Journal of Cardiovascular Disease Research

ISSN: 0975-3583,0976-2833 VOL13, ISSUE 08, 2022

ORIGINAL RESEARCH

COMPARATIVE ASSESSMENT ON VARIOUS ROOT CANAL IRRIGATING MATERIALS

Paritosh Sharma[1], Kartik Salaria[2] , Palak Malhi[3]

[1,2,3]Senior Lecturer, Department of Conservative and and Endodontics
Himachal Dental College, Sundernagar,H.P.

Corresponding author
Dr. Palak Malhi
[3]Senior Lecturer, Department of Conservative and and Endodontics
Himachal Dental College, Sundernagar,H.P.

Received: 24 November, 2022 Accepted: 22 December, 2022

Abstract

Introduction: Endodontic treatment success rate relies majorly on apical and coronal sealing. In order to achieve a good hermetic seal the removal of smear layer is unavoidable. Hence this study was conducted to assess the various root canal irrigating materials.

Materials and Methodology: Freshly extracted human mandibular premolar teeth were selected and were randomly divided into two groups. Inclusion criteria include those teeth that have less than 10 degrees of angulation. The study samples include 30 freshly extracted teeth that were basically divided into two groups. Group – 1 comprised of manual syringe needle irrigation, Group – 2 consisted of automated root canal irrigation. Canals were effectively dried with paper points after which the roots were split longitudinally and examined.

Results: The debris score and smear layer score was observed in both the study groups namely manual needle and automated irrigation device. Interestingly a low mean score in debris as well as smear layer was observed in both the groups. ($p>0.05$) Moreover no statistically significant difference was prompt in the debris and the smear layer score at the apical, middle or coronal region.

Conclusion: To conclude, it has been effectively observed that the manual syringe irrigation and automated irrigation devices clearly showed identical results in removing the smear an debris layer with no significant differences were elicited between the two groups.

Keywords: irrigation, automated, manual, smear layer

Introduction

The most important step in determining the success rate of root canal treatment greatly is the biomechanical preparation which helps the irrigant that were employed in the process of debridement to thoroughly disinfect the root canal system.[1] A successful root canal treatment mandates the use of a irrigation since it fulfils various mechanical, chemical and microbiological functions that include healing of the periapical tissues. Therefore irrigation plays a major role in determining the success of an endodontic treatment but there has been no single irrigant that efficiently satisfies all the requirements of an ideal irrigating solution.[2] The two most important features of an endodontic irrigants that majorly predicts the root canal treatment success are the tissue dissolution capacity and the antimicrobial effect which make them an integral part in chemo-mechanical root canal preparation. While improving the elimination of microbiota and facilitating the elimination of necrotic tissue and dentin debris

ISSN: 0975-3583,0976-2833 VOL13, ISSUE 08, 2022

from the root canal system, an ideal irrigant should possess the property of being non-irritant to the surrounding root and the peri-radicular tissues and thereby should not debilitate the tooth structure by promoting excessive wear of minerals from the dentin.[2,3]

Various irrigants and medicaments have been employed in cleaning root canals with various results. These include saline, sodium hypochlorite (NaOCl), chlorhexidine (CHX), EDTA, citric acid and MTAD. In the recent years, all of the techniques and instruments were used to clean and shape canals which produce some amount of apically extruded debris (AED). Mechanical cleansing of the root canals in addition to the removal of the necrotic or the vital pulp ultimately results in the formation of a thin layer of debris that is called as "smear layer". This layer is effectively made up of potentially infective organic and inorganic substances that should be removed from the root canal walls, dentin tubules as well as the root canal branches with the support of root canal irrigants. Irrigants can augment mechanical debridement by flushing out debris, dissolving tissue, and disinfecting the root canal system.[4,5] An ideal irrigant or medication should effectively be able to disinfect the dentin and the dentinal tubules in a single visit. Moreover, it should have a sustained antimicrobial property that should be available in longevity and it should be bio-compatible with live host tissue.[6]

Extrusion of debris into the peri-radicular tissue is one of major aetiological factors in initiating the periapical inflammation and postoperative flare-ups that have been a persistent problem over the consecutive years.[7] It is the most often seemed to be associated with pain and swelling during or after completion of root canal therapy. Thus the importance of minimizing AED needs to be reiterated. Earlier studies have evaluated the amount of AED resulted with various instruments or techniques and in different types or in various concentrations of irrigants.[8,9] Therefore the present study was taken for assessing and comparing the two different root canal irrigating solutions during root canal therapy.

