Evaluation of Bioceramic Sealer Apical Seal in Dry and Wet Condition

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Abstract

Objectives: To evaluate the apical seal of different types of root canal sealers in dry and moist condition.

Materials and methods: Forty eight sound premolar teeth were decoronated. Canals were prepared with protaper rotary system up to predetermined working length. Samples were divided into two groups according to the moisture condition of canals (dry and wet). Each group was subdivided into three groups according to the type of root canal sealers (Endosequence, Epoxy resin and zinc oxide Eugenol). Roots were painted with nail varnish leaving apical part and immersed in indian ink for three days. Samples were sectioned longitudinally and split. The apical dye penetration in millimeters was measured under stereomicroscope at 40x. Data was analyzed with one way ANOVA and student T-test at 0.05 level of confidence.

Result: Significant difference in microleakage between different sealer types ($p<0.05$). ZOE sealer show highest microleakage value in comparison to the other types while no difference was seen between Bioceramic and Epoxy sealers ($P>0.05$). Significant difference was observed between the conditions in Bioceramic sealer only with higher leakage was recorded under dry condition ($p<0.05$).

Conclusion: Sealer types and moisture conditions influenced the sealing ability of the evaluated sealers. Bioceramic has better performance than other sealers especially under moist condition.

Keywords: Root canal sealers • Micro leakage • Bioceramic sealer • Moist condition

Introduction

Hermetic obturation of the root canal system is a major objective in root canal treatment after proper cleaning and shaping of the root canal. Sealer intends to block the passage of fluid through the canal restoration to achieve tight seal of the system. Improper bonding of the sealer might lead to interface microleakage subsequently failure of the system. Based on the sealer component different types of endodontic sealers currently available like: Zinc Oxide Eugenol, Calcium hydroxide, Glass Ionomer and Resin based sealer. Of the long history and commonly used sealers is ZOE that based on zinc oxide (ZnO) powder and Eugenol liquid.Study showed that one drawback of ZOE is a water solubility that might decrease their physical properties when contaminated with moisture during service, especially at the early stage of setting reaction. ZOE showed gross leakage due to poor sealing property. Another reason for low sealing is the debonding from dentinal walls or cohesive fracture caused by shrinkage setting stresses. Effort to introduce better sealer was continue resulting in development of resin sealer based on resin adhesion as epoxy resin. Epoxy sealer has gain popularity due to good physical properties, apical sealing ability, adequate biologic function and micro retention to root dentin. As the epoxy material depends on polymerization mechanism, moisture contamination would decrease the monomer conversion leading to incomplete resin polymerization and decrease bond to dentin. Thus the sensitivity to moisture contamination persists with incidence of leakage side effect [1].

To overcome leakage problems associated previously mentioned sealers type, another type of sealer has been emerged recently based on aqueous mix of calicium phosphate silicate thus called Bioceramic sealer as EndoSequence BC Sealer. Such kind of sealer may take the advantages of moisture condition within the tooth structure for initiation and completion of their setting process. Utilization of moisture within the dentinal tubules during the setting reaction will expands material laterally resulting in superior marginal adaptation. On other side an analytical research of has demonstrated that hydroxyapatite can precipitated within the calcium silicate hydrate phase to produce a composite-like structure. (9) A behavior will reinforce the set cement and creating a chemical bond between dentinal wall and sealer. This type of sealer seems to be promising because some time practitioner may accidently face difficulty to dry the root canal space completely. A condition may be caused by poor isolation, apical exudate, and inadequate apical extrusion of paper points while drying up [2].

Conventionally complete dryness prior to obturation recommended for increasing the adhesion of sealers to the dentinal wall. Bioceramic sealer manufacturers recommended that dentinal walls are kept moist, to take maximum advantages of hydrophilic properties of sealers. Effect of moisture on the apical seal of different sealers should be determined. Therefore this study aim to evaluate the sealing ability of the newly introduced Bioceramic in dry and moist canal condition and compare result with the other commonly used ZnO and Epoxy sealers. The null hypothesis was that canal condition and type of sealer has no significant influence on the microleakage of the used sealers.

