

Influence of activation of irrigation on effectiveness of calcium hydroxide removal from the root canal.

Mariam Salah AbdElkariem, Shehab Eldin M.Saber** and Mohamed Mokhtar Nagi****

Abstract

Introduction: the purpose of this study is to evaluate the amount of CH removal with aid by ultrasonic and sonic activation of irrigation. **Methods:** forty-eight straight single rooted teeth were prepared up to master file F4 ProTaper NiTi Rotary System (Dentsply Maillefer, Baillagues, Switzerland). Teeth were randomly divided into two experimental groups (n=24), group I: filling with Metapaste, group II: pure CH powder mixed with distilled water. Then CH was either removed by (n=8) (A) ultrasonic irrigation with 2.5% NaOCl refreshed and activated 3 times for 20 seconds (B) sonic activation in the same way (C) beveled needle irrigation. The amount of remaining CH was evaluated under a stereomicroscope. Statistical evaluation was performed using Kruskal–Wallis and Bonferroni-Correction Mann–Whitney U tests. **Results:** CH paste (42.82 ± 12.81) had a significantly higher percentage of remnants compared to pure CH paste (30.47 ± 10.27) ($P < 0.001$). Highest value was found in NI (52.46 ± 11.50) followed by USI (30.93 ± 10.49) the lowest value was found in SI (29.64 ± 9.62) significantly ($P < 0.001$). **Conclusion:** None methods was able to remove CH completely. Both sonic and ultrasonic

* bachelor degree from Cairo University 2012.

** Professor at Endodontic department, Faculty of Dentistry, Ain Shams University.

*** Associate professor at Endodontic department, Faculty of Dentistry, Ain Shams University.

irrigation improves CH removal with no significant difference between them.

Introduction:

Proper cleaning and shaping for the reduction of the intracanal bacteria and their byproducts is the foundation for the successful endodontic treatment. Therefore placement of intracanal medication as an intermediate treatment between visits have been proposed, there is various types of intracanal medication like CH. Using CH operator aims to kill bacteria, decrease inflammation, control inflammatory root resorption and avoid contamination between visits that can cause flare ups when endodontic treatment cannot be done in single visit as one of treatment strategies for infected root canal system. Despite all this benefits, there are draw backs from application of CH as it is difficult to remove all CH from the root canal without leaving residues and these remnants may block the dentinal tubules and affect the penetration of endodontic sealers as well as the proper adaptation of root canal filling materials. Therefore complete CH removal is needed before filling of the root canal. Several methods have been investigated, for removal of CH, including filling with master apical file, Ultrasonic irrigation, Sonic irrigation, LASER activated irrigation ,self-adjusting file and different rotary files they showed better removal of CH, but none of them was able to remove CH completely. So, there is no general agreement regarding the best method for the removal of CH. Therefore conducting a study to evaluate the effectiveness of sonic or ultrasonic aided removal of CH was thought to be of value.

Materials and methods:

Teeth:

A total of 48 straight, single rooted, human permanent teeth were collected. Teeth with no visible root caries, fractures, cracks, nearly equal lengths and completely formed apex were selected. Teeth were immersed in sodium

hypochlorite solution for 30 minutes to remove organic tissues. After that teeth were scaled to remove any calculus and hard deposits, and then stored in saline solution till use. The crowns of the teeth were left to simulate the clinical situation, but were reduced with diamond disk to standardize the tooth length to 22mm. Access cavity was made according to standard endodontic procedures.

Root canal instrumentation:

Teeth were instrumented with the ProTaper NiTi Rotary System (Dentsply Maillefer, Baillagues, Switzerland) up to F4 as the master apical file at a working length of 1 mm short from the anatomic apex. Irrigation was made in between each file with 3ml of 2.5%. After root canal preparation, a size 20 K-file was passed 1 mm beyond the apex to remove any dentinal shaving plug. Then a final irrigation protocol to all teeth was done as following ; 3ml of 2.5% NaOCl , followed by 17% EDTA solution, then finally 3ml distilled water. Canals were dried with paper points.

Calcium hydroxide placement:

Teeth were randomly divided into two equal groups according to the type of CH intracanal medication used. Group I: n = 24 teeth in which Metapaste (Meta Biomed Co, Cheongju, Korea) was injected inside the root canal till the material extruded from the apex. Group II: n = 24 teeth in which pure CH powder mixed with distilled water was placed inside the root canal with lentulo spiral till the material extruded from the apex. The apex of all samples was sealed with sticky wax, then covered with saline-saturated cotton, and stored in an incubator at 37°C and 100% humidity for a week.

