Effect of Different Acid Irrigating Solutions on Microhardness and Surface Roughness of Root Canal Dentin

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By

Amgad Hassan Soliman
B.D.S.
Faculty of Dentistry, Ain Shams University, ٢٠٠٧

Faculty of Dentistry
Ain Shams University
٢٠١٣

SUPERVISORS

Prof. Dr. Salma Hassan El Ashry

Professor of Endodontics
Endodontic Department,
Faculty of Dentistry, Ain Shams University

Dr. Mohamed Salah Abd-El Aziz

Associate Professor of Biomaterial
Biomaterial Department,
Faculty of Dentistry, Ain Shams University

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Amgad Hassan Soliman

DEDICATION

My Dear Parents

whom I owe everything I ever did and will achieve …

My wife

for always being there for me and her continuous support …

My Lovely son

for endless love, and being the light of my life …

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المشرفـــــون

أ.د/ سلمى حسن العشرى

أستاذ علاج الجذور

قسم علاج الجذور

كلية طب الاسنان ـ جامعة عين شمس

د/ محمد صلاح عبد العزيز

استاذ مساعد خواص مواد

قسم خواص المواد

كلية طب الاسنان ـ جامعة عين شمس

П

ربِ اوزِعنِي انِ اشكر نِعمتكِ
الَّتِي أنعمتَ عَلَيَّ وعَلَى والِدَيَّ
وأَنْ أعمل صالحاً ترضاه
وأصلح لي في ذُريتي
إنـــي تُبـتُ إليـكَ و إنـــي
مِـنَ المُسلِمَيـــنَ

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سورة الأحقاف
(١٥)

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INTRODUCTION

The success of root canal therapy depends on the technique and the quality of instrumentation, irrigation, disinfection, and three-dimensional obturation of the root canal system.

Mechanical instrumentation of the root canal either using manual or rotary instruments produces a smear layer that covers the dentinal tubules. The smear layer can be removed using various chelating agents like EDTA, citric acid, and a mixture of tetracycline isomer (doxycycline), an acid (maliec acid) and a detergent but the combination of EDTA and sodium hypochlorite is used most often for smear layer removal.

Chelation is a physicochemical process that prompts the uptake of multivalent positive ions by specific chemical substances. In radicular dentine, the agent reacts with the calcium ions of hydroxyapatite crystals. This process can cause changes in the microstructure of the dentine and changes in the calcium to phosphorus ratio. Changes in the mineral content ratio may alter the original proportion of organic and inorganic components, which in turn reduces the microhardness, increases the permeability and solubility of the root canal dentin, and inhibits resistance to bacterial ingress and permitting coronal leakage. It has been indicated that microhardness determination can provide indirect evidence of mineral loss or gain in dental hard tissues.

Changes in the mineral content of root canal dentine may also adversely affect the sealing ability and adhesion of dental materials such as resin-based cements and root canal sealers.

EDTA is capable of decreasing the microhardness of root canal dentine, since microhardness is sensitive to composition and surface changes of tooth structure. The following effects of several solutions had an effect on dentine microhardness such as EDTA, EDTAC, various concentrations of citric acid, combination of EDTA and NaOCl, and hydrogen peroxide combination with NaOCl. Recently, 7% maleic acid in combination with 2.5% sodium hypochlorite has been found to be significantly better than EDTA in the removal of the smear layer from the root canal system. To date, there are no studies evaluating the effect of maleic acid on the microhardness of root canal dentine. It is of great value to study the effect of 7% maleic acid, 15% citric acid and 17% EDTA solutions on the microhardness and the surface roughness of human root canal dentine.

REVIEW OF LITERATURE

Yamada et al. **(1983)**[1] tested the efficacy of instrumenting forty root canal with 1 ml of 5.25% NaOCl solution between each instrument and final flushing with 20 ml of Groupl: 5.25%NaOCl, Group 2:17% EDTA, Group 3: 8.5%EDTA, Group 4: 25% citric acid, Group 5:17% EDTA &NaOCl, Group 6: 8.5% EDTA and NaOCl, Group7: 25% citric and NaOCl, Group 8: saline as control. Qualitative assessment using scanning electron microscope showed that a final flush with 10 ml of 17% EDTA buffered to pH 7.7 followed by 10 ml of 5.25% NaOCl solution were the most effective.

Pashley et al. (1985)[2] determine the possible correlation between dentin microhardness and dentin tubule density in normal human permanent teeth by permitting serial determinations of the microhardness and tubule density of the same group of tubules, beginning near to the dentino-enamel junction and progressing to the pulp chamber. There was a highly statistically significant inverse between dentin microhardness and tubular density. Tubular density increased as the pulp chamber was approached and this was associated with a decrease in the microhardness due to decrease in the amount of intertubular dentin and an increase in individual tubular diameter.

Lewinstein and Rotstein (1992)[3] examined the effect of 90% trichloracetic acid on the microhardness and surface morphology of human dentin and enamel. Intact extracted human teeth were sectioned and embedded in acrylic resin. Each tooth was grinded and highly polished exposing a flat surface of dentin and enamel. The teeth were treated with 90% trichloracetic acid for 30, 60 and 90 s. Vicker's microhardness of the dentin and enamel was assessed for each tooth before and after each treatment. In addition the surface morphology of a trichloracetic acid treated tooth was examined via SEM. The results showed that 90% trichloracetic acid caused a second order type reduction of the microhardness, as well as structural changes in both dentin and enamel.

Lewinstein et al. (1994)[4] examined the effect of 30% hydrogen peroxide and a paste of sodium perborate mixed with hydrogen peroxide at different temperatures and time intervals on the microhardness of human enamel and dentin. Intact extracted human teeth were sectioned, embedded in acrylic resin, polished, and divided into four test groups related to surface treatment. The groups were 30% hydrogen peroxide at 37 ºC, 30% hydrogen peroxide at 50 ºC in an illuminated chamber, a paste of sodium perborate mixed with hydrogen peroxide at 37 º C, and a paste of sodium perborate mixed with hydrogen peroxide at 50 ºC, in an illuminted chamber. Teeth treated with distilled water at either

37ºC or 50 ºC served as controls. The results indicated that treatment with 30% hydrogen peroxide reduced the microhardness of both enamel and dentin. This reduction was statistically significant after 5-min treatment for the dentin and after 15-min treatment for the enamel. Treatment with sodium perborate mixed with hydrogen peroxide did not alter the microhardness of either the enamel or dentin at the tested temperatures and intervals. It is therefore suggested that the use of high concentrations of hydrogen peroxide for bleaching purposes should be limited. Sodium perborated appears to be a less damaging bleaching agent.

Brobosa et al. **(1994)**[5] examined the influence of NaOCl and hydrogen peroxide on the structure of dentin and they demonstrated that there was weight loss of dentin observed with both solutions. This weight loss was approximately 14% of the dry weight of dentin when NaOCl was used. It was suggested that the use of high concentration of NaOCl might negatively affect the integrity of the dentin wall.

Meredith et al. **(1996)**[6] measured the microhardness and Young’s modulus of human enamel and dentin using an indentation technique. Freshly extracted molar teeth were sectioned, and the cut surfaces were grounded and polished progressively to 1 micron. The polished surfaces were indented at different distances from the surface and amelodentinal junction