[UCI]I804:24011-200000264564

2015년 2월 석사학위논문 Efficacy of various irrigation methods for the removal of $Ca(OH)_2$ paste in the root canal 이 의 중

2015년 2월
석사학위 논문

Efficacy of various irrigation methods for the removal of $Ca(OH)_2$ paste in the root canal

조선대학교 대학원

치 의 학 과

이 의 중

Efficacy of various irrigation methods for the removal of $Ca(OH)_2$ paste in the root canal

다양한 세척방법에 따른 근관 내 수산화칼슘 첩약제의 제거 효율

2015년 2월 25일

조선대학교 대학원

치 의 학 과

이 의 중

Efficacy of various irrigation methods for the removal of $Ca(OH)_2$ paste in the root canal

지도교수 황 호 길

이 논문을 치의학 석사학위신청 논문으로 제출함.

2014년 12월

조선대학교 대학원

치 의 학 과

이 의 중

이의중의 석사학위논문을 인준함.

위원장 조선대학교 교수 고 영 무 인

위 원 조선대학교 교수 황 호 길 인

위 원 조선대학교 교수 민 정 범 인

2014년 12월

조선대학교 대학원

CONTENTS

TABLE LEGENDS

FIGURE LEGENDS

국 문 초 록

다양한 세척방법에 따른 근관 내 수산화칼슘 첩약제의 제거 효율

이 의 중
지도교수 황호길
조선대학교 대학원
치의학과

본 연구에서는 음파 근관세척 기구인 EndoActivator와 초음파 근관세척 기구인 DH tip의 근관 내 수산화칼슘 첩약제의 제거 능력을 평가하고, 더 나아가 기존의 수동 세척법과 비교하여 차이가 있는지 알아보고자 하였다. 직선형의 근관을 갖는 단근치 90개를 준비하였다. #10 K-file을 이용하여 개방성 및 근관장 확인 후 PROTAPER·NEXT^{TM} X1, X2, X3 Ni-Ti file을 순차적으로 사용하여 근관확대 시행하였다. 각 확대 과정 중에는 1 ml의 2.5 % NaOCl로 세척하였고, 최종 세척은 5 ml의 2.5 % NaOCl로 시행되었다. 근관확대 완료 후, 해당치아들은 치관부를 절단하였고, 치근을 종단하여 근원심으로 분리하였다. 두 시편 중 더 큰 것을 선택하여 근단부 1/3에 표준화된 groove를 형성하였다. 그리고, 형성한 groove에 수산화칼슘 재제인 Calcipex II를 적용하였고, 해당 시편들은 sticky wax를 이용하여 재조합하였다. 90개의 시편들은 무작위로 30개씩 3개의 그룹으로 나누어 3가지의 세척 방법을 시행하였다. 첫 번째 그룹은 기준의 conventional syringe irrigation으로 근관세척을 시행하는 대조군으로 설정하였고, 두 번째 그룹은 EndoActivator와 전용 #30 polymer tip을 사용하여 세척액이 채워진 근관 내에서 음파 세척을 적용하였으며, 세 번째 그룹은 DH tip을 사용하여 초음파 세척을 시행하였다. 근관 건조 후 치근을 재분리하였고, groove에 존재하는 수산화칼슘을 현미경을 이용하여 19배 확대한 후 관찰하였다. 독립된 두 명의 조사자가 현미경하에서 얻은 이미지를 통해 groove에 남아있는 수산화칼슘 재제의 제거 정도를 평가하였다. 분석 결과 치근단 1/3부위에서 EndoActivator와 DH tip을 사용한 두 실험군 모두 대조군에 비해 유의적으로 높은 수산화칼슘제거 효과를 보였으며 두 실험군 간에는 유의적인 차이를 보이지 않았다.

