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Review Article

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An Overview on Endodontic Irrigation Solution Role in Management

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ABSTRACT

The main objective of endodontic treatment is the total removal of any necrotic tissues and microorganisms along with their byproducts found within the infected root canal to treat and prevent the recolonization of these micrbad oorganisms. To date, no known irrigant has a 100% elimination rate on microorganisms, many combinations of irrigates have been suggested, and care must be taken to their mixing interaction and side effects. The irrigant of choice varies from one practitioner to another, yet NaOC1 is considered the gold standard irrigant in clinical practice despite its complications. PubMed database was used for articles selection, and the following keys were used in the mesh ((“endodontic Irrigation solution "[Mesh]) AND (“features and disadvantage”[Mesh]) OR (“endodontic Irrigation solution Mesh])).
In regards to the inclusion criteria, the articles were selected based on the inclusion of one of the following topics: Endodontic Irrigation solution features and disadvantages. Exclusion criteria were all other articles, which did not have one of these topics as their primary endpoint. Features and disadvantages. Many methods were used as an irrigant, each one has it is own advantage and disadvantages, the field is still open for more improvement in this field to get the best care to the patient.

Keywords: *Endodontic irrigation solution, Antimicrobial, Root canal system, Sodium hypochlorite*

INTRODUCTION

The main objective of endodontic treatment is the total removal of any necrotic tissues and microorganisms along with their byproducts found within the infected root canal to treat and prevent the recolonization of these microorganisms. The exact anatomy of the root canal system is known for its complexity and variability between people, which make full cleaning and disinfection, not an easy task [1]. Most of the time, the root canals are shaped by constant irrigation using hand instruments and rotary systems. In a study, micro-CT pictures were taken before and after the root canal shaping process [2]. Of these 35% of the root, canal surface was untouched, regardless of the canal preparation. Thus, the need for complete irrigation and disinfecting of the root canal has been identified by the scientific community. To reach full disaffection, the smear layer must be removed and no single solution can achieve that. Therefore, combining two or more of these solutions are needed to reach full

effective irrigation [2]. The purpose of this review is to discuss the methods and components of irrigation and the advantages and disadvantages of each one.

MATERIALS AND METHODS

PubMed database was used for articles selection, and the following keys were used in the mesh ((“endodontic Irrigation solution "[Mesh]) AND (“features and disadvantage”[Mesh]) OR (“endodontic Irrigation solution Mesh])).

In regards to the inclusion criteria, the articles were selected based on the inclusion of one of the following topics: Endodontic Irrigation solution features and disadvantages. Exclusion criteria were all other articles, which did not have one of these topics as their primary endpoint.

Around 90 publications were chosen as the most clinically relevant out of 1,202 articles indexed in the previous two decades, and their full texts were evaluated. A total of 31 of the 90 were included after a thorough examination. Additional research and publications were found using reference lists from the recognized and linked studies. Expert consensus recommendations and commentary were added where relevant to help practicing physicians assess cirrhosis most simply and practically possible.

RESULTS AND DISCUSSION

Properties of an ideal irrigant

For an irritant solution to be ideal it must possess the following features: Firstly, a prolonged and sustained germicidal, bacterial and fungicidal impact. Secondly, it should include lubricant properties to facilitate the process during instrumentation. Moreover, the ability to dissolve both inorganic dental tissues and organic ones such as collagen, pulp tissue, and biofilm, and it should have the ability to work in an environment soiled in serum, blood, and protein product with the might to completely remove the smear layer [3]. Additionally, the solution should not irrigate or interfere with periapical tissue healing, cause toxic or carcinogenic effects on peripheral tissues, or trigger an immune reaction. Also, it should not leave a stain or weakening of the tooth tissue [4, 5]. Lastly, the solution is stable with low surface tension, available at a low cost, and has no negative effect on the sealing process [6].

Sodium hypochlorite

Owing to its antimicrobial effectiveness effect and tissue dissolving capabilities, sodium hypochlorite is the most common endodontic irrigant used worldwide; its low viscosity facilitates easy introduction into the canal system, proper half-life, and low price solution is considered cost-effective. Both the antimicrobial and dissolving properties of the solution are concentration-dependent; unfortunately, the toxicity is concentration-dependent. It was firstly introduced by Dankin during world war I when he used 0.5-0.6 % solution (aka Dankin solution) on a wounded soldier [7]. Nowadays, a range of 0.5-5.25% is accepted, however for clinical use, a concentration ranging from 0.5 and 1% is recommended. Sodium hypochlorite mechanism of action depends on the free chlorine in the solution, which dissolves both necrotic and vital tissue by breaking their protein into amino acids; fortunately, studies have proven far more significant effect on the necrotic tissue compared to vital [7]. Also, several studies have demonstrated NaOCl virucidal, sporicidal, and broad bactericidal effects. Several studies have demonstrated that raising the temperature of low concentration NaOCl will improve the effectiveness with lower side effects [8]. Thus, warmed NaOCl exhibits better results compared to non-heated ones [8]. The main disadvantages of NaOC1 solution are the cytotoxicity to the peri radicular tissue; also it leaves foul smell and taste in the mouth and may cause corrosion of metal objects. Moreover, it does not cover all bacteria, nor does full removal of the smear layers [9].

