Research Article

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A Study to Assess the Effectiveness of Different Irrigation Protocols on Root Dentine Micro-Hardness

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ABSTRACT

Background: Endodontic treatment effectiveness is dependent on the use of dental tools and effective irrigants solutions to chemomechanically remove the root canal system. Root canal dentin microhardness may be affected by the physicochemical properties of dentin structure, which can be altered by different irrigation solutions. The purpose of this study was to examine how various irrigation methods influenced the microhardness of human root canal dentin.

Materials and Methods: A total of 100 extracted single maxillary and mandibular root canal central incisors, lateral incisors were used. After each tooth was instrumented with hand treated steel records and flooded with 2 mL of refined in the center of each document, each tooth was split longitudinally. An irrigant was used to soak the roots for five minutes after they had been divided into four groups of 25 (n = 25). Ten milliliters of 2.5 percent sodium hypochlorite (NaOCL), 10 milliliters of 17 percent ethylene diamine tetraacetic corrosive (EDTA), and ten milliliters of 2.5 percent NaOCL, followed by 10 milliliters of 2 percent chlorhexidine digluconate (CHX), and 10 milliliters of 2.5 milliliters of 2 percent chlorhexidine digluconate (CHX), were used (CHX). A Vickers microhardness analyzer was used to examine the dentin microhardness of ten root sections from each of the two groups.

Results: The t-test, ANOVA test, and Post Hoc test were used to analyse the data. The biggest percentage decrease in microhardness values was seen in group II, followed by group III, group IV, and finally group I. Except for groups III and IV, there was a significant difference amid them (P 0.05). The coronal third showed the greatest percentage drop, with a significant difference amid the apical and middle thirds (P 0.05), but the apical and middle thirds showed no significant change.

Conclusions: CHX is the best final irrigant if there is a good interim flush to keep NaOCL from precipitating. Because it is the most damaged third, the coronal third requires a cautious approach.

Keywords: Endodontics, Microhardness, Chlorhexidine, NaOCL, EDTA, Precipitate.

INTRODUCTION

An irrigant must also be effective against Enterococcus faecalis in order to obtain the desired effects, hence a combination of auxiliary solutions is necessary (1,2, 3). Because of its broad-spectrum antibacterial activity and tissue-dissolving qualities, sodium hypochlorite (NaOCl) is the gold standard

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irrigant utilized in root canal therapy (6). To understand why NaOCl and chelating chemicals impact dentin hardness, it is necessary to understand how they interact with calcium ions in the tooth structure (7). The organic dissolving effects of NaOCl on the collagen component of dentin explain this (5). No other antibacterial agent is as non-toxic as CHX, which has the added benefit of improving the adhesiveness of the dentin structure, in contrast to sodium hypochlorite (NaOCl) (2, 3). Furthermore, it was discovered that CHX had no effect on root canal dentin's microhardness (8). Despite this, chlorhexidine gluconate's inability to break down organic molecules is a major flaw. The last irrigation step after NaOCl might be chlorhexidine gluconate (PH 5.5-6.0), which cannot replace NaOCl. An orange-brown precipitate was formed by mixing NaOCl and CHX (2, 3), and this precipitate has the potential to alter root canal dentin's microscopic hardness. (9, 10-15). Irrigant solutions were used in this investigation to investigate how they altered the microhardness of root canal dentin. No effect on the microhardness of root canal dentin was seen when NaOCl and chlorhexidine gluconate precipitates were used in this investigation compared to previous irrigating regimens.

