

STUDY ON THE PROPERTIES OF A NEW IRRIGANT USED IN THE ENDODONTIC THERAPY FOLLOWED BY PROSTHETIC RESTORATIVE TREATMENT

- A LITERATURE REVIEW-

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ABSTRACT

The purpose of endodontic therapy is the most judicious decontamination of the endodontic space and its subsequent sealing through a tight filling of the canal. In this sense, obtaining the permeability of the root canal system is essential. Of the irrigating solutions valid for endodontic use can be mentioned: NaOCl, EDTA, chlorhexidine, potassium iodide (IKI). However, none of these irrigants meet the ideal requirements, each having the advantages and disadvantages of their own. Materials and method: A number of 34 articles ranged from 2003 to 2015 were analyzed, in view to assess the cleaning effect and the antibacterial properties of the MTAD, the newer irrigant used in the chemomechanical endodontic treatment. Conclusions: The studies have demonstrated the efficacy of MTAD as an antimicrobial agent, being very effective in removing the smear layer from the instrumented canal walls and favoring further adhesive restorative and prosthetic procedures.

Key words: Endodontic irrigant, MTAD, chemomechanical treatment, prosthetic restoration

INTRODUCTION:

Obtaining the permeability of the root canal system is essential in having a long term success of the endodontic treatment. This goal can be achieved by biomechanical and chemical irrigation and instrumentation, the irregularities of the canal system preventing

permeability through just mechanical instrumentation [1]. In addition, microorganisms considered responsible for pulpal and periapical pathology are present not only in root canals but also in dentinal tubules at different depths. For these

reasons, chemical irrigation is of critical importance [2].

Of the irrigating solutions valid for endodontic use, we can mention NaOCl, EDTA, chlorhexidine, potassium iodide (IKI). However, none of these irrigants meet the ideal requirements, each with its own advantages and disadvantages. In recent years, a new irrigant has imposed itself as an effective endodontic solution [3].

This is a mixture of 3% doxycillin - a bacteriostatic antibacterial agent of the tetracycline class, 4.25% citric acid - a demineralizing agent and 0.5% polysorbate 80 (Tween 80) [4], a detergent that lowers surface tension and increases the antimicrobial effect of different irrigation solutions. It is commercially available as a bi-component product under the name BiopureMTAD, Dentsply.

The antimicrobial effect: As is known, MTAD contains doxycycline, which has a bacteriostatic effect by inhibiting the protein synthesis and reversible binding to ribosomal subunits. [5] The bacteriostatic effect may be advantageous by preventing bacterial cell lysis, thus avoiding the release of endotoxins. [6] In this way, the affinity of doxycycline for hydroxyapatite makes the antibacterial effect prolonged. [7]

Torabinejad et al. [8] have studied the antimicrobial efficacy of MTAD in vitro on *Enterococcus faecalis* comparing its efficacy with 2.5% NaOCl and EDTA. The last one did not show antibacterial activity against *E. faecalis*, while NaOCl and MTAD have shown varying degrees of antibacterial efficacy. NaOCl continued to exert its effect up to 32x dilution, while MTAD was

MTAD inhibited most strains of *E. faecalis* growth when diluted 1:8192 times and killed most strains of *E. faecalis* when diluted 1:512 times.

Torabinejad and Shabahang [9] have shown that the association of 1.3% NaOCl as initial canal irrigant with MTAD as the final irrigant was significantly more effective against *E. faecalis* than other regimens. On the other hand, Newberry et al. [10] have shown that MTAD associated with 1.3% NaOCl was effective in completely inhibiting the growth of 7 of 8 subtypes of *E. faecalis*. The CMI tests showed that MTAD inhibited most *E. faecalis* serotypes when diluted 1: 8192 and killed most serotypes when diluted 1: 512.

Similarly to those mentioned above, Davis et al. [11] found that MTAD showed significantly more microbial inhibition sites for *E. faecalis* than NaOCl, CHX.

In contrast to the studies mentioned, subsequent research showed less than optimal microbial activity. Kho and Baumgartner [12] demonstrated that there is no difference between antimicrobial efficacy in irrigation with 5.25% NaOCl / 15% EDTA vs. irrigation with 1.3% NaOCl / MTAD in the last 5 mm apical infected with *E. faecalis*. Dunavant et al. [13] found that 6% and 1% NaOCl were significantly more effective in eliminating *E. faecalis* biofilms than other irrigants such as 2% CHX, MTAD and EDTA.

A study by Baumgartner et al. [14] found that there was no increase in *E. faecalis* in canals irrigated with 5.25% NaOCl / 15% EDTA, while 50% of canals

irrigated with 1.3% NaOCl / MTAD showed the presence of *E. faecalis*.

