

EVALUATION OF EFFICACY OF MTAD AND EDTA BASED ROOT BIOMODIFIER ON PERIODONTALLY INVOLVED TEETH – A SEM STUDY

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Abstract

Background: Tooth surface modification by root conditioning results in improved connective tissue attachment and advancement in the the goal of reconstructive periodontal treatment.

Aim: Evaluation and comparison of novel root canal irrigant- MTAD and QMix on periodontally involved teeth.

Settings and design: 30 teeth were collected and stored in saline. By making two parallel grooves with a cylindrical bur under copious saline irrigation, samples were taken from the cervical third of the root. First groove is prepared at cemento-enamel junction and another 7 mm apical to it. Root surfaces of the teeth were scaled with an ultrasonic scaler and thoroughly planed with #1-2, 3-4 Gracey curettes for the elimination of all the diseased cementum. The dentin sample of dimension 4 mm x 6 mm were prepared and stored in normal saline before use.

Materials and method: Samples were randomly divided into three groups: BioPure MTAD™, QMix™ 2 in 1 and saline. Specimens were actively burnished for 3 min and following treatment, were prepared for scanning electron microscopy and examined at 5000X magnification. Samples were scored according to sampaio's index. Mann - Whitney U test and chi square tests were being applied.

Results and conclusion: BioPure MTAD™ is most efficient in removing the smear layer and showed significant dentinal tubules opening followed by QMix™ 2 in 1 and saline.

Keywords: BioPure MTAD™, QMix™ 2 in 1, saline, scanning electron microscopy

Introduction

Root surface debridement is carried out to facilitate reattachment of gingival and connective tissue to the periodontally affected root surfaces.¹ However, root surfaces will be covered by smear layer, when root planing is done with or without flap procedure. Smear layer inhibits migration and proliferation of fibroblasts and prevents new attachment of periodontal fibres.²

When observed under scanning electron microscope (SEM), smear layer appear as an amorphous, granulated, and irregular layer covering the root surface. It consists of organic (bacteria, odontoblastic processes and blood cells) inorganic material (phosphate, calcium) and bacterial products (exo and endotoxins) which results in hypermineralization of root surface which might function as a physical barrier to connective tissue to the root surface growth.³

Root biomodifiers have been found to be effective in eliminating adherent inorganic and organic material and toxins retained from the altered root surface. Moreover, they have shown to expose cementum bound proteins and dental collagen which results in a root surface which is conducive in promoting periodontal regeneration.³ Doxycycline hydrochloride, citric acid, sodium hypochlorite, tetracycline hydrochloride, phosphoric acid, ethylenediamine tetraacetic acid (EDTA), Cohn's factor, fibronectin, laminin, Stannous fluoride etc are some of the chemicals used for root conditioning.⁴

BioPure MTAD (Dentsply Tulsa Dental, USA) is a material developed for use during endodontic treatment as a final irrigant for the removal of smear layer from the walls of root canal prior to filling of root canal. It is a mixture of doxycycline (a tetracycline isomer), citric acid and polysorbate 80 (a detergent).¹ The unique properties of MTAD contribute to its status as an endodontic irrigant seems to be transferable to the conditioning process in the periodontal therapy.⁵

QMix™ 2 in 1 is a novel endodontic irrigant for smear layer removal with added antimicrobial agents. It contains EDTA, chlorhexidine and a detergent.⁶ It is a clear solution, which is ready to use with no chair side mixing. QMix™ was evaluated as an effective irrigant similar to 17% ethylenediamine tetraacetic acid (EDTA) in canal wall smear layer removal after using 5.25% NaOCl as a final rinse.⁷

On the basis of above facts, the present in vitro study was aimed to evaluate and compare novel root canal irrigant and other root biomodifiers for smear layer removal on periodontally involved teeth.

Methods

The study sample consisted of 30 freshly extracted single- rooted periodontally compromised teeth with hopeless prognosis and caries free root surfaces. The teeth with wasting diseases, tooth fracture, endodontically treated, and prosthodontically restored were excluded from the study. Following extraction samples were stored in normal saline.

