ISSN: 2581-5989
PubMed - National Library of Medicine - ID: 101738774

International Journal of Dental Science and Innovative Research (IJDSIR)

IJDSIR : Dental Publication Service

Available Online at: www.ijdsir.com

Volume – 6, Issue – 4, August - 2023, Page No. : 32 - 40

Irrigation In Endodontics

[1]Harshvardhan Jain, BDS, Goregaon Dental Centre.

[2]Naval Ghule, BDS, Goregaon Dental Centre.

[3]Amar Shaw, MDS Public Health Dentistry, Goregaon Dental Centre.

Corresponding Author: Harshvardhan Jain, BDS, Goregaon Dental Centre.

Citation of this Article: Harshvardhan Jain, Naval Ghule, Amar Shaw, "Irrigation In Endodontics", IJDSIR- August - 2023, Volume – 6, Issue - 4, P. No. 32 – 40.

Type of Publication: Review Article

Conflicts of Interest: Nil

Abstract

The key to a successful root canal procedure is irrigation. It performs a number of crucial tasks, which may differ depending on the irrigants employed, including lowering friction between the instrument and dentine, enhancing the cutting efficiency of the files, dissolving tissue, cooling the file and tooth, and additionally having washed and antimicrobial/antibiofilm effects. Additionally, the only way to affect the parts of the root canal wall that are not reached by mechanical instrumentation is through irrigation. The primary irrigating agent used effectively dissolve organic materials and destroy germs is sodium hypochlorite. Sodium hypochlorite (NaOCl) in high concentrations performs better than 1 and 2% solutions. As a final rinse, ethylenediaminetetraacetic acid (EDTA) is required to get rid of the smear layer. Between these two main irrigants, sterile water or saline may be utilised, but they must not be the only solutions employed. Irrigation provides a unique challenge in the apical root canal since it is here where the balance between safety and effectiveness is most crucial. A collection of the many sources and their effects must be researched both in vivo and in vitro because numerous irrigants have now been studied. For root canal irrigation, a variety of delivery methods are used, including the conventional syringe-needle delivery method and different machine-driven systems, such as automated pumps and sonic or ultrasonic energy. The aim of this article is to prove importance of irrigation in endodontics , provide an overview of solutions used in the irrigation of the root canal. , and outline old and new equipment for irrigation.

Keywords: Endodontics, EndoVac, EDTA, Irrigation, NaOCl , Root Canal , Ultrasonic .

Introduction

Since irrigation performs numerous crucial mechanical, chemical, and (micro) biological functions, it is an essential component of successful root canal therapy. The only approach to affect the parts of the root canal wall that are not reached by mechanical instrumentation is also through irrigation. The impact of irrigation on the smear layer has been the subject of a lot of research on endodontic irrigation. However, when the right procedures are followed, smear layer removal can be done fairly easily. The portions not covered by the files, such as fins, isthmuses, and extensive lateral canals, may present a greater problem for irrigation. Despite meticulous instrumentation, a sizable portion of the oval and flat canals may remain undisturbed. These regions have biofilms and tissue remains that can only be eliminated chemically through irrigation1. A few years ago, a safe way to efficiently irrigate the mostapical canals was introduced to endodontic therapy: negative pressure irrigation. Studies comparing negative pressure and positive pressure irrigation have shown that the negative pressure approach can enhance the quality of cleansing of the apical root canal without running the risk of solution extrusion2. For root canal irrigation, a variety of delivery methods are employed, including the conventional syringe-needle delivery method and different machine- driven systems, such as automated pumps, vibrating tips, and sonic or ultrasonic energy. The various methods of irrigation improvement all aim to ensure effective irrigants distribution throughout the root canal system for more reliable cleaning of the hard-to-reach areas3. Cleaning even the most problematic locations, including the lengthy and narrow isthmuses between two canals, has showed promise with ultrasonic irrigation, which uses ultrasonic tips to transport the solutions directly into the canal space1.

Solutions used in the irrigation of the root canal.