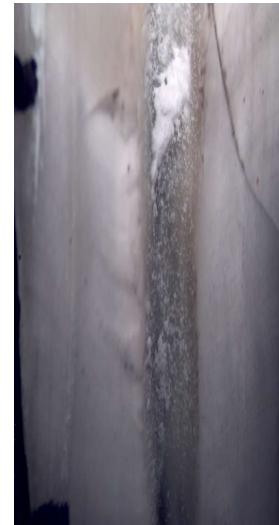
Calcium hydroxide removal:

Teeth were randomly divided in to 3 subgroups n=8 according to method used for CH removal. Teeth of each subgroup were fixed in rubber impression materials separately which act as vials for the teeth, temporary filling was then removed with small excavator. Passive ultrasonic irrigation (A) Teeth in both

subgroups were irrigated with 3ml 2.5% NaOCl using open ended disposable plastic syringe with 27-gauge needle (Endo Eze; Ultradent Products Inc., South Jordan, UT, USA) then Irrisafe ultrasonic tip (size 25, 0.02 taper) (Satelec Acteongroup, France) was introduced passively into the canal 1mm short than the working length and operated by VDW-Ultra device; VDW; setting 30% resulting in about 30 kHz with a pull-stroke and backwards movement to drive the debris back to the surface for 3 x 20 seconds. In between each 20-second cycle, the canal was rinsed with 3 mL NaOCl and finally with 3mL. So that the total activation time was 60 sec, and total irrigation volume was 12ml 2.5% NaOCl. Sonic irrigation (B) in the same manner as before teeth in with EDDY sonic tip (VDW, Munich, Germany). Beveled needle irrigation (C) canals were irrigated with 2.5%NaOCl using open ended 3ml disposable plastic syringe with 27-gauge needle (Endo Eze; Ultradent Products Inc., South Jordan, UT, USA) placed 1mm short from the working length without binding and moving it in up and down movement, this was repeated for 3 times again to obtain equal irrigation volume of 12ml 2.5% NaOCl.

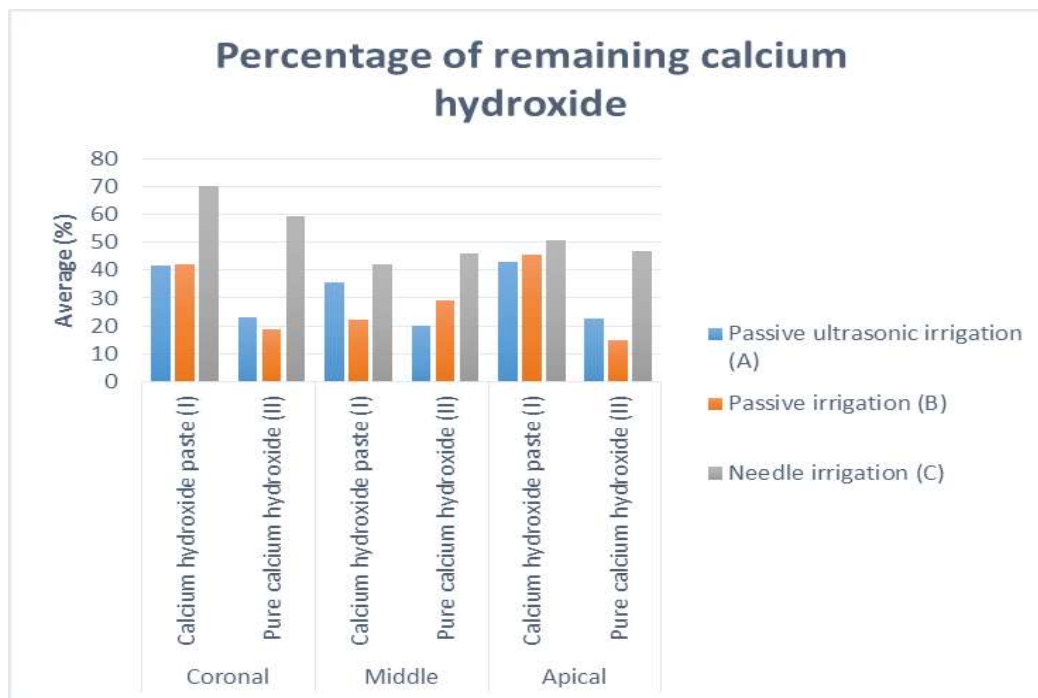
Stereomicroscope Evaluation:

All roots (n = 48) were split longitudinally using a hammer and chisel preserving the inner shelf of dentine surrounding the canal. Digital images at 30xmagnification were obtained using a stereomicroscope (Ningbo; Zhejiang, China) attached to a digital camera and were transferred to the computer. Two calibrated endodontists, blinded to the C remoHval technique, analyzed the amount of remaining CH using ImageJ 1.46 software. calculating the mean and median values and using Kolmogorov-Smirnov and Shapiro-Wilk tests. Three-way mixed model ANOVA followed by bonferroni post hoc test was used to study the effect of different tested variables and their interaction.