MATERIALS AND METHODS

A total of 100 extracted single maxillary and mandibular root canal central incisors, lateral incisors were used. This problem was not caused by endodontic therapy, tooth decay, or the formation of calcification. Anatomically, radiographs at the distal view confirmed the existence of a patent single trench after all delicate tissue and math had been removed. Root lengths were evaluated and erupted using Gates-Glidden drills after a size 10 K-record (Mani, Inc., Japan) was inserted into the root trench terminal until it was clearly visible through apical foramen in the following request: (size 3, 2, 1). It was decided that the apical portion of the trench would be instrumented using a 30-K expert apical document (MAF) and summarized with a 15-K record after it reached size 45. Afterwards, the outer layer of the root sections was permitted to expose the dentin, which was equally lowered in an auto polymerizing acrylic tar (Dent Product, Egypt). A Vickers Microhardness Tester was used to get the gauge microhardness value by applying a 25 gram force for 10 seconds at an amplification of x100 (Model LM-100, FM 1159, LECO Corporation, Michigan, U.S.A.). On the buccal or lingual side of each segmented root, microhardness estimates were performed for the coronal, central and apical thirds. At the coronal, middle, and apical levels, the root segments were divided into three equal halves each. Scaled micrometers were used to quantify the length of the two diagonals, and then a Vickers hardness number (VHN) was calculated using the formula (5,16): HV=1854 (F/D2). An indenter with a new calculating method was used to figure out how much weight was being applied in grams, and how much force was being applied to the space that was out of alignment, and these values were utilized to determine the situation's stable value (m).

Evaluation of microhardness for the tested irrigants

According to the irrigant utilised, the samples were randomly divided into four parallel groups (n=25). After that, each sample was immersed for 5 minutes in each of the examined irrigant solutions.

Grouping

Group I: 10 mL of 2.5 percent NaOCl (Clorox for Chemical Industries, A.R.E.).

Group II: 10ml EDTA (17%) (Prevest Denpro Limited, India), followed by 10ml 2.5 percent NaOCl.

Group III: 10ml NaOCl (2.5%), followed by 10ml CHX (2%). (Kempetro for Chemical Industries, A.R.E).

Group IV: 10ml 2.5 percent NaOCl, followed by 10ml distilled water (intermediate immersion) and 10ml 2 percent CHX.This meant that each individual irrigant solution received a total immersion time of 5 minutes; group I samples received a total immersion time of 5 minutes, group II samples received a total immersion time of 10 minutes, group III samples received a total immersion time of 10 minutes, and group IV samples received a total immersion time of 15 minutes.

Statistical Analysis

IBM SPSS version 20 statistical software was used to enter the data. Two-tailed tests with an alpha error of 0.05 and a statistically significant P value of less than or equal to 0.05 were used for all statistical analysis. To compare two independent populations, the independent student t-test was employed, while the F-test (ANOVA) and Post Hoc tests were utilised to compare more than two populations (Scheffe).

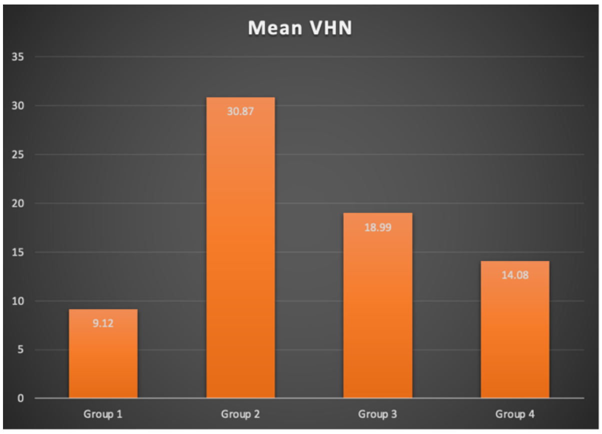

Figure: Graph showing mean VHN.

RESULTS

According to Vickers' hardness number (VHN) values for all studied groups, all irrigating solutions significantly reduced the microhardness of the canal dentin surface after immersion of the specimens in the irrigating solution for 5 minutes compared to pre-treatment values. Group II (EDTA+NaOCl) had the greatest percentage decrease in microhardness values (30.876.70 VHN), followed by group III (NaOCl + Distilled water + CHX), which had a percentage decrease of 18.990.62 VHN, and finally group IV (NaOCl+CHX), which had a percentage decrease of 14.081.09VHN. The lowest percentage decline was 9.121.111 VHN in Group I (NaOCl). With the exception of groups III and IV, all groups showed a significant difference (P 0.05). The coronal third had the greatest percentage decline in microhardness values, as shown in figure 1, with a significant difference from the apical and middle thirds (P 0.05), but the apical and middle thirds exhibited no significant difference (2).

