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Comparison of different techniques for calcium hydroxide removal from the mesial root canals of mandibular first molars

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Abstract

Objective: This study aimed to compare the efficacy of passive ultrasonic irrigation (PUI), EndoActivator, Sonic Air, and hand filing in removing calcium hydroxide (CH) from the mesial root canals of mandibular first molars.

Methods: The mesiobuccal and mesiolingual root canals of 40 extracted mandibular first molars were instrumented and filled with CH paste. The specimens were randomly assigned to four groups (n = 20) based on the CH removal technique: (1) PUI, (2) EndoActivator, (3) Sonic Air, and (4) hand K-file (#25). Irrigation was performed with 5.25% sodium hypochlorite (NaOCl), 17% ethylenediaminetetraacetic acid (EDTA), and a final rinse with distilled water. Residual CH was assessed using the Van der Sluis method under a stereomicroscope and analyzed with Kruskal-Wallis and Mann-Whitney U tests (α=0.05).

Results: There were significant differences in residual CH among groups in both mesiobuccal (P<0.001) and mesiolingual (P=0.002) canals. In the mesiobuccal canal, PUI and EndoActivator were equally effective (P>0.05) and superior to Sonic Air and hand filing (P<0.05), whereas Sonic Air significantly outperformed hand filing (P<0.05). In the mesiolingual canal, no significant difference was found between PUI, EndoActivator, and Sonic Air (P>0.05), but all methods were significantly more effective than hand filing for CH removal (P<0.05).

Conclusions: PUI, EndoActivator, and Sonic Air systems were significantly more effective than hand filing in removing CH from the mesial root canals of extracted mandibular first molars. Among the experimental groups, the efficacy of PUI and EndoActivator were better than Sonic Air in CH removal from mesiobuccal root canals.

Keywords: Calcium hydroxide, Endodontic treatment, Root canal medicaments, Root canal therapy, Sodium hypochlorite, Ultrasonics

Introduction

Calcium hydroxide (CH) is commonly used as an interappointment intracanal medicament due to its antimicrobial properties and ability to induce periapical healing. However, residual CH on the root canal walls can interfere with the adhesion and sealing ability of endodontic sealers, leading to compromised obturation and increased microleakage, thus increasing the risk of treatment failure (1,2). Residual CH may also alter the physical properties of endodontic sealers by extending the setting time and reducing their flow, hindering their penetration into dentinal tubules (3). Therefore, thorough removal of CH before root canal obturation is essential to optimize the sealer's penetration into dentinal tubules and improve long-term treatment outcomes (1).

Various irrigation solutions have been investigated for their ability to dissolve intracanal medicaments. Chelating agents such as ethylenediaminetetraacetic acid (EDTA) are commonly used to remove the smear layer and inorganic components. Sodium hypochlorite (NaOCl), in concentrations ranging from 0.5% to 5.25%, is the preferred irrigant for dissolving organic debris. The combination of EDTA and NaOCl is considered the most effective approach for removing both inorganic and organic residues. However, no single irrigation technique has been proven to eliminate CH completely (4).

Several techniques have been introduced for CH elimination from the root canals, but complete removal remains challenging (5, 6). The most commonly used method for CH removal involves hand instrumentation with a K-file of an appropriate size, combined with abundant irrigation (7). Several activation techniques,

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including ultrasonic and sonic methods, have been developed to enhance intracanal CH removal (8).

Passive ultrasonic irrigation (PUI) employs an ultrasonically activated file in conjunction with a continuous irrigant supply (9). PUI has achieved great popularity due to its ability to enhance irrigation efficacy, particularly in anatomically complex root canals, through cavitation and acoustic microstreaming (10, 11).

Sonic devices are designed to safely agitate and activate intracanal irrigants, facilitating debris and biofilm removal (12). These devices are beneficial in curved canals due to their flexible tips, which allow better adaptation to canal morphology (13). The EndoActivator system operates using sonic energy and has been shown to improve the elimination of the smear layer and residual medicaments. Another commercially available sonic device is Sonic Air, which enhances intracanal irrigation to improve debris removal (14).

Given the lack of consensus on the most effective technique for CH removal, this study aimed to compare the efficacy of PUI, Sonic Air, the EndoActivator system, and hand filing in eliminating CH from the mesial root canals of mandibular first molars. The null hypothesis was that no significant difference would be found among these techniques in the amount of residual CH within the root canal system.