Ethylenediaminetetraacetic acid (EDTA)

To fully clean the root canal system, a combination of organic and inorganic irrigation solution are required. As described earlier, NaCO1 is effective in dissolving organic tissue only, thus another solution should be added to clear the debris from the canal system and remove the smear layer [10]. Therefore, combining demineralizing agents such as EDTA and CA as an adjuvant in root canal treatment is essential nowadays. EDTA in usual clinical practice used in a 17% neutralized solution, calcium ions in the dentin react with the solution forming soluble calcium chelates [11]. 10 ml of EDTA 17% solution for a minute was shown to fully remove the smear layer from

the canal wall; it was demonstrated that the demineralization process has a direct relationship with the contact time [11].

Citric acid (CA)

Citric acid with concentrations ranging from 1-40% is used in endodontic practice, yet 10% solution was proven to be the most effective when used as an adjuvant in root canal therapy and showed an excellent result when used as final irrigation to remove the smear layer and even superior to EDTA at a similar concentration [12]. Both CA and EDTA should be used carefully with NaOC1, as they should never be mixed [12].

Chlorhexidine

Chlorhexidine is a cationic bisbiguanide. Salt-like form of Chlorhexidine such as Chlorhexidine gluconate is considered the most stable form of it. A concentration of 0.1-0.2 % is being used as an aqueous solution in chemical plaque intervention. On the other hand, 2% is the desired concentration for mechanical root irrigation [13]. The solution possesses high antimicrobial activity, especially when used at low PH (5.5-7), and the effect lasts long even after removing the solution, yet it has no tissue dissolving activity [13]. Usually, Chlorhexidine is used together with NaCOL as an irritant. However, Chlorhexidine is known to be a highly reactive molecule, and it is not recommended to use it in a multiple-irrigant regimen [7]. When mixed, chlorhexidine and sodium hypochlorite precipitate an orange-brown plaque known as para-chloroaniline, which is difficult to remove and famous for its carcinogen effect. Advantages of this solution over Sodium Hypochlorite are many [7]. They include minimum cytotoxic activity compared to the NaCO1, and unlike the latter, this solution does not leave a bad taste or foul smell in the mouth. Regardless of its features, Chlorhexidine is not considered a gold standard endodontic irrigant because it can not dissolve necrotic tissue and leaves debris. Moreover, it is less efficient against Gram-negative bacteria [14].

Hydrogen peroxide

In dentistry, hydrogen peroxide has several uses; it is an odorless, clear liquid and considered highly unstable and is decomposed by light and heat. H2O2 exerts its effect by releasing nascent oxygen, which interferes with the bacteria metabolism when it comes in contact and produces the bactericidal effect. Also, nascent oxygen rapid release creates ebullition or bubbling action, which is known for its mechanical effect and debridement action on necrotic tissue as well. However, H202 is concentration-dependent, and high concentrations are toxic to the tissues. Although a concentration of 1-30% is being used in dentistry, only 3-5% concentrations are used in endodontic irrigation [15]. It is efficient against viruses, bacteria, and yeasts but compared to NaCO1, it has low capacity. Individual use of either H202or NaCO1 is proven to be more efficacious than the combination of both. One disadvantage is the rapid release of nascent oxygen can result in severe pain when it reacts with the blood or pulp debris [7].

Iodine compounds

Iodine compounds are known for their virucidal, fungicidal, bactericidal, tuberculocidal, and sporicidal activities. For endodontic irrigation, iodine 2% in potassium iodide is the solution of choice [15]. Away from its antimicrobial effect, it has low cytotoxicity and leaves no dentine stain. Although it has many advantages, it is not used as a first choice irrigant due to its allergic effect. Furthermore, many of the substances found deep in the canal root-like dentin powder and organic dentin matrix have an inhibitory effect on potassium iodide [16].

Recommended irrigation method

Many irrigation methods have been used, but a syringe and tip are traditionally used to deliver the irrigant to the root canal system. Other famous approaches include using files or gutta-percha points to perform dynamic agitation, and brush-based agitation [17]. These former methods are mechanical irrigation techniques. Nowadays, modern rotary irrigation techniques are performed widely, such as applying negative pressure during irrigation and continuous irrigation of the root canal system and using ultrasonic and sonic vibrations [17]. Flushing the root canal system with NaOC1 is advised along with the cleaning and shaping process; this will not only increase the available working time but also will enhance the efficiency of cutting for instruments [7]. To furthermore improve the debridement, other methods are suggested, such as using laser light to give rise to lethal photosensitization on microbiota in the canal, also activating electrochemically water irrigation and ozone gas infiltration into the root canal system [18].

CONCLUSION

The success of endodontic irrigation is mainly dependent upon the elimination of pathogens and the removal of the smear layer during the shaping and cleaning of the root canal system. Care should be taken to the storage, PH, and concentration of the irrigant due to their impaction on the potential of the used irrigant on the root canal system. To date, no known irrigant has a 100% elimination rate on microorganisms, many combinations of irrigates have been suggested, and care must be taken to their mixing interaction and side effects. The irrigant of choice varies from one practitioner to another yet despite its complications, NaOC1 is considered the gold standard irrigant in clinical practice.

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