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The Sealing Ability of Bio Ceramic Sealer using Different Irrigation Solutions (A Comparative Study)

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ABSTRACT

Aims: To evaluate the effect of different root canal irrigants (17%EDTA, 5.25%NaOCl, 17%EDTA+5.25%NaOCl and distilled water) on the sealing ability of bio ceramic endodontic sealer.

Materials and method: The root canals of 28 human teeth with single root were decoronated, prepared and divided into 4 groups as related to the type of final irrigant used (n=7): In group A (control group): distilled water was used, in group B: (17%EDTA) was used, in group C: (5.25%NaOCl) irrigant was used, and in group D: (both 17%EDTA and 5.25%NaOCl) were used alternatively. All the canals were obturatred with bio ceramic sealer and X2 protaper next gutta-percha points. After incubation period for 3 days, all the root was immersed in an Indian ink dye and kept in an incubator for another 3 days. Then the teeth were washed and cleaned, sectioned and the apical microleakage was evaluated by using stereomicroscope.

Results and discussion: Statistical analysis revealed a significant difference between groups ($p \le 0.05$). The lowest mean of microleakage was found in group D in which both 17% EDTA and 5.25%NaOCl irrigants were used, followed by group B in which 17% EDTA irrigants was used, then group C in which 5.25%NaOCl irrigants was used while group A that used distilled water as final irrigant revealed the highest mean of microleakage.

Conclusion: Alternative irrigation of the root canals with 17%EDTA and 5.25%NaOCl enhanced the apical seal of the bio ceramic root canal sealer and decreased the apical microleakage.

Key words: Irrigants, Endo sequence, Apical microleakage

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INTRODUCTION

Root canal therapy aims to sealing of root canals with obturation materials to prevent microorganisms and bacterial colonization inside the root canal system by occupying the root canal space [1]. Root canal filling materials include core materials called gutta percha and sealer materials that bond the core materials with the root canal walls, filling the accessory and lateral canals, filling the remainder space between the canal walls and the core materials [2], and at the same time acts to increase the interface present between the root canal dentin and the root filling materials when the sealer penetrate into the dentinal tubules of root canal dentin that leads to increasing the mechanical retention of root canal filling materials [3].

The properties of ideal sealer may include: no dimensional change, a slow setting time to allow sufficient working time, not soluble in tissue fluids, good adhesion to the canal walls, biocompatible, strengthening the root, acting as a lubricant and facilitate the placement of the filling core and decrease the micro leakage [4]. Many types of endodontic sealers have been introduced to endodontics. A focus was made on obtaining “a mono block" in which the root canal dentin forms a single unit with sealer and core materials [5]. A new Endo sequence Bioceramic root canal sealer has been introduced which is a premixed and injectable paste that has many good properties like radio opacity and insolubility in liquids [6]. Constituents of bio ceramic include: calcium silicates, calcium hydroxide, zirconium oxide filler, calcium phosphate monobasic and thickening agents [6].

Instrumentation of root canals results in accumulation of a smear layer that covers and plugs the dentinal tubules and prevent the sealer introducing into the tubules that may influences the mechanical retention of root canal obturation materials and also leads to micro leakage, therefore, many authors suggest that this smear layer must be removed to increase the bond between the sealing material and the canal wall and to decrease the micro leakage [7,8]. Many root irrigation solutions may be used to eliminate the smear layer [9].

Shokouhinejad et al. in studied the effect of different irrigation protocols (17% EDTA (ethylenediaminetetraacetic acid), 17% EDTA with 5.25% NaOCl(sodium hypochlorite), 17% EDTA with 2% CHX(chlorhexidine) and 17% EDTA + saline) on the SBS of EndoSequence Sealer to root dentin and found no significant difference between the bond strengths of the groups [10].