Sodium hypochlorite (NaOCl) is crucial in the irrigation process of a root canal. The only solution in use right now that can dissolve organic materials in the canal is this one. Therefore, the use of hypochlorite is crucial for getting rid of both biofilm and the remnants of necrotic tissue. The direct effects of hypochlorous acid on a microbial cell's is quick cell death[1]. Use of hypochlorite ranges from 0.5 to 6% concentrations. The solution should be periodically replenished and kept in motion by agitation or continuous irrigation to enhance the efficiency of hypochlorite irrigation[4]. The sole solution at this point is hypochlorite, which should be utilised throughout the instrumentation as well as for one to two minutes after it is over. NaOCl loses its antibacterial properties when used in combination with other chemicals, such as ethylenediaminetetraacetic acid (EDTA), hence this practise should be avoided[1]. One recent investigation found that tissue that has been exposed to EDTA is not adequately dissolved by NaOCl thereafter. Hypochlorite should not be utilised once EDTA or citric acid have finished removing the smear layer because it erodes the dentine[4]. Upon coming into contact with hypochlorite , An orange-brown precipitate containing potentially cancer-causing para-chloroaniline (PCA) is created when hypochlorite interacts with chlorhexidine[5]. Therefore, after using either of these two solutions, the canal should be rinsed, for instance with water or saline. To avoid chemical interactions between two irrigating solutions, such as NaOCl and chlorhexidine, sterile water and saline can be used between them. However, since neither water nor saline have tissue-dissolving or antimicrobial activity, they shouldn't be used as the primary irrigants[1]. The final irrigant utilised after NaOCl is EDTA.

Fig 1: Sodium Hypochlorite (Naocl) Irrigant

EDTA: A chelator. EDTA precipitates at an acidic pH; EDTA solution is either neutral or slightly alkaline. Although some studies have found that 5% and even 1% EDTA solutions are powerful enough to remove smear layers, EDTA is typically used as a 17% or 15% solution[5]. The recommended removal time for smear layers is about two minutes, however thick coatings might need to be exposed for extended periods of time. Only the inorganic portion of dentine and the smear layer (hydroxyapatite) are affected by EDTA, and complete removal of the smear layer requires the use of NaOCl prior to the final rinse with EDTA[1]. Even though some researches have suggested that EDTA has antifungal activity, it has little to no antibacterial activity. Although EDTA weakens bacterial cell walls without actually killing them, it may work better when combined with other substances like chlorhexidine, which more forcefully attack bacterial cell walls[6]. NaOCl's action is substantially diminished by EDTA, thus it shouldn't be used in conjunction with it or in place of it. EDTA produces a white, hazy precipitate when combined with chlorhexidine. After the smear layer has been removed by NaOCl and EDTA has been used as a final rinse, the instrumented canal wall is then irrigated[5]. After using NaOCl.

Fig. 2: EDTA Irrigant

Citric Acid: After using NaOCl, citric acid can be used as the last rinse in place of EDTA to get rid of the smear layer. Solutions ranging from 1% to 10% have been employed. Because citric acid is a bit more aggressive than EDTA and should not be used immediately after, the root canal wall will erode more quickly than it would with EDTA and NaOCl. The combination products for removing smear layers, MTAD and Tetraclean, both contain citric acid as a component[1].

Fig. 3: Citric Acid Irrigant

Chlorhexidine Digluconate (CHX): Because of its effective antibacterial activity it is used in dentistry to reduce plaque buildup and disinfect teeth. Additionally, it has seen extensive use in endodontics as a final irrigant following EDTA. CHX cannot be used as the only irrigating solution since it does not dissolve organic or inorganic materials. The microorganism is killed when CHX penetrates the microbial cell wall or outer membrane6. Its effectiveness against bacteria in biofilms is equal to or weaker than that of 1 and 2% NaOCl and much weaker than 5 or 6% NaOCl. One of the uses of CHX is that it binds to hard tissue and keeps its antibacterial properties (substantivity)5. 2% CHX may be used as irrigation after the smear layer is removed since, contrary to NaOCl, CHX as the final rinse following EDTA does not promote dentine erosion[6].

Fig. 4: Chlorhexidine Digluconate (CHX)

