COMPARISON OF SODIUM HYPOCHLORITE AND MIXTURE OF TETRACYCLINE CITRIC ACID AND DETERGENT AS IRRIGATING MATERIAL IN ENDODONTICS

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ABSTRACT

The main objectives of root canal therapy are cleaning, shaping and obturating the canal system in three dimensions and preventing reinfection. So the irrigation is important part of a root canal treatment as it allows for cleaning beyond the reach of root canal instruments. Inadequate irrigation or instrumentation without irrigation increases the accumulation of debris on the cutting surfaces of instruments as well as debris and smear layer on root canal walls.

In this review article, comparison of MTAD (mixture of tetracycline citric acid and detergent) and sodium hypochlorite (NaOCl) as irrigating material in endodontics is made.

Key Words: Root canal treatment, sodium hypochlorite (NaOCl), MTAD (mixture of tetracycline citric acid and detergent), irrigation.

INTRODUCTION

Root canal treatment can be summarized as a series of procedures for cleaning, shaping, and filling the root canal system. The success of any endodontic treatment depends on the satisfactory completion of the endodontic triad of biomechanical preparation, disinfection and obturation in three dimensions to create a fluid tight seal. Root canal irrigants are used alone or in combination, during biomechanical preparation of the root canal to remove the organic/inorganic debris, lubricate endodontic instruments and minimize the number of micro-organisms.

Sodium hypochlorite, one of the most popular irrigating solutions with excellent organic tissue solvent and antibacterial properties, if concentrated solution is forced beyond the tooth apex produces severe irritation in periradicular tissues, but when used alone may have little or no effect on the smear layer. Drawbacks of sodium hypochlorite are unpleasant odor, very toxic, incapable to eradicate smear layer and does not entirely eliminate all bacteria, presented in the infected root canals therefore, intracanal medications are used during root canal treatment.

MTAD (mixture of tetracycline citric acid and detergent) introduced as a final rinse for decontamination of root canal system. When MTAD is used as intracanal irrigation it eliminates smear layer and effectively eradicate Enterococcus faecalis. Ultimate aim of the root canal instrumentation and irrigation is to prepare a clean, bacteria and debris free canal for obturation.

The objective of endodontic treatment is to prevent or eliminate infection within the root canal. Irrigation is an important part of successful root canal treatment because it assists in removing bacteria, microbes, tissue remnants and debris from root canal system. Using a combination of products in the proper irrigation sequence leads to favorable outcome.

Factors that modify activity of intracanal irrigation solutions

There are several factors associated with the efficacy of agents used. Some modifying factors such as host resistance bacterial virulence microbial resistance
or susceptibility of etc are beyond our control. Other factors which can be controlled or at least predicted are: concentration, contact, presence of organic tissue, quantity and temperature.

Currently there is no single irrigant that can fulfill all the set criteria therefore different combinations of irrigants were tried in literature. Most common irrigants in use are sodium hypochlorite, MTAD, chlorhexidine and ethylenediamine tetra acetic acid.

**Sodium hypochlorite**

Sodium hypochlorite (NaOCl) is an effective tissue solvent and antimicrobial agent. Its germicidal ability is related to the formation of hypochlorous acid when in contact with organic debris. It tends to discolor and corrode surgical instruments; and it has a very unpleasant odor, very toxic, incapable to eradicate the smear layer and does not destroy all bacteria in the contaminated root canals. Sodium hypochlorite contains 5% of free chlorine which is important for breakdown of proteins into amino groups. At body temperature, reactive chlorine in aqueous solution exists in two forms hypochlorite (OCL) and hypochlorous acid (HOCl). State of available chlorine depends on pH of solution i.e. above pH of 7.6 mainly hypochlorite and below this hypochlorous acid. The pH of commonly used sodium hypochlorite is 12, at which the OCL form exists. As hypochlorous acid is more bactericidal, so to increase the efficacy of NaOCl solution, 1% sodium bicarbonate is added as buffering agent. Buffering makes the solution unstable thus decreases its shelf life to even less than one week. Buffered and diluted sodium hypochlorite should be stored in dark place.

Different concentrations of sodium hypochlorite from 0.5-5.25 percent have been used as root canal irrigants. When instrumented with NaOCl as root canal irrigation, it does not entirely eliminate bacteria from infected root canals.

Sodium hypochlorite is nontoxic during intracanal use but 5.25 percent NaOCl can cause serious damage to tissue if injected periapically. Thus irrigation with sodium hypochlorite solution should always be a great deal of care especially in case of large apical diameter.

**Use of sodium hypochlorite solution in the combination with other medicaments**

The efficacy of sodium hypochlorite as antimicrobial agent is increases when used in combination with other irrigating solutions like EDTA, chlorhexidine and MTAD.

**MTAD (mixture of tetracycline citric acid and detergent)**

MTAD stands for mixture of tetracycline, an acid and a detergent. Acid is citric acid and detergent is Tween 80. MTAD is used as a final rinse for decontamination of root canal system, eliminate the smear layer and effective against Enterococcus faecalis, a microorganism resistant to the action of antimicrobial medication. Efficacy of MTAD is to completely remove smear layer can be enhanced, if NaOCl in 1.3% concentration is used as irrigant before irrigation with 1 ml of MTAD. Moreover, MTAD has constant antibacterial activity, biocompatibility and superior bond strength.

**Smear layer in endodontics**

Smear layer is consequenting from instrumentation, contains organic and inorganic particles of cut dentine, necrotic or vital pulp fragments, odontoblasts endings, microorganisms and blood cells. When analyzed by scanning electron microscope (SEM), smear layer on root canal walls appears as an irregular amorphous mass with grained surface. Most researchers agree that extensive instrumentation of root canal subsequently is leading to formation of smear layer, which means that thickness of the layer depends on instrumentation. Common depth of superficial sublayer is 1-2 μm, while the depth of the sublayer impressed into dentinal tubules may be up to 40 μm.

