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Review Article

Root canal irrigants: A comprehensive review

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ABSTRACT:
The primary step in root canal therapy is local wound debridement in the infected pulp area to stop the tooth from becoming an infection source. Solutions of sodium hypochlorite are advised for use as the primary irrigants. This is due to their extensive antibacterial range and distinctive ability to destroy residues of necrotic tissue. Concerns about chemicals and toxicology are highlighted in relation to their use, along with several methods for improving local efficacy without raising the caustic potential. Before filling the root canal system, chelating solutions are also advised as adjunct irrigants to help stop the development of a smear layer and/or to get rid of it.
Key words: Root, Canal Irrigants

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INTRODUCTION

It has long been known that bacteria are the main etiologic agents behind pulp and periapical diseases. Thorough chemo-mechanical debridement of pulpal tissue, dentin debris, and infectious bacteria is necessary for successful root canal therapy. By washing away debris, disintegrating tissue, and cleaning the root canal system, irrigations can support mechanical debridement. For teeth with intricate internal architecture, such as fins or other anomalies that instruments might overlook, chemical debridement is especially necessary.[1, 2]

Desired Irrigant Actions

Historically, countless compounds in aqueous solution have been suggested as root canal irrigants, including inert substances such as sodium chloride (saline) or highly toxic and allergenic biocides such as formaldehyde. Based on the above knowledge, it appears evident that root canal irrigants ideally should:

- Have a broad antimicrobial spectrum and high efficacy against anaerobic and facultative microorganisms organized in biofilms
- Dissolve necrotic pulp tissue remnants
- Inactivate endotoxin
- Prevent the formation of a smear layer during instrumentation or dissolve the latter once it has formed

Furthermore, as endodontic irrigants come in contact with vital tissues, they should be systemically nontoxic, noncaustic to periodontal tissues and have little potential to cause an anaphylactic reaction.

Choosing the Main Irrigant Although iodine is less cytotoxic and irritating to vital tissues than sodium hypochlorite and chlorhexidine, it bears a much higher risk to cause an allergic reaction. The same is true for quaternary ammonium compounds. Sensitivities to hypochlorite and chlorhexidine are rare. Despite its ubiquitous use, only few cases of allergic reactions to sodium hypochlorite from a root canal irrigant have been reported.

Hypochlorite has the unique capacity to dissolve necrotic tissue and the organic components of the smear layer. It kills sessile endodontic pathogens organized in biofilms and in dentinal tubules as efficiently as chlorhexidine or iodine at comparable concentration. Inactivation of endotoxin by hypochlorite has been reported; the effect, however, is minor compared to that of a calcium hydroxide

dressing. In conclusion, the currently available evidence is strongly in favor of sodium hypochlorite as the main endodontic irrigant. However, the use of chlorhexidine solutions may also be indicated under certain conditions.

Sodium Hypochlorite

Chlorine is one of the most widely distributed elements on earth. It is not found in a free state in nature, but it exists in combination with sodium, potassium, calcium, and magnesium. In the human body, chlorine compounds are part of the nonspecific immune defense. They are generated by neutrophils via the myeloperoxidase-mediated chlorination of a nitrogenous compound or set of compounds.

Hypochlorite preparations are sporicidal and virucidal and show far greater tissue dissolving effects on necrotic than on vital tissues. These features prompted the use of aqueous sodium hypochlorite in endodontics as the main irrigant as early as 1920. It appears that the majority of American practitioners use “full strength” 5.25% sodium hypochlorite as it is sold in the form of household bleach leading to several adverse reactions like irritation and decrease in flexural strength of dentin. Also decrease in microbiota was also not significantly altered with this high concentration. It must be realized that during irrigation, fresh hypochlorite consistently reaches the canal system, and concentration of the solution may thus not play a decisive role.

