

# REVIEW ARTICLE

## IRRIGANTS IN ROOT CANAL THERAPY: A MINI REVIEW

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### ABSTRACT:

The major objective in endodontic therapy is to disinfect the entire root canal system. This requires that the pulpal content be eliminated as sources of infection. This goal may be accomplished by mechanical instrumentation and chemical irrigation, in conjunction with medication of the root canal between treatment sessions. Microorganisms and their by-products are considered to be the major cause of pulpal and periradicular pathosis. Various root canal irrigants are available these days. Thence; we tend to summarize some of the root canal irrigants along with their different aspects.

Key words: Endodontic, Irrigation, Root canal

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### INTRODUCTION

The success of endodontic treatment depends primarily on the eradication of micro-organisms from the root-canal system and prevention of their reinfection. The root canal system is shaped with the help of stainless steel and nickel-titanium instruments. This shaping process is accomplished in conjunction with constant irrigation to remove the inflamed and necrotic tissue, microbes/biofilms, and other debris from the root-canal space. Despite the advent of numerous modern techniques and instruments in canal shaping, more than 35% of the root canal's surface can be left uninstrumented after non-surgical root canal treatment.<sup>1,2</sup>

The presence of necrotic or vital tissue remnants within the root canal space may provide a source of nutrition for the surviving bacteria. Thus, microorganisms, either remaining in the root canal space after treatment or those re-colonizing the filled canal system, are the main etiological causes of endodontic failures. The role of the irrigation protocol thereby plays a key role in the disinfection of the root canal space. Ideal requirements of root canal irrigants includes:<sup>3,4</sup>

- Broad antimicrobial spectrum
- High efficacy against anaerobic and facultative microorganisms organized in biofilms
- Ability to dissolve necrotic pulp tissue remnants
- Ability to inactivate endotoxin
- Ability to prevent the formation of a smear layer during instrumentation or to dissolve the latter once it has formed.
- Systemically nontoxic when they come in contact with vital tissues, noncaustic to periodontal tissues, and with little potential to cause an anaphylactic reaction.

### Sodium hypochlorite

Sodium hypochlorite (NaOCl) is the most frequently recommended and a commonly used endodontic irrigant. Its advantages are two-fold; pulpal dissolution and antimicrobial effect. NaOCl is a strong base (pH>11) and acts as an organic solvent, causing amino acid degradation and hydrolysis through the production of chloramine molecules. There is evidence to show that a decrease in microbial numbers is achievable when using NaOCl for endodontic treatment of teeth with apical periodontitis. The smear layer is not removed by NaOCl. NaOCl is available from a variety of sources from supermarkets to dental supply companies and in a variety of concentrations. When NaOCl is chosen, it must be remembered that the concentration and temperature of the solution has a bearing on its effectiveness.<sup>4,5</sup> A concentration of over 0.5% is required to reduce bacterial load significantly. In vitro evidence has implied that using NaOCl at a concentration of 0.5% for 10 seconds can reduce the bacterial load of *A. naeslundii* (found in untreated necrotic root canals) and *C. albicans* (found in endodontic failure cases) to below the limit of detection. It was seen that a contact period of 30 minutes was required to reduce the bacterial load of *E. faecalis* below the limit of detection. At a concentration of 5.25%, 2 minutes of contact was required to reduce the bacterial load. Other studies have shown that a concentration of 5.25% NaOCl can kill *E. faecalis* and *C. albicans* within 15–30 seconds. NaOCl, at a concentration of 1% heated to 20°C, is less effective than that at 45°C, which in turn is less effective than that at 60°C, as more chlorine is released at higher temperatures. NaOCl at a concentration of 5.25% heated to 20°C is as effective as NaOCl at a concentration of 1% heated to 45°C. NaOCl at a concentration of 1% heated to 60°C is significantly more effective than 5.25% at 20°C.<sup>6</sup>