I. Introduction

The goals of endodontic treatment are the complete debridement of infected root canals, and the complete obturation of disinfected root canals.[1] This is achieved by mechanical instrumentation with antimicrobial irrigation and intracanal medication.[2]

To obtain the acceptable adaptation of filling materials, it is essential to remove the smear layer, debris and intracanal medication of root canal.[3] Due to antimicrobial properties of the calcium hydroxide ($Ca(OH)_2$), which has been commonly used in endodontic treatment as intracanal medication for interappointment root canal dressing material.[4] It is known that remaining $Ca(OH)_2$ on root canal could interfere adaptation of filling materials and increase apical leakage.[5]

Therefore, before obturation, complete removal of $Ca(OH)_2$ is required from the root canal.[5] Commonly used method for removal of $Ca(OH)_2$ is instrumentation of the root canal using a master apical file and copious irrigation.[6] However, despite of efforts for the removal of $Ca(OH)_2$, which may be existed due to irregularities of root canal. For this reason, many studies have been investigated for the removal efficacy of $Ca(OH)_2$ in the root canal.[7-11]

EndoActivator (Dentsply, Tulsa Dental, Tulsa, OK) is sonically activated device for canal irrigation. It has portable hand-piece and three different sizes of flexible polymer tip. It has been known to safely clean the root canal system without damaging the canal wall. The ability of intracanal fluid agitation has resulted in the better irrigation compared with traditional needle irrigation.[12] Mechanical oscillations are produced mainly at the tip of the activator with a frequency ranging from 1 to 10 kHz.

And, as an ultrasonically-driven device, the DH tip (epdent, Seoul, Korea) which is connected to hand-piece of ultrasound generator was developed for passive ultrasonic irrigation (PUI). And it is compatible with both EMS and

SATELEC system. During PUI, DH tip is placed into the center of root canal and activated to generate acoustic streaming. This streaming makes it bubbling action and circulates the irrigant in the root canal.[13] For this reason, PUI was known to be effective in the removal of dentin debris from root canal.

However, there was no study comparing sonic and ultrasonic irrigation methods about removal efficacy of $Ca(OH)_2$ paste in the root canal. Therefore, the aim of this study was to compare the removal efficacy of $Ca(OH)_2$ paste in the apical part of the root canal with anatomical irregularities among three irrigation methods; conventional syringe, sonic and ultrasonic irrigation methods.

II. Materials and Methods

1. Sample Selection

Ninety intact and single-rooted human teeth with mature apex were selected for this study. All teeth were radiographed in a bucco-lingual and a mesio-distal direction to examine single, straight root canal. The teeth were stored in 0.9% physiologic saline after extraction.

2. Preparation of root canals

#10 K-file was used for achieving apical patency of all teeth. The working length was determined by subtracting 1mm from apical foramen.[3] The root apex was sealed using melted sticky wax to close apical foramen.[14] The reason was to prevent the irrigant from escaping through the apical foramen in order to simulate in vivo condition.[15] The root canals were prepared using PROTAPER·NEXT™ (Dentsply Maillefer, Ballagiues, Switzerland) to the working length up to X3. During the preparation, root canals were irrigated using 1 ml 2.5% NaOCl with 27-guage side-vented needle (PacDent, Walnut, CA, USA) and 10 ml syringe. After preparation, final irrigation was performed using 5 ml 2.5% NaOCl.

3. Standardized groove preparation

The crowns were removed horizontally at the cemento-enamel junction with a diamond disk. The roots were split longitudinally without damaging the root canals. Between two longitudinal sections of the root, the wider one was chosen to make standardized groove at the apical 3rd. The CK file (B&L Biotech, Ansan, Korea) with a tip size of #20 was selected and coupled to the CK tip (B&L Biotech, Ansan, Korea) of the handpiece of the EMS ultrasonic system. Longitudinal groove which is 0.2 mm in width, 3 mm in length and 0.5 mm in depth was shaped to simulate the uninstrumented canal irregularities at 2 mm away from apical foramen.[5] Then, $Ca(OH)_2$ paste (Calcipex II, Nishika, Shimonoseki, Japan) was placed into the standardized groove. Finally, split two sections of each root were reassembled using melted sticky wax. The samples were immersed in at 37℃ with 100% relative humidity for a week.

4. Final irrigation procedure

All samples were randomly divided into 3 groups: conventional syringe (n = 30), sonic activation (n = 30) and ultrasonic activation (n = 30) groups. Then, all samples were instrumented with a PROTAPER·NEXT™ X3 file and 3 different irrigation methods were performed as follows.