Materials And Methodology

After obtaining the permission from the institutional ethical committee as well as from the college authorities, the study commenced with 30 extracted natural teeth. Freshly extracted human mandibular premolar teeth were selected and were randomly divided into two groups. Inclusion criteria include those teeth that have less than 10 degrees of angulation. Certain exclusion criteria were also followed in this study includes those teeth with calcifications and with open apices. Immediately after the extraction, hand curettes were employed to remove the soft tissue that was usually stuck to the tooth apices or on the surface.

The collected teeth were subjected to be kept at $+4^{o}C$ in the physiological saline solution till the commencement of the study which helps in preserving the properties of the teeth and aslo helps in providing potential storage medium for quite a longer duration. All the root surfaces of the teeth were immersed in a molten wax to a depth of 0.2 – 0.4 mm thick to depth of 1 mm clearly apical to the cemento-enamel junction. This molten layer ideally mimicks the alveolar bone and the periodontal ligament attachment. Once the resin set, the wax was removed from the tooth surfaces and embedded 1 mm apical to CEJ in a self-cure acrylic. The mould cavity was then filled with elastomeric impression material and the teeth were then reseated.

A conventional access cavity preparation was made to access the root canal system. A size 10 K-file was used to check in each canal in order to determine its patency. Based on the manufacturer's protocols, the working length was set at 1 mm below the apex and the canals were progressively enlarged till the size F2 Protaper Gold (Dentsply, Maillefer, Switzerland) while being irrigated with 5 mL of the appropriate irrigating solution in between each instrumentation. 2 mL of 17.5% EDTA solution (MD Cleanser, Meta Biomed, South Korea) and 2 mL of 5.25% NaOCl were alternately used. Each root canal received 2 mL of 5.25%

ISSN: 0975-3583,0976-2833 VOL13, ISSUE 08, 2022

NaOCl followed by 5 mL of a 5.25% NaOCl solution for the final irrigation. Distilled water was used as the final irrigant to flush and paper points were used to dry the canals in the end.
The study samples include 30 freshly extracted teeth that were basically divided into two groups. Group – 1 comprised of manual syringe needle irrigation, Group – 2 consisted of automated root canal irrigation. Canals were effectively dried with paper points after which the roots were split longitudinally and examined. The cleaning ability of irrigating solutions was evaluated and all the results were recorded in Microsoft excel sheet and were analysed by SPSS software. Student t test was used for evaluation of level of significance. P- value of less than 0.05 was taken as significant.

Results

The debris score and smear layer score was observed in both the study groups namely manual needle and automated irrigation device. Interestingly a low mean score in debris as well as smear layer was observed in both the groups. ($p>0.05$) Moreover no statistically significant difference was prompt in the debris and the smear layer score at the apical, middle or coronal region.

Table – 1: Mean distribution of debris score between two groups.

Groups	Debris score			P – value
	Apical	Middle	Coronal	
Group - 1	1.45 ± 0.52	1.44 ± 0.52	1.21 ± 0.44	0.13
Group – 2	1.34 ± 0.83	2.15 ± 1.05	2.22 ± 0.85	0.09
P – value	0.00	0.01	0.01	

Table – 2: Mean distribution of smear score between two groups.