Inclusion criteria

- Periodontally compromised teeth

- Caries free root surfaces
- Teeth with hopeless prognosis

Exclusion criteria

- Teeth with wasting diseases
- Fractured teeth
- Endodontically treated teeth
- Prosthodontically restored teeth

Extraction samples were stored in normal saline.

(a) Preparation of samples

Two parallel grooves were made with a cylindrical bur under copious saline irrigation and 30 samples were obtained from the cervical third of the root. One groove is prepared at cemento-enamel junction and another at 7 mm apical to it. All the teeth with diseased root surfaces were scaled with ultrasonic scaler and thoroughly planed with #1-2, 3-4 Gracey curettes (Hu-Friedy) to remove the entire diseased cementum. The samples were obtained first by transverse sectioning the root from the grooves. The dentin sample of dimension 4 mm x 6 mm were prepared. In such way 30 dentinal blocks are obtained and stored in normal saline before use. The allocation of samples to specific groups was done using Lottery method.

Total 30 samples were divided into 3 groups:

Group 1: BioPure MTAD™

Group 2: QMix™ 2 in 1

Group 3: Saline

All the agents were applied on the curetted root surfaces by “active burnishing” for 3 min. The cotton pellets were changed after every 30 seconds to ensure consistent application of the solution. After treatment, samples were rinsed thoroughly with distilled water.

(b) Preparation of the samples for scanning electron microscopy

After chemical treatment, all the samples were dehydrated in graded series of ethanol (10 – 90%) and finally in 100% acetone for 30 min more. Samples were dried under the lamp, mounted on the aluminum stubs and inserted in SC7640 sputter coater machine for gold/palladium coating on specimens. Specimens were examined in a Polaron-SEM (Leo-430) at magnification of 5000X and photomicrographs were evaluated to found the extent of root biomodification by removing smear layer, patent dentinal tubules in relation to total number of dentinal tubules.

(c) Analysis of photomicrographs

Photomicrographs were distributed to calibrated trained blind examiners for the determination of degree of removal of smear layer according to the root surface modification index (Sampaio's index). The scores are as follows:

Score 1: Root surface without smear layer, dentinal tubules completely opened; no evidence of smear layer in the dentinal tubule gaps.

Score 2: Root surface without smear layer, dentinal tubules completely opened; evidence of smear layer in the dentinal tubule gaps.

Score 3: Root surface without smear layer, dentinal tubules partially opened.

Score 4: Root surface covered with smear layer, with uniform aspect; evidence of dentinal tubule gaps.

Score 5: Root surface covered with smear layer, with uniform aspect; no evidence of dentinal tubule gaps.

Score 6: Root surface covered with smear layer, with irregular aspect and presence of grooves and/or scattered debris.

Results

The Sampaio's index scores of group I, II, III ranged from 1- 2, 2- 3 and 5 – 6. Group I,II,III shows the score range of 1-2,3-4 and 5-6 (Figure 1,2,3). On applying Mann – Whitney U test significant difference was found between three groups ($p < .001$). Intergroup analysis of different groups was done using their mean ranks (Table 1). Mean rank of Group 1(MTAD) was significantly different and lower as compared to Group II (QMix) ($p < .001$). Similarly on comparing the mean rank of Group 2(QMix) and Group 3 (Saline), mean rank of group II (QMix) was found to be significantly lower as compared to Group III (Saline) ($p < .001$). Mean rank of group 1 (MTAD) was found to be significantly lower as compared to group III (Saline) ($p < 0.001$)

Discussion

The main aim of periodontal regeneration is to alter the root surface affected by periodontitis and make it a hospitable substrate to encourage and support migration, proliferation, attachment and proper phenotypic expression of periodontal connective tissue progenitor cells.⁸ However, the root surfaces affected by periodontitis are hyper-mineralised, contaminated with cytotoxic and other biologically active substances as such surfaces are not biocompatible with the adjacent periodontal cells, the proliferation of which is crucial for periodontal wound healing and it is not possible to decontaminate the root surface affected by periodontitis by mechanical mean alone.⁸

The surface which is instrumented will be covered by smear layer after root planing. This smear layer consist of remnants of dental calculus, contaminated root cementum and sub gingival plaque and bacterial endotoxins.⁹ It serve as a physical barrier between the periodontal tissue and root surface and may inhibit new connective tissue attachment formation to the root surface.¹⁰

Considering the above facts an effort has been made in this study to determine the surface characteristics of diseased root surface by conditioning with MTAD Biopure™, QMix™ 2 in 1 and saline under scanning electron microscope.

