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Bond Strength of Endosequence Bioceramic Sealer to Root Canal Dentine Irrigated with Different Solutions

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Abstract

Objective: The purpose of this study was to evaluate the effect of different solutions as final irrigant on the push out bond strength of Endosequence bioceramic sealer (EBC) to root canal dentine.

Method: Eighteen single rooted teeth were decoronate and root prepared using ProTaper rotary system and finally irrigated with different solutions. Group (1): irrigating with 17% EDTA. Group (2): irrigating with 2% of CHX. Group (3): irrigating with 5.25% NaOCL. The EBC sealer was prepared and applied according to the manufacturer's recommendation. All samples were wrapped in saline moistened gauze and stored at 37°Cfor 48h in incubator. Two-millimeter-thick slices were sectioned from coronal part of root (n = 6slices/group). Bond strength of the sealer to root canal dentin was measured using a universal testing machine at a cross head speed of 0.5 mm/min. The data were analyzed statistically by One-way ANOVA and Tukey tests at $P < 0.05$.

Results: Type of irrigating solution affect the bond strength of EBC sealer. Final irrigation with EDTA result the highest bond strength of sealer to root dentin which was significantly different from irrigation with NaOCl. Bond strength values was as follows: EDTA > CHX >NaOCl.

Conclusions: The type of final irrigation solution affects the adhesion of Endosequence Bioceramic sealer(EBC) to root canal dentin.

Introduction

Successful root canal treatment depends on the debridement of the root canal system, the elimination of pathogenic organisms and finally the complete sealing of the canal space(1).Thus adhesion of the filling material to the root canal wall is necessary. Preferably the sealer should be capable of producing bond between core material and dentin wall because gutta-percha does not directly bond to the dentin surface (2). Endosequence bioceramic sealer (EBC) is newly introduced sealer by (Brasseler, Savannah, USA)which is based on calcium phosphate silicate compounds hence its structure and composition similar to miniral trioxide aggregate(MTA) (3).EBC sealer is a premixed, injectable, and hydrophilic product composed of tricalcium silicate, dicalcium silicate, calcium phosphate monobasic, calcium hydroxide, zirconium oxide. Although it use the moisture present within the dentinal tubules to initiate and complete the setting reaction.EBC sealer have dimensional stability and do not shrink upon setting.(4).

Root canal irrigants are used during shaping and cleaning procedures to disinfect the canal space and remove smear layer (5). A number of chemical irrigants has been used in root canal therapy and to remove the smear layer as final irrigation of root canals such as 17% Ethylene diamine tetra-acetic acid (EDTA), 5.25% Sodium hypochlorite (NaOCl) or use 2% Chlor hexidine digluconate (CHX) (6). The type of final irrigating solution may affect the quality of adhesion between root canal dentin and EBC sealer. The mechanical interlocking of the sealer plug inside the dentinal tubules following smear layer removal may different by type of irrigating solution (7). The manufacturers of EBC sealer recommend that the root canals be maintained in a moist state to benefit from the hydrophilic properties of their sealers (8). The objective of the present study was to evaluate the effect of different final irrigating solutions on the push-out bond strength of EBC sealer to root canal dentin. The null hypothesis tested was that the type of irrigating solutions does not affect the bond strength of EBC sealer to root canal dentine.

Materials and Methods

Specimen Preparation:

