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Comparative evaluation of Radicular Dentin Microhardness with CHX, 17% EDTA, 5% Sodium hypochlorite and Twin kleen complemented with Passive Ultrasonic activation: An In-vitro stud

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Abstract

Introduction: This study aim was to evaluate the effects of irrigating solutions with 2% chlorhexidine gluconate (CHX) 17% ethylene diamine tetra acetic acid (EDTA), Twin kleen and 5% sodium hypochlorite (NaOCl) on root dentin microhardness

Methods: Fifty mesio buccal canals from lower molars were irrigated with passive ultrasonic irrigation (PUI). The roots were divided into five groups. The Vickers microhardness test was used to evaluate indentations in the cervical, middle and apical thirds. The results were analyzed with the Anova & Post hoc test.

Results: In the cervical third, the highest and lowest values were found in the CHX Group and EDTA groups, respectively (P<0.05). In the middle third, the highest and lowest values were found in the CHX and Twin

kleen groups, respectively (P<0.05). In the apical third, the highest and lowest values were found in the NaOCl and EDTA groups, respectively (P<0.05).

Conclusion: Dentin microhardness was affected by these irrigating solutions. There was a greater reduction of microhardness in the cervical and middle thirds with 17% EDTA followed by Twin kleen.

Keywords: Passive ultrasonic irrigation, Irrigating solutions, Dentin hardness

Introduction

The success of root canal therapy depends on the method and the quality of instrumentation, irrigation, disinfection, and three-dimensional obturation of the root canal. Endodontic instrumentation using either manual or mechanized techniques, produces a smear layer and plugs of organic and inorganic particles of calcified tissue and organic elements such as pulp tissue debris, odontoblastic processes, microorganisms and blood cells in dentinal tubules (1).

Different irrigant solutions have been used to remove the smear layer. Decalcifying solutions such as citric acid and EDTA have been reported as suitable to remove the smear layer (2,3). Various EDTA solutions have been studied for their ability to ease instrumentation and for effective removal of the smear layer (3) and their effects on radicular dentin microhardness was evaluated (4).

It has been reported that these kind of chemical agents caused alterations in the chemical structure of human dentin and changed the Calcium/Phosphorus (Ca/P) ratio of the dentin surface (5). The alterations in Ca/P ratio may change the original ratio between organic and inorganic components that in turn change the permeability, solubility characteristics of dentin and may also effect the adhesion of dental materials to hard tissues (6).

Dentin microhardness, defined as local resistance to deformation, is sensitive to composition and surface changes in the tooth structure [7]. Determining microhardness could provide indirect evidence of mineral loss or gain in dental hard tissues [8]

Ultrasonic agitation was introduced to increase the effectiveness of chemical-mechanical preparation by more effectively cleaning the canal system and disorganizing bacterial communities [9, 10]. Passive ultrasonic irrigation (PUI) involves the transmission of acoustic energy from an oscillating file or tip to an irrigant within the root canal.

This *in vitro* study aimed to evaluate the effects of final irrigation with different solutions using PUI on root dentin microhardness. The null hypothesis was that there would be no significant difference between the protocols.

Materials and Methods

A total of 50 human mandibular molars (Figure 1) indicated for exodontia were obtained, recently extracted for periodontal reasons were collected were used in this study. The selection of teeth was made on the basis of relative dimensions, similarity in morphology, and absence of any cracks or carious defects specially within the root portions. Debris and soft tissue remnants on the root were cleaned with a sharp scalpel and all the teeth were stored in phosphate buffered saline at 4°C until used. The crowns were removed at the cemento-enamel junction using a high-speed burunder water-cooling. The root length was standardized at 16 mm in the apical-cervical direction with a digital caliper. A #10 K-type file was used to determine root length, i.e. until it was observed exiting the apical foramen, and the working length was set at 1 mm beyond this point. Biomechanical preparation of the mesiobuccal canal was performed

with an X-Smart Plus motor with an 25/0.08 file .During root canal preparation, irrigation with Normal Saline was performed using a 5 mL syringe and a 30-gauge intracanal needle for 30 seconds. The speed (rpm), torque (N.cm) and kinematics followed the endodontic motor manufacturer's parameters. The instrumentation and specimen irrigation procedures were always performed by the same operator.