Giardino et al [15] comparing the antimicrobial efficacy of 5.25% NaOCl, MTAD and Tetraclean on *E. faecalis* biofilms found that only 5.25% NaOCl could disintegrate biofilm at any time, and Tetraclean demonstrated a greater degree of disintegration of biofilm at any interval versus MTAD. Stojic S et al. [16] showed that MTAD and CHX are inferior to 2% NaOCl and QMix solutions for antibacterial activity against *E. faecalis* planctonic and from biofilm. Ruff demonstrated that irrigation solutions of 6% NaOCl and 2% CHX were equally effective and superior to MTAD and 17% EDTA in antifungal activity. [17]. However, Mohammadi [18] found greater substantivity of MTAD versus 1.3% NaOCl and 2% CHX. The antifungal property of MTAD has been kept in the root canal dent for at least 28 days.

Lei Lei [19] et al. studying the MTAD effect associated with endosonic irrigation in the disintegration of *E. faecalis* biofilm found that after 30 seconds of application of MTAD ultrasound showed more viable bacteria vs. 5.3% NaOCl, 17% EDTA and 1.3% NaOCl / MTAD. However, at a 60 second ultrasound application there was no statistically significant difference between the three groups. In 2009, a radiological clinical trial on the antibacterial efficacy of MTAD in teeth with apical periodontitis was published. Gevik Malkhassian et al. [20] concluded that MTAD final irrigation and 2% CHX medication did not reduce the number of

bacteria at lower levels than those obtained with irrigation of the NaOCl channel.

The effect on smear layer (SL)

Torabinejad et al. [21] showed that MTAD effectively removes SL and does not significantly alter dentinal tubing structure when used after 5.25% NaOCl compared to EDTA irrigation and 5.25% NaOCl. Park et al. [22] evaluating the effect of SL removal with MTAD on coronal accessory canals obstruction, found that MTAD-treated teeth indicated a lower microleakage than teeth treated with EDTA, although the difference was not statistically significant.

Ghoddusi et al. [23] did not find a difference in the microleakage of teeth to which SL was removed with MTAD or EDTA, while De-Deus et al. [24] reported significantly faster dissolution of the inorganic material than 5% citric acid and MTAD compared to 17% EDTA. Beltz et al. [25] found that MTAD has a solubilization capacity of organic and inorganic material in dentin, as well as organic pulp material similar to EDTA. Lei Lei [26] et al. studied the effect of MTAD associated with endosonic irrigation in the disintegration of *E. faecalis* biofilm and the removal of SL in the confocal laser scanning microscope. MTAD and 1.3% NaOCl / MTAD appeared to preserve dentinal surface structure without erosion, effectively removing the smear layer.

The effect on dental structure

Some authors have suggested that irrigating solutions could affect the dentine structure and thus the adhesion strength. [27] Tay et al [28] investigating mechanically instrumental intranadicular dentine after

MTAD irrigation showed that both EDTA and MTAD exposed the collagen matrix in the eroded dentin and around the dentinal tubules. MTAD being slightly more acidic, was more aggressive than EDTA.

According to Garcia -Godoy et al. [29] both MTAD and EDTA determined the collapse of the dentinal matrix hindering sealing infiltration and the formation of a well-represented hybrid layer. But De-Deus et al. [30] comparing the effect of different irrigant chelating solutions on adhesion strength showed that teeth treated with 17% EDTA, MTAD or only 1.25% NaOCl, had lower values than teeth treated with 18.1% etidronate chelating solution.

Biocompatibility

Zhung and Torabinejad [31] studying the cytotoxicity of MTAD, 3% H₂O₂ and 5.25% NaOCl or demonstrated that 5.25% NaOCl is 195x more cytotoxic than MTAD and 3% H₂O₂ 50x more cytotoxic. Ring, [32] also found that cytotoxicity of MTAD is slightly lower than that of NaOCl, indicating MTAD biocompatibility.

Torabinejad et al [33] demonstrated in an in vivo study that the clinical protocol of 1.3% NaOCl / MTAD did not have an increased incidence of postoperative pain compared to 5.25% NaOCl and 17% EDTA. However, despite good biocompatibility, MTAD showed the lowest number of viable dental cells attached to the root canal, cells that would play a role in pulp regeneration. The same effect was found on the attached cells on the root surface [34] This suggests that MTAD can not be the choice irrigant in pulp revascularization techniques.

Avantages

- Reasonable antimicrobial activity
- More efficient SL removal
- Fewer adverse effects on dental structure (low erosion)
- More effective in promoting adhesion to dentin
- The least cytotoxic.

Disadvantages

- As a tetracycline derivative has an intrinsic pigmentation potential during odontogenesis, leading to coloration in temporary and permanent dentition
- It is more expensive than other jerks
- Prepare ex tempore; Once prepared, the availability is up to 48h even if it is refrigerated, less than other irrigants
- Not indicated in revascularization techniques.

Conclusions:

1. In vitro studies have demonstrated the efficacy of MTAD as an antimicrobial agent, but studies in clinical settings have shown less antimicrobial activity.
2. MTAD is an effective solution for removing SL from instrumental channels when used in conjunction with NaOCl. Also, the ability to dissolve pulp tissue seems to be advantageous.
3. MTAD favors adhesive restorative procedures
4. MTAD is biocompatible
5. It does not negatively affect the physical properties of the tooth

It can therefore be concluded that MTAD is a promising irrigation solution, but further clinical studies are needed to establish it as an ideal irrigant.

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