Old and new equipment for irrigation

Manual Agitation Techniques : Syringe Irrigation with Needles/Cannulas - Using a syringe(using 1- to 5-mL syringes rather than larger ones is advised to maximise safety and control) and needle is the traditional method of irrigating the root canal. Needles irrigation can be efficient and sufficient when utilised properly2. To reach the apical canal, small size 27-gauge or, preferable, 30-gauge needles should be utilised3. The efficiency of the solutions is substantially increased by agitation of the irrigant and continuous rehydration. The effectiveness of syringe irrigation depends on the space available in the apical third, how close the needles are to the root canal's apical terminus, and, in some situations, the flow rate of the irrigant7. According to the available data, there are two types of irrigation needles: open-ended needles, which allow the irrigant to flow directly through their tip regardless of its specific shape, and closed-ended needles, which have a closed tip that prevents direct outflow and instead direct the irrigant through one or more side vents. Open-ended needles appear to be more effective than closed-ended needles of the same size in terms of irrigant penetration and exchange due to the direction and strength of the produced irrigant jets, but they also carry a larger risk of unintentional irrigant extrusion through the apical foramen8. The best placement for open-ended needles is 2-3 mm below working length (WL), whereas closed-ended needles must always be positioned within 1 mm of WL to avoidbinding7. Use of flexible, tiny needles (27–31G), which can access these sites even in curved root canals, is therefore essential. The 31G needle may soon replace the 30G needle as the clinical standard due to changes in root canal instrumentation. Currently, the 30G needle maybe regarded as the standard9. The root canal must be made larger to a minimum apical size of30-35 to prevent binding when 3031G needles are used. In terms of the removal of bacteria or biofilm from the main root canal or the healing of apical periodontitis in teeth with a single root canal and relatively simple anatomy, several ex vivo studies and one clinical trial found no significant differences between syringe irrigation and a variety of other methods, including negative pressure irrigation, sonic and ultrasonic activation. Studies that came to the contrary conclusion, however, typically did not sufficiently widen the canals or put the needles too far away from WL10. Syringe irrigation therefore seems to be an adequate irrigation technique fortieth with a single root canal and straightforward anatomy. However, anatomical anomalies like fins, isthmuses, and lateral canals prevent the developed flow from penetrating very far inside of them. For this reason, irrigant activation techniques may be useful in situations involving more complex anatomy[7].

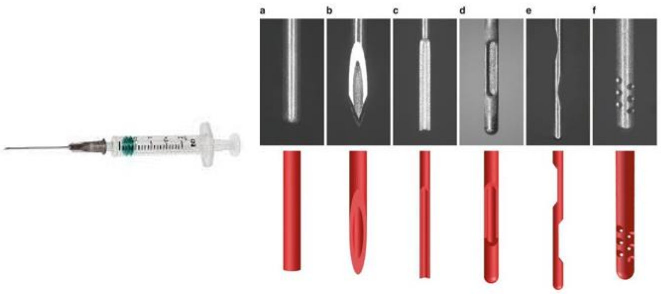

Fig. 5: Syringe Irrigation with Needles/Cannulas

Brushes: In actuality, introducing an irrigant into the canal spaces does not directly involve the employment of brushes. They are accessories that have been created for agitating root canal irrigant or debridement of the canal walls. They might also play a supporting role in the movement of irrigants inside the canal areas[9]. A 30-gauge irrigation needle with a brush- covered tip recently had its commercial debut as the NaviTip FX from Ultradent Products Inc. in South Jordan, Utah. According to a recent study, the coronal third of instrumented root canal walls had better cleanliness after being irrigated and stirred using the NaviTip FX needle as opposed to the brushless NaviTip needle[10].Even with the use of a surgical microscope, radiolucent bristles in the canals that are difficult for physicians to see may become dislodged as a result of friction between the brush bristles and the abnormalities in the canals. Keir et al. reported comparable results in the early 1990s, showing enhanced canal debridement with the use of canal brushes. They applied the Endobrush in an active brushing and rotational motion. Due to the Endobrush's size, it was not possible to use it to its maximum working length, which could have resulted in packing of debris into the apical portion of the canal after brushing[11].

Fig. 6: Brushes For Agitating Root Canal Irrigant

Manual-Dynamic Irrigation: For an irrigant to work, it needs to be in close proximity to the canal walls[8]. However, due to the so-called vapour lock effect, it is frequently challenging for the irrigant to reach the apical portion of the canal[12,13]. According to research, manually irrigating an instrumented canal by gently rotating a master cone made of gutta-percha up and down in short 2 to 3 mm strokes can induce a hydrodynamic effect that greatly enhances the displacement and exchange of any given reagent[10,13]. Recent research by McGill et al. and Huang et al. have verified this. These investigations showed that compared to static watering and an automated dynamic irrigation system (RinsEndo; Duerr Dental Co, Bietigheim, Germany), manual dynamic irrigation was much more efficient[14].

Mechanical Agitation Techniques

Rotary Brush: Both Canal Brush and Ruddle Brush fall under this heading[12]. Debris and smear layer removal from instrumented root canals has been made easier with the aid of a rotary handpiece-attached microbrush[15]. The microbrush vibrates at around 300 rpm during the debridement phase, causing the bristles to bend into the imperfections of the preparation. This aids in coronal displacement of any remaining debris out of the canal[16].