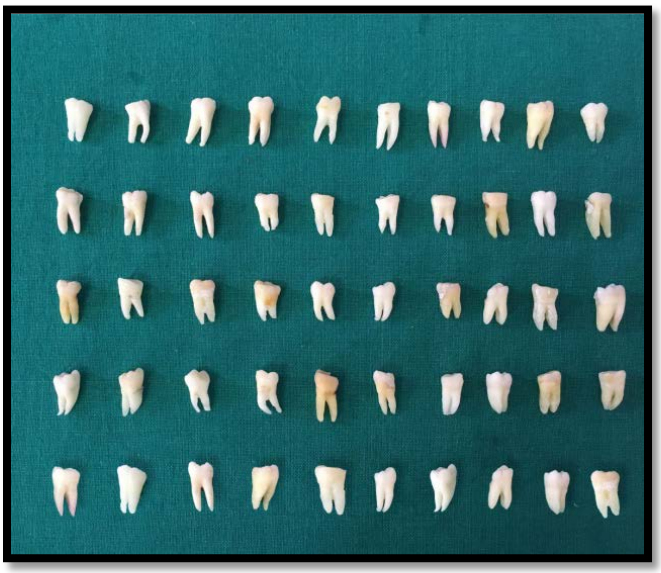

Figure 1: 50 human mandibular molars

Final irrigation protocol

The tested solutions were: 2% CHX ,17% EDTA, Twin kleen, 5% NaOCl and distilled water was used as a negative control .The final irrigation protocol was performed as follows :The ultrasonic irrigation tip(figure 2)was placed 1 mm below the working length, and the test solution was dispensed until it filled the root canal and set at a frequency of 25 kHz was placed 1.0 mm short of the working length and initially activated with 5 mL of the test solution for 3 cycles of 20 s (intermediate irrigation with distilled water)

Figure 2: Passive ultrasonic irrigation

Experimental groups:

The roots were randomly divided into five groups (n = 10) :

Group 1- 5% NaOCl

Group 2- 2% CHLORHEXIDINE

Group 3-17%EDTA

Group 4-Twinkleen

Group 5-Distilled water

The irrigation procedure was followed by sectioning the root perpendicularly along the axis with a high concentration diamond wafering blade in a precision sectioning saw to obtain 1.0 mm thick slices of the cervical, middle and apical thirds. Both slice surfaces were polished with silicon carbide sandpaper (400, 600 and 1,200 grit), followed by polishing with felt discs.

The Vickers microhardness test

Microhardness was assessed with a digital microhardness tester (figure 3), with 40X magnification and a 300 gram load for 20 seconds. In each sample, three indentations were made at 100 µm from the canal lumen wall in the cervical, middle and apical thirds. The hardness value for each specimen at each recorded distance was obtained by averaging the values of the three indentations in each third.

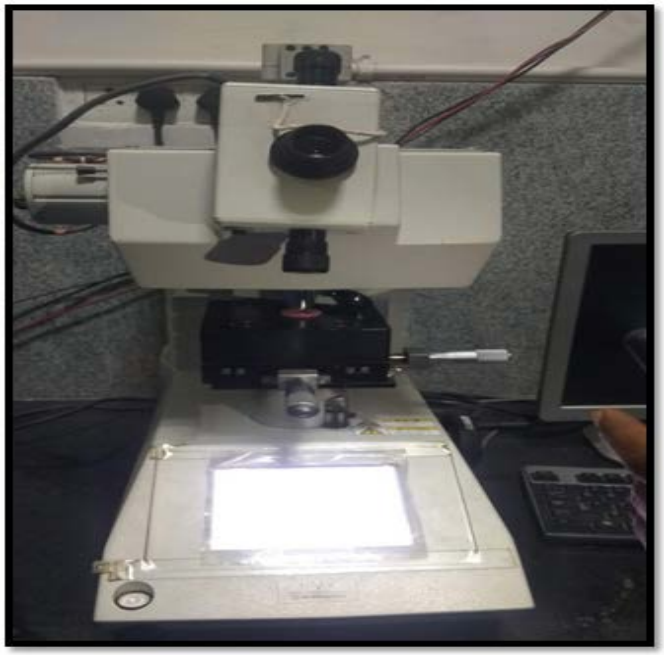

Figure 3: Digital microhardness tester

Statistical analysis

The ANOVA parametric test was applied, with a significance level of 5%.