Results:

There was an excellent agreement between both examiners (ICC=0.861) (86.1%) which was statistically significant ($P<0.001$). Samples with CH paste (42.82 ± 12.81) had a significantly higher percentage of remaining CH in comparison to pure CH (30.47 ± 10.27) ($P<0.001$). There was a significant difference between the percentage of remaining CH with different irrigation techniques ($P<0.001$). The highest value was found in needle irrigation (52.46 ± 11.50) followed by Passive ultrasonic (30.93 ± 10.49) while the lowest value was found in passive irrigation (29.64 ± 9.62). Pairwise comparisons showed that needle irrigation had a significantly higher percentage than other subgroups ($P<0.001$).



Discussion:

In this study passive ultrasonic irrigation and sonic irrigation were compared in their effectiveness in CH removal to beveled needle irrigation. Beveled needle irrigation was used referring to the daily practice in endodontic clinic, and can possibly act as a control group. This comparison well helps to understand, how irrigant agitation is strongly needed to reduce debris and CH remnants specifically. Several different methods have been used to measure residual CH in root canals in previous studies, one of them is scanning electron microscopy but it allows assessment of only limited areas of the root canal wall. Another methods are direct visualization, digital microscopy and then The amount of remaining CH in a canal was evaluated by measuring the surface area of the remnants on the canal walls (Lambrianidis et al. 1999 ⁽¹⁾, Kenney et al. 2006 ⁽²⁾, Balvedi et al. 2010 ⁽³⁾, Tasdemir et al. 2011 ⁽⁴⁾), or using a scoring method (van der Sluis et al. 2007 ⁽⁵⁾). The main shortcomings of these techniques are the possibility of losing the residual CH during splitting and underestimation of remnants because of the two-dimensional imaging, also the variation between observers owing to subjective evaluation. More recently, the volume of remaining CH was measured by spiral computed tomography (CT) (Nandini et al. 2006 ⁽⁶⁾). Although volume analysis is more accurate than surface area measurement, the spiral CT resolution is quite low. Recently, (Wiseman et al. 2011 ⁽⁷⁾) assessed the remaining CH in mesial roots of mandibular molars using 3D micro-CT. it provides better evaluation of CH remnants at a higher resolution and a cross-sectional examination of the root canal. With no need for specimen preparation. Because of the unavailability of the micro CT scan, Stereomicroscope was used for evaluation. Regarding the type of CH Results of this study showed that Samples with CH paste (42.82 ± 12.81) had a significantly higher percentage of remaining CH in comparison to CH powder (30.47 ± 10.27). These results were conceding with Nandini et al. ⁽⁶⁾ who reported that Metapex was more difficult to remove than CH powder mixed with distilled water. This was also reported by Lambrianidis et al. 1999 ⁽¹⁾ there was significant difference between Pulpdent and pure CH. Although Balvedi

et al. ⁽³⁾ reported that despite the differences in the surface tension between the CH vehicles, it did not influence its removal efficiency from the root canal walls. Regarding the technique used for CH removal, results of this study showed that passive ultrasonic irrigation and sonic irrigation showed the least amount of remnants (29.64 ± 9.62) and (30.93 ± 10.49) respectively, while needle irrigation was the highest (52.46 ± 11.50). These results were convenient with Urban et al. ⁽⁸⁾ who tested the same techniques for removal of smear layer and debris, and reported that none of the techniques used were able to remove all the debris, but the Irrisafe tip, EDDY tip were able to remove more debris than the needle irrigation significantly, with no significant difference between the first two techniques. Coinciding with this study result, Ma et al. 2015 ⁽⁹⁾ have also tested ultrasonic, sonic and conventional needle irrigation for removing CH from C-shaped canals. They reported similar results although different ultrasonic and sonic instruments were used. Also Wiseman et al. 2010 ⁽⁷⁾ reported that Ultrasonic activation removed significantly more CH (69.5%) than sonic activation (48.6%). Regarding the amount of CH remnants in each root third, There was a significant difference between the percentage of remaining CH in different root sections ($P < 0.001$). The highest value was found in the coronal sections (41.71 ± 13.50) followed by apical sections (37.23 ± 9.09) while the lowest value was found in the middle sections (31.70 ± 10.21). This can be explained because most of the sample was canine teeth or maxillary central teeth with very wide canals and long roots, and both the sonic and ultrasonic tip have small diameter compared to diameter of the coronal section of the teeth. Moreover teeth were prepared up to size 40 taper 6%. On the contrary Balvedi et al. 2010 ⁽³⁾ and Lambrianidis et al. 2006 ⁽¹⁰⁾ reported that CH remnants were highest in apical thirds more than the other thirds in all the experimental groups.

Conclusion:

Under the conditions of this study, it may be concluded that:

1- None of the tested methods was able to remove calcium hydroxide intracanal medication completely.

2- Both Eddy sonic tip and Irrisafe ultrasonic tip aided irrigation improves calcium hydroxide removal with no significant difference between them

3- Oil- based calcium hydroxide is more resistant to removal than water-based calcium hydroxide.

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