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Comparative evaluation of efficacy of different irrigants for smear layer removal using SEM. An invitro study

KEYWORDS

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ABSTRACT

Aim: The purpose of this study is to evaluate and compare the efficacy of 17% EDTA, 25% citric acid and MTAD in smear layer removal using scanning electron microscopic image analysis. **Materials and Methods:** Thirty, freshly extracted mandibular premolars were procured. The teeth were decoronated to obtain working length of 17mm and instrumentation up to 40 (K file) with 5.25% NaOCl irrigation between each file was done. The samples were divided into Groups I (17% ethylenediaminetetraacetic acid (EDTA)), II 25% citric acid and III MTAD containing 10 samples each. Longitudinal sectioning of the samples was done. Then the samples were observed under scanning electron microscope (SEM) . **Statistical Analysis:** Data was analyzed statistically using Kruskal-Wallis analysis of variance (ANOVA). The level for significance was set at 0.05. **Results:** The present study showed that all the three experimental irrigants removed the smear layer from different tooth levels (coronal, middle, and apical). Final irrigation with MTAD is more efficient than 17% EDTA and 25% citric acid in the removal of smear layer

Introduction

The success of endodontic treatment depends on the eradication of microbes (if present) from the root-canal system and prevention of reinfection. The root canal is shaped with hand and rotary instruments under constant irrigation to remove the inflamed and necrotic tissue, microbes/biofilms, and other debris from the root-canal space.(1)During instrumentation smear layer formation is predictable. Smear layer formation, biofilm formation, dental erosion and accessibility to uninstrumented parts of root canal are main challenges for endodontic irrigation.(2)

Smear layer contains a layer of organic and inorganic materials which contain bacteria and by_ products. It can prevent the penetration of intracanal medicaments into dentinal tubules and influence the adaptation of filling materials to canal walls. Most of smear layer contains small particles of mineralized collagen particles.(2)Some authors suggest that maintaining the smear layer may block the dentinal tubules and limit bacterial or toxin penetration by altering dentinal permeability (Michelich et al. 1980, Pashley et al. 1981, Safavi et al. 1990). Others believe that the smear layer, being a loosely adherent structure, should be completely removed from the surface of the root canal wall because it can harbour bacteria and provide an avenue.(2)

Chemical removal of smear layer is most popular method for removal of smear layer. The most common chelating solutions are based on EDTA which reacts with the calcium ions in dentine and forms soluble calcium chelates. Numerous authors have agreed that the removal of smear layer as well as soft tissue and debris can be achieved by the alternate use of EDTA and NaOCl (Yamada et al. 1983, White et al. 1984, Baumgartner & Mader 1987, Cengiz et al. 1990). Goldman et al. (1982) examined the effect of various combinations of EDTA and NaOCl, and the most effective final rinse was 10 mL of 17% EDTA followed by 10 mL of 5.25% NaOCl.(3)

The effectiveness of citric acid as a root canal irrigant has been demonstrated (Loel 1975, Tidmarsh 1978) and confirmed to be more effective than NaOCl alone in removing the smear layer (Baumgartner et al. 1984). (4)

Torabinejad et al. (2003) developed a new irrigating solution containing a mixture of a tetracycline isomer, an acid, and a detergent (MTAD). Their work concluded MTAD to be an effective solution for the removal of the smear layer. It does not significantly change the structure of the dentinal tubules when the canals are irrigated with sodium hypochlorite and followed with a final rinse of MTAD.(5)In addition to this lasers and ultrasonic removal of smear layer is deemed to be effective.(2)

The present study evaluates and compares the efficiency of 17% EDTA, 25% Citric acid, and MTAD in their ability to remove smear layer following root canal instrumentation on human extracted tooth using scanning electron microscope (SEM).

Materials and methods

Selection of samples

Thirty mandibular premolars with single canals extracted for periodontal reasons were collected from Apollo dental hospitals. All the teeth with cracks and fracture lines were discarded.

Teeth preparation for the study

All the teeth were cleaned with an ultrasonic scalar to remove debris and soft tissue remnants and stored in saline. Teeth were decoronated using diamond disk to obtain uniform working length of 17mm. The root canals were accessed and hand filing was done up to size 40 with 5.25% NaOCl irrigation and then samples were divided.

The samples are divided into Groups I, II, and III containing 10 samples each.