Groups	Debris score			P – value
	Apical	Middle	Coronal	
Group - 1	1.43 ± 0.55	1.42 ± 0.54	2.23 ± 0.87	0.24
Group – 2	1.33 ± 0.82	2.05 ± 0.85	2.05 ± 0.78	0.19
P – value	0.03	0.00	0.01	

Discussion

When a tooth is prepared for a root canal instrumentation with the help of manual or rotary instruments, almost all the mineralized tissues are shredded in producing a huge amount of debris. A majority of the portion of the smear layer is usually comprised of extremely fine particles consisting of mineralised collagen matrix that is being presented to the surface to create what is called a 'smear layer'. Moreover, based on the results obtained from the earlier studies on periapical pressure assessment model, 1 – 4 mL/min is kept as an optimal irrigation flow rates in order to prevent the inherent apical pressure during the irrigation procedure.[10,11] IT is difficult for the operator to maintain a constant irrigation flow rates. A study conducted by *Boutsioukis* et al, observed that the syringe needle irrigation is difficult to standardize in various clinical setting since the irrigation efficiency varies based upon the gender and clinical experience of the operator.[12] Therefore an automated root canal irrigation device could possibly benefit the operator by preventing the operator fatigue as well as delivering the irrigant solution at a constant flow rate. There are studies conducted by *Virdee* SS et al clearly explained that the inefficiency of the manual syringe needle irrigation in effectively removing the debris and smear layer.
Histological studies in evaluating the amount of debris accumulation or residual smear layer in the root canal following the instrumentation have been effectively implemented to measure the cleanliness inside the root canal systems. *Robinson* JP et al proposed that the reciprocating rotary file approach ultimately leads to the accumulation of increased debris

ISSN: 0975-3583,0976-2833 VOL13, ISSUE 08, 2022

accumulation. It has also been researched that the file's design is more important than kinematics of the system in analysing the effectiveness of the disinfection.[14] Hence, in this study, the file systems are standardized which might not create differences in debris accumulation or smear layer formation.

When considering the irrigation protocol, the proposed irrigation regime was standardized in all the groups with no activation was conducted. Study by Kim JG et al stated that the smear layer as well as the debris removal could partly attribute to the irrigation protocols that have been adopted. The irrigation protocol that has been followed in this study was basically dependent on the earlier research that has been researched in the former years or decades. NaOCl significantly decreased the organic components of the dentin like carbonate and phosphate when compared to novel irrigating solutions such as silver citrate and ozonated olive oil. This is in concordance with the studies conducted by *Sakae* et al who briefed that NaOCl is capable of removing magnesium and carbonate ions from dentin.[16] NaOCl when used at a concentration of 1.5% was seemed to reduce the collagen content present in the root dentin causing subsequent reduction in the flexural strength. When NaOCl is used in the concentration of above 5% - 9%, it can possibly cause alterations in the carbon and nitrogen contents of dentin thereby reducing the micro-hardness of dentin.[17]

Study conducted by *Saini* et al[18] effectively compared the efficacy of NaviTip, Max I Probe, and EndoVac in removal of debris from the root canal. They reported that the least amount of mean percentage debris with EndoVac followed by Max I probe and NaviTip. This difference between the groups was found to be significant ($P < 0.05$). It was proved from the results that 3.5 mm level showed relatively less amount of debris as compared 1.5 mm level, though EndoVac irrigation system revealed nonsignificant difference ($P < 0.05$). Another study conducted by *Al-Obaida* et al[19] found that the sonic irrigation was reportedly better than the control group in removing loose debris at 3 mm from the radiographic apex. Another study by *Heilborn* et al[20] assessed the cleaning efficiency of EndoVac system with the Max-I-Probe and found that Max-I-Probe system was least effective in debris removal as compared to EndoVac system; however, no significant difference was found between groups at 3 mm level.

Conclusion

To conclude, it has been effectively observed that the manual syringe irrigation and automated irrigation devices clearly showed identical results in removing the smear an debris layer with no significant differences were elicited between the two groups.