Eighteen straight single-rooted human teeth were selected from (Department of Orthodontic and Oral Surgery, Mosul University, Iraq). Crown sectioned at level below cement enamel junction to prepare a standardized root length of 16 mm using diamond disc under water coolant. Working length, location of the apical foramen and the patency of the canals were verified by insertion of a No.15 K-file (Technical and General LTD; United Kingdom) into the canal and advancing until it is visualized at the apical foramen. The working length was determined by subtracting 1 mm from the visually determined canal length. The root canals were prepared using ProTaper rotary system according to manufacture instruction. The root canals were irrigated with 2 mL of 5.25% sodium hypochlorite (NaOCl) between each file size. The samples were randomly divided into three groups (n=6). This distribution was based on the type of final irrigating solution. Group (1): Irrigated with 17% Ethylene Diaminete Tetra-acetic Acid (EDTA) (Master_dent; USA), Group (2): Irrigated with 2% of Chlorhexidinedigluconate (CHX) (Sun star Suisse; Spain), Group(3): Irrigated with 5.25% Sodium hypochlorite (NaOCl) (National Cleaning Product CO.; Dammam, Saudi Arabia). All irrigations were performed using 5ml syringe of gauge 30 needle. The final irrigating solutions were left inside the canal for 1 min to ensure complete removal of smear layer (9).Each experimental sample were dried with a 4 paper points each left inside canal for 3 seconds in order to achieve moist condition. This procedure was based on the pilot study to achieve the manufacture recommendation of application the EBC sealer in moist canals. The EBC sealer was injected inside canal through disposable tips up to coronal portion of canal according to the manufacturer's recommendations. All samples were wrapped in saline moistened gauze then stored at 37°Cfor 48h in incubator in closed plastic vial allowing the sealer to set completely.

Push out Bond Strength test (PBS)

Samples were sectioned at coronal portion using diamond disk (Horico; Germany) perpendicular to their long axis under water-cooling to produce2 mm thickness disk. Disks were examined by digital stereomicroscopeX20 (Motic; Italy) before testing to confirm that the sealer filled the entire canal space without voids. Samples were mounted in an apical to coronal direction to avoid any constriction interference due to root canal taper during push out testing. The filling material was loaded with cylindrical stainless steel plunger of 0.8 mm in diameter, which was mounted in the upper part of digital universal testing machine (China). The plunger provide almost complete coverage over the sealer without touching the canal wall. The test was conducted at a crosshead speed of 0.5 mm/min until bond failure. The bond strength was calculated in megapascals (MPa) by dividing the load in Newton (N) over the area of the bonded interface. The bonded area of each section was calculated using the following formula: **(σ= Fmax/A)**, where (Fmax) was the maximum load when dislodgement of the filling materials occurred (N), (A) the effective adhesive surface area which can be calculated according to the following formula: $A\ (mm^2)=(D_1+D_2) \times \pi \times h$

Where π=constant 3.14, (D_1= larger diameters, D_2= smaller diameters of root canal). h=the thickness of the section in mm.

Statistical Analysis:

Bond strength data were analyzed with SPSS statistical software (Version 20; SPSS Inc, Chicago). One way analysis of variance used to determine existents difference in bond strength value between groups irrigated with different solutions .Tukey'sHSD was usedas post hoc test. All analysis was complete at 5% level of significant.

Results

One-way ANOVA indicated that the push-out bond strength values of EBC sealer were significantly affected by type of final irrigation solutions ($P < 0.05$). Bond strength values was obtained as follows (EDTA > CHX > NaOCl). Tukeys test analyzing shows that the push out bond strength of EBC sealer after irrigation with EDTA was significally higher than bond strength value of NaOCl ($P<0.05$) while no significant difference with value of CHX irrigating solution ($p>0.05$).No significant difference was observed between NaOCl and CHX irrigating solution ($p>0.05$).The push-out bond strength values (MPa) are presented in Figure 1.

