Original Article

Strategic Evaluation of Efficacy of Different Irrigants in Effective Removal of Triple Antibiotic Paste from the Canal Spaces: An Original Research Study

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Abstract

Background and Aim: Literature has well evidenced that triple antibiotic paste (TAP) can be successfully used in restricting pathogenesis in root canal milieu. However, its efficient removal is also very technique sensitive and must be performed efficiently. This study was conducted to strategically evaluate the efficacy of three common root canal irrigants in removal of TAP from the canal spaces. Stereomicroscope was used to score the effectiveness of studied irrigating solutions. **Materials and Methods:** This study was conducted on 15 extracted single-rooted tooth samples. Sterilized glass vials were used to make the accurate impressions of the all root samples individually using silicon impression materials. TAP was prepared and painted equally in the canal area of only one half. These vial assemblies were incubated for 1 week. Three popular root canal irrigants were analyzed, that is, BioPure MTAD (Group 1), chlorhexidine gluconate (Group 2), and 5.25% NaOCl (Group 3). Individual root halves were separated and examined under stereomicroscope. Scoring system of 1–4 was used to assess the amount of residual TAP in the canal. Results thus obtained were compiled and sent for necessary statistical analysis. **Results:** All tabulated information were sent for statistical analysis using statistical software Statistical Package for the Social Sciences version 21. BioPure MTAD was very efficient and demonstrated 1 score in four out of five samples. Level of significance evaluation using Pearson Chi-square test (for Groups 1, 2, and 3) showed highly significant *P* value. Standard deviation for all three groups was ranging from 1.033 to 1.102. Standard error was in the range of 0.642–0.902 for all three studied groups. Comparison of the three study groups using one-way ANOVA revealed significant ($P = 0.001$). **Conclusion:** Within the limitations of the study, authors concluded that BioPure MTAD was most effective root canal irrigant for efficient cleaning of TAP. About 5.25% NaOCl was found to be least effective among all three tested root canal irrigating solutions.

Keywords: BioPure MTAD, NaOCl, Triple antibiotic paste, Stereomicroscope.

Introduction

The ultimate success or failure of any root canal therapy solely depends on the extent of bacterial inhibition in the root canal and surrounding areas. Ideal biomechanical preparation only cannot attain strict sterilization. Many root canal irrigants have been discussed by researchers over the decades.[1,2] Most of them possess sufficient antimicrobial activity and designed to chemically clean and disinfect the root canal system following endodontic instrumentation. The infection of the root canal system is considered to be multifactorial in origin. It frequently consists of both aerobic and anaerobic bacteria.[3] Due to the intricacy of the root canal infection, it is doubtful that any single antibiotic can render efficient sterilization of the root canal. Hoshino *et al*. have discussed the importance of combining three different antimicrobial agents and their role in sterilization of root canals.[4] They termed it as triple antibiotic paste (TAP) which contains metronidazole, ciprofloxacin, and minocycline. Many pioneer workers have concluded that this paste is very effective in diminishing bacterial load in root canals.[5-8] However, it must be able to be completely cleaned by common irrigation systems without any remnant. Few studies have proved that it show some complication in longevity of endodontic treatment when traces are left out in the root canal.

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These traces interfere with the normal physiologic mechanisms of root canal spaces. Therefore, the long-term success of teeth is compromised.[9,10] Hence, its absolute removal from the tooth in the succeeding stages of the treatment becomes very imperative. This study was conducted to strategically estimate the efficacy of three common root canal irrigants in removal of TAP from the canal spaces. Stereomicroscope was used to score the effectiveness of studied irrigating solutions.