Sonic Irrigation: Alternatives to ultrasonic files for irrigant agitation have traditionally included devices with plastic tips oscillating at low frequency[15-17] . highly frequent wall contact is unavoidable. As a result, a significant amount of the cleansing and disinfection created in the main root canal in vitro and ex vivo may be caused by this specific physical action rather than irrigant agitation[18,].

Fig.7: Sonic Irrigation

Ultrasonic Activation

The second most popular irrigation method now is ultrasonic activation, which is also the most popular way for activating irrigant[10,11]. Despite the terms' self-contradictory meanings, this technique was incorrectly referred to for a long time as "passive activation" or "passive ultrasonic irrigation" because it was thought that ultrasonic files could oscillate in the root canal without making direct contact with the wall. This claim has been debunked numerous times[19]

Ultrasonic files work primarily by agitating the surrounding irrigant rather than having a direct physical effect that would undoubtedly be restricted to the primary root canal despite the frequent wall contact[22]. Their oscillatory motion at 30 kHz creates acoustic streaming, which improves mechanical cleaning by raising wall shear stress and stirs up the irrigant in the main canal. It also transports the irrigant farther into remote regions of the root canal system[23-25].

Fig. 8: Ultrasonic Activation

Endovac System

Consists of a)macrocannula with handpiece b) microcannula with fingerpiece c) master delivery tip d) Tip of microcannula 65ml of rinsing solution oscillating at frequency of 1.6Hz is drawn from attached syringe and transported to root apex through an adapted canal while suction is maintained at 100 times per min[25-27] . The EndoVac System (Discus Dental, Culver City, CA) removed statistically significantly more smear layer than all groups at 1, 3, 5, and 8mm from the apex[28-32].

Fig. 9: Endovac

Conclusion

The two components of root canal therapy that are most crucial are instrumentation and irrigation. The two most significant purposes of irrigation are to disintegrate tissue and have an antibacterial impact. Apical irrigation presents a unique challenge in terms of efficiency and security. The best outcomes in this crucial location will be achieved with small, 30-gauge side- vented needles and/or negative pressure irrigation with NaOCl and EDTA in the apical canal. It is possible to draw the conclusion that mechanical active irrigation devices help endodontists by lowering post-operative discomfort and enhancing canal and isthmus cleanliness. It has been hypothesised that devices with apical negative pressure, such as EndoVac, may increase the penetrability of irrigation solutions to the apical section of the root while protecting periapical tissues from NaOCl/debris extrusion in the event of an irretrievably separated instrument. Better cleaning of the main and simulated lateral canals was encouraged by negative pressure irrigation and PUI.

References

1. Haapasalo M, Shen Y, Wang Z, Gao Y. Irrigation in endodontics. British dental journal. 2014;216(6):299-303.
2. Boutsioukis C, Arias-Moliz MT. Present status and future directions–irrigants and irrigation methods. International Endodontic Journal. 2022;55(3):588.
3. Swimberghe RC, Buyse R, Meire MA, De Moor RJ. Efficacy of different irrigation technique in simulated curved root canals. Lasers in Medical Science. 2021;36(6):1317-22.
4. Abuhaimed TS, Abou Neel EA. Sodium hypochlorite irrigation and its effect on bond strength to dentin. BioMed research international.2021;36(4):1167-32.
5. Kawashima N, Wadachi R, Suda H, Yeng T, Parashos P. Root canal medicaments. International dental journal. 2009;59(1):5-11.
6. Gatewood RS. Endodontic materials. Dental Clinics of North America. 2007;51(3):695-712.
7. Dioguardi M, Di Gioia G, Illuzzi G, Laneve E, Cocco A, Troiano G. Endodontic irrigants: Different methods to improve efficacy and related problems. European journal of dentistry. 2018;12(03):459-66.
8. Prada I, Micó-Muñoz P, Giner-Lluesma T, Micó-Martínez P, Muwaquet-Rodríguez S, Albero-Monteagudo A. Update of the therapeutic planning of irrigation and intracanal medication in root canal treatment. A literature review. Journal of clinical and experimental dentistry. 2019;11(2):185.
9. Chubb DW. A review of the prognostic value of irrigation on root canal treatment success. Australian Endodontic Journal. 2019;45(1):5-11.
10. Teja KV, Ramesh S, Battineni G, Vasundhara KA, 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. The Saudi Dental Journal. 2022;34(2):87-99.
11. Chubb DW. A review of the prognostic value of irrigation on root canal treatment success. Australian Endodontic Journal. 2019;45(1):5-11.
12. Darcey J, Jawad S, Taylor C, Roudsari RV, Hunter M. Modern endodontic principles part 4: irrigation. Dental update. 2016;43(1):20-33.
13. Moser JB, Heuer MA. Forces and efficacy in endodontic irrigation systems. Oral Surgery, Oral Medicine, Oral Pathology. 1982;53(4):425-8.