Materials and methods

Study design

The protocol of this in-vitro study was approved by the ethics committee of the Islamic Azad University (IR.IAU.DENTAL.REC.1404.057), Tehran, Iran.

Forty freshly extracted human mandibular first molars with fully developed apices were selected for this study. The teeth were examined under a magnifying loupe (Zumax Medical Co., Jiangsu, China) to verify their accordance with the eligibility criteria. The inclusion criteria were mandibular first molars with intact roots and no previous endodontic treatment or restorations. Exclusion criteria were teeth with root resorption, fractures, carious lesions extending into the root, anatomical anomalies, root canal calcifications, open apices, and any evidence of inadequate storage conditions.

The sample size was determined based on the study by Keskin et al. (15), assuming $\alpha = 0.05$ and $\beta = 0.2$, resulting in a minimum sample size of 19 per group. The final sample size was set at 20 per group. The calculation was performed using the power analysis feature of PASS (version 11; NCSS, LLC, Kaysville, UT, USA).

Sample preparation

The collected teeth were decoronated using a sterile diamond disc to ensure a root length of 18 mm. After accessing the pulp chamber and removing the pulp tissue, hand K-files (#15; Mani Inc., Tochigi, Japan) were used into the mesiobuccal and mesiolingual canals until the file tips were visible at the apex. The working length was determined to be 1 mm shorter than the measured length.

Root canals were instrumented using RaCe rotary files (#30/0.06; FKG Dentaire, La Chaux-de-Fonds, Switzerland) and irrigated with 5.25% NaOCl (Morvabon, Tehran, Iran) via a 30-gauge syringe (Luer-lock; Ava Pezeshk, Tehran, Iran). After mechanical instrumentation, the root canals were rinsed with 2 mL of distilled water and 2.5 mL of 17% EDTA (Morvabon). Calcium hydroxide (CH) powder (Sultan Healthcare, Hackensack, NJ, USA) was mixed with distilled water in a 1:1.5 ratio, and CH paste was applied to the root canals using a Lentulo spiral (#30; Mani Inc.).

A sterile cotton pellet was then placed in the pulp chamber, followed by temporary sealing with a 4-mm layer of temporary restorative material (Golchai, Tehran, Iran). The teeth were stored at 37°C and 100% humidity for two weeks. Afterward, the temporary restorative material was removed, and a #15 K file was used to loosen the paste.

Experimental groups

The samples were randomly divided into four groups based on the CH removal technique (n=20 each) applied, as follows:

Group 1 (passive ultrasonic irrigation, PUI): Root canals were irrigated separately with 5 mL of 5.25% NaOCl using a 30-gauge syringe and 5 mL of 17% EDTA. Each irrigant was activated for one minute using a silver tip (#25/0.02) ultrasonic device (Ultra X-Ultrasonic Activator; Eighteeth Medical, Changzhou, China).

Group 2 (EndoActivator): Root canals were irrigated using the same solutions, followed by EndoActivator (Dentsply, Maillefer, Switzerland) sonic activation at working length for one minute per irrigant, according to the manufacturer's instructions.

Group 3 (Sonic Air): Root canals were irrigated by the same solutions as previous groups and then activated for one minute per irrigant using a sonic device (Sonic

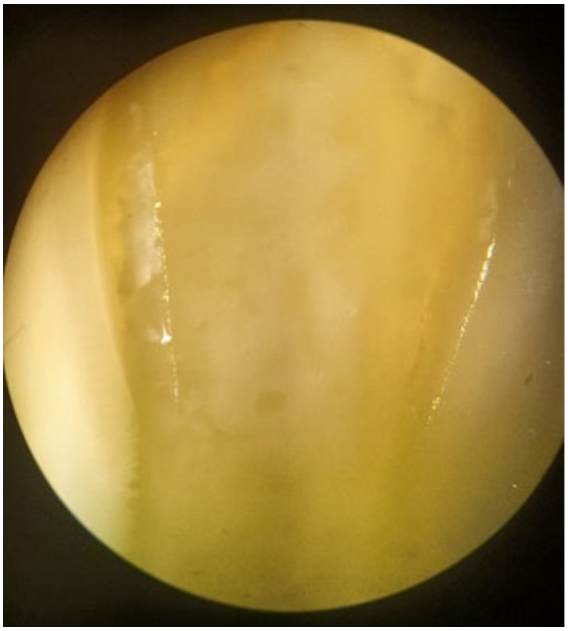

Figure 1. Inspection of an extracted mandibular first molar tooth half under a stereomicroscope at 20x magnification to score the amount of residual CH according to the Van der Sluis classification. As seen, the canal is free from CH residues, indicating a score of 0.