References

1. Dhaimy, S.; Imdary, S.; Dhoum, S.; Benkiran, I.; El Ouazzani, A. Radiological Evaluation of Penetration of the Irrigant according to Three Endodontic Irrigation Techniques. Int. J. Dent. 2016, 2016, 3142742.
2. Kaur, P. Role of Irrigants in Endodontics. J. Dent. Probl. Solut. 2020, 7, 100–104.
3. Ghorbanzadeh, S.; Loodaricheh, S.A.; Samizade, S.; Zadsirjan, S. Irrigants in endodontic treatment. Structure 2015, 11, 12.
4. Barnett F, Godick B, Tronstad L. Clinical suitability of a sonic vibratory endodontic instrument. Endod Dent Traumatol. 1985;1:77–81.
5. Gutarts R, Nusstein J, Reader A, Beck M. In vivo debridement efficacy of ultrasonic irrigation following hand-rotary instrumentation in human mandibular molars. J Endod. 2005;31:166–70.
6. Zehnder M. Root Canal Irrigants J Endod 2006 May 32(5):389-398.
7. Seltzer S, Naidorf IJ. Flare-ups in endodontics: I. Etiological factors. 1985. J Endod. 2004; 30:476-81.

ISSN: 0975-3583,0976-2833 VOL13, ISSUE 08, 2022

8. Froughreyhani M, Lotfi M, Rahimi S, Shahi S, Salem A. Evaluation of the amount of apically extruded debris using Mtwo and RaCe systems – An in vitro study. Afr J Biotech. 2011; 10:19637-40.
9. Fairbourn DR, McWalter GM, Montgomery S. The effect of four preparation techniques on the amount of apically extruded debris. J Endod. 1987; 13:102-8.
10. Teja, K.V.; Ramesh, S.; Battineni, G.; Vasundhara, K.A.; Jose, J.; Janani, K. The effect of various in-vitro and ex-vivo parameters on irrigant flow and apical pressure using manual syringe needle irrigation: Systematic review. Saudi Dent. J. 2022, 34, 87–99.
11. Park, E.; Shen, Y.; Khakpour, M.; Haapasalo, M. Apical pressure and extent of irrigant flow beyond the needle tip during positive-pressure irrigation in an in vitro root canal model. J. Endod. 2013, 39, 511–515.
12. Boutsioukis, C.; Lambrianidis, T.; Kastrinakis, E.; Bekiaroglou, P. Measurement of pressure and flow rates during irrigation of a root canal ex vivo with three endodontic needles. Int. Endod. J. 2007, 40, 504–513.
13. Virdee, S.S.; Seymour, D.W.; Farnell, D.; Bhamra, G.; Bhakta, S. Efficacy of irrigant activation techniques in removing intracanal smear layer and debris from mature permanent teeth: A systematic review and meta-analysis. Int. Endod. J. 2018, 51, 605–621.
14. Robinson, J.P.; Lumley, P.J.; Cooper, P.R.; Grover, L.M.; Walmsley, A.D. Reciprocating root canal technique induces greater debris accumulation than a continuous rotary technique as assessed by 3-dimensional micro–computed tomography. J. Endod. 2013, 39, 1067–1070.
15. Kim, J.-G.; Kum, K.-Y.; Kim, E.-S. Comparative study on morphology of cross-section and cyclic fatigue test with different rotary NiTi files and handling methods. J. Korean Acad. Conserv. Dent. 2006, 96–102.
16. Sakae, T.; Mishima, H.; Kozawa, Y. Changes in bovine dentin mineral with sodium hypochlorite treatment. J. Dent. Res. 1988, 67, 1229–1234.
17. Marending, M.; Luder, H.U.; Brunner, T.J.; Knecht, S.; Stark, W.J.; Zehnder, M. Effect of sodium hypochlorite on human root dentine–mechanical, chemical and structural evaluation. Int. Endod. J. 2007, 40, 786–793.
18. Saini M, Kumari M, Taneja S. Comparative evaluation of the efficacy of three different irrigation devices in removal of debris from root canal at two different levels: An in vitro study. J Conserv Dent 2013;16:509-13.
19. Heilborn C, Reynolds K, Johnson JD, Cohenca N. Cleaning efficacy of an apical negative-pressure irrigation system at different exposure times. Quintessence Int 2010;41:759-67.