Materials and Methods

This study was designed, planned, and executed in the department of conservative dentistry and endodontics of the institute. The study was completed on the extracted single-rooted tooth samples. Fifteen extracted single-rooted teeth (maxillary central incisors only) were collected having no signs of pathological and physiological changes. Crown portion of all teeth were sectioned (near cementoenamel junction) with diamond disc precisely so as to leave 12 mm of root length in all samples (Figure 1). All length standardized roots were subjected to meticulous cleaning and shaping up to 50 size K-file. Sodium hypochlorite solution (2% concentration) was used throughout these procedures to ensure optimal irrigation. Standard sized and sterilized glass vials (Polylab Cryo Vial) were used to make the accurate impressions of the all root samples individually using silicon impression materials. Silicon material was filled in to the glass vials and sample roots were pressed into it up to their full length. After setting, roots were retrieved and bisected into to two equal longitudinal halves using diamond disc with coolant. Sodium hypochlorite solution was used again to remove all debris and shavings. TAP which contains metronidazole, ciprofloxacin, and minocycline (as per recommendations of Hoshino *et al*.) was prepared and painted equally in the canal area of only one half.[4] Following the application of TAP, both the sections of samples were rejoined and placed back carefully in their respective silicon impressions in the vials. Vials along with sample teeth were studied into three groups of five each (depending on irrigant used). These vial assemblies were incubated for 1 week at 37 degree at 100% humidity. Three popular root canal irrigants were analyzed, that is, BioPure MTAD (Group 1), chlorhexidine (CHX) gluconate (Group 2), and 5.25% NaOCl (Group 3). All samples were irrigated with their respective irrigant and dried efficiently by paper points. Finally, individual roots halves were separated and examined under stereomicroscope. As per the recommendations of Lambrianidis *et al*., scoring system of 1–4 was used to assess the amount of residual TAP in the root canal.[1] Images were captured and transferred for further analysis (scoring). Score 1 denoted no viable remnant of medicament. Score 2 denoted few areas of medicament in dispersed form. Score 3 denoted several areas of medicament in coagulated form. Score 4 denoted numerous areas of medicament in dense coagulated form. The visual scoring analysis was attempted by two independent expert examiners to avoid any observational bias. Results thus obtained were compiled and sent for necessary statistical analysis. $P < 0.05$ was considered statistically significant ($P < 0.05$).

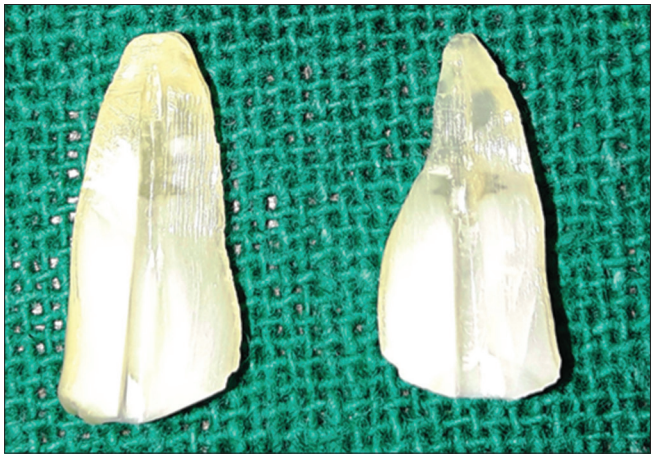

Figure 1: Two halves of bisected root

Statistical Analysis and Results

In the present study, all noticeable findings and data were gathered in logical manner. Compiled data were sent for statistical analysis using statistical software Statistical Package for the Social Sciences version 21 (IBM Inc., Armonk, New York, USA). The processed data were subjected to suitable statistical tests to obtain *P* values, mean, standard deviation, Chi-square test, standard error, and 95% CI. Table 1 shows observational scoring chart for all three studied irrigants against TAP. BioPure MTAD appeared to be very effective and fetched 1 score in four out of five samples. CHX gluconate exhibited less irrigating activity as compared with BioPure MTAD. About 5.25% NaOCl showed lowest irrigating activity among all three tested solutions. In one sample, it showed several areas of medicament (TAP) in coagulated form (Figure 2). Table 2 denotes basic statistical explanation with level of significance evaluation using Pearson Chi-square test (for group 1, 2, 3). *P* value was highly significant here (0.001). Standard deviation for all three groups was ranging from 1.033 to 1.102. Standard error was in the range of 0.642–0.902 for all three studied groups. Pearson Chi-square value was minimum for Group 1 (1.564) and maximum for Group 2 (2.673). Table 2 demonstrated comparison of the three study groups

Table 1: Observational scoring chart for all three studied irrigants against triple antibiotic paste

Sample no.	SCORES		
	Group 1 (BioPure MTAD)	Group 2 (chlorhexidine gluconate)	Group 3 (5.25% NaOCl)
1.	1	2	1
2.	1	1	2
3.	2	1	1
4.	1	2	1
5.	1	1	3

Table 2: Basic statistical explanation with level of significance evaluation using Pearson Chi-square test (Groups 1, 2, and 3) and comparison of the three study groups using one-way ANOVA

Groups	Mean	Std. deviation	Std. error	95% CI	Pearson Chi-square value	df	Level of significance (*P* value)
Group 1	1.029	1.033	0.820	1.69	1.564	1.0	0.001*
Group 2	1.022	1.096	0.902	1.27	2.673	1.0	0.100
Group 3	1.301	1.102	0.642	1.96	2.562	1.0	0.090

ANOVA

Parameters	Degree of freedom	Sum of squares ∑	Mean sum of squares m∑	F	Level of significance (*P* value)
Between groups	1	2.845	1.033	2.460	0.001*
Within groups	12	12.049	0.342	-	
Cumulative	23.87	11.526			