**Smear layer removal**

Another study investigated that efficacy of various concentrations of sodium hypochlorite as a root canal irrigant prior to the use of MTAD as a final rinse to

**TABLE 1 ILLUSTRATES ADVANTAGES AND DISADVANTAGES OF RECENT IRRIGATING SOLUTIONS USED DURING ROOT CANAL TREATMENT**

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>MTAD</th>
<th>NaOCl</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shelf life stability</td>
<td>+</td>
<td>–</td>
</tr>
<tr>
<td>Antimicrobial activity</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Ability to remove smear layer</td>
<td>+</td>
<td>–</td>
</tr>
<tr>
<td>Biocompatibility</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Ability to dissolve pulp tissue</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Dentin conditioning properties</td>
<td>+</td>
<td>–</td>
</tr>
<tr>
<td>Positive effect on root canal seal</td>
<td>+</td>
<td>–</td>
</tr>
<tr>
<td>Negative effect on dentin structure</td>
<td>–</td>
<td>+</td>
</tr>
<tr>
<td>Upregulation of regional immune response</td>
<td>+</td>
<td>–</td>
</tr>
<tr>
<td>Application time (minutes)</td>
<td>5</td>
<td>40</td>
</tr>
</tbody>
</table>

(Root Canal Irrigants & Disinfectants. AAE Colleagues for Excellence Winter 2011)
eradicate the smear layer. Study results show that when MTAD is used for intracanal irrigation to eradicate the smear layer, a few organic remnants of smear layer remain scattered on surface of root canal walls. Efficacy of MTAD to entirely eliminate the smear layer is improved when small concentrations of sodium hypochlorite are used as intracanal irrigation prior to use of MTAD as a final rinse. Procedure does not appear to considerably modify the structure of dentinal tubules.17

Antibacterial

Torabinejad M, Shabahang S, Aprecio RM. et al. tested the ability MTAD to eradicate Enterococcus faecalis and comparing its effectiveness of sodium hypochlorite and ethylene diamine tetra acetic acid. Based on the results of this study, appears that capability of MTAD to eradicate most of smear layers and possesses enhanced bacterial action in contrast with NaOCl or EDTA when tested against Enterococcus faecalis.19

Shabahang S, Torabinejad M. et al, in another study compared the antimicrobial effect of MTAD with that of sodium hypochlorite (with and without EDTA) as a final irrigant on Enterococcus faecalis. On the behalf of these results, it shows that MTAD is successful final rinse for elimination of Enterococcus faecalis from human extracted teeth.13

Biocompatibility

Zhang W, Torabinejad M. et al. tested the cytotoxicity of MTAD compared with commonly used irrigants and medications. Study results, appears that MTAD is less cytotoxic than 3% H2O2, eugenol, Ca(OH)2 paste, 5.25% NaOCl, EDTA and Peridex. Results illustrates MTAD is more cytotoxic than 2.63%, 1.3% and 0.66% NaOCl.21

Torabinejad M, Shabahang S, Bahjri K. they compared levels of post-operative discomfort after cleaning and shaping of root canals using two protocols for removal of the smear layer. Result of this study, No patient developed severe swelling, pain or other side effects necessitating removal from this study. Mild pain decreased gradually in both groups over the seven days.22

Effect of MTAD on modulus of dentin and flexural strength of dentin

Machnick TK, Torabinejad M, Munoz CA, Shabahang S. evaluated the effect of MTAD on the flexural strength and modulus of dentin. The study reveals that the use of the clinical protocol for MTAD causes no adverse effects upon the physical properties of exposed dentin. The results in vitro study suggest that MTAD possesses most of the positive qualities of an ideal root canal irrigant.23

Bond strength

Machnick TK et al. compared effect of phosphoric acid and MTAD on bond strength toward enamel by conventionally Bond dentin adhesive system. According to the study findings, it appears that teeth endodontically treated with MTAD procedure for clinically use (20 minutes 1.3% NaOCl 5 minutes with MTAD) may not need further conditioning prior to use of the dental adhesive.24 Hence, MTAD enhanced abilities to disinfect the root canal system, effectively eliminating Enterococcus faecalis, eradicating the smear layer, and preparing the dentin surface for bonding may not require further conditioning before the application of the dental adhesive.24

Coronal leakage

Park DS, Torabinejad M et al. compared the effect of the BioPure MTAD antibacterial root canal cleanser to that of other materials for preventing coronal leakage. Numerically, the EDTA group had more microleakage than the BioPure MTAD group, but the difference was not statistically significant.25 while the antimicrobial property of MTAD is comparing with NaOCl and EDTA using Standard in vitro microbiologic methods, MTAD was considerably more effective.22

Another study illustrate that efficacy of MTAD to entirely eradicate the smear layer is superior while small concentrations of NaOCl used intracanal irrigate earlier than MTAD. The procedure does not seem to significantly change the structure of dentinal tubules,17 post-operative discomfort and side effects.22

CONCLUSION

It is concluded that NaOCl and MTAD are effective as irrigating solutions but MTAD is better as compared to NaOCl for removal of smear layer and for greater antibacterial effects for infected root canals.

REFERENCES

5. Siqueira JP Jr, Rôças IN, Favieri A, Lima KC. Chemomechanical reduction of the bacterial population in the root canal after
Comparison of sodium hypochlorite instrumentation and irrigation with 1%, 2.5%, and 5.25% sodium hypochlorite. J Endod 2000; 26: 331-34.


