Effect of Different Irrigating Regimes on Chemical Structure and Cleanliness of Root Canal Dentin

Thesis

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Dedication

To:

My Dear Parents whom I owe everything I ever did and will achieve.

My husband, for always being there for me.

My lovely son

تاثير انظمة محاليل الغسيل المختلفة على التركيب الكيميائي ونظافة عاج قنوات الجذور
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وَقَالَ رَبِّ أَوْزِعْنِي أَنْ أَشْكُرَ نِعْمَتَكَ الَّتِي أَنْعَمْتَ عَلَيَّ وَعَلَى وَالِدَيَّ

سورة النمل (١٩)

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INTRODUCTION

The main objectives of root canal therapy are cleaning, shaping, and obturating the root canal system in three dimensions, hence preventing reinfection. The complexity of the root canal system requires the use of an irrigating solution to efficiently clean webs, fins and anastomosis in this system.

The choice of irrigants is of great importance because they act as lubricants during instrumentation, flush debris and bacteria out of the canal, debride necrotic tissues and microorganisms.

Sodium hypochlorite is a potent antimicrobial agent, effective in dissolving organic tissues, good lubricant for endodontic instruments and helps to flush debris from canal system. However, effective concentrations of this solution are cytotoxic, also this solution corrodes and weakens endodontic instruments and has a disagreeable odor. Sodium hypochlorite also may affect mechanical properties of dentin through affecting the inorganic material or by dissolving the organic components of dentin.

Alternative irrigants to sodium hypochlorite such as ٢ % chlorhexidine gluconate have been suggested and used.

Chlorhexidine gluconate is a broad spectrum antimicrobial agent and more biocompatible than sodium hypochlorite. However, it lacks the tissue dissolution capability of sodium hypochlorite so combined usage of sodium hypochlorite and chlorhexidine gluconate can be beneficial.

(I)Irrigation and Root Canal Cleanliness

Abbott et al[١] studied the effect of different irrigation sequences and ultrasonics on smear layer removal. Six irrigation sequences used in this study were as follows: Savlon, Savlon with ultrasound, EDTAC /NaOCl /EDTAC, EDTAC/NaOCl/EDTAC with ultrasound NaOCl/ EDTAC/ NaOCl, and NaOCl / EDTAC / NaOCl with ultrasound. The root canals of ٣٠ extracted human teeth with single canals were prepared biomechanically with hand instruments using a flaring technique. Scanning electron microscopic (SEM) examination showed a complete smear layer when savlon was used. The most effective irrigation regime for removing smear layer and other debris was EDTAC/NaOCl/EDTAC. In all groups there was a significant decrease in cleaning efficiency at the apical end of the canal.

Walker and Del Rio[٢] evaluated histologically the ultrasonic debridement comparing sodium hypochlorite and water. Twenty extracted human mandibular first and second molars were randomly divided into two groups. The mesial root canals were ultrasonically instrumented, using tap water in the first group or ٢,٦٪ sodium hypochlorite irrigation in the other. Wall planning and soft tissue debridement were blindly evaluated using the light microscope and compared by multiple tests. Results showed that sodium hypochlorite, in conjunction with ultrasonic

instrumentation, was more effective than tap water in wall planning. Sodium hypochlorite, in conjunction with ultrasonic instrumentation, was more effective than tap water in soft tissue debridement in the middle third of the canal. Both irrigants were ineffective in conjunction with ultrasonic instrumentation in removing soft tissue from the main canal.

Franchi et al[٣] evaluated the cleaning effect of ٥٪ NaOCl and ٠,٢٪ EDTA irrigating solutions in endodontics. Human premolar roots were manually instrumented with K-type files and irrigated with different solutions (٥٪ solution of NaOCl and ٠,٢٪ solution of EDTA) to evaluate the rate of cleaning of endodontic surface. Results showed that root thick smear layer was always present on endodontic walls rinsed with ٥٪ solution of NaOCl. Specimens treated with ٠,٢٪ solution of EDTA showed partially clean dentinal tubules orifices and remnants of a thin smear layer. The root canals irrigated with NaOCl and EDTA solutions alternated after each instrument showed at the dentin surface thick smear layer: only few dentinal tubules orifices were visible. Endodontic surface of root canals irrigated with NaOCl during instrumentation and finally rinsed with EDTA solutions showed the most homogeneous ultra-structural pictures: partially clean dentinal orifices were detectable in the whole canals.

Berutti and Marini[٤] evaluated the effect of raising the temperature of the irrigant ٥٪ NaOCl solution on the smear layer removal. After hand instrumentation of twenty two human upper incisors and treatment with the irrigant at ٢١°C and at ٥٠°C. Teeth were fractured into halves and examined by scanning electron microscopy for smear layer. Results showed that in the middle third, where NaOCl had been used at ٥٠°C, the smear layer was thinner and made of finer, less well-organized particles than where it had been used at ٢١°C. In the apical third, the smear layer was of almost the same thickness in the two groups of specimens, although the particles were finer where the NaOCl had been used at ٥٠°C.

Turkun and Cengiz[٥] evaluated the efficacy of sodium hypochlorite (NaOCl) and calcium hydroxide ($Ca(OH)_2$) in dissolving necrotic tissue and cleaning root canals. In the first part of the study, ٠,٥٪ NaOCl solution and $Ca(OH)_2$ paste and solution were tested with samples of necrotic bovine muscle. The necrotic tissue was weighed before and after the test and the percentage of weight change was calculated. In the second part of the study, ٤٠ extracted single-rooted human teeth were hand instrumented and then subjected to different irrigation regimens. The cleansing efficacy in root canals of ٠,٥٪ NaOCl with $Ca(OH)_2$ pre-treatments and ultrasonics was examined using scanning electron microscopy. Results showed that a solution of

٥٪ NaOCl was significantly more effective than ٠,٥ % NaOCl as a solvent of necrotic tissue and Calcium hydroxide was an effective solvent for necrotic tissue as a paste but not as a solution. ٥٪ NaOCl plus ultrasonic irrigation produced cleaner root canal walls at the middle and apical thirds. Pre-treatment of root canals with $Ca(OH)_2$ paste increased the effectiveness of ٠,٥٪ NaOCl plus ultrasonic irrigation, except in the coronal third of the root canal.

Takeda et al[٦] evaluated the effects of three endodontic irrigants and two types of laser on removal of smear layer created by hand instrumentation in middle and apical thirds of root canals. A total of sixty human mandibular premolar teeth with a single root canal were cleaned and shaped up to a size ٦٠ master apical file using a step-back technique. The root canals were irrigated with alternating ٣ml of **٥,٢٥%** NaOCl and **٣%** H_2O_2 between each file size. According to final flush, the teeth were randomly divided into five groups. Group ١ (G_1); ١٧٪ EDTA, group ٢ (G_2); ٦٪ phosphoric acid and group ٣ (G_3) ٦٪ citric acid. In the specimens of group ٤ (G_4) the root canals were irradiated with a carbon dioxide (CO_2) laser, and specimens of group ٥ (G_5) were irradiated with an Er:YAG laser. The teeth were split longitudinally and prepared for examination by scanning electron microscopy. Results showed that samples of (G٢) and (G٣) showed more clean root canal walls with absence of smear layer at