

## **EFFECT OF BIOPURE MTAD, SODIUM HYPOCHLORITE AND EDTA ON DENTIN MICROHARDNESS: IN VITRO STUDY**

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### **ABSTRACT**

**Objectives:** The aim of this study was to evaluate the microhardness of root dentin wall before and after irrigation with BioPure MTAD, 17% Ethylenediamine tetra acetic acid (EDTA) and sodium hypochlorite (NaOCl).

**Study Design:** Sixty-four freshly human extracted single-rooted teeth was used in this study. The teeth were divided into 4 groups, according to the irrigating solution used as final rinse: group (1) BioPure MTAD, group (2) 17% EDTA, group (3) 5.25% NaOCL and group (4) control group (distilled water). The teeth were sectioned longitudinally and prepared for evaluation of microhardness of root dentine before and after irrigation with each irrigants which the baseline microhardness testing was carried out using Vickers Microhardness Tester.

**Results:** The results were statistically analyzed ( $p < 0.05$ ) showing significant difference between all the irrigating solutions in relation to the control group.

**Conclusion:** The EDTA and BioPure MTAD drastically reduced the microhardness of root canal dentin followed by NaOCL.

### **INTRODUCTION**

One of the primary objective in chemo mechanical preparation of the root canals in the endodontic therapy is debridement which include two phases: mechanical instrumentation and the use of irrigating solutions.<sup>1</sup> During the mechanical instrumentation a smear layer is produced which consists of inorganic and organic substances that cover the surfaces of root canal walls and occludes

the orifices of the dentinal tubules.<sup>2</sup> Many different irrigation solutions has been used to remove the smear layer such as a sodium hypochlorite (NaOCl) in a 1% to 5.25% concentration which is widely used in root canal treatment because it has antibacterial properties. Also, it has the ability to dissolve organic tissues. However, it has been shown to be ineffective in removing the entire smear layer when it used alone.<sup>3</sup> The use of chelating agents such as EDTA which is generally accepted as the most effective in

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removing the smear layer from the root canalwalls.<sup>2</sup> The removal of organic and inorganic material in the smear layer cannot be done by a single solution. Accordingly, alternate use of (EDTA) and (NaOCl) solutions have been advocated as an effective in removing the organic and inorganic remnants of smear layer.

Newly introduced irrigants such as BioPure MTAD could be beneficial in removal of the smear layer from root canal when used as a final rinse. The microhardness of the root canal dentin will be changed during the using of the irrigating solutions and chelating agents.<sup>4</sup>

Microhardness is defined as the resistance to local deformation, and its test based on the induced permanent surface deformation that remains after removal of the load.<sup>5</sup> Hardness measurements can be correlated with other mechanical properties such as fracture resistance, modulus of elasticity and yield strength. A stronger relationship exists between microhardness of dentin and the respective bond strength. So microhardness provides a first step toward predicting the behavior of dentin/restoration interfaces. Microhardness of crown dentine is somewhat harder than root dentine, but the dentine increased in hardness with age and also at area of caries or attrition than the normal.<sup>6</sup>

The aim of this study was to evaluate the microhardness of root dentin wall before and after irrigation with BioPure MTAD, EDTA 17% and sodium hypochlorite (NaOCl).

## MATERIAL AND METHODS

### Teeth selection:

Sixty-four freshly human extracted single-rooted teeth were used in this study. The teeth were cleaned from any soft tissue attachments and deposits and scaled to remove any hard deposits and calculus and stored in isotonic saline solution until use.

### Sample preparation

After preparing a conventional access preparation for each tooth by diamond bur using a high-speed (350,000 rpm) hand piece. The patency of each root canal was confirmed using #10K-flex file and inserted into the canal until just visible at the apex. One millimeter was subtracted from this length to establish the working length. Instrumentation of all root canals was performed by step-back technique up to size #35. During instrumentation, 10 ml 5.25% NaOCL was used as initial rinse, to ensure consistency of the control and experimental groups. The canals was then rinsed with 10 ml of sterile water to minimize potential interaction of NaOCL with the irrigants that will employed as a final rinses.

### Grouping of samples: (figure 1)

All samples was divided into 4 groups according to the final irrigation regmein as the following:

(A) Three experimental groups (each 16) whereby 5 ml final irrigation was preformed by BioPure MTAD (DentsplyTulsa, UK), 17% EDTA (ultradent Cairo, Egypt) and 5.25% NaOCL, each for 5 minutes respectively.

All groups were tested by using Vickers hardness tester to evaluate the microhardness of root dentine after irrigation with each irrigants.

(B) One control group (n=16) was irrigated with sterile distilled water.