Air MM 1500; Micro Mega, Prodonta Sk, Geneva, Switzerland).

Group 4 (hand file): Root canals were irrigated with the same solutions as previous groups for one minute per irrigant, followed by up-and-down movement using a hand K-file (#25; Mani).

As explained previously, activation was performed separately for each solution, with NaOCl activated for one minute and EDTA for another. All root canals were then rinsed with 5 mL of distilled water. One experienced investigator performed the preparation and cleaning process for all root canals in the study groups.

Calcium hydroxide residual measurements

In all 40 teeth, grooves were created in the buccal and lingual surfaces of the roots using a disc. Vertical cuts were made extending from the cervical to the apical region, and the roots were split into halves using a chisel. Each tooth half was inspected under a stereomicroscope (Zumax, 2050; Zumax Medical Co.) at 20x magnification, and digital photographs were obtained from each tooth half (Figure 1).

Two calibrated endodontists, blinded to group allocations, evaluated each photograph and scored the amount of residual CH in the root canal system. To assess intra-observer reliability, each photograph was evaluated twice with a one-week interval between assessments. The intra-class correlation coefficient (ICC) for both inter- and intra-observer reliability was greater than 0.90, indicating strong agreement.

The scoring system was performed using the classification by Van der Sluis et al., as follows (16):

Score 0: No CH was left on the root canal walls.

Score 1: Less than half of the root canal walls were covered with CH.

Score 2: More than half of the root canal walls were covered with CH.

Score 3: Root canal walls were covered entirely with CH.

Statistical analysis

The Kruskal-Wallis test was used to compare residual CH among the groups, followed by the Mann-Whitney U test for pairwise comparisons. Data were analyzed using SPSS software (version 22; IBM Corp., Armonk, NY, USA). A $P< 0.05$ was considered statistically significant.

Results

In the mesiobuccal root canal (Table 1), the PUI and EndoActivator groups demonstrated the highest effectiveness in removing CH, with 50% of samples achieving a zero score indicating complete elimination. In contrast, the hand file cleaning group showed no samples with a score of 0, making it the least effective method.

The frequency of score 1 was 50% in the PUI and EndoActivator groups and 55% in both the Sonic Air and hand file groups. Score 2 was observed in 45% of samples in the hand file group and 20% in the Sonic Air group, while no samples in the PUI or EndoActivator groups exhibited this level of CH remnants. Notably, none of the groups had samples with a score of 3, indicating that all methods achieved at least some degree of CH removal (Table 1).

Statistical analysis using the Kruskal-Wallis test revealed a significant difference in residual CH in the mesiobuccal canal among the four groups ($P < 0.001$). Pairwise comparisons using the Mann-Whitney U test showed no significant difference between PUI and EndoActivator ($P = 1.000$). However, both methods were significantly more effective than Sonic Air ($P = 0.037$ for both) and hand file instrumentation ($P < 0.001$ for both) for Ch removal. Furthermore, Sonic Air was significantly superior to the hand file method in CH removal ($P=0.022$).

In the mesiolingual root canal (Table 2), complete CH elimination (score 0) was achieved in 35%, 30%, and 25%

Table 1. The frequency and percentage of residual calcium hydroxide scores in the mesiobuccal root canal in the study groups

Group	Residual CH score (N/%)				Pairwise P-value			
	0	1	2	3	Group 1	Group 2	Group 3	Group 4
Group 1: PUI	10 (50%)	10 (50%)	0 (0%)	0 (0%)	-	1.000	0.037*	<0.001*
Group 2; EndoActivator	10 (50%)	10 (50%)	0 (0%)	0 (0%)	-	-	0.037*	<0.001*
Group 3; Sonic Air	5 (25%)	11 (55%)	4 (20%)	0 (0%)	-	-	-	0.022*
Group 4; Hand file	0 (0%)	11 (55%)	9 (45%)	0 (0%)	-	-	-	-
P-value	<0.001*				-	-	-	-