*$P<0.05$ significant

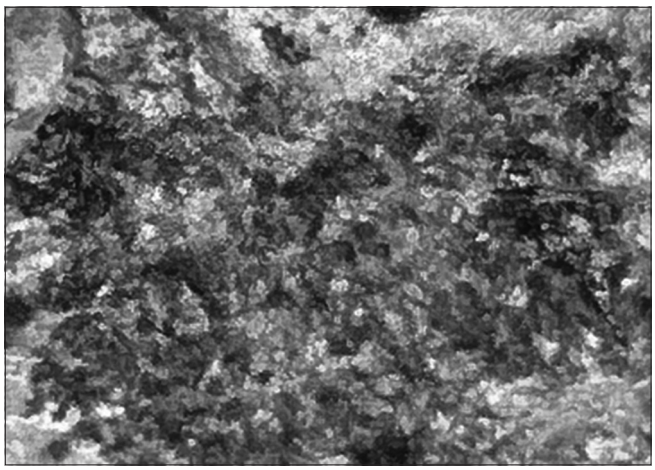

Figure 2: About 5.25% NaOCl: Several areas of medicament (triple antibiotic paste) in coagulated form (stereomicroscopic view for score 3)

using one-way ANOVA. Comparison between groups revealed significant ($P = 0.001$).

Discussion

Endodontic treatments are one of the most significant and crucial treatments in the field of dentistry. Endodontic treatments enable optimal tooth function and sustain the dental structure in the mouth. Many of the researchers have shown that the pulpal and periapical infection is triggered by the colonies of bacteria.[11,12] The overall success of the therapy is directly related to the reduction of bacterial load in the pulpal milieu and surrounding region. Literature is overwhelmed with the studies those have investigated the behaviors of microorganisms of root canal. In the initial phase of pulpal infection, affected pulp tissue usually demonstrates multiple microbial floras.[13,14] These primarily contain Gram-negative bacterium of various species including anaerobic microorganisms. All these colonies generally form more than 90% of causative microorganisms. As per the novel statement of Grossman, a methodical instrumentation and biomechanical preparation is the most essential part of root canal therapy. The most of the microorganisms noticed in the root canal can be eliminated merely by precise endodontic instrumentation.[4,15,16] However, we should not expect this in all circumstances because root canal has different anatomy and accessibilities. This leads to inadequate cleaning, instrumentation and flushing action of the irrigant solutions. These inaccessible areas are generally organic residues, dentinal shavings, and bacteria positioned deep in the dentinal tubules. Many of the advanced root canal irrigant solutions claim to solve these issues efficiently. Researchers have explored several irrigant and their actions in detail. Many pioneer workers have emphasized the significance of using antimicrobial irrigants to guarantee complete and deep disinfection.[6,9,12] It is also advised to use irrigating solutions multiple times in between various steps of canal preparation to eradicate remains and necrotic tissues. These procedures also been shown to abolish microorganisms that cannot be achieved by simple instrumentation. Since root canal is frequently attacked and infected by multiple species of microorganisms, single antibiotic does not seem to be sufficient in complete eradication.[17,5] Consequently, to abolish the canal microorganisms comprehensively; using a combination of antibiotics is required. The original experiment and experience of trying multiple antibiotics in endodontics was stated by Grossman. He used a paste so called "PBSC" or "polyantibiotic past." Polyantibiotic past has penicillin to kill Gram-positive creatures, bacitracin for penicillin-resistant variants, streptomycin curbing Gram-negative creatures, and sodium caprylate for restricting yeasts. The scientific evaluation of PBSC demonstrated therapeutic effects. However, PBSC was proved to be least useful against anaerobic microorganisms of root canal. As a result, the United Sates Food and Drug Administration banned PBSC for endodontic therapies.[5,18] In the recent past, one more experimental amalgamation of antibiotics becomes popular, called "TAP." Initially, TAP was principally investigated by Hoshino *et al*. They confirmed that TAP can restrict Gram-negative, Gram-positive, and anaerobic bacteria.[4,19]

Conclusion

Authors evaluated three root canal irrigants (BioPure MTAD, CHX gluconate, and 5.25% NaOCl) for effective removal of TAP from the canal spaces. Within the limitations of the study, authors concluded that BioPure MTAD was most effective root canal irrigant for efficient cleaning of TAP. NaOCl (5.25%) was found to be least effective among all three tested root canal irrigating solutions. Therefore for effective cleaning of TAP, it is advisable to utilize BioPure MTAD. Our study results must be considered as suggestive for presuming prognosis for similar clinical conditions. However, we expect some other large-scale studies to be performed that might further establish certain standard and authentic guidelines in these perspectives.

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