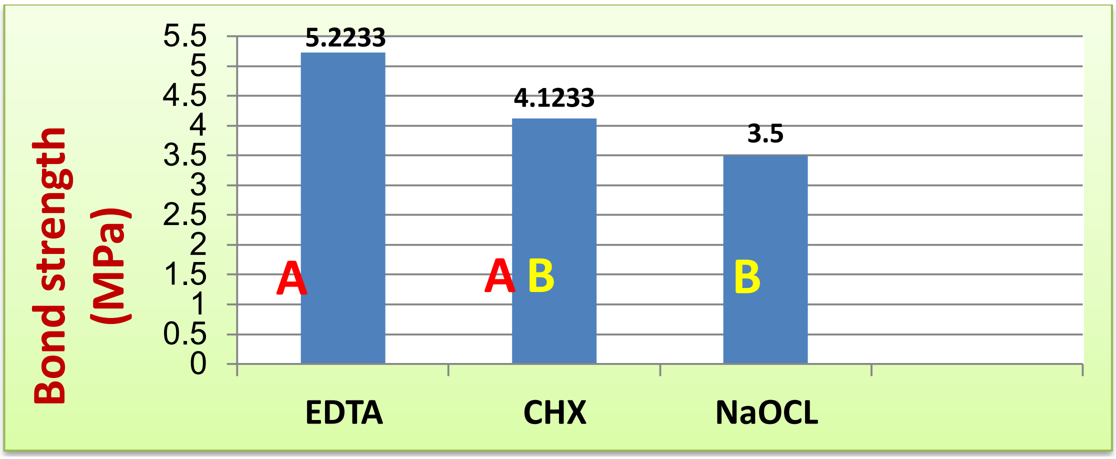

Figure 1. Bar chart graph show the mean Push-out bond strengths (MPa) of EBC sealer with respect to the types of irrigating solutions.(Different letters indicated significant difference(P<.05)between groups).

Discussion:

One of main properties of the Endo Sequence bioceramic (EBC) sealer is needs water for setting and utilizes the moisture within the dentinal tubules to initiate and complete its setting reaction. EBC sealer release calcium hydroxide during their hydration setting reaction resembling hydroxyapatite in structure and composition is formed between root canal dentin and the sealer..Dentin surface treatment with different irrigation regimens may cause alteration in the chemical and structural composition of root canal dentin, thereby changing its characteristics and hence affecting the adhesion of materials to dentin surfaces (10). Studies suggest the formation of a chemical bond between the EBC sealer and root canal dentin (11). Optimum adhesion requires intimate contact between the adhesive material and the substrate. A recent studies showed the formation of intra-tubular tags in conjunction with an interfacial mineral interaction layer which referred as the “mineral infiltration zone” (11). Intra canal adhesive materials are frequently evaluated using push-out bond strength. is a reliable technique to measure the bond strength of root canal filling materials to root dentin(12). Remainant of irrigating solution and inter tubules may negatively affect molecular attraction, chemical adhesion or penetration for micromechanical surface interlocking to enhance the integrity of the sealer-dentin interface (13).

Removal of the smear layer is another factor that need to be consider in associated with different irrigating solutions and different ability of smear layer removal(14).According to the results of the present study final irrigation with EDTA resulted in higher bond strength values for EBC sealer, which might be related to the absence of a smear layer and smear plugs formed during biomechanical preparation allowing sealer penetration inside the dentinal tubules to increase the mechanical retention of the sealer and the bond strengths of sealer to root canal dentin (15). This is in agreement with Moon et al and Parirokhet al. (16-17) who showed the effectiveness of a 1-min irrigation of 17% EDTA on complete smear layer removal. Although the result show no sig. deferens between CHX and NaOCl but the high values of push-out bond strength of EBC sealer with CHX in comparing with NaOCl could be attributed to the presence of surface surfactant in CHX composition, which increases the dentin surface energy and, hence, the dentine wett ability, a property that is required for the adhesion of EBC sealer. Also CHX enhanced the cationic charging of the dentin surface, thus increasing the reaction between material and dentine(18). NaOCl irrigation alone is capable of removing the organic portion only of the smear layer, it is not effective at removing the entire smear layer. NaOCl solution may affect the structural, chemical and mechanical properties of dentin by the degradation of organic dentin components, also reduction of elastic modulus and flexural strength in human root dentin. In addition, reduction in carbon and nitrogen content will result in alteration in intertubular dentin (19).All these factors could be an important reason for the low bond strengths reported for adhesive sealer when react with dentine surface (20).

Conclusion:

Under the conditions of this study, it could be concluded that the type irrigating solution play an a major role on the adhesion property of the EBC sealer. Irrigation with EDTA as final irrigant produce high PBS of EDTA than CHX and NaOCl.

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