Unclean areas may be a result of the inability of solutions to physically reach these areas rather than their concentration. Hence, based on the currently available evidence, there is no rationale for using hypochlorite solutions at concentrations over 1% wt/vol. One of the methods to improve the efficacy of sodium hypochlorite was to use heated solution. This improves their immediate tissue-dissolution capacity. Furthermore, heated hypochlorite solutions remove organic debris from dentin shavings more efficiently than unheated counterparts. The optimal time that a hypochlorite irrigant at a given concentration needs to remain in the canal system is an issue yet to be resolved.[14- 16]

Chlorhexidine

Chlorhexidine (CHX) is a strong antiseptic that is often used to chemically control plaque in the mouth. Mouthwash is made up of 0.1-0.2% aqueous solutions, while root canal irrigation in endodontic treatment is done with a 2% concentration. The antibacterial action of CHX is dependent on achieving an ideal pH (5.5-7). At lower quantities, CHX is bacteriostatic; at larger quantities, it is bactericidal. CHX is effective against Gram-positive and -negative bacteria, spores of bacteria, lipophilic viruses, yeast, and fungi. But since CHX is pH-dependent, these effects are much reduced when organic matter is present. Aside from destroying bacteria, CHX is incapable of removing biofilms and other organic debris.[17- 20]

A CHX solution of 2% after the chemo-mechanical preparation provides the appropriate antibacterial effect. Calcium hydroxide (Ca(OH)2) is a common intracanal medication in this solution. One of the reasons for the extensive use of CHX is it attaches to hard tissues and retains its antibacterial action. This is because of the interaction of a large number of CHX molecules with dentin at any point in time. According to White et al., 2% of CHX produced effects lasting from 72 hours to 12 weeks. The main drawback of CHX is its inability to dissolve in tissue. CHX is a matrix metalloproteinase (MMP) inhibitor with a wide range of action (anti-collagenolytic effect). The possible complications that arise when a surfactant-containing irrigation fluid spills from the periapical tissues in clinical practice have not been studied yet. To complete the canal cleaning process, QMix is a root canal irrigation product. CHX is mixed with a surfactant and ethylenediaminetetraacetic acid (EDTA) to better penetrate the dentinal tubules.[17- 20]

EDTA

EDTA reacts with the calcium ions in dentine and forms soluble calcium chelates. It has been reported that EDTA decalcified dentin to a depth of 20–30 μm in 5 min. A continuous rinse with 5 ml of 17% EDTA, as a final rinse for 3 min efficiently removes the smear layer from root canal walls. According to one previous study. greater smear layer removal was found in the 1-min EDTA irrigation group than the 30-sec or 15-sec groups. Irrigation with 5% NaOCl alone or alternated with 17% EDTA (used in 30-min cycles) significantly increased tooth surface strain. The alternated regimen showed significantly greater changes in tooth surface strain than NaOCl alone. Irrigation with 3% NaOCl and 17% EDTA individually or in combination did not significantly alter the tooth surface strain. A 1-min application of 17% EDTA combined with ultrasonics is efficient for smear layer and debris removal in the apical region of the root canal. EDTA performed significantly better than NaCl and NaOCl in smear layer removal and dentinal tubule opening.[20- 23]

Herbal

Triphala Triphala consists of dried and powdered fruits of three medicinal plants Terminalia bellerica, Terminalia chebula, and Emblica officinalis. Triphala achieved 100% killing of E faecalis at 6 min. This may be attributed to its formulation, which contains three different medicinal plants in equal proportions; in such formulations, different compounds may help enhance the potency of the active compounds, producing an additive or synergistic effect. Triphala contains fruits that are rich in citric acid, which may aid in removal of the smear layer. The major

advantages of using herbal alternatives are easy availability, cost-effectiveness, longer shelf life, low toxicity, and lack of microbial resistance.[22- 24]

Green tea Green tea polyphenols, the traditional drink of Japan and China is prepared from the young shoots of the tea plant Camellia sinensis. Green tea polyphenols showed statistically significant antibacterial activity against E faecalis biofilm formed on tooth substrate. It takes 6 min to achieve 100% killing of E faecalis. Morinda citrifolia Morinda citrifolia (MCJ) has a broad range of therapeutic effects, including antibacterial, antiviral, antifungal, antitumor, antihelmintic, analgesic, hypotensive, anti-inflammatory, and immune-enhancing effects. MCJ contains the antibacterial compounds L-asperuloside and alizarin.[25- 28]

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