Group I- 17%EDTA
Group II- 25% citric acid
Group III- MTAD

Then each sample was irrigated with 5 ml of each irrigant for 1 min. All the irrigants were freshly prepared and standardized. And the final irrigation was done with 5 ml of distilled water for each sample.

Teeth preparation for sem analysis

The canals were dried with paper points and with the diamond discs grooves were placed on buccal and lingual surfaces of roots and roots were split longitudinally with chisel and mallet. One half of each tooth is selected and prepared for SEM examination.

Semanalysis

The specimens were dehydrated by ethyl alcohol. After that the specimens were mounted on coded stubs, air dried, placed in a vacuum chamber, and sputter-coated with a 300 Agold layer. The specimens were then analyzed using a SEM (Cam scan MV 2300, Oxford Instrument, UK). The dentinal surfaces were observed at cervical, middle, and apical thirds with a magnification of ×2,000 for the presence/absence of smear layer. The efficacy of removal of smear layer was analysed in sem samples.

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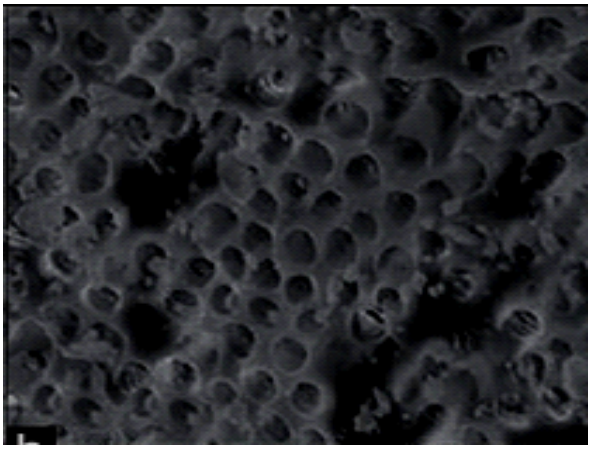
Statistical analysis

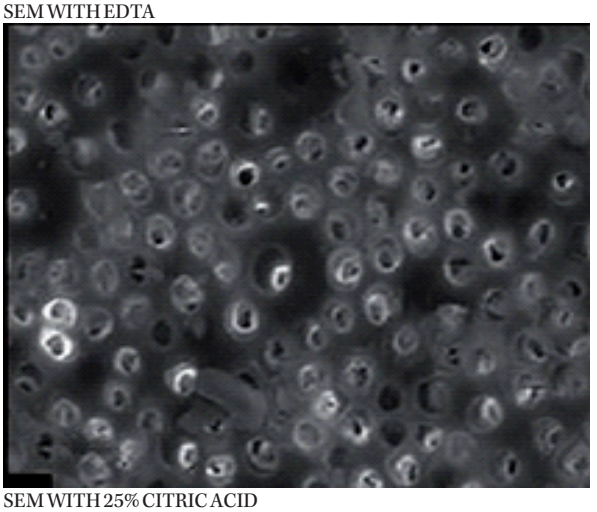
1. Kruskal-Wallis analysis of variance (ANOVA) was used for intragroup comparisons.

Results

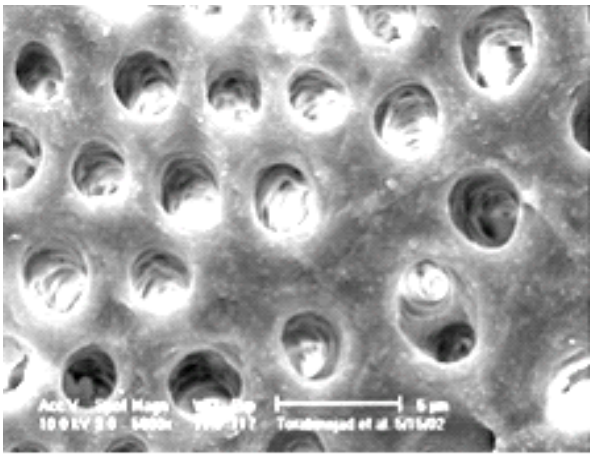
The irrigants tested effectively removed smear layer from the root canal walls. Smear layer removal was maximum in the coronal and middle third followed by least in the apical third with in the groups. Citric acid removed the smear layer effectively in the middle third . 0verall the smear layer removal was greatest with MTAD when compared to group EDTA and group Citric acid. Not much significant difference was shown among the three groups.