(1) Control group (n = 30) : Conventional syringe irrigation

The canals were irrigated with 5 ml 2.5% NaOCl for 60 seconds.

(2) Group 1 (n = 30) : Irrigation with Sonic activation using EndoActivator (Dentsply Tulsa Dental, Tulsa, OK)

The canals were irrigated with 2.5 ml 2.5% NaOCl for 30 seconds. And then, sonic activation was performed for 60 seconds. And, irrigation with 2.5 ml 2.5% NaOCl was performed for 30 seconds again.

(3) Group 2 (n = 30) : Irrigation with Ultrasonic activation using DH tip (epdent, Seoul, Korea)

Canal irrigation was performed in the same method as described above for group 2 with DH tip instead of EndoActivator.

For all groups, each device was inserted and activated at 2 mm away from the working length.

5. Microscopic evaluation and statistical analysis

After irrigation, size #30 paper points were used to dry for wet canals. And samples were split into 2 halves again. The grooves were examined under a dental operating microscope (Global, St. Louis, MO) at ×19 magnification. The amount of remnant $Ca(OH)_2$ paste in the groove was scored by using a 4-steps scale described by van der Sluis et al.[8]: score 0, the groove is empty; score 1, $Ca(OH)_2$ paste is present in less than half of the groove; score 2, $Ca(OH)_2$ paste covers more than half of the groove; and score 3, the groove is completely filled with $Ca(OH)_2$ paste (Table 1). The remained quantity of $Ca(OH)_2$ paste in the groove was scored blindly and independently by two calibrated endodontists. The kappa test was used to analyze inter-examiner agreement. And the results were statistically evaluated using Kruskal-Wallis test and Mann-Whitney test. The level of significance was set at α = 0.05.

The study design and evaluation procedure are schematically illustrated in Figure 1.

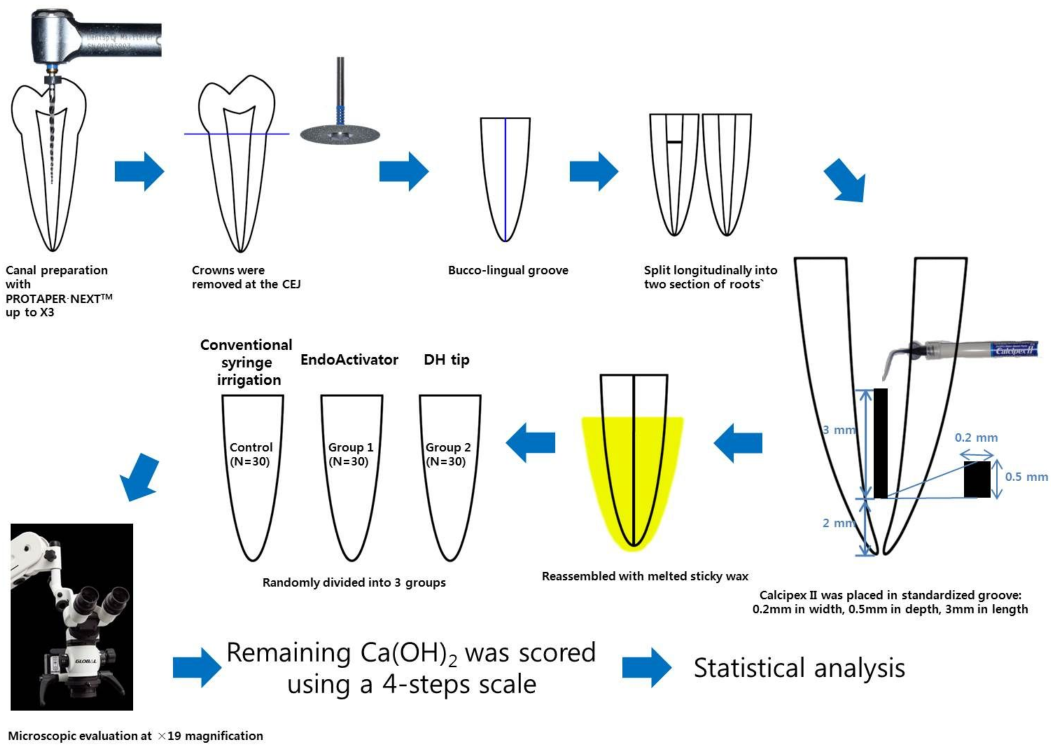

Figure 1. Schematic illustration of study design and evaluation procedure.