DISCUSSION

Root-trench treated teeth are more prone to cracking when microhardness is reduced, while instrumentation is simpler when microhardness is reduced (15-19, 20). Aside from that, since the irrigants initially come into touch with the dentin's shallowest layer, this investigation also measured the microhardness of the root trench dentin When assessing hardness values between the major trench and the cementum layer in the past, researchers used cross-sections of root into plates. It seems that the radicular dentin microhardness of an identical tooth has been altered in various regions. For the purpose of distinguishing the cervical, middle, and apical thirds of the dentin, holes were cut into the radicular dentin at a distance of 0.2 mm from the trench divisions (14, 18, 21 - 24). If a microhardness value is less than 0.02 mm, it may cause an example crack, while a value greater than 0.02 mm may cause microhardness measurements to be incorrect (16, 18). A five-minute drenching was used to mimic clinical application periods throughout this study (25). Goldberg et al. (5) investigated the impact of sodium hypochlorite arrangements of 2.5 percent and 6 percent on pull dentin microhardness for various water system durations and found that 5 minutes of water system did not trigger a significant change in dentin microhardness. An additional observation was the fact that although EDTA is effective in destroying the smear layer in a one-minute water system time, a long 10-minute water system time with the chemical generates large peri- and intertubular dentinal disintegration, especially when NAOCL is used after EDTA. A consideration of the water system layout should be made when conducting the post-treatment microhardness study. Due of its higher viability and lower cytotoxicity than the 5% fixation and 10% concentrations, this investigation used a 2.5 percent NaOCl arrangement (5, 14, 24). Enterococcus faecalis may be killed in less than 5 minutes using a 2.5 percent NaOCl solution. Research found that NaOCl reduced microhardness values only little and that 0.5% NaOCl should be used as the most common fixation during root trench treatment in order to avoid NaOCl-induced dentin deproteinization. In order to increase water system efficiency, both volume and term should be extended at low NaOCL concentrations (28). CHX was employed at a 2% concentration since it is the root trench water system's primary focus in clinical practice (3,8). CHX's bacteriostatic effects at low doses give way to bactericidal effects at higher concentrations, although gradually (2,3). EDTA and NAOCL are also effective in reducing microhardness levels when used in conjunction with each other (3, 6, 17, 20, 24). NaOCl as the last water system after

EDTA treatment has been shown to accelerate dentinal disintegration and induce significant disintegration of the root trench divider dentin and a decrease in the dentin microhardness. Throughout the present request, it was crystal-clear that this was the case. Dentin microhardness differed greatly between the coronal, middle, and apical areas in all of the groups studied. This conclusion has been generated by more than two studies (14, 24). Carrigan and Pashley (22) observed that tubule thickness decreased from cervical to apical dentin, while Pashley et al. (22) discovered a reverse correlation between dentine microhardness and rounded thickness in the apical dentin. Dentin sclerosis has been seen in the apical portion of human teeth with precise frill root pits, changing levels of sporadic optional dentine, and cementum-like tissue. In any event, because of its influence on the smear layer and non-collagenous proteins, EDTA may not have as large an effect as it did earlier in the third branchial region. (NCPs). In the apical third of the trench, NaOCl as well as EDTA were less effective than in the center and coronal thirds, perhaps because surface strain has been demonstrated to be less powerful in the apical area than in the center and coronal thirds, or because the flooding arrangement entrance is lower in the apical third of the channel, with less watering arrangement coming into contact with the root canal dividers.

CONCLUSION

All of the irrigating solutions utilised in this investigation considerably reduced dentin microhardness, according to our findings. The biggest percentage drop in microhardness values was seen with 17 percent EDTA, followed by 2.5 percent NaOCl. Dentin microhardness values are significantly affected by the precipitate produced when 2.5 percent NaOCl and 2 percent CHX interact. Irrigation solution has the greatest impact on the coronal third of the root canal. If there is an excellent intermediate flush for preventing precipitation with NaOCL, chlorohexidine is the best final irrigant. Because it is the most damaged third, the coronal third requires a cautious approach.

CONFLICTS OF INTEREST

The authors declare they have no potential conflict of interests regarding this article.

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