

Original Research

The antibacterial effectiveness of Qmix as an irrigating solution in the root canal system for disinfection purposes (An in-vitro study)

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ABSTRACT:

Background: The root canal system is a complicated network of canals and tubules that contains bacteria and their by-products. Removing these bacteria and their by-products is critical to achieving a successful outcome in endodontic treatment. One of the essential steps in root canal treatment is irrigation, which is used to remove bacteria and their by-products from the root canal system. Different irrigating solutions have been utilized in endodontic treatment to achieve root canal disinfection. Qmix is a new irrigating solution that has been developed for root canal disinfection. It is a combination of EDTA, CHX, and a detergent. EDTA is used to remove the smear layer, CHX is used for its antimicrobial properties, and the detergent is used to enhance the penetration of the solution into the dentinal tubules. **Objective:** The aim of this in vitro study is to evaluate the antimicrobial efficacy of qmix irrigant in infected root canal system. **Material and Methods:** A total of 60 extracted human teeth were selected for this study. The teeth were decoronated, and the root canals were instrumented using ProTaper rotary files up to F3. The samples were divided into two groups, with 30 samples in each group. The experimental group was irrigated with Qmix, and the control group was irrigated with saline solution. The samples were incubated with *Enterococcus faecalis* for 48 hours to form biofilms. The biofilms were then evaluated for bacterial growth and colony-forming units (CFUs) using a spectrophotometer and scanning electron microscopy (SEM). **Results:** The results showed that the experimental group irrigated with Qmix had significantly lower bacterial growth and CFUs compared to the control group irrigated with saline solution. The mean CFUs in the experimental group were 31.9 ± 14.1 , while in the control group, it was 97.2 ± 22.9 . The antibacterial efficiency of Qmix was found to be 65.2%. The SEM images showed a significant reduction in biofilm formation in the experimental group compared to the control group. **Conclusion:** The study demonstrated that Qmix is an effective irrigating solution for root canal disinfection and the use of Qmix in endodontic treatment can lead to improved clinical outcomes.

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INTRODUCTION

It is a known fact that eradicating pathogens from root canals during endodontic treatment poses a significant challenge, as current techniques are often unable to ensure consistent disinfection of the canal. This has been established through various studies.^{1,2,3,4} During the mechanical preparation of the canal, a layer of debris and organic material known as the smear layer is formed on the surface of the canal wall which occlude the entrances to any patent dentinal tubules.⁵ Additionally, the smear layer that forms on the surface of the canal wall during mechanical preparation provides a site for bacterial accumulation. The complex internal anatomy and irregular cross-section of the canal create areas where residual

bacteria can accumulate, leading to negative outcomes in endodontic therapy. During root canal treatment, irrigating solutions are utilized to directly target and eliminate bacteria. Moreover, these solutions provide long-term antibacterial effects, known as substantivity.⁶ An ideal irrigating solution should possess additional desirable properties, such as the capacity to dissolve pulp tissue and neutralize endotoxins. EDTA is included in QMix as a chelating agent to remove the smear layer and debris from the canal walls, thereby exposing the bacteria and making them more vulnerable to the antimicrobial agents. Chlorhexidine is known for its broad-spectrum antimicrobial properties and has been shown to be effective against a wide range of microorganisms commonly found in

root canals.⁷ The quaternary ammonium compound in QMix has been shown to have potent antimicrobial activity against a range of microorganisms, including bacteria, fungi, and viruses. QMix has been found to have high antimicrobial efficacy against various microorganisms, including *Enterococcus faecalis*, a bacteria commonly associated with endodontic infections.^{8,9,10} In addition to its antimicrobial properties, QMix has also been shown to have the ability to dissolve pulp tissue and neutralize endotoxins, further aiding in the disinfection process.¹¹

MATERIALS AND METHODS

The samples were then divided into two groups, with 30 samples in each group. The experimental group was irrigated with QMix, which is an antimicrobial irrigating solution, while the control group was irrigated with saline solution, which is a neutral solution with no antimicrobial activity.