Al-Zaka et al. in (2013) investigated the effect of EDTA, MTAD (mixture of citric acid, doxycycline and a detergent), and CHX irrigants on the bonding ability of both EndoSequence Bio ceramic and AH plus root canal sealers and found that CHX & BC sealer revealed the lowest microleakage, followed by EDTA and AH Plus, MTDA and BC, CHX and AH Plus while the highest leakage was shown by MTAD& AH Plus and EDTA& BC [11]. Pawar et al. in (2014) compared the microleakage of three sealers; EndoSequence bio ceramic (BC) sealer, AH Plus and Epiphany and found that the EndoSequence BC Sealer showed the lowest value of microleakage [12]. Ha et al. in (2018) evaluated the adhesion and wetting of three bio ceramic sealers to root canal human dentin and found that the EndoSequence Bio ceramic sealer yielded the best wettability to root canal dentin in comparison with other sealers. Good wetting enhances the adhesion present between root canal dentin and the sealer as it improves penetration inside the micro-irregularities [13].

This study aimed to compare the effects of using different types of root canal irrigants on the apical sealing ability of EndoSequence Bio ceramic root canal sealer.

MATERIALS AND METHOD

28 single rooted human teeth were used in this study. Teeth with curvature at apices, resorption, having multiple canals, and teeth with previous endodontic treatments were discarded.

The teeth were decoronated using a diamond disc with water irrigation, standardizing the length of the roots at 13 mm and the working length was adjusted to be 1mm shorter of the apical foramen. So, the final working length was adjusted to be 12 mm.

Preparation of the root canals performed with protaper next rotary endodontic system (Dentsply, Maillefer, Switzerland) and according to manufacturer instructions at speed 300 RPM and torque 4N/Cm. Protaper next X1 file was worked to slide down 3mm shorter of the full working length of the canal, then the file removed out of the canal and re-reinserted until full working length was reached. Then, protaper next X2 file was inserted using the same protocol as protaper next X1file. The root canals were irrigated with 3ml. of distilled water for each file size. The canals were recapitulated with manual file size 15 and irrigated with 3ml of distilled water to dislodged cutting debris from the canal orifices. The canals were then dried with X2 taper paper point (Dentsply, Mailefer, Switzerland).

The specimens were then divided randomly into 4 groups (n=7) according to the type of final irrigant solution used as follow:

Group A (Control group): Prepared root canals irrigated by 5ml of distilled water.

Group B: Prepared root canals irrigated by 5ml of 17% ethylene diamine tetra acetic acid (EDTA).

Group C: Prepared root canals irrigated by 5ml of 5.25% sodium hypochlorite (NaOCl).

Group D: Prepared root canals irrigated by 5ml of 17% ethylene diamine tetra acetic acid (EDTA) and 5 ml of 5.25% sodium hypochlorite (NaOCl) alternatively.

After irrigation with the specific irrigating solution, all canals were dried by X2 paper point then obturatred with Endo sequence bio ceramic sealer (BRASSELER, USA) and X2 protaper next gutta-percha points (Dentsply, Mailefer, Switzerland) using single cone technique according to the following technique:

The tip of Endo sequence BC sealer was inserted to 1mm shorter of the working length inside the canal and the sealer injected to fill the whole canal during which the tip was slowly withdrawn while injecting the sealer, followed by master cone gutta-percha insertion in to the canal. Excess gutta percha cone was cut using heated instrument.

After obturation of all groups; roots were stored in an incubator (EN 400, nuve, Turkey) at 37°C for 3 days to complete sealer setting [13,14]. After that all surfaces of roots were painted with 2 layers of nail varnish except 1mm of apical root. All roots were immersed in an Indian ink dye (Dollar Industries\ Pakistan) till the middle third of the root and kept them in incubator for 3 days at 37°C [13,14]. After that the roots were washed in running water and sectioned longitudinally parallel to long axis of the tooth in buccolingual direction by using diamond disc.

Apical micro leakage was evaluated by using stereomicroscope (Hamilton, Italy) at X40 magnification for all samples. The extent of dye penetration into the canal was measured in micrometers from the apex to the maximum depth of dye penetration coronally by the aid of ocular micrometer and slide micrometer, then digital images of sectioned teeth were taken using a microscope attached camera.

Statistical analysis: The obtained data were analyzed by using IBM SPSS statistical program (24.0) at 95% confidence level. One-Way Analysis of Variance (ANOVA) was made to identify any significant difference at ($P \leq 0.05$) among the different groups followed by Duncan's multiple range test as post hoc comparison to locate which group caused the significant difference.