Table 1. Classification of scoring criteria to evaluate remained $Ca(OH)_2$ paste

score	conditions of groove after being removal of $Ca(OH)_2$
score 0	the groove is empty
score 1	$Ca(OH)_2$ paste is present in less than half of the groove
score 2	$Ca(OH)_2$ paste covers more than half of the groove
score 3	the groove is completely filled with $Ca(OH)_2$ paste

(a) Score 0

(b) Score 1

(c) Score 2

(d) Score 3

Figure 2. Microscopic images of the scores

III. Results

In the kappa test, inter-examiner agreement was 0.664 for the removal of $Ca(OH)_2$ paste. This value showed good agreement (0.60 to 0.80).[16]

Figure 2 presents the results of the scores for the each group.

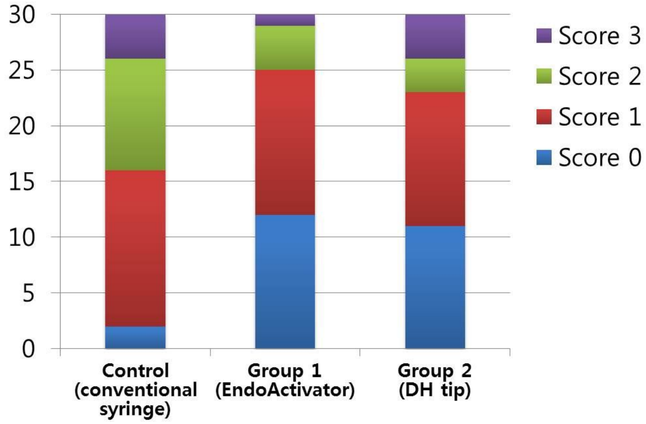

Figure 3. The results of scores for the each group.

The results for the removal of $Ca(OH)_2$ paste in standardized groove are present in Table 2 and Figure 3.

Table 2. Mean and SD value for scores

Control	30	1.53 ± 0.819
Group 1	30	0.80 ± 0.805
Group 2	30	1.00 ± 1.017

The results showed that Group 1 and Group 2 had significantly effective in removal of $Ca(OH)_2$ paste from the groove than that of conventional syringe irrigation (Group 1) ($p < 0.05$). However, there was no significant difference between group 1 and group 2.

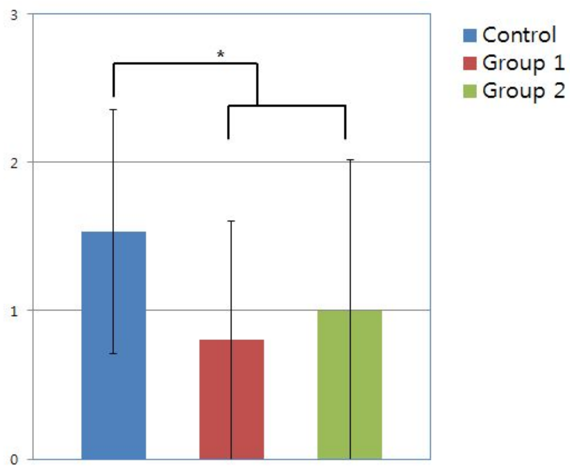

Figure 4. Statistical analysis using Kruskal-Wallis test and Mann-Whitney test ($p < 0.05$).

IV. Discussion

Irrigation of the entire root canal is essential part of endodontic treatment. However, due to complexity and variety of a root canal system especially in the apical 3rd, debris and intracanal may be incompletely removed. In this study, for the purpose of simulating irregularities, artificial standardized groove was prepared at apical 3rd of root canal. But the limitation of this design is that standardized groove does not exactly represent the complexity and variety morphology of root canal system.