### Methods of evaluation:

The experimental and control groups were sectioned longitudinally and prepared for evaluation of the microhardness of root dentine at baseline and after irrigation with each irrigants. In which the baseline microhardness testing was carried out using *Vickers hardness Tester*, The indentations were made with a Vicker's diamond indenter at a minimum of three widely separated locations. The locations were chosen in apical, middle, and cervical

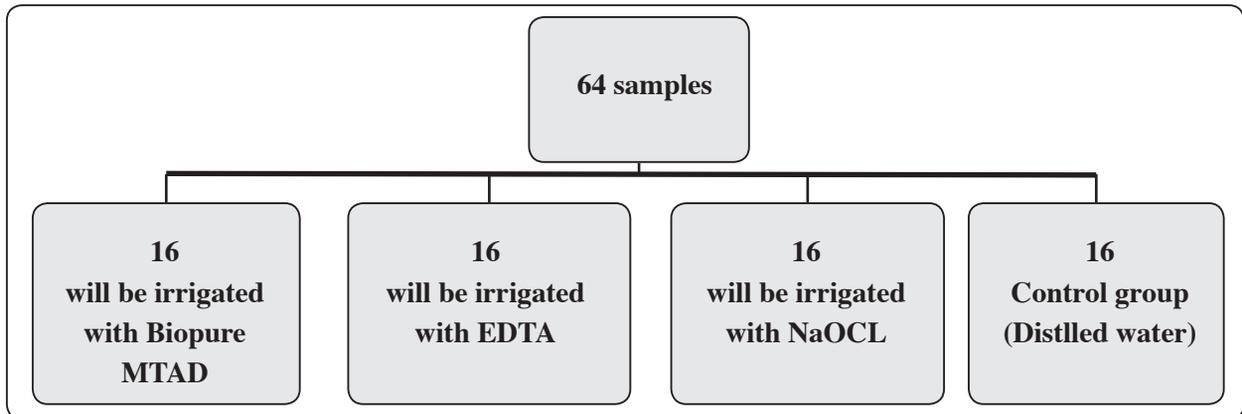


Fig. (1) Flowchart representing the grouping of samples in the present study.

region of the root canal wall. The indentations were made on the cut surface of each specimen using 300 g load and a dwell time of 20 seconds. The values were averaged to produce one hardness value for each specimen. These measurements were converted into Vicker's numbers. A 20 × objective lens to obtain pretreatment record for each individual half. The corresponding half of each root immersed in the tested solution for 5 minutes. The results were analyzed statistically using One-way analysis of variance (ANOVA) followed by Tukey HSD method which was employed to specify the significant groups. In this study, the level of significance was set as  $p \leq 0.05^2$ .

## RESULTS

MTAD, EDTA, NaOCL and the control group have the effect of decreasing the microhardness of the canal dentin surface but with different rate when compared to the measurements of the baseline. Baseline microhardness test was carried out using *Vickers Hardness Tester*, with a Vickers diamond indenter and a 20× objective lens to obtain pretreatment record for each individual half. The baseline measurements microhardness of canal dentin of surface ranged from 51.3 + 11.04 VHN to 55.8 + 10.06 VHN with no significant difference between the tested groups.

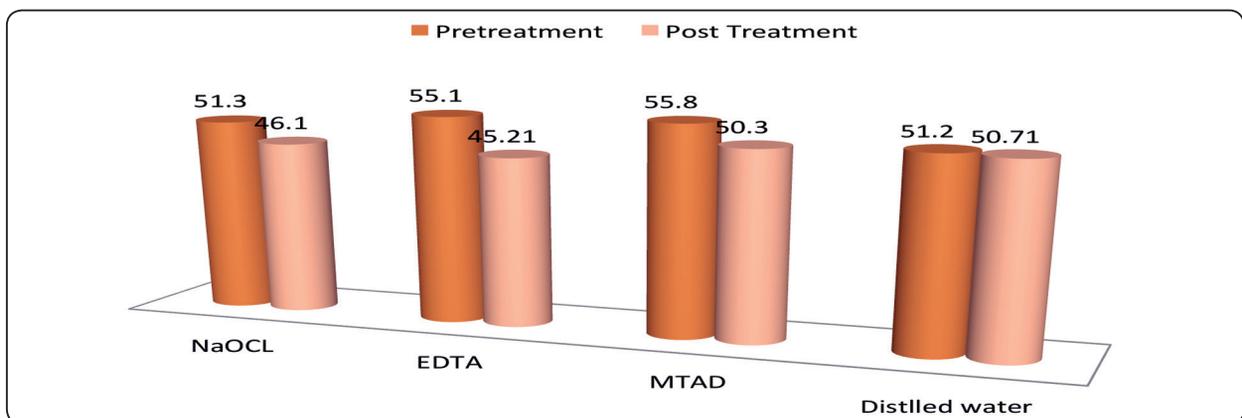


Fig. (2) Schematic diagram showing changes in microhardness values for the test groups. NaOCL, EDTA, MTAD and distilled water.

