

Mixture Tetracycline Citric Acid and Detergent (MTAD): A Root Canal Irrigant

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ABSTRACT

Background: Root canal irrigants play an indispensable role for the complete disinfection of the root canal system. Sodium hypochlorite, Ethylene Diamine Tetra Acetic acid, Hydrogen peroxide and Chlorhexidine gluconate were commonly used root canal irrigants in endodontic practice, but they do not satisfy all the properties of an ideal root canal irrigant. BioPure MTAD (Mixture Tetracycline citric Acid and Detergent) (Dentsply, Tulsa Dental, Tulsa, OK) is a newer root canal irrigant. In this review article, we aimed to provide the composition, manipulation, mechanism of action, biocompatibility, antimicrobial efficiency, effect on endodontic smear layer, advantages and disadvantages of MTAD.

Keywords: BioPure MTAD, Biocompatibility, Antimicrobial efficiency.

INTRODUCTION

Root canal system becomes a privileged site for microorganisms and its by-products.¹ Because of the presence of irregularities in the root canal system, narrow isthmi and apical deltas, which prevents complete debridement by mechanical instrumentation alone. Thus chemical disinfection of the root canal system by the use of root canal irrigants becomes a critical adjunct in root canal treatment.²

According to Ingle,³ a root canal irrigant needs to have certain properties like antibacterial activity, ability to dissolve organic tissues, smear layer removal, should be non toxic to the periapical tissues, biocompatible and should aid for complete debridement of the root canal system.

Composition of BioPure MTAD:⁴

BioPure MTAD (Mixture Tetracycline citric Acid and Detergent) is commercially available in powder-liquid system. [Figure No: 1]



Fig 1: BioPure MTAD (Mixture Tetracycline citric Acid and Detergent)

Part-A is liquid and is supplied in syringes (single dose of 5ml and multiple dose of 20ml).

The liquid contains 4.25% citric acid and 0.5% polysorbate 80 detergent (Tween 80). Citric acid helps in the removal of smear layer. Tween 80 is known to decrease the surface tension and increase the antimicrobial effect of various root canal irrigants.⁴

Part-B is powder and is supplied in bottles (single dose of 150mgs and multiple dose of 600mg).

It contains 3%Doxycycline hyclate, being a bacteriostatic antibiotic, does not kill the bacteria,

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but it prevents the multiplication of many susceptible bacteria. The bacteriostatic property is advantageous as in the absence of bacterial cell lysis, antigenic by-products (endotoxins) are not released.⁴ Single doses are used in teeth with single canal and multiple doses are used in teeth with multiple canals. MTAD is highly effective as an intra canal irrigant only when used in full dosage that is 5ml per root canal.⁴

Manipulation of BioPure MTAD:⁴

Depending upon the number of root canals to be irrigated, single or multiple doses of MTAD should be selected. The nozzles of the syringe containing liquid and the bottle containing powder are snugly fit. Slowly and steadily the entire liquid from the syringe should be injected into the bottle containing powder. With the syringe still attached to the bottle, gently shake the combination back and forth for upto 60 seconds for the complete assimilation of powder and liquid. Never vigorously shake the combination as it may cause bubble formation which may hinder the MTAD to reach into the entire root canal space. Now withdraw the mixed component from the bottle into the syringe slowly. And if we notice any powder particles suspended in the liquid, then the solution is injected back into the bottle and is shaken gently back and forth for 30 seconds until the entire powder particles gets completely dissolved in the liquid and the final solution which is obtained appears yellowish in colour.

Now the syringe is separated from the bottle and a 28 gauge needle with side vented bore which comes along with MTAD is fixed to the nozzle of the syringe. The solution should be passively injected into the root canal space depositing upto 1ml of the MTAD close to the root apex. Now agitate the solution with a No:15 K-file for 5 min after which the entire solution is suctioned out followed by irrigating the canal space with the remaining 4ml of the MTAD for 5 min.

Mechanism of action of BioPure MTAD:

The P^H of MTAD is 2.15,⁵ so it contributes to its role as a calcium chelator, thereby causing enamel and root surface demineralization; the extent of dentin surface demineralization is comparable to that of

citric acid, and it mainly removes the inorganic substances.^{6,7}

MTAD contains Citric acid and Tween 80. Citric acid is a crystalline organic acid, antibacterial and helps in removal of smear layer in concentration of 10% and 25%, thus helping for the deeper penetration of doxycycline into the dentinal tubules and exerts its antibacterial action.⁸ Tween 80 (Polyoxyethylene sorbitan monooleate), is a detergent present in MTAD and is a nonionic surfactant, helps in reducing the surface tension of distilled water, Sodium hypochlorite, EDTA, thereby enhancing the flow and penetration of irrigating solutions deeper into the dentinal tubules and thus completely disinfecting the canal spaces. P^H of MTAD is 7.0 and is a biologically acceptable material.^{9,10,11}

MTAD also contains Doxycycline hyclate in powder form¹² and is a broad spectrum antibiotic effective against wide range of microorganisms. It is an isomer of tetracycline, a variation in structure but not in its composition. Tetracyclines acts by inhibiting protein synthesis by reversibly binding to the 30s ribosomal subunits of susceptible microorganisms.

