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EVALUATION OF THE EFFECT OF ACTIVATED CHARCOAL AND ACTIVATED CHARCOAL CALCIUM HYDROXIDE COMBINATION VERSUS CALCIUM HYDROXIDE ON DENTIN MICROHARDNESS

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ABSTRACT

Objective: To evaluate effect of activated charcoal and activated charcoal calcium hydroxide combination mixed with distilled water on dentin microhardness.

Materials and methods: 48 extracted human maxillary incisor teeth were decoronated at the cementoenamel junction and prepared using Protaper next up to X 4. Then they were randomly allocated to three treatment groups and one control group (12 samples for each group) according to applied medicament as follows: The control group (no medication was applied), Group I: $Ca(OH)_2$ (Cerkamed, Poland) mixed with distilled water, Group II: Activated charcoal (Eucarbon Sedico, Cairo, Egypt) / $Ca(OH)_2$ combination mixed with distilled water, Group III: Activated charcoal mixed with distilled water. After medicament application, specimens were incubated at 37 °C for 24 h, 3 and 7 days. After each storage period, 4 randomly selected specimens were taken from each group and a middle 2-mm root cylinder was horizontally sectioned from each root for microhardness evaluation using the Vickers microhardness tester. Data were analyzed using Two-way ANOVA test to study the effect of intracanal medication, time, and their interactions on mean micro-hardness values.

Results: There was no statistically significant difference between microhardness values of specimens treated with different intracanal medications and control group at different time periods.

Conclusion: Activated charcoal alone or combined with calcium hydroxide mixed with distilled water as intracanal medication up to one week didn't affect dentin microhardness.

KEYWORDS: Activated charcoal; Calcium hydroxide; Microhardness

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INTRODUCTION

Root canal medicament is used to complement root canal disinfection and promote healing of apical periodontitis [1].

The most frequently recommended intracanal medicament is calcium hydroxide $Ca(OH)_2$. [2] , however it is not efficient against all microorganisms such as Enterococcus faecalis [3] also, its long term use reduces root fracture resistance [4].

Long term use of calcium hydroxide causes surface alterations of dentin which results in reduction in dentin microhardness so that affecting dentin strength which may affect long term function of treated tooth [5].

Charcoals containing oral and dental care preparations are a popular health ingredient at the moment and represents the revival of traditional medical practises. When compounds of animal and plant origin are stripped of water and other volatile components, black carbon and ash residual hydrocarbon are essentially what remains that form Charcoal[6].

Charcoal naturally has the ability to absorb toxins, poisons, and unpleasant substances, along with these advantages it has antimicrobial properties [7].

Surface structure and material components both affect microhardness [8] the dentin of the canal wall is exposed to the medication's action when it is introduced, this could affect the surface of root dentin in various ways, as many root canal irrigants and intracanal medications have affected dentin microhardness and its fracture resistance [9-11].

To best of our knowledge there was no studies in literature that have evaluated effect of activated charcoal on radicular dentin microhardness, so the aim of the present study was to evaluate effect of activated charcoal and activated charcoal calcium hydroxide combination mixed with distilled water versus calcium hydroxide on dentin microhardness.

MATERIALS AND METHODS

The Faculty of Dentistry, Minia university's Research Ethics Committee gave the study the nod of approval; (Committee No 92, Decision No 675)

Sample size calculation

Using the findings of a pilot testing with three samples per group, the computed effect size (f) for the first factor (intracanal medication) was found to be (0.3) and the effect size (f) for the second factor (time) was found to be (0.35). The minimum anticipated sample size was 12 specimens per group with alpha (α) level of 5% and and Beta (β) level of (20%)i.e. power = 80%.Sample size calculation was performed using IBM® SPSS® Sample Power® Release 3.0.1

Samples collection and preparation:

48 extracted human maxillary mature incisor teeth that were free of root caries and cracks with radiographed patent root canals that were extracted for orthodontic or periodontal causes were selected. Scalers (Roydent Scurette, USA) were used to remove debris and soft tissue remains from the root surfaces. The teeth were stored in distilled water for maximum of 30 days until use.

A water-cooled diamond bur was used to decoronate the teeth at the cementoenamel junction. The working length was determined by visualizing the tip of a size 15 K-file (Dentsply Maillefer, Ballaigues, Switzer- land) extending beyond the apical foramen and subtracting 1 mm from the length of the file. Root canals were enlarged using Protaper next up to X 4 (Dentsply Maillefer, Ballaigues, Switzerland). During instrumentation, root canals were irrigated with distilled water. Root canals were then dried with sterile Protaper next X4 paper point (Dentsply Maillefer, Ballaigues, Switzerland).

Medicament application

The specimens were then randomly allocated to three treatment groups and one control group

(12 samples for each group) using the Randomize List software program according to applied medicament as follows:

The control group (no medication was applied), Group I: $Ca(OH)_2$ (Cerkamed, Poland) mixed with distilled water, Group II: Activated charcoal (Eucarbon Sedico, Cairo, Egypt) / $Ca(OH)_2$ combination mixed with distilled water, Group III: Activated charcoal mixed with distilled water

The medicament paste was applied using a sterile lentulo spiral (Dentsply Caulk, Milford, DE, USA) in a slow-speed handpiece to the canal spaces and packed in the canal space to the level of the cemento-enamel junction using various sizes of sterile pluggers.

Teeth in the four groups were incubated at 37 °C for 24 h, 3 and 7 days.