Several Authors have reported the removal efficacy of $Ca(OH)_2$ paste, . Van der Sluis et al[8] investigated that the efficacy of PUI compared with NaOCl or distilled water to remove $Ca(OH)_2$ paste from root canal and reported that PUI with NaOCl was more effective in removing $Ca(OH)_2$ paste. Wiseman et al[9] used micro-computed tomographic scanning to compare the efficacy of sonic versus PUI on $Ca(OH)_2$ removal and reported that PUI removed significantly more $Ca(OH)_2$ paste than sonic irrigation. In this study, sonic and ultrasonic irrigation with NaOCl as irrigant were significantly more effective methods for the removal of $Ca(OH)_2$ paste than conventional syringe irrigation (Fig. 3) and there were no significant difference between sonic and ultrasonic irrigation group. Present results differed from Wiseman et al[9]. This difference may be due to study design because our study was performed in apical 3rd of root canals and their study was performed in entire root canals. Also, in several studies[8,9,17] remaining $Ca(OH)_2$ paste were identified in their all experimental groups. Similarly, there were no groups that complete removal of $Ca(OH)_2$ paste was achieved in this study (Fig. 3).

EDTA was not used in this study. Çalt & Serper[18] showed complete removal of $Ca(OH)_2$ from root canal after combined irrigation with EDTA and NaOCl when compared with NaOCl alone. It is likely that EDTA may chelate remaining $Ca(OH)_2$ which is then more effectively removed by irrigation with

NaOCl.[19] However, several studies using combined EDTA with NaOCl irrigation method could not achieve same results and still found considerable remaining $Ca(OH)_2$ in root canal.[20,21] Because there is no obvious evidence that EDTA can completely dissolve $Ca(OH)_2$ in root canal wall from superficial to deep layer, EDTA irrigation was excluded in this study.[8]

Various methods have been described to evaluate the residual $Ca(OH)_2$ in root canal. In this study, the remaining $Ca(OH)_2$ of apical 3^{rd} of root canal was evaluated and scored by two independent endodontists. To obtain objectivity of results, further studies are required to quantify assessment of residual $Ca(OH)_2$ in the root canal.

And, in this study crowns were removed at cemento-enamel junction, which may eliminate any coronal reservoir for the irrigant. When applying the sonic and ultrasonic activation, a large amount of irrigant may be lost coronally, reducing the hydrostatic pressure toward the apical 3^{rd} of root canal.[9]

Also, in this study, the teeth with single-root canal were used. The removal efficacy of $Ca(OH)_2$ may be reduced in curved, oval-shaped, C-shaped and Wein's type II root canal. Therefore, root canal with various anatomy have to be studied in the future. And, although sonic and ultrasonic irrigation methods could enhance the removal efficacy of $Ca(OH)_2$, no method was able to remove entire $Ca(OH)_2$ in root canal. Additionally, more certain, predictable method for $Ca(OH)_2$ removal should have to be suggested.

V. Conclusion

According to the results and the limitations of this study, the use of EndoActivator and DH tip with irrigant was effective in the removal of $Ca(OH)_2$ paste at the apical third of the root canal. Considering the removal efficacy of $Ca(OH)_2$ paste in the apical part of root, sonic and ultrasonic devices may be used as an effective methods for cleansing the root canal.