Antimicrobial efficiency of BioPure MTAD:

MTAD contains tetracycline which is bacteriostatic, as they prevent the growth of microorganisms, this property is advantageous as in the absence of bacterial cell lysis, antigenic by-products (endotoxins) are not released. Tetracycline also shows the property of substantivity as it can be absorbed and gradually released from tooth structures such as cementum and dentin, also shows anticollagenase activity.

Franklin R.Tay et al⁴ demonstrated that the use of 1.3% Sodium hypochlorite as an initial root canal irrigant followed by the use of MTAD as a final irrigant resulted in 30% reduction in the antimicrobial substantivity of MTAD, but it was seen that erosion of dentinal tubules was less when compared to that of when MTAD was used as an initial root canal irrigant.

Torabinejad M et al¹³ studied the antimicrobial efficiency of MTAD by an in-vitro investigation. The purpose of this investigation was to test the ability of MTAD to kill *Enterococcus faecalis* and compare

its efficacy to that of 2.5% Sodium hypochlorite and Ethylene Diamine Tetraacetic Acid (EDTA). The zones of inhibition and minimum inhibitory concentrations were measured for these root canal irrigants. EDTA demonstrated no antibacterial effects against *E. faecalis*, Sodium hypochlorite and MTAD proved to be antibacterial to varying degrees. Sodium hypochlorite continued to exert its efficacy up to 32X dilutions. On the other hand, MTAD was effective in killing *E. faecalis* up to 200X dilutions. The results showed that MTAD has superior antibacterial activity compared with 2.5% or 5% Sodium hypochlorite or EDTA when tested against *E. faecalis*.

Newberry BM et al¹⁴ showed that MTAD in conjunction with 1.3% Sodium hypochlorite was effective in completely eliminating growth in 7 of 8 strains of *E. faecalis* bacteria. The minimum inhibitory concentration tests showed that MTAD killed most strains of *E. faecalis* growth when diluted to 1:512 times. Davis JM et al¹⁵ found that MTAD showed significantly more zones of microbial inhibition of *E. faecalis* than sodium hypochlorite and chlorhexidine gluconate.

Effect of BioPure MTAD on endodontic smear layer:

Torabinejad M et al⁵ studied the effect of various concentrations of sodium hypochlorite on the ability of MTAD to remove the smear layer and it was found that MTAD removed most of the smear layer when used as an intracanal irrigant with some remnants of the organic component of the smear layer remain scattered on the surface of root canal walls.

Torabinejad M et al⁵ reported that the effectiveness of MTAD to completely remove the smear layer from the walls of the root canal is enhanced when lower concentrations of sodium hypochlorite were used as an initial root canal irrigant followed by the use of MTAD as a final irrigant. Torabinejad M et al¹² found that the sequential use of 1.3% sodium hypochlorite as initial root canal irrigant followed by the use of MTAD as final root canal irrigant was more effective against *E. faecalis* compared to the use of 5.25% sodium hypochlorite and 17% EDTA.

Biocompatibility of BioPure MTAD:

In choosing a root canal irrigant, biocompatibility should be a major consideration. Wu Zhung et al¹⁶ studied the cytotoxicity of MTAD, 3% Hydrogen peroxide and 5.25% Sodium hypochlorite and demonstrated that 5.25% Sodium hypochlorite is about 195 times more cytotoxic than MTAD and 3% Hydrogen peroxide is 50 times more cytotoxic than MTAD and concluded that the cytotoxicity of MTAD is very minimal as evaluated by MTT-Tetrazolium Assay.

Instructions for the use of MTAD¹²:

1. Unmixed powder and liquid should always be stored at room temperature away from direct sunlight.
2. Mixed solution can be stored for 48 hours if refrigerated.
3. For a single canal disinfection, 5ml of MTAD should always be used, failure to do so reduces its clinical efficiency.
5. MTAD should never be washed out but only suctioned out from the root canal.
6. It should always be the last irrigant to be used in the root canal space.
7. It is contraindicated in pregnancy, in children below 8 yrs of age and in patients who are sensitive to doxycycline.

Advantages of BioPure MTAD:

1. It is biocompatible with least cytotoxicity and high antimicrobial efficiency.
2. It is found to be highly effective against *E. faecalis* bacteria and in refractory root canal infections.
3. Do not cause any irritation to the periapical tissues even if it is extruded into periapical area.
4. Causes minimal erosion of dentinal tubules.

Disadvantages of BioPure MTAD:

1. MTAD, a tetracycline derivative has the ability to intrinsically stain teeth during odontogenesis, can chelate calcium ions and get incorporated into teeth, resulting in the discolouration of both primary and permanent dentitions.¹¹
2. Contraindicated in pregnancy.
3. MTAD is expensive when compared to the other commonly used root canal irrigants.

4. MTAD (once the liquid component is mixed with the powder) it has a short shelf life and should to be used within 48 hours even if refrigerated.

CONCLUSION

BioPure MTAD is a highly efficient and biocompatible root canal irrigant, with potential antibacterial substantivity and it represents an innovative approach in simultaneous removal of endodontic smear layer and disinfection of the root canal system. It is highly potent against *Enterococcus faecalis* bacteria in refractory root canal infections. BioPure MTAD is a promising root canal irrigant in endodontic practice.

CONFLICTS OF INTEREST

The authors declare they have no potential conflict of interests regarding this article.

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