In the present study active burnishing of the samples with cotton pellet saturated with the respective conditioner is done and changed after every 30 seconds for a period of 5 minutes. Change pellets after every 30 seconds to apply a constant concentration of drug over the application interval. This procedure enhances a mechanical/chemical action which chemically loosens surface debris and inorganic material, thereby exposing underlying dentin to fresh acid resulting in demineralization.

SEM evaluation of efficacy of conditioned root surfaces revealed that smear layer removal by Biopure MTAD was better than QMix and saline. MTAD remove most of the smear layer

and possess superior bactericidal activity as compared to EDTA or NaOCl when tested against *E. faecalis*. Toribinejad et al¹¹ verified that 1% NaOCl proceeding MTAD can dissolve the organic portion of smear layer which covers the dentinal tubules after instrumentation which allows MTAD to dissolve the inorganic portion of smear layer, penetrate in to dentinal tubules and decalcify them.

The score achieved in group B showed significant effect of QMix on removing smear layer than the control group (Saline) which is according to the study done by Shewale A et al, 2015.⁸ The advantages of QMix may be because of its various effective components, such as CHX, EDTA and a detergent (surface active agent). Dai et al.¹² reported that QMiX was equally effective when compared with 17% EDTA in removal of smear layer. Stojicic et al¹³ evaluated the efficacy of a novel root canal irrigant, QMix, against *E. faecalis* and the ability for smear layer removal was examined, using SEM and they concluded that NaOCl and QMix were superior to MTAD and CHX under laboratory conditions in *E. faecalis* killing and the ability of smear layer removal by QMix was comparable to EDTA.

The score achieved in saline showed that it does not have any influence on the removal of smear layer which is been proved by the highest score as supported by the earlier studies by McComb et al¹⁴, Baumgartner et al¹⁵ in permanent teeth and Salama et al¹⁶ in primary teeth.

Conclusion

Root conditioning agents used in the study were found to be effective in the smear layer removal, uncovering and widening dentinal tubules. However, among the three groups, the results were best in Biopure MTAD showing that BioPure MTAD is best suited to be used as a root conditioning agent.

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Table 1: Intergroup analysis of different groups using their mean ranks

Comparison	Groups	No. of Specimens	Mean Rank	Mann Whitney U	P value
1	Group1 MTAD	10	5.80	3.00	.001
	Group2 QMIX	10	15.20		
2	Group1 MTAD	10	5.50	0.00	.001
	Group3 Saline	10	15.50		
3	Group 2 QMIX	10	5.50	.00	.001
	Group3 Saline	10	15.50		