SEM WITH EDTA



SEM WITH 25% CITRIC ACID



SEM WITH MTAD

Discussion

The first researchers to describe the smear layer on the surface of instrumented root canals were McComb & Smith (1975). They suggested that the smear layer consisted not only of dentine as in the coronal smear layer, but also the remnants of odontoblastic processes, pulp tissue and bacteria. (6)

Brannstrom & Johnson (1974) and Mader et al. (1984) concluded that the tubular packing phenomenon was due to the action of burs and instruments and so it becomes prudent to eradicate the smear layer from root dentine.(7)

The question of retaining or removal of smear layer was widely debated previously. It contains bacteria, their by-products and necrotic tissue (McComb & Smith 1975, Goldberg & Abramovich 1977, Wayman et al. 1979, Cunningham & Martin 1982, Yamada et al. 1983). Bacteria may survive and multiply (Brannstrom & Nyborg 1973) and can proliferate into the dentinal tubules (Olgart et al. 1974, Akpata & Blechman 1982. So removal of smear layer was advocated.(2)(6)

George et al in 2oo5 concluded that It may act as a substrate for bacteria, allowing their deeper penetration in the dentinal tubules. Smear layer is found to contaminate the fillings and it can act as a barrier between filling materials and the canal wall and therefore compromise the formation of a satisfactory seal.((Lester & Boyde 1977, White et al. 1984, Cergneux et al. 1987, Czonstkowsky et al. 1990, Foster et al. 1993, Yang & Bae 2002). Lester & Boyde (1977) .(8)(2).The current methods advocated for removal of smear layer are chemical , ultrasonic and lasers.(2) (9)

In 2002 zehnder et al concluded that the tissue-dissolving capacity and microbicidal activity of NaOCl make it an excellent irrigating solution, but it has only a limited effect on dissolution of the smear layer. (10)The smear layer may be removed by the chelating agent ethylene diaminetetra-acetic acid (EDTA) and solutions containing EDTA, which have been recommended for irrigation.(11)(2)

Also, acid solutions have been recommended for removing the smear layer including sodium salt of EDTA at a concentration of 15-17%, citric acid at concentrations of 10, 25, and 50%, and orthophosphoric acid at concentrations of 10, 32, and 37%.Garberoglio R, Becce C.(12)

More recently a new irrigant – MTDA was proposed as a final attempt to remove the smear layer. MTDA is made up of a mixture of a tetracycline isomer, an acid, and a detergent. It is an effective smear layer removing solution.(5)The better effects of MDTA were enhanced when lower concentrations of NaOCl were used as irrigant before the use of MTDA.(13)

The present study compares the efficacy of three irrigants 17% EDTA , 25% citric acid and MTAD as final irrigants combined with 5.25% NaOCl as primary irrigant while cleaning and shaping. In this study single rooted mandibular premolars were selected with a single canal to maintain standardization.

An SEM was used to assess the effectiveness of such irrigants to remove the smear layer and the erosion caused in the dentinal tubules. In this study smear layer was effectively removed with all the three irrigants from middle and coronal third. The smear layer removal was not complete in apical third due to inadequate penetration of solution.

The alternative use of 17% EDTA and 5.25% of NaOCl is effective method for removal of smear layer according to study done by Yamada et al.(1983) and Baumgartner and Mader (1987).(14)

Calt and Serper'sinvestigation on 1 and 10 min application time has shown that the ability of 17% EDTA in 1 min application time is agreeable and prevents harmful consequences such as excessive erosion, enlargement of dentinal tubule openings, and deterioration of the dentinal surface.(15).The effectiveness of citric acid as a root

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canal irrigant has been demonstrated (Loel 1975, Tidmarsh 1978) and confirmed to be more effective than NaOCl alone in removing the smear layer (Baumgartner et al. 1984.(4)

In this study in the group 2 where citric acid 25% was used the canals were free of smear layer in middle and coronal third. This may be attributed to availability of better volume and better penetration of the acid in this region. The effectiveness of different acid irrigating solutions in root canal after instrumentation was done by Perez-herediam and Ferrer et al in 2002 comparing citric acid, edta and orthophosphoric acid revealed that acids solutions were effective in removing smear layer. The results of this present study were consistent with these findings. But, the disadvantage of citric acid is that it leaves precipitated crystals in the root canal which might be disadvantageous to the root canal filling. (16)

