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**Research Article**

# EVALUATION AND COMPARISON OF CLEANING EFFICACY OF TWO IRRIGANTS AS JUDGED BY MICROBIAL QUANTIFICATION – AN INVIVO STUDY

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**A R T I C L E I N F O**

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**A B S T R A C T**

***Context:*** The endodontic triad comprises of cleaning, shaping, disinfection and obturation. Success of root canal therapy is majorly achieved by proper cleaning and shaping. To effectively clean the root canal system, a disinfecting agent must penetrate the difficult areas and kill the microorganisms with minimal damage to the host tissues.

***Aim:*** The purpose of this in vivo study was to evaluate the antimicrobial efficacy of two irrigating solutions QMix and BioPure MTAD.

***Materials and Method:*** Twenty four single canalled teeth were randomly divided into two groups of twelve each. Root canals in both the groups were instrumented with WaveOne Rotary files and irrigated with sodium hypochlorite. In Group I final irrigation was done with BioPure MTAD and QMix in group II. Samples for culture were taken immediately after accessing the canal and following irrigation. The samples were collected in test tubes containing nutrient broth and cultured in tryptone soya agar at incubation temperature of 37°C for 24-48 hours. Pre and post bacterial colonies were counted with digital colony counter.

***Results:*** The pre- and post-irrigation counts were used to obtain the percent reduction in microbial counts. The statistical significance of difference in the percent reduction between two groups was evaluated using Wilcoxon rank sum test. The test resulted into a P-value of 0.004 indicating significant difference in the reduction of microbial count in both groups.

***Conclusion:*** This study concluded that QMix performed better than BioPure MTAD.



## INTRODUCTION

The speciality of endodontics has evolved and got revolutionized over the years.The modern endodontic speciality practice is moving towards advancements in the traditional techniques and materials for successful results in less time [1]. In the past decade, considerable efforts have been made on developing new irrigants for effective removal of smear layer and eradication of microbes simultaneously from the root canal system [2]. Microorganisms are present not only in the root canals but also invade the dentinal tubules upto varying depths. Hence, chemical disinfection is a critical adjunct for the elimination of bacterial contamination [3]. MTAD and Qmix are recently introduced irrigating agents with the capability to remove smear layer and microbial biofilms. This study is performed to check the antimicrobial effectiveness of these irrigants.

## MATERIALS AND METHOD

Twenty four patients with single root and canal that had pulpal and/or periapical pathology reported to the Department of Conservative Dentistry and Endodontics of Chhattisgarh Dental College and Research Institute, Rajnandgaon were selected for this study. The pulpal and periapical pathology was assessed with the use of radiographs and pulp vitality tests. Health histories of all the participating patients with a complete written informed consent was obtained. Patients who received antibiotic treatment in the previous three months or had any systemic disease were excluded from the study. These cases were randomly divided into two groups of twelve each.

### *Access Cavity Preparation*

Under strict aseptic conditions, the procedural tooth was anesthetized and isolated with rubber dam. The tooth, clamp and its surroundings were cleaned with sodium hypochlorite solution. Endodontic access was achieved with a sterile high speed carbide bur.

### *Sample Collection*

On gaining access to the pulp, a pre-sterile paper point (DentsplyMaillefer) pre-moistened with sterile saline to provide a 'pooling effect' for collection of bacteria was

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introduced into the root canal upto the apical third [4]. It was kept in the canal for one minute and root canal contents were obtained. These contents were transferred into sterile test tubes containing culture medium (5% nutrient broth) and sealed tightly for onward transfer to the microbiological laboratory, where they were stored for 24 hours in an incubator at 37 degrees. This constituted the sample for "Pre irrigant culture".

***Biomechanical Preparation***

Canal patency was determined and working length was established. WAVE ONE rotary file system was used for preparing the canals. All canals were prepared with primary Wave One files. During instrumentation, canals were irrigated with 1ml of 1.3% sodium hypochlorite solution using side vented needles. 5 ml of 1.3% sodium hypochlorite was used as an initial irrigant.The samples were then randomly divided into two groups of twelve each. Final irrigation in group I was done with BioPure MTAD and in group II with QMix. Five ml of the respected final irrigant was delivered by using a side vented irrigation needle and agitated using ultrasonic irrigation tips.Each irrigant was left in the root canal for five minutes. Root canal walls were gently filed and a post irrigation sample was collected from the canals as aforementioned and transferred to the lab. This constituted the sample for "Post irrigant culture". All the pre and post samples were stored for 24 hours in an incubator at 37 degrees. The vials containing samples were agitated for 30 seconds on a vortex before aliquot disbursement. Sample dilutions of $10^{-4}$ were accomplished and 1 micro lt of the sample was delivered to the plates. Plates were inoculated with tryptone soya agar with 5% human bloodand were incubated at temperature of 37°C for 3 days. Colony characteristics were noted in case of any growth and colony forming units were counted with digital colony counter [5].

***Statistical analysis***

The descriptive statistics like mean, standard deviation, median and inter quartile range (IQR) of microbial counts were obtained for pre- and post-irrigation in two irrigant groups. The baseline microbial count in two groups was compared using *t-test for independent samples*. The percent reduction in microbial count for two groups was compared using *Wilcoxon Rank Sum test*. The significance was tested at 5% level and the analysis was performed in SPSS ver 18 (SPSS Inc.) software.