The value of the baseline microhardness for each sample was compared with its post-treatment value as shown in Fig. 2. The EDTA showed the greatest change in microhardness between the baseline and post-treatment measurements, the change equal (9.89) followed by MTAD (5.50), NaOCL (5.20) and Distilled water (0.49) which showed the least change in microhardness. The change in microhardness was calculated and represented in Table 1.

Statistical analysis using one-way (ANOVA) showed that EDTA, MTAD and NaOCl have a significant reduction in root dentin microhardness ( $P < 0.05$ ). Control group (saline) did not decrease the microhardness values significantly ( $P > 0.05$ ). EDTA caused the greatest reduction in root dentin microhardness ( $P < 0.05$ ). There was no significant difference found between MTAD and EDTA with changed in microhardness of root dentine ( $P > 0.05$ ), Table 1.

TABLE (1) Reduction values and one-way ANOVA for microhardness of canal dentin surface for irrigant solutions.

Group	Pre	post	Amount of reduction	ANOVA	
	treatment	treatment		Test	value
NaOCl	51.3	46.1	5.20	4.325	0.038 <sup>a</sup>
EDTA	55.1	45.21	9.89		
MTAD	55.8	50.3	5.50		
Saline	51.2	50.71	0.49		

*a: Significance, p-value < 0.05.*

**DISCUSSION**

The cleaning, shaping, disinfection and good three dimensional obturation are the most importance factors that responsible for the successful of root canal therapy. The use of the irrigants for cleaning the root canal is the most useful method

for removing the dentin debris and tissue remnants during mechanical instrumentation.<sup>7</sup> The most commonly irrigating solutions used for cleaning the root canal are NaOCl, EDTA, H2O2, Chlorhexidine and BioPure MTAD which is a newly introduced irrigant.

This study was aiming to evaluate the microhardness of root dentin wall before and after irrigation with BioPure MTAD, EDTA 17% and sodium hypochlorite (NaOCl).

Because of the variation in the microhardness between the teeth, the measurement of the microhardness of root dentine was performed for each sample at baseline and after treatment with the different irrigation solutions to establish a reasonable evaluation for the effect of the irrigant solutions on the root dentin surface.<sup>2</sup> After the treatment with different irrigation, the indentations were performed on each sample at same areas that were at symmetrical constant points of the baseline for both sides of the root canal to make evaluation of the tested irrigants by using vicker test.

The result of this study showed the greatest change in microhardness between the baseline and post-treatment measurements with the EDTA following by MTAD, NaOCL and Distilled water which showed the least change in microhardnes. In Previous studies showed significantly decrease in microhardness of root canal dentin after irrigation with sodium hypochlorite.<sup>4,15</sup> The reducing effect of EDTA on dentin microhardness has been reported by Kandil et al.<sup>2</sup>

Kalluru et al.<sup>10</sup> evaluate the microhardness of human dentin by using EDTA, MTAD and NaOCL and they suggested that there was no statistically significant difference in mean values between four experimental irrigating solutions. Oliveira et al<sup>13</sup> studied the evaluation of the effects of endodontic irrigants on the microhardness of root canal dentine using normal saline, 2% chlorhexidine gluconate solution and 1% sodium hypochlorite (NaOCl). Af-

ter 15 minutes of irrigation, dentine microhardness was measured on each section at 500  $\mu\text{m}$  and 1000  $\mu\text{m}$  from the pulp-dentine interface with a Vickers diamond microhardness tester in Vickers hardness number (VHN). The result was the Specimens irrigated with 2% chlorhexidine (group 2) or 1% NaOCl (group 3) presented lower values of dentine microhardness, with significant difference in relation to the control group ( $P < .05$ ). Goldberg et al<sup>12</sup> evaluated the effect on root dentine microhardness of 2.5% and 6% sodium hypochlorite solutions for various irrigation periods. Forty-two bovine roots were divided into seven groups. The control group was irrigated with saline. The experimental samples were continuously irrigated with 2.5% or 6% NaOCl for 5, 10, or 20 min. Microhardness was measured at depths OF 500  $\mu\text{m}$ , 1000  $\mu\text{m}$ , and 1500  $\mu\text{m}$  from the lumen. A decrease in microhardness was found at 500  $\mu\text{m}$  between the control and samples irrigated with 6% NaOCl and 2.5% NaOCl ( $p = 0.352$ ,  $p = 0.084$  respectively) at all irrigation periods. There also was a significant difference in groups irrigated for 10 or 20 min ( $p = 0.001$ ,  $p < 0.001$  respectively). At all distances, the decrease in microhardness was more marked after irrigation with 6% NaOCl than 2.5% NaOCl.

## CONCLUSION

All kind of irrigation solutions has effect in reducing the microhardness of the root dentine but with different values. The EDTA and BioPure MTAD drastically reduced the microhardness of root canal dentin followed by NaOCL, so it should be used carefully.

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