A study done by torabinejad et al in 2003 investigated the effect of a mixture of a tetracycline isomer, an acid, and a detergent (MTAD) as a final rinse on the surface of instrumented root canals. The results of the study revealed that MTAD is an effective solution for the removal of the smear layer and does not significantly change the structure of the dentinal tubules when canals are irrigated with sodium hypochlorite and followed with a final rinse of MTAD.(5) The present study also revealed that MTAD was superior to citric acid and EDTA in removing smear layer from all the portions of root dentine which is consistent with the study done by mohan lal paul etal in 2003.(17)

Conclusion

The present study reveals that all these agents were effective in removal of smear layer. Since root canals are affected by multiple factors, proper selection of root canal irrigation regime is necessary for success of root canals. Nevertheless, further long-term clinical studies are necessary to confirm these results and evaluate their relevance to treatment outcome.

References

1. Markus Haapasalo,Ya Shen, Wei Qian, Yuan Gao. Irrigation in Endodontics. Dent Clin N Am 54 (2010) 291–312
2. D. R. Violich & N. P. Chandler. The smear layer in endodontics – a review .International Endodontic Journal, 43, 2–15, 2010
3. Goldman M, Goldman LB, Cavaleri R, Bogis J, Lin PS.The efficacy of several endodontic irrigating solutions: a scanning electron microscopic study: Part 2. Journal of Endodontics 8, 487–92.1982
4. Baumgartner JC, Brown CM, Mader CL, Peters DD, Shulman JD.A scanning electron microscopic evaluation of root canal debridement using saline, sodium hypochlorite, and citric acid. Journal of Endodontics 10, 525–31,1984
5. Torabinejad M1, Khademi AA, Babagoli J, Cho Y, Johnson WB, Bozhilov K, Kim J, Shabahang S.A new solution for the removal of the smear layer. J Endod. 2003 Mar;29(3):170-5
6. McComb D, Smith DC. A preliminary scanning electron microscopic study of root canals after endodontic procedures. Journal of Endodontics 1, 238–42. 1975
7. Brannstrom M, Johnson G. Effects of various conditioners and cleaning agents on prepared dentin surfaces: a scanning electron microscopic investigation. Journal of Prosthetic Dentistry 31, 422–30,1974
8. George S, Kishen A, Song KP.The role of environmental changes on monospecies biofilm formation on root canal. J Endod. 2005 Dec;31(12):867-72
9. Torabinejad M, Handysides R, Khademi A, Bakland LK. Clinical implications of smear layer in endodontics: A review. Oral Radiol Endod. 2002;94:658–66
10. Zehnder M, Kosicki D, Luder H, Sener B, Walumo T. Tissue dissolving capacity and antimicrobial effect of buffered and unbuffered hypochlorite solution. Oral Surg Oral Med Oral Path Oral Radiol Endod. 2002;94:756–62.
11. Paula Dechichi Camilla Christian Gomes Moura Smear layer: a brief review of general concepts. Part II. The most common agents to remove endodontic smear layer. RFO UPF 2006; 11(2):100-104
12. Garberoglio R, Becce C. Smear layer removal by root canal irrigants: A comparative scanning electron microscopic study. Oral Surg Oral Med Oral Pathol. 1994;78:359–67.
13. Torabinejad M, Cho Y, Khademi AA, Bakland LK, Shabahng S. The effect of various concentrations of sodium hipochlorite on the hability of MTDA to remove the smear layer. J Endod 2003; 29(4):233-9.)
14. Yamada RS, Armas A, Goldman M, Lin PS. A scanning electron microscopic comparison of a high volume final flush with several irrigating solutions: Part 3. Journal of Endodontics 9, 137–42.1983
15. Calt S, Serper A. Time-dependent effects of EDTA on dentin structures. J Endod. 2002;28:17–9.
16. Perez-Heredia M, Ferrer-Luque CM, González-Rodrguez MP. The effectiveness of different acid irrigating solutions in root canal cleaning after hand and rotary instrumentation. J Endod. 2006 Oct;32(10):993-7. Epub 2006 Jul 26.
17. Mohan Lal Paul, Dibyendur Mazumdar, Abhijit Niyogi. Comparative evaluation of the efficacy of different irrigants including MTAD under SEM. Journal of conservative dentistry. 2013 16(4), 336-341.