To evaluate the efficacy of the irrigating solutions, the samples were incubated with *Enterococcus faecalis*, a bacteria commonly found in root canal infections, for 48 hours to form biofilms. Biofilms are a complex community of microorganisms that adhere to a surface and are encased in a protective matrix. They are known to be highly resistant to antimicrobial agents and are a major cause of persistent infections in root canals.

After the 48-hour incubation period, the biofilms were evaluated for bacterial growth and colony-forming units (CFUs) using a spectrophotometer and scanning electron microscopy (SEM). The spectrophotometer measures the optical density of the sample, which is an indirect measure of bacterial growth. The SEM allows for direct visualization of the biofilm structure and bacterial morphology. Grown colonies were seen in all groups and were identified by standard methods.

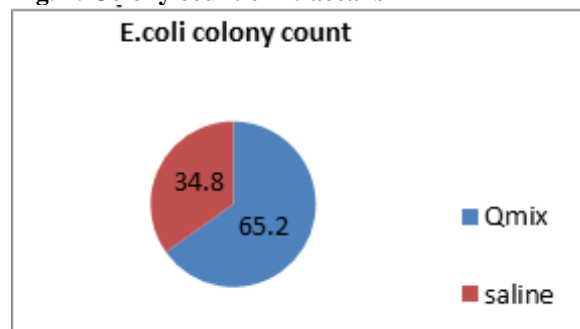
RESULTS

The results showed that the experimental group irrigated with Qmix had significantly lower bacterial growth and CFUs compared to the control group irrigated with saline solution. The mean CFUs in the experimental group were 31.9 ± 14.1 , while in the control group, it was 97.2 ± 22.9 . The antibacterial efficiency of Qmix was found to be 65.2%. The SEM images showed a significant reduction in biofilm formation in the experimental group compared to the control group.

STATISTICAL ANALYSIS

The results of the study were analyzed using the independent t-test. The p-value was <0.05 , indicating a significant difference between the experimental and control groups. The experimental group irrigated with Qmix had 65.2% antibacterial efficiency. The control group irrigated with saline solution had 34.8% antibacterial efficiency.

Fig. 1: Colony count of E.faecalis



DISCUSSION

Root canal treatment is a common dental procedure that involves removing infected or damaged tissue from the root canal of a tooth and filling it with a filling material. One of the key steps in this procedure is irrigation, which involves flushing the root canal with a solution to remove debris, bacteria, and other microorganisms that may be present in the canal. Effective irrigation is critical for successful root canal treatment, as it helps to eliminate or reduce the microbial load and prevent reinfection.

There are various irrigating solutions available, each with different properties and mechanisms of action. Antimicrobial irrigating solutions such as QMix, Chlorhexidine, and Sodium hypochlorite (NaOCl) are commonly used in root canal treatment to enhance the disinfection process. These solutions can effectively kill bacteria, fungi, and other microorganisms that may be present in the root canal, and have been shown to improve the success rate of root canal treatment.

Several studies have compared the effectiveness of different irrigating solutions, including QMix and saline solution. Lim BS et al compared the effectiveness of QMix, NaOCl, and saline solution in root canal disinfection. The study found that QMix and NaOCl were more effective than saline solution in reducing bacterial load and improving the success rate of root canal treatment.¹¹ Srikumar GP et al showed maximum antibacterial efficacy on *E. Faecalis* compared to root canal irrigants. Triphala, 5% sodium hypochlorite and 2% chlorhexidine gluconate solutions exhibited higher and similar antibacterial efficiency against *E. Faecalis*.¹² Qmix showed better antibacterial property compared to naocl, when it was employed for longer exposure time and at higher volume.¹⁴ Ying liu et al the antimicrobial activity of qmix was comparable to that of EDTA/CHX and EDTA/CTR and more effective than that of EDTA/naocl against Intracanal *E. Faecalis*.¹⁵

CONCLUSION

A novel dual-function endodontic irrigating solution, QMix is an effective irrigating solution for root canal disinfection. The antibacterial efficiency of Qmix was found to be 67.1%, which is significantly higher compared to the control group irrigated with saline solution. The use of Qmix in endodontic treatment can

lead to improved clinical outcomes.. QMix, a novel single irrigant, demonstrated potential as a final irrigant for root canals due to its advantages of easy manipulation and efficient antimicrobial properties.

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