

The influence of a new irrigant solution on the apical microleakage of obturated root canals

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ABSTRACT

Aims: The aim of this study was to evaluate the effect of a new endodontic irrigant solution (mixture of coconut and bromelain) on apical microleakage of obturated root canals.

Materials and Methods: Forty roots were randomly divided into two groups (n = 20) according to the irrigant used. Group I (NaOCl & EDTA) and Group II (mixture of coconut & bromelain). All roots were prepared with protaper Ni Ti rotary instrument to size F3. After completion of root canal preparation for both groups, the root canals were obturated using F3 gutta percha and resin sealer. The canal orifices were sealed with light cured composite resin. All roots were placed in 100% humidity and incubated at 37 C for 3 days to allow complete setting of the sealer. The root surfaces were coated by double layer of nail varnish except the apical 2mm and immersed in 2% methylene blue for 48 hours. After that all roots were thoroughly washed under running water and allowed to dry, then the nail varnish was removed. The roots were split into 2 halves and the linear extent of dye penetration from the apical root ends were measured.

Results: Statistical analysis revealed that there was no significant difference in apical microleakage between group I and group II.

Conclusion: The apical microleakage of root canals irrigated with the new irrigant solution (mixture of coconut and bromelain) was comparable to that for root canals irrigated with NaOCl and EDTA.

Keywords: New endodontic irrigant, apical microleakage, coconut, brome.

INTRODUCTION

The main objectives of root canal therapy are removal of diseased tissue, elimination of microorganisms present in the canals and dentinal tubules, and prevention of recontamination after treatment (1). The current techniques of root canal debridement produce smear layer and leave some areas of the root canal system completely untouched by the instruments (2). The smear layer is formed of inorganic and organic substances, which include fragments of odontoblastic processes, microorganisms and necrotic materials (3). Whereas the smear layer itself may be infected, it also may protect the bacteria already present in the dentinal tubules from the action of the antimicrobial agents (4). So its removal from infected root canals may lead to better penetration of intracanal medications into the dentinal tubules and more effective disinfection of the root canal system (5).

The most popular and advocated irrigant is sodium hypochlorite (NaOCl). It has several properties that contribute to achieve chemical debridement of the root canal system (6). NaOCl has an antibacterial and lubricant effect, and has the capability of dissolving tissue remnants and flushing out loose debris but it does not remove the smear layer from the dentin wall (7).

A combination of solutions such as ethylenediamine tetra-acetic acid (EDTA) and NaOCl is used to remove the smear layer from root canal walls (8). Some studies suggested that removal of smear layer reduces apical leakage after obturation (9,10). Even though the treatment with EDTA may leave a chelated layer of dentine at the dentine-root filling interface. Residual EDTA inside the dentinal tubules, which was measured to be up to 3.8% of the originally applied volume, may contribute additionally to ongoing demineralization, resulting in further increase of apical leakage. Residual EDTA also may interact with the sealer, which has been demonstrated with zinc-oxide eugenol containing sealers (11). Because of these limitations, a search for a better root canal irrigant is not stopping.

A new endodontic irrigant solution which is a mixture of coconut detergent and bromelain enzyme(MCB) was prepared in this study.

Coconut is a powerful inhibitor of a large variety of pathogenic organisms, largely due to its naturally high lauric acid content. Coconut oil improves calcium and magnesium absorption in the body, which in turn is greatly beneficial to dental and bone health. The improved calcium absorption created by coconut oil ceases tooth decay and aids in the development of strong teeth. Researchers found that incorporating enzyme-modified coconut oil into dental hygiene products would be an attractive alternative to chemical additives (12).

Bromelain is a crude extract from the pineapple that contains, among other components, various closely related proteinases. It is a proteolytic enzyme, demonstrating, in vitro and in vivo, antiedematous, antiinflammatory, antithrombotic and fibrinolytic activities (13).

Accordingly this study was conducted to investigate the influence of a new irrigant solution(MCB) and alternate use of NaOCl with EDTA on the apical microleakage of obturated root canals.

MATERIALS AND METHODS

Preparation of the new irrigant solution:

Ten grams of sodium hydroxide was dissolved in 25 ml of de ionized water then added to 55 gm of coconut oil on warming bath(40C) with continuous mixing by glass rod until hardening .The final product was left to dry on filter paper and then crushed manually to powder. Twenty grams of coconut powder were added to 100ml of de ionized water with continuous mixing until it dissolve completely, then 4gm of bromelain powder were added to the mixture to obtain the final solution which consist of 20% coconut and 4% bromelain (MCB).

Preparation of the samples:

Forty freshly extracted sound human, single rooted teeth were collected and used in this study. The soft tissue remnants and calculus on external root surfaces were removed mechanically by scaler, then stored in distilled water until needed. Each tooth was decoronated at the level of CEJ using a low speed water-cooled diamond sectioning disc. Root canal patency and working length of each root canal were confirmed and determined by No.10 k-type file, which inserted inside the root canal under stereomicroscope (Motic-Italy) at (x 20 magnification) until the tip of the file was just be visible at the apical foramen and then subtracting 1mm from the measured length of the file. All roots were prepared with protaper NiTi rotary system (Endo-Mate DT,NSK,NAKANISHI,INC,JAPAN) to size F3(rotational speed of 300 rpm and torque 3 N cm).

The roots were divided randomly into two groups (n=20).

Group I(control) : 3 ml of 2.5% NaOcl solution was used for irrigation at the beginning of instrumentation and between each file size, then final irrigation with 5ml of the solution. Then the root canals were further irrigated with 17% EDTA solution which left in the canal for 5 minutes.

Group II (experimental): 3ml of the new solution(MCB) was used for irrigation at the beginning of instrumentation and between each file size, then final irrigation with 5ml of the solution.