Significance is denoted by an asterisk (*).
PUI: Passive ultrasonic irrigation; CH: Calcium hydroxide; N: Number

of samples in the PUI, EndoActivator, and Sonic Air groups, respectively. Once again, the hand file cleaning group had no samples, achieving a score of 0, making it the least effective method. Score 1 was the most frequently observed score across all groups, with 65% in PUI, 70% in EndoActivator and Sonic Air, and 75% in the hand file groups. Score 2 was observed in 25% of samples in the hand file group and 5% in the Sonic Air group, while no samples in the PUI or EndoActivator groups exhibited this level of CH remnants. Like the mesiobuccal root canal, none of the groups had samples with a score of 3, confirming that all methods facilitated some degree of CH removal from the mesiolingual canal (Table 2).

The Kruskal-Wallis test indicated a significant difference in residual CH in the mesiolingual canal among the four groups (P=0.002). Pairwise comparisons showed no significant differences between PUI and EndoActivator (P=0.754), PUI and Sonic Air (P=0.374), or EndoActivator and Sonic Air (P=0.565). However, PUI, EndoActivator, and Sonic Air were all significantly superior to the hand file method in CH removal (P<0.001, P=0.001, and P=0.009, respectively).

Discussion

This study compared the efficacy of passive ultrasonic irrigation (PUI), EndoActivator system, Sonic Air, and hand file instrumentation in removing residual calcium hydroxide (CH) from the mesial root canals of mandibular first molars. The results revealed significant differences in residual CH among the study groups in both the mesiobuccal and mesiolingual canals. Further analysis revealed that in the mesiobuccal root canal, PUI and EndoActivator were significantly more effective than Sonic Air and hand file instrumentation in CH removal. In addition, Sonic Air was significantly superior to hand filing in CH removal. In the mesiolingual root canal, all three activation techniques demonstrated comparable efficacy, superior to the hand file instrumentation for CH removal. Consequently, the null hypothesis of the study was rejected.

Activation of the irrigation solution generates sufficient shear forces to dislodge debris and enhance canal cleanliness. Sonic irrigation devices were developed to enhance the irrigation phase by generating vigorous intracanal fluid agitation. The EndoActivator system comprises a portable, battery-operated handpiece and three flexible, disposable polymer tips of varying sizes. These tips are designed to safely activate irrigants without cutting root dentin, ensuring adequate agitation and enhancing debris removal (17). The EndoActivator operates at a frequency range of 2,000–10,000 Hz and provides high-energy activation, significantly improving the removal of the smear layer

Table 2. The frequency and percentage of residual calcium hydroxide scores in the mesiolingual root canal in the study groups

Group	Residual CH score (N/%)				Pairwise P-value b			
	0	1	2	3	Group 1	Group 2	Group 3	Group 4
Group 1: PUI	7 (35%)	13 (65%)	0 (0%)	0 (0%)	-	0.754	0.374	<0.001*
Group 2; EndoActivator	6 (30%)	14 (70%)	0 (0%)	0 (0%)	-	-	0.565	0.001*
Group 3; Sonic Air	5 (25%)	14 (70%)	1 (5%)	0 (0%)	-	-	-	0.009*
Group 4; Hand file	0 (0%)	15 (75%)	5 (25%)	0 (0%)	-	-	-	-
P-value [a]	0.002				-	-	-	-

Significance is denoted by an asterisk (*).
PUI: Passive ultrasonic irrigation; CH: Calcium hydroxide; N: Number

and CH remnants from the canal walls. Another sonic irrigation device, the Sonic Air Micro-Mega 1500, also utilizes sonic activation but operates at a fixed frequency of 1,500 Hz, producing moderate activation. In the present study, both sonic systems effectively enhanced irrigant distribution and CH removal compared to hand file instrumentation. However, the EndoActivator's broader frequency range and higher energy output probably contributed to the superior results observed in the mesiobuccal root canal compared to the Sonic Air device.

PUI systems are designed to introduce a smooth, non-cutting tip file or wire into the canal while controlling energy transmission to minimize unintended contact with canal walls. However, wall contact may be unavoidable in anatomically constrained regions, limiting free oscillation. This phenomenon is especially problematic in complex apical root anatomies, where it can lead to tip fracture, deformation of root canal morphology, and weakening of the apical constriction (11).

