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An in- vitro evaluation the effect of endodontic irrigation solutions on the microhardness of root canal dentin.

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Abstract

The aim of this study was to evaluate the effect of 5.25 sodium hypochlorite and 17%EDTA on the microhardness of root canal dentin .

Fifteen, maxillary incisor teeth extracted for periodontal reasons were used. The crowns of the teeth were removed at the CEJ. The roots were separated longitudinally into two segments, embedded in acrylic resin, and polished. A total of 30specimens were divided into 3 groups of 10 teeth at random according to the irrigation solution used: group 1: 5.25% NaOCl for 1min; group 2: 17% EDTA for 1 min; and group 3: distilled water (control). Each group was submitted to Vickers microhardness indentation tests. The data were recorded as Vickers numbers and the results were analyzed statistically by using one-way ANOVA.

The results showed that, irrigation with either sodium hypochlorite or EDTA decreased the microhardness value of root dentin. Irrigation with EDTA gave more reduction of dentin compared to sodium hypochlorite. The reduction of VHN of dentin following the irrigation treatment was statistically significant ($p< 0.05$) .

Both sodium hypochlorite and EDTA irrigation solution significantly reduced the microhardness of root dentin.

Key word : Microhardness, irrigation, root dentin.

Introduction

The quality of root canal obturation depends on root canal preparation, root canal filling material and the filling technique used [(1)]. The final result will also be influenced by the amount of a removed smear layer. During root canal preparation, cut debris is smeared over the dentinal surface, forming a smear layer.

The smear layer has been defined as any debris composed of organic and inorganic particles of calcified tissue, necrotic tissue, odontoblast processes and microorganisms. It has been described by scanning electron microscopy (SEM) as an amorphous substance with an irregular surface. *Mc Comb and Smith1987* reported that the smear layer was only loosely attached to the root canal wall whereas other studies demonstrated that the smear layer adhered firmly to dentine because it was difficult to remove [(2)]. SEM studies have demonstrated that the smear layer covers the anatomical structures of the root canal. The smear layer thickness is not constant but ranges from 1 to 5 **µ**m; *Goldmann et al 1988*. found that it varied between10–15 **µ**m [(3)]

The smear layer composition has usually been studied in relation to the possibilities of its removal [4]. It has become apparent that only agents combining both organic and inorganic solvents can effectively and totally remove smear layers [5] The need for an irrigating solution during biomechanical preparation is not questionable Compatibility with clinical use in terms of the physical-chemical properties, antibacterial efficacy, tissue dissolution, cleaning properties might be considered when selecting an irrigating solution.[6]

Sodium Hypochlorite (NaOCl) is a non specific proteolytic agent effectively removing organic components at room temperature. The literature shows indeed that NaOCl treatment removes dentinal organic components and changes their composition.[1]

Ethylenediamine Tetra Acetic Acid (EDTA) is a chelating substance that has been also used. It is capable of removing calcium ions of the dentin, giving rise to demineralization and as a consequence, increasing the dentin permeability of the root canals. EDTA is used in concentrations from 10 to17% and in association with other drugs [10]. The efficiency of chelating agents generally depends on many factors, such as root canal length, penetration depth of the material, hardness of the dentin, application time, pH, and concentration.

Dentin is a hydrated complex composed of four elements, oriented tubules surrounded by a highly mineralized peritubular zone embedded in an intertubular matrix consisting largely of type-I collagen with apatite crystals and dentinal fluid.[8] Considerable research attention has been given to this relation between dentine microhardness and the structural changes associated with caries process, pulpectomy and the application of restorative materials.[9] Fusayama and Maeda (1969) reported a decrease in the dentin microhardness value of pulpless teeth compared to that of vital teeth.

As microhardness is sensitive to composition and surface changes of tooth structure, the effects of some chemicals such as fluorides, trichloracetic acid, and endodontic bleaching agents on dentine hardness were previously evaluated. A similar correlation can be made between microhardness of root dentin and irrigation Solutions [9].

The purpose of this study was to evaluate the effect of two irrigation solution on the microhardness of root dentin

Materials and methods

Fifteen freshly extracted human maxillary incisor teeth were used in this experiment. Clinical examination were made to select teeth with no defects (cracks) on the root area . Debris, calculus and soft tissue remnants on the root surfaces were cleaned using a curette and all teeth were stored in normal saline .

The crowns were sectioned at the cementoenamel junction by using diamond disk under water cooling. The roots then sectioned longitudinally.

For the microhardness test, the root specimens were embedded in self curing acrylic resin, polished with abrasive paper (Matador Abrasive paper,240, Germany) to remove any surface scratches.

The root specimens were divided randomly in to three groups of ten specimens each as follows:

Group A:

The root specimens irrigated with distilled water for (control group).

Group B:

The root specimens irrigated with 5.25% sodium hypochlorite .

Group C:

The root specimens irrigated with 17% EDTA .

All the specimens irrigated with 2ML for 60 second exposure time.

The microhardness measurements were performed by using a Vickers Diamond Microhardness Tester (Schimatzu, Japan) in Vickers Hardness units. at two different points from the lumen. Each measurement was carried out by using a 300 g load for 10 seconds, oriented perpendicular to the surface.

Results

The results presented in Table-1 which demonstrate the microhardness value for the samples while table-2 and graph-1 demonstrate that the mean value of microhardness measured was : 58.56 , 50.14 and 53.99 for group A, B and C respectively.

ANOVA analysis test demonstrated that irrigation with different solution exhibited different microhardness measured in Vickers microhardness units which was statistically significant (P value < o.o5). Group A showed significantly high microhardness value and Group C demonstrated least microhardness value.