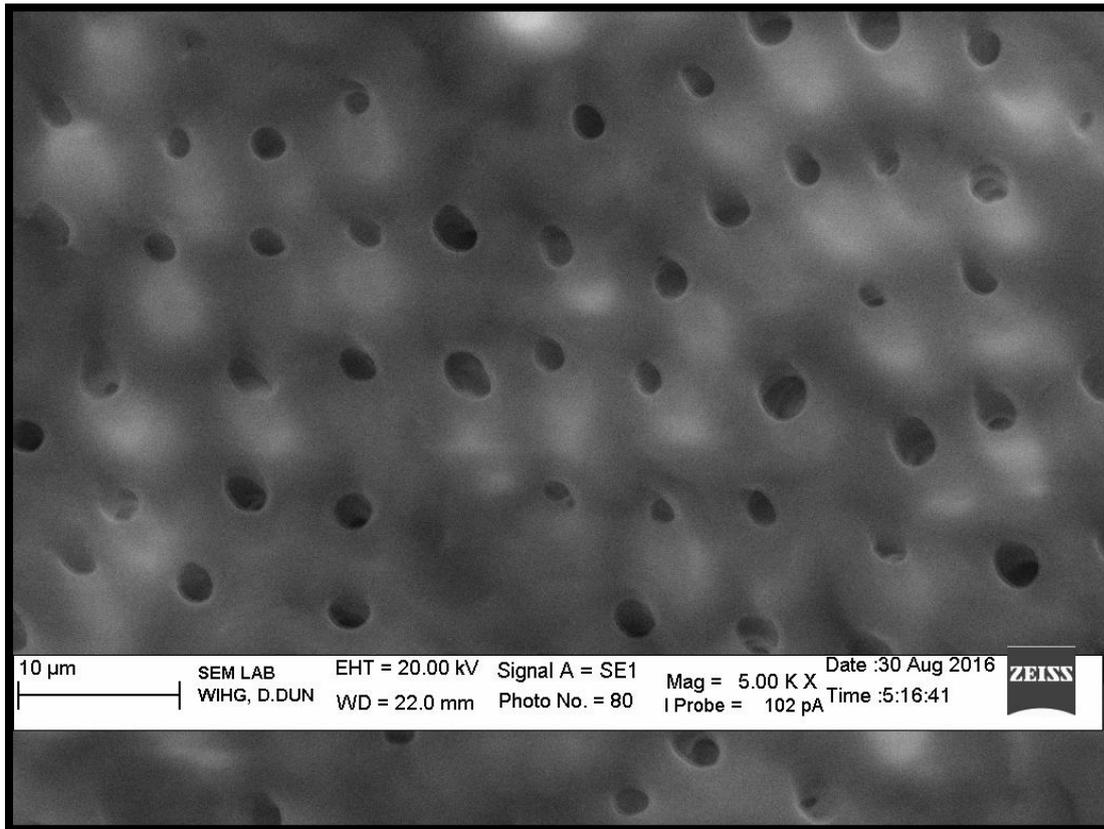


FIG 1: ROOT SURFACE WITHOUT SMEAR LAYER, WITH DENTINAL TUBULES COMPLETELY OPENED; NO EVIDENCE OF DENTINAL TUBULE GAPS (SCORE 1)