## RESULTS

The baseline microbial count in two study groups was compared. Table 1 shows that the mean for Group I was 194.4 ± 9.737 (× $10^4$), while that of Group II was 199.2 ± 9.408 (× $10^4$). The difference in the mean counts was statistically insignificant with P-value of 0.2372 (P > 0.05), using t-test for independent samples. Thus, the baseline sample characteristic as regards CFUs was the same in two study groups.

**Table 1** Pre and post descriptive statistics of microbial counts for two irrigant groups (× $10^4$)

| Group | *n* | Pre-irrigant count | | | Post-irrigant count | | | P-value |
|---|---|---|---|---|---|---|---|---|
| | | Mean | SD | Range | Mean | SD | Range | |
| I | 12 | 194.4 | 9.737 | [180, 216] | 40.33 | 4.163 | [36, 48] | 0.2372 |
| II | 12 | 199.2 | 9.408 | [186. 216] | 33.83 | 3.601 | [30, 40] | |

The pre- and post-irrigation counts were used to obtain the percent reduction in microbial counts. Such reduction was obtained for each sample in both the groups. Table 2 shows the summary statistics for the two groups.

**Table 2** Percent reduction in microbial count in two irrigant groups

| Group | n | Mean | SD | Median | IQR | P-value |
|---|---|---|---|---|---|---|
| I | 12 | 79.19 | 2.508 | 79.67 | 3.21 | |
| II | 12 | 82.71 | 2.163 | 83.51 | 3.37 | 0.004 |

The statistical significant difference in the percent reduction between two groups was evaluated using Wilcoxon rank sum test. The test resulted into a P-value of 0.004 indicating significant difference in the reduction of microbial count in two groups. In other words, the reduction of microbial count in Group II was significantly higher than that of Group I.

## DISCUSSION

The effectiveness of endodontic files, rotary instrumentation, irrigating solutions and chelating agents to clean, shape and disinfect root canals underpins the success, longevity and reliability of modern endodontic treatments [6]. Elimination of microorganisms from infected root canals is the most complicated task in endodontic therapy.The chances of a favorable outcome with root canal treatment are significantly higher if microorganisms are effectively eradicated before the root canal system is obturated.Mechanical instrumentation alone does not result in a bacteria-free root canal system because of the complex anatomy. Hence, the use of chemical agents during and after instrumentation to completely clean all aspects of root canal system is essential for successful endodontics [7].

Sodium hypochlorite is the most widely used endodontic irrigant because of its bactericidal activity and ability to dissolve vital and necrotic organic tissue. However, sodium hypochlorite solutions exert no effects on the inorganic components of smear layer [8]. Demineralizing agent such as ethylenediaminetetraacetic acid (EDTA) has been widely used as a final irrigant after sodium hypochlorite over the years.Due to the increased surface tension, lower penetration depth and poor antibacterial properties, EDTA does not remove smear layer and bacteria as effectively as the newer promising irrigating agents [9]. Irrigants used for final irrigation should remove smear layer and disinfect simultaneously. Qmix and MTAD are newer materials on the horizon used as final irrigants which remove the smear layer and disinfect in one single step without deleterious effects on the root dentin.

MTAD is an aqueous solution of 3% doxycycline [a broad spectrum antibiotic], 4.25% citric acid, a demineralizing agent and 0.5% polysorbate 80 detergent [10]. QMix, contains EDTA, chlorhexidine and cetrimide mixed in distill water [7]. In the present study the antimicrobial efficacy of these irrigants was evaluated. The percentage reduction in microbial count was more with Qmix [83.51%] than MTAD [79.67%] which was statistically significant (P<0.05).QMix performed better which may be attributed to its substantivity, i.e ability to adsorb onto dentine and prevent microbial colonization on the dentine surface [Ferretti *et al*] [11]. An additional interesting feature is the effect of chlorhexidine when it is mixed with compounds like cetrimide[12]. The lower surface tension and increased wettability of QMix enables better

penetration of the irrigant into the canal walls which can be attributed for better scores in this group[13]. The results of our study corroborate with thestudy conducted by Stojicic S *et al* [14]. Poor performance of MTAD in the present study may be related to higher surface tension, reduced penetration and poor substantivity as compared to Qmix. In terms of carry over effect, MTAD performed better than QMix which indicates suppressed bacterial growth for a longer period of time.In the present study samples were collected from the root canal immediately after irrigation, hence the carry over effect was not evaluated. Better results with MTAD can be expected if the current methodology in our study was altered and the carry over effect was evaluated [12, 15]. Recent reports evaluating the smear layer removal property of irrigants have proven adequate performance with both QMix and MTAD [7, 16]. Hence, QMix and MTAD can be focussed on in the near future as final irrigants which are biocompatible, have tissue dissolving capacity, smear layer removal property and good antibacterial efficacy. Further studies should be performed to evaluate the efficacy and biocompatibility of these irrigants with devices that incorporate an apical negative pressure approach for irrigation.

## CONCLUSION

Within the limitations of this experimental design, it can be concluded that canals that were irrigated with QMix showed less bacterial count than those irrigated with MTAD. Advent of ultrasonics and single file systems in dentistry have tremendously improved the quality of endodontic treatment. Once the use of these new instruments and irrigants is fully appreciated, endodontics will become easier and time saving for all.

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