Reference

1. da Silva JM, Andrade Junior CV, Zaia AA, Pessoa OF. Microscopic cleanliness evaluation of the apical root canal after using calcium hydroxide mixed with chlorhexidine, propylene glycol, or antibiotic paste. *Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology* 2011;111:260-264.
2. Caron G, Nham K, Bronnec F, Machtou P. Effectiveness of different final irrigant activation protocols on smear layer removal in curved canals. *Journal of endodontics* 2010;36:1361-1366.
3. da Silva JM, Silveira A, Santos E, Prado L, Pessoa OF. Efficacy of sodium hypochlorite, ethylenediaminetetraacetic acid, citric acid and phosphoric acid in calcium hydroxide removal from the root canal: a microscopic cleanliness evaluation. *Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology* 2011;112:820-824.
4. Athanassiadis B, Abbott P, Walsh LJ. The use of calcium hydroxide, antibiotics and biocides as antimicrobial medicaments in endodontics. *Australian dental journal* 2007;52:S64-S82.
5. Capar ID, Ozcan E, Arslan H, Ertas H, Aydinbelge HA. Effect of Different Final Irrigation Methods on the Removal of Calcium Hydroxide from an Artificial Standardized Groove in the Apical Third of Root Canals. *Journal of Endodontics* 2014;40:451-454.
6. Lambrianidis T, Margelos J, Beltes P. Removal efficiency of calcium hydroxide dressing from the root canal. *Journal of Endodontics* 1999;25:85-88.
7. Kenee DM, Allemang JD, Johnson JD, Hellstein J, Nichol BK. A quantitative assessment of efficacy of various calcium hydroxide removal techniques. *Journal of endodontics* 2006;32:563-565.
8. Van der Sluis L, Wu M, Wesselink P. The evaluation of removal of calcium hydroxide paste from an artificial standardized groove in the apical root canal

using different irrigation methodologies. *International endodontic journal* 2007;40:52-57.
9. Wiseman A, Cox TC, Paranjpe A, Flake NM, Cohenca N, Johnson JD. Efficacy of sonic and ultrasonic activation for removal of calcium hydroxide from mesial canals of mandibular molars: a microtomographic study. *Journal of endodontics* 2011;37:235-238.
10. Taşdemir T, Celik D, Er K, Yildirim T, Ceyhanli K, Yeşilyurt C. Efficacy of several techniques for the removal of calcium hydroxide medicament from root canals. *International endodontic journal* 2011;44:505-509.
11. Rödig T, Hirschleb M, Zapf A, Hülsmann M. Comparison of ultrasonic irrigation and RinsEndo for the removal of calcium hydroxide and Ledermix paste from root canals. *International endodontic journal* 2011;44:1155-1161.
12. de Gregorio C, Estevez R, Cisneros R, Heilborn C, Cohenca N. Effect of EDTA, Sonic, and Ultrasonic Activation on the Penetration of Sodium Hypochlorite into Simulated Lateral Canals: An In Vitro Study. *Journal of endodontics* 2009;35:891-895.
13. Ahmad M, Pitt Ford TR, Crum LA. Ultrasonic debridement of root canals: acoustic streaming and its possible role. *Journal of Endodontics* 1987;13:490-499.
14. Tay FR, Gu L-s, Schoeffel GJ, Wimmer C, Susin L, Zhang K, et al. Effect of vapor lock on root canal debridement by using a side-vented needle for positive-pressure irrigant delivery. *Journal of endodontics* 2010;36:745-750.
15. Schoeffel GJ. The EndoVac method of endodontic irrigation: safety first. *Dentistry today* 2007;26:92, 94, 96 passim.
16. Cohen J. Weighted kappa: Nominal scale agreement provision for scaled disagreement or partial credit. *Psychological bulletin* 1968;70:213.
17. Saðsen B, Üstün Y, Aslan T, Çanakçi BC. The effect of peracetic acid on removing calcium hydroxide from the root canals. *Journal of endodontics* 2012;38:1197-1201.
18. Çalt S, Serper A. Dentinal tubule penetration of root canal sealers after root canal dressing with calcium hydroxide. *Journal of endodontics*

1999;25:431-433.

19. Margelos J, Eliades G, Verdelis C, Palaghias G. Interaction of calcium hydroxide with zinc oxide-eugenol type sealers: a potential clinical problem. *Journal of endodontics* 1997;23:43-48.
20. Tatsuta CT, Morgan LA, Baumgartner JC, Adey JD. Effect of calcium hydroxide and four irrigation regimens on instrumented and uninstrumented canal wall topography. *Journal of endodontics* 1999;25:93-98.
21. Lambrianidis T, Kosti E, Boutsioukis C, Mazinis M. Removal efficacy of various calcium hydroxide/chlorhexidine medicaments from the root canal. *International Endodontic Journal* 2006;39:55-61.