The outcomes of this study are in agreement with the results of Murwakani et al. (18) who compared sonic activation (Eddy™) to PUI activation for CH removal, assessing the results with micro-computed tomography. They found no significant difference in the volume of residual CH between the two groups in the mesiolingual canal, suggesting comparable efficacy (18). Donnermeyer et al. (19) compared PUI, sonic activation with Eddy™, XP-Endo Finisher, and manual irrigation for CH removal from artificially created grooves in straight root canals. They reported that all activation techniques were significantly more effective than manual irrigation. Additionally, they found no significant difference between sonic activation and PUI, which aligns with the present findings (19). Similarly, Generali et al. (20) evaluated PUI, negative apical pressure using EndoVac, XP-Endo Finisher, and manual irrigation for CH removal from straight root canals. The results showed that all activation techniques were superior to manual irrigation (20). Tobar et al. (9) compared PUI and manual irrigation in removing CH from root canals and demonstrated that PUI was significantly more effective in the coronal, middle, and apical thirds of the root.

In contrast to the outcomes of this study, Pabel and Hülsmann (21) compared the efficacy of PUI, EndoActivator, hydrodynamic irrigation (RinsEndo®), a motor-driven plastic brush (CanalBrush™), and manual irrigation for CH removal. Consistent with the findings of the present study, they demonstrated that PUI was significantly more effective than other methods, including EndoActivator. Paiva et al. (11) assessed PUI, Easy Clean, XP-Endo Finisher, XP-Endo Finisher plus PUI, and hand files for CH removal from simulated root canals with internal resorption. Contrary to our results, they found no significant difference between the PUI method and manual irrigation in CH removal. However, they reported the superiority of XP-Endo Finisher + PUI compared to other techniques. Al-Garni et al. (17) compared the CH removal efficacy of EndoActivator with hand file instrumentation. They reported that the EndoActivator system did not enhance CH removal in the middle and apical root thirds compared to hand file instrumentation. Acharya et al. (22) found no significant difference between the CH removal efficiency of EndoActivator and the hand file technique, which also contrasts with the present results.

A key strength of this study was the careful selection of nearly identical teeth, which helped to minimize the confounding effect of anatomical variations. However, inherent differences among samples may still have affected the results. Furthermore, this study was conducted in an in vitro setting, limiting the complete simulation of clinical conditions. Therefore, caution is warranted when extrapolating these findings to clinical practice. Future clinical trials are needed to assess the efficacy of PUI, Sonic Air, and EndoActivator for CH removal and their effects on long-term treatment success.

Conclusions

Within the limitations of this in vitro study, PUI, EndoActivator, and Sonic Air were significantly more effective than hand file instrumentation in removing CH from the mesial root canals of extracted first molars. Although PUI and EndoActivator were superior to Sonic Air in the mesiobuccal canal, the efficacy of all three experimental techniques was comparable for CH removal from the mesiolingual root canal.

Acknowledgments

None to declare

Conflict of Interest

The authors declare no conflict of interest.

Author Contributions

N.R. conceived and planned the experiments and contributed to the interpretation of the results; F.A.K. carried out the experiments; S.S. carried out the

experiments and conceived and planned the experiments; M.M. contributed to the interpretation of the results and took the lead in writing the manuscript. All authors read and approved the final manuscript.

Ethical Considerations

The study protocol was approved by the ethics committee of the Islamic Azad University (IR.IAU.DENTAL.REC.1404.057).

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References

1. de Freitas JV, Ebert J, Mazzi-Chaves JF, de Sousa-Neto MD, Lohbauer U, Baratto-Filho F. Do contaminating substances influence the rheological properties of root canal sealers? J Endod 2020;46(2):258-63.

2. 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. J Endod 2014;40(3):451-454 .

3. Nabeeh Hassanen AM, Nagy MM, Abdelaziz TM. Cleaning Ability of Three Different Rotary Files Systems;(An In-Vitro Study). Egypt Dent J 2024;70(4):3765-3777.

4.Masudi SA, Azhar L, Awang RA, Alam MK. Removal efficiency of calcium hydroxide intracanal medicament using two irrigation solutions. Int Medical J 2014;21(1):106-109.