Results

At 100 µm in the cervical third, the highest microhardness value was found in the CHX group, which was significantly different from the EDTA and DW groups. The lowest microhardness value in the cervical third was found in the EDTA group, which was significantly different from the NaOCl.

In the middle third, the highest microhardness value was obtained in the CHX group, which was significantly different from the EDTA and NaOCl groups (P<0.05).

In the apical third, the highest microhardness value was found in the CHX group , which was significantly different from the EDTA group & Twin kleen (P<0.05). The lowest microhardness value was found in the EDTA, which was significantly different from the CHX, NaOCl and DW groups (P<0.05).

Comparison of Microhardness level among Naocl, Chlorhexidine, EDTA, Twinkleen and Control Groups at cervical region using ANOVA test

S.N.	Study Group	Mean Microhardness level (Mean ± S.D.)	p value
1.	Group A1(Naocl)	32.9 ± 2.34	0.0000 (P<0.05) Very Highly Statistically Significant
2.	Group B1(Chlorhexidine)	47.88 ± 0.80	
3.	Group C1 (EDTA)	32.33 ± 1.24	
4.	Group D1(Tweenklin)	33.79 ± 1.6	
5.	Group E1 (Control)	47.80 ± 0.85	

Discussion

Results of the present study indicated that irrigation of root canals either with EDTA, NaOCl, CHX or Twin kleen solutions reduced the microhardness of root canal dentin.

Chemicals used for root canal irrigation may lead to changes in chemical and physical properties of root dentin (11). It has been indicated that microhardness determination can provide indirect evidence of mineral loss or gain in the dental hard tissues (12). Although a reduction in microhardness facilitates root canal instrumentation, it may also weaken the root structure leading to fracture of the endodontically treated tooth (13). Moreover, decrease in the dentin microhardness can affect the adhesion and sealing ability of the sealers to the root dentin walls(14).

Dentin hardness is related with location, and its value decreases as the indentations tested were made closer to the pulp.(15) Pashley et al.(16) reported that the microhardness of dentin fell when dentin was tested from superficial to deep regions. The increased number of widely opened dentinal tubules free of peritubular dentin near the pulp, offered little resistance to the testing indenter (17, 18). Carrigan et al. (19) showed that tubule density decreased from cervical to apical dentin and Pashley et al. (16) reported an inverse correlation between dentin microhardness and tubular density. This

histological pattern probably contributes to the hardness reduction at the cervical region of the root.

Previous investigations have shown the suitability and practicality of Vicker's micro hardness test for evaluating surface changes of dental hard tissues treated with chemical agents, although the Knoop hardness test was used for evaluating surface changes of dental hard tissues in some studies (20, 16).

The results of the present study indicate that all irrigating solutions except chlorhexidine decreased microhardness of root canal dentin significantly. The authors found that 0.2% chlorhexidine gluconate was more effective, had more residual antibacterial effect and lower toxicity than NaOCl solutions.[22] Thus, 0.2% chlorhexidine gluconate seemed to be an appropriate irrigating solution, because of its harmless effect on the microhardness and roughness of root canal dentin.

A 17% EDTA demonstrated a significant reduction in micro-hardness of dentin. EDTA favors removal of smear layer by affecting the inorganic content of root canal walls. The fact that 17% EDTA reduces the micro-hardness of dentin could be due to its chelating property

In this study, a comparison on dentin microhardness of the new irrigant solution Twin kleen (with the traditional irrigants have been done. Twin kleen, which is a chelating agent, was also seen to affect the microhardness of dentin negatively.

Conclusion

Within the limitations of this in vitro study, it may be concluded that all the used irrigating solutions affected the micro-hardness of root canal dentin.

In the present study it was found that the results obtained with the use of CHX, NaOCl and control groups and does not significantly affect the dentin micro-hardness in contrast to the other two irrigants used i.e. EDTA group & Twin kleen.

Hence, it may be concluded that irrigants like Twin kleen may serve as an effective alternative to the conventionally used root canal irrigants as they cause minimal alteration of dentin structure in addition to being less toxic when compared with other irrigants.

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