### Chlorhexidine

Chlorhexidine is a cationic solution which can be used during treatment. It has a wide range of antimicrobial activity. There is no adequate evidence on different aspects of Chlorhexidine (CHX). Delany et al. evaluated the 0.2% CHX gluconate on infected root canals. Bacteriologic samples were obtained before, during, immediately after and 24 hours after instrumentation, irrigation, and medication either with CHX gluconate or with sterile saline. There was a highly significant reduction in microorganisms in the CHX-treated specimens after the instrumentation and irrigation procedures. Basson and Tait compared the effectiveness of calcium hydroxide, iodine potassium iodide (IKI) and a CHX solution in disinfecting *Actinomyces (A) israelii*-infected root canal walls and dentinal tubules in vitro. The root canals were exposed to either IKI, calcium hydroxide or 2% CHX for periods of 3, 7 and 60 days. CHX was the only disinfectant that was able to eliminate *A. israelii* from all the samples at all periods while 25% of the specimens treated with IKI and 50% of the specimens treated with calcium hydroxide still had viable *A. israelii* after treatment. Oncag et al. evaluated the antibacterial properties of 5.25% sodium hypochlorite (NaOCl), 2% CHX and 0.2% CHX plus 0.2% cetrimide (Cetrexidin) after 5 min and after 48 h in extracted human teeth, whose canals were infected by *Enterococcus faecalis*. The 2% CHX and Cetrexidin were significantly more effective on *E. faecalis* than the 5.25% NaOCl at both time periods. Gomes et al. and Vianna et al. investigated in vitro the antimicrobial activity of three concentrations (0.2%, 1% and 2%) of two forms of CHX (gel and liquid) against endodontic pathogens and compared the results with the ones achieved by five concentrations of NaOCl (0.5%, 1%, 2.5%, 4% and 5.25%).<sup>7-9</sup> Both 2% gel and liquid formulation of CHX eliminated *Staphylococcus aureus* and *Candida albicans* in 15 seconds, whereas the gel formulation killed *E. faecalis* in 1 min. All tested irrigants eliminated *Porphyromonas endodontalis*, *Porphyromonas gingivalis*, and *Prevotella intermedia* in 15 seconds. The time required to eliminate all microorganisms was the same for 5.25% NaOCl. The timing required for 1.0% and 2.0% CHX liquid to eliminate all microorganisms was the same required for 5.25% NaOCl. The antimicrobial activity is related to type, concentration, and presentation form of the irrigants as well as the microbial susceptibility.<sup>10</sup>

### Ethylene diamine tetra acetic acid

Ethylene diamine tetraacetic acid (EDTA) is a chelating agent can bind to metals via four carboxylate and two amine groups. It is a polyamino carboxylic acid and a colorless, water-soluble solid, which is widely used to dissolve lime scale. It is produced as several salts, notably disodium EDTA and calcium disodium EDTA. EDTA reacts with the calcium ions in dentine and forms soluble calcium chelates. According to Patterson, EDTA had limited antibacterial activity. It seems that the antibacterial activity of EDTA is due to the chelation of

cations from the outer membrane of bacteria. Russell revealed that 10% EDTA produced a zone of bacterial growth inhibition similar to Creosote. However, lower concentrations of EDTA produced little to non-inhibition zone.<sup>11, 12</sup> Kotula and Bordáčová indicated that the antimicrobial effect of Na-EDTA was maintained as long as the chelators have not formed bonds with metal ions. Yoshida et al. assessed the antibacterial activity of EDTA combined with ultrasonic activation clinically. After 7 days, without placing any intracanal medicament, most cases were bacteria-free. According to Heling and Chandler, RC-Prep was more effective against gram-negative bacteria than Gram-positive ones. According to Heling et al. increasing the temperature of RC-Prep from 10°C to 45°C increased its efficacy against *Staphylococcus aureus*. A study investigated the effect of components of RC-Prep on *Streptococcus sobrinus*. Findings revealed that minimum concentration for a bactericidal effect was 0.25% for EDTA and 50% for glycol. On the other hand, Orstavik and Haapasalo putted the antibacterial activity of 17% EDTA under question. Ordinola-Zapata et al. revealed that EDTA had no significant effect on the biofilm viability and architecture. Ballal et al. indicated that efficacy of EDTA against *Enterococcus faecalis* was equivalent to maleic acid. Arias-Moliz et al. showed that EDTA had no efficacy against *E. faecalis* even after 60 min contact. Bystrom and Sundqvist demonstrated that combination of EDTA and 5% NaOCl had better antibacterial activity of NaOCl alone. Using the agar diffusion technique, Sen et al. revealed that EDTA was effective against *Candida albicans*.<sup>13-16</sup>