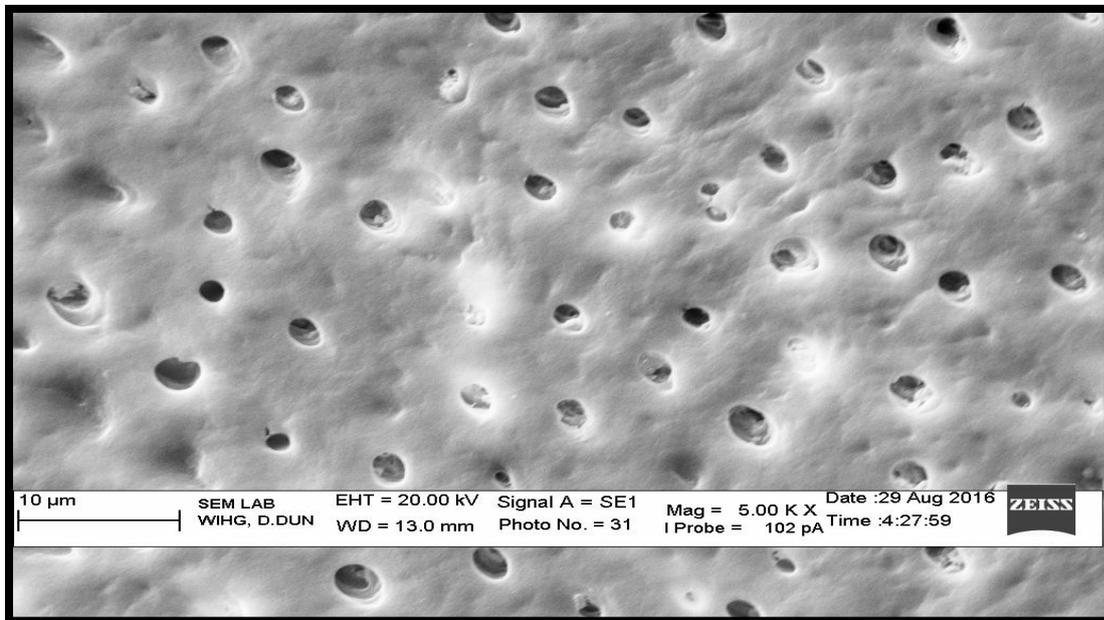


FIG 2: ROOT SURFACE WITHOUT SMEAR LAYER, WITH DENTINAL TUBULES PARTIALLY OPENED (SCORE 4)

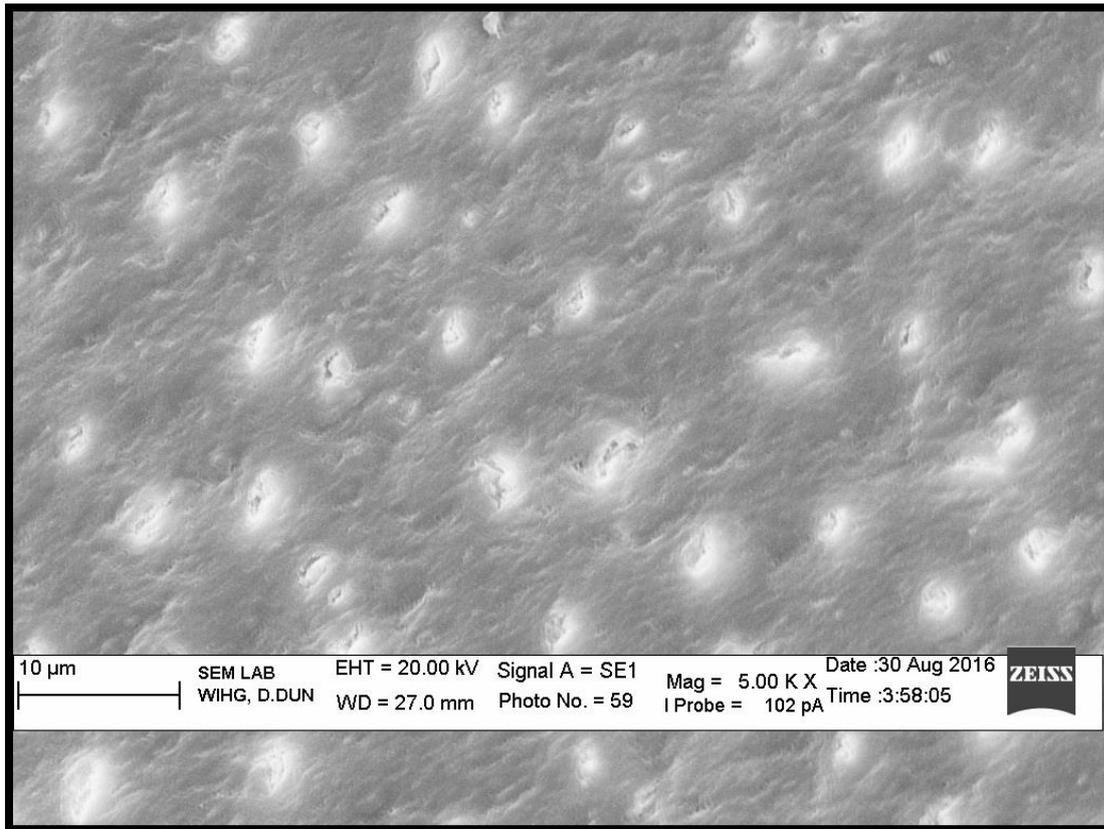


FIG 3: ROOT SURFACE COVERED WITH SMEAR LAYER, WITH IRREGULAR ASPECT AND PRESENCE OF GROOVES AND/ SCATTERED DEBRIS (SCORE 6)