5. Camargo C, Leal FM, Silva GO, de Oliveira TR, Madureira PG, Camargo S. Efficacy of different techniques for removal of calcium hydroxide-chlorhexidine paste from root canals. Gen Dent 2016;64(2):e9-12.

6. Kirar DS, Jain P, Patni P. Comparison of different irrigation and agitation methods for the removal of two types of calcium hydroxide medicaments from the root canal wall: an in-vitro study. Clujul Med 2017;90(3):327-332.

7. Mozo S, Llena C, Forner L. Review of ultrasonic irrigation in endodontics: increasing action of irrigating solutions. Med Oral Patol Oral Cir Bucal 2012;17(3):e512-516.

8. Silva L, Pessoa O, Teixeira M, Gouveia C, Braga R. Micro-CT evaluation of calcium hydroxide removal through passive ultrasonic irrigation associated with or without an additional instrument. Int Endod J 2015;48(8):768-773.

9. Tobar RS, Hassanen E, Ghobashy AM, Bayoumi AA. A Comparison of Two Techniques for the Removal of Calcium Hydroxide and Nano Calcium Hydroxide intracanal medicaments from Root canals:(In-Vitro Study). Int J Chem and Biochem Sci 2023;24(11):621-627.

10. Plotino G, Grande NM, Mercade M, Cortese T, Staffoli S, Gambarini G, Testarelli L. Efficacy of sonic and ultrasonic irrigation devices in the removal of debris from canal irregularities in artificial root canals. J Appl Oral Sci 2019;27:e20180045.

11. Paiva HC, Barros AM, de Miranda Candeiro GT, Paz LR, Iglecias EF, Gusukuma LG, Gavini G. Evaluation of different methods of calcium hydroxide removal from root canals with simulated internal resorptions. Braz Dent Sci 2024;27(2): e4198.

12. Gu LS, Kim JR, Ling J, Choi KK, Pashley DH, Tay FR. Review of contemporary irrigant agitation techniques and devices. J Endod 2009 Jun;35(6):791-804.

13. Moon W, Chung SH, Chang J. Sonic irrigation for removal of calcium hydroxide in the apical root canal: A micro-CT and light-coupled tracking analysis. PloS one. 2022;17(6):e0268791.

14. Neuhaus KW, Liebi M, Stauffacher S, Eick S, Lussi A. Antibacterial efficacy of a new sonic irrigation device for root canal disinfection. J endod 2016;42(12):1799-803.

15. Keskin C, Sariyilmaz E, Sariyilmaz Ö. Efficacy of XP-endo Finisher file in removing calcium hydroxide from simulated internal resorption cavity. J endod 2017;43(1):126-130.

16. 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. Int Endod J 2007;40(1):52-57.

17. Al-Garni S, Al-Shahrani S, Al-Nazhan S, Al-Maflehi N. Evaluation of calcium hydroxide removal using EndoActivator system: An: in vitro: study. Saudi Endod J 2014;4(1):13-17.

18. Murwakani NS, Usman M, Djauharie RN, Marissa C. Comparison of sonic and ultrasonic activation for removal of calcium hydroxide from root canals-A micro-CT study. Journal of Int Dent Med Res 2019;12(1):123-128.

19. Donnermeyer D, Wyrsch H, Bürklein S, Schäfer E. Removal of Calcium Hydroxide from Artificial Grooves in Straight Root Canals: Sonic Activation Using EDDY Versus Passive Ultrasonic Irrigation and XPendo Finisher. J endod 2019;45(3):322-326.

20. Generali L, Cavani F, Franceschetti F, Sassatelli P, Giardino L, Pirani C, et al. Calcium Hydroxide Removal Using Four Different Irrigation Systems: A Quantitative Evaluation by Scanning Electron Microscopy. Appl Sci 2022;12(1):271
21. Pabel AK, Hülsmann M. Comparison of different techniques for removal of calcium hydroxide from straight root canals: an in vitro study. Odontology 2017;105(4):453-459.
22. Acharya N , Poudel D , Chakradhar A . A Comparative Evaluation of Removal of Intracanal Calcium Hydroxide with Endoactivator System and Mechanical Instrumentation with K File, Using Two Irrigating Solutions: an in Vitro Study. Kathmandu Univ Med J (KUMJ) 2018;16(61):74-77.