After each storage period, 4 randomly selected specimens were taken from each group.

A middle 2-mm root cylinder was horizontally sectioned from each root using a water-cooled diamond saw (Buehler Ltd., Lake Bluff, IL, USA) for microhardness testing.

The treatment groups' root cylinders received distilled water irrigation to remove the medicaments and dried with soft absorbent paper before measuring microhardness.

Microhardness Measurement

The microhardness values of the specimens were measured using the Vickers microhardness tester (Tukon 1102 Wilson microhardness tester Buehler Germany), all specimens were measured at 3 different time points, Figure (1)

Each specimen had three indentations with a 50-g weight for 10 seconds in this test. [12]. The microhardness value for each specimen was considered as an average of these 3 points. After the load was removed, the indentation was focused with the magnifying eye piece and the two impression diagonals were measured, 500 μm from the pulp–dentine interface, with a micrometer, and averaged. The Vickers hardness (HV) was calculated using: $HV = 1854.4L/d^2$

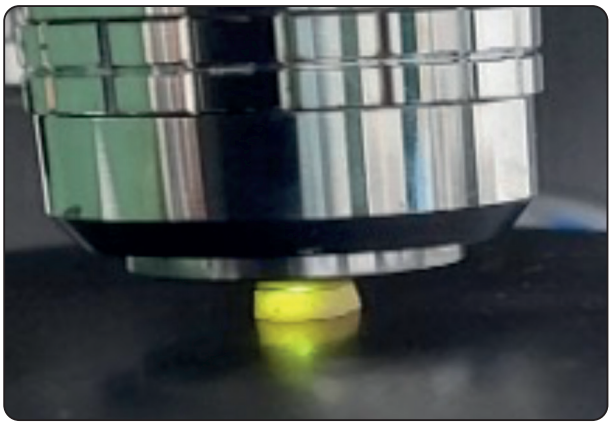

Fig. (1): Vicker microhardness testing

Where the load L is in gf and the average diagonal d is in μm (this produces hardness number units of $gf/\mu m^2$. in practice the numbers are reported without indication of the units).

Statistical Analysis

By examining the distribution of the data and applying normality tests (Kolmogorov-Smirnov and Shapiro-Wilk tests), numerical data were examined for normality. A mean and standard deviation (SD) value was used to present the data.. Two-way ANOVA test was used to study the effect of intracanal medication, time, and their interactions on mean micro-hardness values. The significance level was set at $P \leq 0.05$.

RESULTS

Table (1) showed that intracanal medication (regardless of time) had no statistically significant effect on mean micro-hardness as there was no statistically significant difference between microhardness of samples treated with different intracanal medications and untreated control group (*P*-value = 0.681, Effect size = 0.011). Also, there was no statistically significant difference between mean micro-hardness values at different times (*P*-value = 0.427, Effect size = 0.013).

TABLE (1). The mean, and standard deviation (SD) values for micro-hardness (VHN) of different groups at different times

Time	Control (n =12)		Calcium Hydroxide (n =12)		Calcium Hydroxide/ Activated charcoal (n =12)		Activated charcoal (n =12)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Day 1	47.4	5.2	47.6	4.7	49.1	4.5	47.2	9.4
Day 3	47.4	5.2	46.9	6.8	45.2	4.1	45.7	2.7
Day 7	47.4	5.2	43.4	6	42.9	3.3	45	4.7

DISCUSSION

Root canal disinfection procedures cause changes in the structure of the radicular dentin which may decrease strength of endodontically treated tooth [13].

Microhardness assessment offers indirect evidence of mineral increase or loss in dental hard tissues [14], So that evaluation of effect of any new intracanal medicament on dentin microhardness is mandatory.

The evaluation period of the present study was up to 7 days as this time period was sufficient for calcium hydroxide to effectively remove bacteria that survived root canal instrumentation [15,16].

In the present study, intracanal medication was placed inside prepared root canals to simulate clinical conditions opposite to other studies in which dentin discs was fully immersed in the intracanal medication [17,18].

The present study evaluated effect of activated charcoal and activated charcoal calcium hydroxide combination on dentin microhardness. Calcium hydroxide was used as a positive control group.

It has been known that calcium hydroxide has denaturation effect on dentin matrix which negatively affect dentine microhardness [19,20].

The results of the present study showed that there was no statistically significant difference between the treatment groups and control group up to 1 week.

Calcium hydroxide didn't significantly decrease microhardness of dentin up to 1 week, this was in agreement with previous studies [18,21] that found no difference between the control and calcium hydroxide groups after 1 week. However, our result was in contrast with another study [17] which they found that calcium hydroxide caused structural changes in dentin after 1 week application. This may be attributed to different carrier in which they mixed calcium hydroxide with glycerin, also different methodology as they fully immersed dentin discs in medicament.

In the present study activated charcoal alone didn't affect dentin microhardness up to one week, this could be explained by its inertness as it didn't show any interaction with dentin regarding mineral loss or gain. Also activated charcoal calcium hydroxide combination had no effect on dentin microhardness which was in agreement with another study [22] that found that addition of activated charcoal to different formulations of calcium hydroxide didn't decrease dentin microhardness.

CONCLUSION

Within limitations of this study, it could be concluded that using activated charcoal alone or combined with calcium hydroxide mixed with distilled water as intracanal medication up to one week didn't affect dentin microhardness.

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