RESULTS

Descriptive statistics of different groups are presented in Table 1. The lowest mean of micro leakage (0.44mm) was recorded for group D in which both 17% EDTA and 5.25% sodium hypochlorite irrigants were used, followed by group B with mean value (0.62mm) in which17% EDTA irrigant have been used. Group C showed a mean value (1.06mm) in which 5.25%NaOCl irrigant was used, while group A revealed the highest mean of micro leakage (1.3mm) with distilled water used as an irrigant.

One way ANOVA revealed that there are significant differences between groups as shown in Table 2. Duncan's test (Table 3) showed that a significant difference existed between group A with B and D groups; between group C with B and D groups. However, no significant difference was evident neither between groups A and C, nor between B and D.

DISCUSSION

Mechanical debridement of the root canals results in inorganic and organic debris named smear layer, this smear layer also contains microorganism and necrotic tissue. This layer overly the root canal walls and prevents root canal disinfectant solutions and medicaments from penetration inside the dentinal tubules and prevents the adherence of root canal filling materials to canal walls [15].

The smear layer removal is very important especially in necrotic teeth due to the presence of bacteria. Removal of smear layer allows the penetration and sealing of the root dentinal tubules [16,17].

This study investigated the effect of using different irrigating solutions on the apical sealing ability of EndoSequence Bio ceramic root canal sealer. The results showed a significant difference between the use of 17%EDTA; 5.25% NaOCl and distilled water (control group) as irrigating solutions. 17%EDTA showed less apical leakage than both 5.25% NaOCl and distilled water. This may be due to that it is more effective in opening of the dentinal tubules with very few superficial smear layer were leaved [18]. This is in accordance with Calt et al. who found complete removal of smear layer by EDTA solution [19]. Removing of smear layer means more cleaning and better adaptation of endodontic filling materials to the canal wall [20]. Nischith et al. revealed that the apical seal increased after smear layer removal leading to increased success of root canal therapy [20]. Also, EDTA solution can interact with calcium ions of the root canal dentin and forms soluble calcium chelates [22].

On the other hand, NaOCl solution is capable of dissolving only the organic tissues and lacks the ability to remove smear layer [23]. NaOCl solution alone is not able to eliminate the smear layer better than the distilled water so irrigation with NaOCl solution alone is not effective in removing smear layer [24].

Also, this study showed that a significant difference existed between the uses of 17%EDTA alternatively with NaOCl irrigations and the use of 17%EDTA irrigation or the use of distilled water irrigation (control group). The alternative application of 17% EDTA and 5.25% NaOCl solution during canal preparation resulted in eliminating smear layer [25]. Alamoudi et al. showed that the most effective root canal cleaning is obtained when 17% EDTA was used followed by 5.25% NaOCl irrigations due to the chelation property of EDTA that dissolves and removes the inorganic debris of the smear layer, while 5.25% NaOCl acts as a solvent for the remaining organic debris of the smear layer [22].

Franchi et al. found that NaOCl solution alone was

Table 1: Descriptive statistics for the test groups.

	Groups			
	A DW	B 17%EDTA	C 5.25%NaOCl	D 17%EDTA+5.25%NaOCl
Means*	1.3	0.62	1.06	0.44
Minimum	0.96	0.25	0.55	0.25
Maximum	1.65	1	1.5	0.76
SE	0.11	0.11	0.12	0.09
SD	0.3	0.28	0.33	0.28
*: In mm				

Table 2: One way ANOVA test.

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	3.25	3	1.083	12.714	0
Within Groups	2.045	24	0.085		
Total	5.295	27			

Table 3: Duncan's multiple range tests.

	Column1	Column 2
Group D	0.44	
Group B	0.62	
Group C		1.0614
Group A		1.2957
Sig.	0.26	0.146
Note: Groups within the same column are not significantly different		

not enough for the removal of smear layer and the combination of NaOCl solution and EDTA was more effective particularly when EDTA used as a final irrigant [25].

CONCLUSION

Although significant difference was present in the sealing ability of the different irrigating solution used in this study, there is no one single irrigant that can act as organic and inorganic solvent at the same time. Therefore, alternating irrigation between organic and inorganic solvent solutions may be advised.

CONFLICT OF INTEREST

There is no conflict of interest.

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