### Tetracyclines based root canal irrigant

Tetracyclines, including tetracycline-HCl, minocycline, demeclocycline and doxycycline, are a group of broad-spectrum antibiotics that are effective against a wide range of microorganisms. Tetracyclines are bacteriostatic in nature. This property may be advantageous because, in the absence of bacterial cell lysis, antigenic byproducts such as endotoxin are not released. Tetracyclines also have many unique properties other than their antimicrobial action, such as the inhibition of mammalian collagenases, which prevent tissue breakdown, and the inhibition of clastic cells, which results in anti-resorptive activity. Inflammatory diseases such as periodontitis include an excess of tissue collagenases which may be blocked by tetracyclines, thus leading to enhanced formation of collagen and bone.<sup>17</sup>

Tetracyclines readily attach to dentine and are subsequently released without losing their antibacterial activity. This property creates a reservoir of active antibacterial agent, which is then released from the dentine surface in a slow and sustained manner. In periodontics, several studies have been conducted on the antibacterial substantivity of tetracyclines. In an in vivo study, one of the researcher compared the antibacterial substantivity of two concentrations of tetracycline HCl (50 mg/ml, 10 mg/ml) and 0.12% chlorhexidine. Their

findings showed that both concentrations of tetracycline demonstrated residual antibacterial activity and the antibacterial substantivity of the three solutions in descending order was: 50 mg/ml tetracycline >10 mg/ml tetracycline > 0.12% CHX.<sup>18,19</sup>

### Tetraclean

Tetraclean, like MTAD, is a mixture of an antibiotic, an acid and a detergent. However, the concentration of the antibiotic, doxycycline (50 mg/ml), and the type of detergent (polypropylene glycol) differ from those of MTAD.<sup>20</sup>

In a previous study, a researcher compared the surface tension of 17% EDTA, Cetrexidin, Smear Clear, 5.25% NaOCl, MTAD and Tetraclean. The NaOCl and EDTA had the highest surface tension, whereas Cetrexidin and Tetraclean had the lowest values. In another study, they compared the antimicrobial efficacy of 5.25% NaOCl, MTAD, and Tetraclean against an *E. faecalis* biofilm generated on cellulose nitrate membrane filters. Only the NaOCl could disaggregate and remove the biofilm at every time interval tested although treatment with Tetraclean caused a high degree of biofilm disaggregation at each time interval when compared with MTAD.<sup>21</sup>

### Effect of citric acid irrigation on the fracture resistance of endodontically treated roots

Citric acid, a chelating agent, reacts with metals to form a non-ionic soluble chelate. It has been applied on root surfaces altered by periodontal diseases. Also, it has been proposed for conditioning agent for dental hard tissues. It has good chemical stability, shows anti-microbial effects against the facultative and obligative anaerobes. Use of citric acid was suggested as root canal irrigating solution because of its properties like the removing capacity of the inorganic component of smear layer and decalcification capacity of dentin. When compared with phosphoric acid, polyacrylic acid or lactic acid, it is more effective in smear layer removal.<sup>22-26</sup> This acidic solution was used in previous studies with different concentrations ranged from 1% to 50%. Vertical root fracture is one of the most serious complications of the root canal treatment. Loss of tissue during instrumentation and pressure during filling process may play an important role in the predisposition of endodontically treated teeth to root fracture. Besides, irrigation solutions have an effect on the fracture resistance of endodontically treated teeth. Citric acid is well-established solution in root canal treatments like EDTA. It is as effective as EDTA in removing smear layer. Moreover citric acid solutions could be more effective than EDTA at short periods (30 s). It has been reported that citric acid is more biocompatible and suitable for clinical use than EDTA. There is a perception that the root canal irrigants would weaken the tooth structure predisposing it to fracture. The use of citric acid concentrations at different time periods did not significantly changed the fracture resistance of

endodontically treated roots. This property of citric acid could provide benefit in root canal treatment.<sup>27-29</sup>

### CONCLUSION

During instrumentation canals should be irrigated using copious amounts of the NaOCl solution. Once the shaping procedure is completed, canals can be thoroughly rinsed using aqueous EDTA or citric acid. Selection of root canal irrigant should be properly made so that successful post-treatment results could be obtained.

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