamycin, Cephalexin, and Augmentin. Amoxicillin containing TAP was found to be beneficial, as it is easily available, less expensive, and has less side effects. But it does result in some discoloration of the

tooth structure when left in the canal for a longer time period mandating its complete removal during the treatment procedure.⁴ The irrigants that are currently used during cleaning and shaping can be divided into antibacterial and decalcifying agents or their combinations. They include sodium hypochlorite (NaOCl), chlorhexidine, ethylene diamine tetra acetic acid (EDTA), and a mixture of tetracycline, an acid and a detergent (MTAD). Sodium Hypochlorite, (NaOCl) an antiseptic and inexpensive lubricant is the most commonly used in dilutions ranging from 0.5% to 5.25%. Free chlorine in NaOCl dissolves vital and necrotic tissue by breaking down proteins into amino acids. As Chlorhexidine has got a broad-spectrum and sustained antibacterial action, and low toxicity it has also been recommended as a potential root canal irrigant. Chelating agents such as ethylene diaminetetraacetic acid (EDTA), citric acid and tetracycline are also in conjunction with other irrigants as they remove the inorganic portion of the smear layer. As an alternative to EDTA for removing the smear layer, a mixture of a tetracycline isomer, citric acid and a detergent (MTAD) was developed as a final rinse to disinfect the root canal system and remove the smear layer.

THE effectiveness of MTAD to completely remove the smear layer is enhanced when a low concentration of NaOCl (1.3%) is used as an intracanal irrigant.¹¹

The results have shown that none of the irrigants was able to completely remove TAP from the root canal and that irrigation alone was not sufficient in removing TAP. Similar type of observation was given by H. Arslan in 2014.¹²

The enhanced mechanical flushing action when saline was mixed with sodium hypochlorite was the reason for its superior action over other agents used in this study.

Though CHX gluconate has a substantial antibacterial activity, the reason for its dismal performance could be the absence of tissue dissolving capacity.

Though EDTA at a concentration of 17% has got more efficiency than any other irrigant, the method of irrigation might have played a major role in removal of intracanal medicament.

CONCLUSION

The concentration and proper combination of the irrigating agents plays an important role in determining the efficacy of the irrigating solution.

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