Discussion

There are different opinions as to whether to remove or to preserve the smear layer. The preserved smear layer influences the movement of fluids in dentinal tubules, prevents penetration of microorganisms into dentinal tubules and reduces the permeability of dentine for toxins of oral bacteria. It may also reduce the cytotoxicity of filling materials. The smear layer prevents the dentin surface from being further wetted by an exudate from dentinal tubules, In addition to positive effects, the smear layer also has a negative influence because it prevent contact between the root canal wall and a filling material and makes the penetration of a filling material, disinfectant and irrigant into dentinal tubules more difficult [(11)].

As a necrotic tissue solvent, 5.25% Sodium Hypochlorite was found to be significantly better than 2.6%, 1% or 0.5%7 But at this concentration

It is highly toxic, meaning that it unnecessarily necrotizes wound surface areas that should remain unharmed [(15)]. Moreover according to a study done by Baumgartner and Cuenin in 1992 examination of scanning electron micrographs of uninstrumented surfaces could not detect any difference in the removal of pulpal remnants and predentin in the middle third of the root canals with 5.25%, 2.5% and 1% NaOCl delivered with either a needle or an ultrasonic device [(16)].

This study was designed to show the effect of sodium hypochlorite and EDTA on the microhardness of root dentin.

The results of this study demonstrated that irrigation with 17%EDTA, decreased root dentin microhardness to a greater extent (50.14 VHN) compared with irrigation With sodium hypochlorite (53.99 VHN).

There was a statistically significant (P<.05) difference between the control group and the two other groups. The control group showed the highest microhardness value (58.56VHN).

The result of this study agree with the result of a study conducted by (Saleh A. A. et al., 1999) to evaluate the effect of 3% H2O2,5% NaOCl and 17% EDTA, the result demonstrated that irrigation with either H2O2 , NaOCl or EDTA decrease the

microhardness with statistically difference and EDTA gave more reduction compare to H2O2 and NaOCl. The same result has been found by (Oliveria LD et al 2007) in their study about the effect of chlorhexidine and sodium hypochlorite on the microhardness of root canal dentin ,they showed that both solution decreased the microhardness with significant difference in relation to the control group.

Study by(Hale Ari et al 2004) showed same result, they used sodium hypochlorite ,EDAT,H2O2 and chlorhexidine gloconate ,they found that all these solution except chlorhexidine significantly decreased microhardness of root dentin .

All the previous studies go with the line of this study, this could be explained by the fact that the degree of minerality and the amount of hydroxyapetite in the intertubuler dentin are considerable factor in the determining hardness of the dentin structure [17] ,in addition to the high inorganic content of the dentin (approximately 75%) compare to the organic content (approximately 20%), this explain the more reduction in dentin microhardness caused by EDTA since it act on the inorganic component of the dentin while sodium hypochlorite which act on the organic component..

Conclusion

This in vitro study demonstrated that:

1-Root canal dentin microhardness decrease as the dentin irrigated with 5.25% sodium hypochlorite and 17% EDTA.

2- 17% EDTA decrease microhardness more than 5.25% sodium hypochlorite.

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Table(1): Microhardness value for the groups

Sample No	Control	NaocL	EDTA
1	58.40	53.60	51.85
2	58.90	54.05	50.25
3	57.90	54.10	49.55
4	58.05	55.35	48.95
5	59.15	53.50	51.20
6	57.30	54.35	48.80
7	59.30	53.30	49.60
8	57.95	53.10	51.05
9	59.50	53.90	51.35
10	59.15	54.60	48.80

Table(2) : mean and SD For the three groups

	Group A	Group B	Group C
Mean	58.56	50.14	53.99
SD ±	0.74	1.155	0.67

Table-(3) One Way Analysis Of Variance

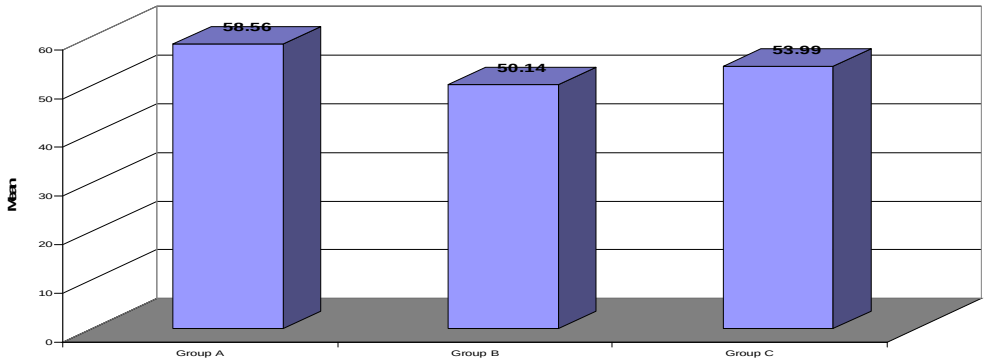
Source	DF	SS	MS	F	P
Factor	2	355.370	177.685	228.91	0.000
Error	27	20.958	0.776		
Total	29	376.328			

DF: Degree of freedom ,SS: Sumation of squares , MS: Median of squares , F: F-test , P: P value

Table(4) t-test between groups

	t-test	P-value	Sig
A&B	19.42	P<0.01	HS
A&C	14.50	P<0.01	HS
B&C	9.11	P<0.05	S

HS:High significant , S: Significant



Graph I : Bar chart show the mean of the microhardness for the three groups