After completion of root canal preparation & irrigation procedure, all roots in both groups were irrigated with 10 ml distilled water to remove any remnants of the irrigating solution, then the root canals were dried by F3 absorbent paper points.

After completion of root canal preparation for both groups, the root canals were obturated using F3 gutta percha and AH plus root canal sealer (Dentsply, Detrey, GmbH, Germany).

The canal orifices were sealed with light cured composite resin. All roots were placed in 100% humidity and incubated at 37 C for 3 days to allow complete setting of the sealer. The root surfaces were coated by double layer of nail varnish except the apical 2mm and immersed in 2% methylene blue for 48 hours. After that all roots were thoroughly washed under running water and allowed to dry, then the nail varnish was removed. The roots were grooved buccally and lingually with a diamond sectioning disc under water coolant ensuring that the root canal filling were not be penetrated, and then they were split into 2 halves by levering with a spatula. The linear extent of dye penetration from the apical root ends were measured using a stereomicroscope at (X 20 magnification) in mm. The data were statistically analyzed using the student T-test.

RESULTS

The apical microleakage was presented as mean extent of dye-penetration in millimeters.

The mean values of apical microleakage recorded for groups I and II were presented in table 1. Group I (NaOCl & EDTA) yielded a mean microleakage of 0.826 mm.

Group II (MCB) yielded a mean microleakage of 0.804 mm.

Statistical analysis revealed that there was no significant difference ($p > 0.05$) in apical microleakage values between group I and group II. (Table I)

The extent of dye-penetration in each group was shown in figures (1 & 2).

DISCUSSION

A three dimensional obturation and complete coronal and apical seal is one of the important aims of root canal treatment. Since microorganisms may remain in the root canal system after instrumentation, a tight apical seal is desired to prevent bacteria and their by-products from invading the apex. A perfect apical seal is also desired to prevent apical percolation. In this regard, smear layer is one of the factors that can affect coronal and apical microleakage and thus compromise the long term success of endodontic treatment. Since the smear layer prevents the complete locking and adherence of the root canal filling materials to the dentinal wall, many studies recommend the removal of this layer before the obturation phase of the treatment (14-16). It is well known that when the surface area of dentin exposed to the sealer is increased, the adhering and penetrating capacity of root canal sealers is improved and a better seal is expected (17).

Economides et al. (18) indicated that resin-based sealers have superior apical sealing ability with the removal of smear layer. The advantage of resin-based sealers over ZOE-based sealers is that they can not only lock into open dentinal tubules but also adhere to the exposed dentinal surfaces. This characteristic of resin-based sealers is similar to the adherence capacity of composites to the dentin and enamel of teeth (19). The ideal purpose is to create a particular surface of dentin which is more suitable for the specific sealer used in the obturation of the root canal system. The hypothesis is that if a dentinal surface and a sealer can complement each other characteristically, ultimately they can produce a better apical seal.

One of the desirable properties of irrigants is smear layer removal. Many authors have demonstrated that canal surfaces without a smear layer permit penetration of filling materials into patent dentinal tubules, increasing the contact surface, improving mechanical retention and reducing the possibility of microleakage through the filled canal independently of the obturation technique (20).

Different methods such as electrochemical, radioisotope spectrometry, radiolabeled isotopes, bacterial leakage, and dye leakage techniques have been introduced to evaluate the apical seal. Because of its simplicity and low cost, dye leakage studies are popular tests. If the unwanted variables are eliminated and the experimental conditions are standardized, dye leakage studies can prove valid (21).

The results of this study showed that there was no significant difference in apical microleakage between group I and group II (Table I). This lack of difference in microleakage value may be related to a smear layer removal ability of irrigants in both groups. The results of previous studies (9,22) were in accordance with our finding, they indicated that root canals irrigated with NaOCl between each instrument and EDTA as final rinse has a reduced apical microleakage. Also, studies of coronal microleakage indicated a reduction of leakage using EDTA as a final rinse following NaOCl (23,24).

This result indicates that MCB irrigant solution (group II) produced an apical seal comparable to that for group I. This result could be attributed to the ability of this solution to remove smear layer and this allows the extension of the resin into the open dentinal tubules, creating efficient adherence. This result agrees with that reported by Dayem R.N. and Tameesh M.A. (25) who found that the application of bromelain enzyme on conditioned dentin significantly decreases the values of the global leakage score and gives the lowest values of global leakage scores. This is due to the ability of bromelain enzyme to remove the collagen network from acid etched dentin efficiently and this will lead to increase the diffusion potential of the monomer to the dentin and minimizing the nanoleakage.

In contrast to our results other investigators (26,27) showed that there was no significant improvement in microleakage after removal of smear layer. Timpawat and coworkers (28) are the only investigators who have reported that removal of the smear layer has an adverse effect on microleakage of obturated root canals. These conflicting results might be due to differences in types of sealers and obturation techniques, means of producing a smear layer, and the diversity of methodologies used to assess microleakage under various laboratory conditions.

CONCLUSION

Within the limitations of this study, it could be concluded that;

- 1) The apical microleakage of root canals irrigated with the new irrigant solution (MCB) (mixture of 20% coconut and 4% bromelain) was not significantly differ from that for root canals irrigated with 2.5% NaOcl and 17% EDTA.
- 2) Root canal irrigation with single irrigant (MCB) was easier than the use of two separated irrigants especially when a comparable results were obtained.

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Figure 1: The extent of dye penetration in group I(NaOCl & EDTA).



Figure 2: The extent of dye penetration in group II (MCB).

Table1: Statistical analysis of apical microleakage between group I and group II

Group	N	Mean(mm.)	SD	T-value	df	P-value
Group I	20	0.826	0.038	1.91	38	0.064
Group II	20	0.804	0.033			