14. Ari H, Erdemir A, Belli S. Evaluation of the effect of endodontic irrigation solutions on the microhardness and the roughness of root canal dentin. Journal of endodontics. 2004;30(11):792-5.
15. Teplitsky PE, Chenail BL, Mack B, MACHNEE CH. Endodontic irrigation—a comparison of endosonic and syringe delivery systems. International endodontic journal. 1987;20(5):233-41.
16. Walters MJ, Baumgartner JC, Marshall JG. Efficacy of irrigation with rotary instrumentation. Journal of Endodontics. 2002;28(12):837-9.
17. Zeng C, Willison J, Meghil MM, Bergeron BE, Cutler CW, Tay FR, Niu L, Ma J. Antibacterial efficacy of an endodontic sonic-powered irrigation system: An in vitro study. Journal of dentistry. 2018;75:105-12
18. Huffaker SK, Safavi K, Spangberg LS, Kaufman B. Influence of a passive sonic irrigation system on the elimination of bacteria from root canal systems: a clinical study. Journal of endodontics. 2010;36(8):1315-8
19. Mozo S, Llena C, Forner L. Review of ultrasonic irrigation in endodontics: increasing action of irrigating solutions. Medicina oral, patologia oral y cirugia bucal. 2012;17(3):512.
20. Sabins RA, Johnson JD, Hellstein JW. A comparison of the cleaning efficacy of short-term sonic and ultrasonic passive irrigation after hand instrumentation in molar root canals. Journal of endodontics. 2003;29(10):674-8.
21. Van der Sluis LW, Versluis M, Wu MK, Wesselink PR. Passive ultrasonic irrigation of the root canal: a review of the literature. International endodontic journal. 2007;40(6):415-26.
22. Nielsen BA, Baumgartner JC. Comparison of the EndoVac system to needle irrigation of root canals. Journal of endodontics. 2007 ;33(5):611-5.
23. Miller TA, Baumgartner JC. Comparison of the antimicrobial efficacy of irrigation using the EndoVac to endodontic needle delivery. Journal of endodontics. 2010;36(3):509-11.
24. First S. ENDODONTICS. Dentistry today. 2007;17(2):112.
25. Susila A, Minu J. Activated irrigation vs. conventional non-activated irrigation in endodontics–A systematic review. European endodontic journal. 2019;4(3):96.
26. Mancini M, Cerroni L, Iorio L, Armellin E, Conte G, Cianconi L. Smear layer removal and canal cleanliness using different irrigation systems (EndoActivator, EndoVac, and passive ultrasonic irrigation): field emission scanning electron microscopic evaluation in an in vitro study. Journal of endodontics. 2013;39(11):1456-60
27. Pawar R, Alqaied A, Safavi K, Boyko J, Kaufman B. Influence of an apical negative pressure irrigation system on bacterial elimination during endodontic therapy: a prospective randomized clinical study. Journal of endodontics. 2012;38(9):1177-81.
28. Uzunoglu-Özyürek E, Dik Güzel C, Dogan Buzoglu H. Effect of different irrigation methods in the presence of a separated instrument: an in vitro study. Acta Odontologica Scandinavica. 2020;78(6):409-16.
29. Tanomaru-Filho M, Miano LM, Chávez-Andrade GM, Torres FF, Guerreiro-Tanomaru JM. Cleaning of Root Canal System by Different Irrigation Methods. The journal of contemporary dental practice. 2015;16(11):859-63.

30. Abdelglil SA, Farag AM, El-Hediny HA, Darrag AM. Efficacy of EndoVac system and needle irrigation on root canal debridement. Tanta Dental Journal. 2016;13(4):171.
31. Desai P, Himel V. Comparative safety of various intracanal irrigation systems. Journal of endodontics. 2009;35(4):545-9.
32. Miller TA, Baumgartner JC. Comparison of the antimicrobial efficacy of irrigation using the EndoVac to endodontic needle delivery. Journal of endodontics. 2010;36(3):509-11