Materials and Methods

Specimen preparation

Forty eight sound human premolars with mature apices were collected from college of Dentistry/Mosul University. Root surfaces were cleaned with a curette and stored in distilled water. All teeth were decoronated with a safe-sided diamond disc under continuous water spray to standardized root length to 12 mm from the apex. Root canals was negotiated with K-file size 15 followed by protaper rotary system preparation (Dentsply, Maillefer, Switzerland).The working length of 11 mm was determined by subtracting 1 mm from the apex. During preparation the protaper system was set at speed =300 rpm and torque=2 n.cm with file size 20(F1) and 25(F2). After each file used, each root canal was irrigated with one ml of 5.25% NaOCL and 17% EDTA and finally washed with distilled water. Roots were divided into three groups according to the types of sealer. Group I (Endosequence Bioceramic), group II (Epoxy resin), and group III (ZOE). Before obturation group was divided into two subgroup according to the moisture condition of canals (n=8). One group was planned for wet condition obturation where canals were dried with only one paper point (size 25 taper to full working length) [3].

Method of use	Manufacturer	Component	Sealer
premixed syringe	Brasseler USA	Zirconium oxide calicium silicates calicium phosphate	Bioceramic Endosequence

		monobasic, calicium hydroxide,fillers and thickening agent	
Automixed preloaded double syringe with mixing tip	Tsealer, London, United Kingdom	Epoxy oligomer resin,ethylene glycol salicylate,zirconium oxide,polyamine calicium cement	Epoxy resin
Powder and liquid one measurement of the powder with one drop of liquid, mixed on a large surface of the glass cement slab to obtain homogenous cream consistency	Eugentin, Tehnodent, Russia	Zincoxide,dexamethasone,hydrocortisone,acetatethymol iodide,zirconium oxide,calicium phosphate, eugenol	ZOE

Table1: The sealer materials used in this study with their composition and application procedure.

While other as dry condition in which the root canals dried with 4 paper points size 25 taper to full working length followed by one ml, 95% ethanol irrigation, left for 30 seconds, and dried with paper point .Groups were obturated with each type of sealer as manufacturer recommendation as shown in Table 1. The canals were filled with sealers till ensured by observing extrude from the apical orifice. The Gutta Percha was loaded with sealer and insert slowly to working length. Excess of Gutta Percha was cut off by hot instrument, and slightly condensed by the plugger. Coronal orifice of each root was sealed by Cavit G. Then all of roots were incubated at 37 c for 7 days to ensure complete setting of sealers. Roots were coated with two layers of nail varnish except 1 mm apically. After two days to ensure complete dryness of nail varnish, the roots were immersed in a container of Indian ink and incubated at 37 c for three days. Then roots washed with tap water and two vertical grooves were prepared one buccally and one lingually with diamond sectioning disc using slow speed hand piece under water cooling. Roots were split up into two parts using chisel.

Microleakage evaluation

Dye penetration in mm along the canals walls were measured under stereomicroscope (Hamilton, Italy) at 40x magnification with micrometer calibration slide. The measurements were collected and analyzed by one way ANOVA and t-test using SPSS statistical software at 0.5% level of significance.

Results

Mean and standard deviation of microleakages of different sealers under both conditions of obturation are shown in Table 2. Irrespective of conditions the one way ANOVA indicated a significant difference in microleakage between different sealer types ($p<0.05$). Bonferoni test show the ZOE sealer has the highest microleakage value in comparison to the other types as shown. While no difference was seen between Bioceramic and Epoxy sealers ($P>0.05$). T-test revealed significant difference between the conditions in canals obturated by Bioceramic sealer only ($p<0.05$). Higher leakage was recorded under dry condition.

Sealer types	Mean (SD) in dry	Mean (SD) in wet
Bioceramic	94 (.66)Aa	33 (0.16)Ab
ZOE	2.95 (0.73)B	3.3125 (1.09)B
Epoxy	1.22 (0.37)A	1.25 (0.80)A

Table2: Means and SD of the microleakae for all experimental groups.

Discussion

The apical sealing ability is important request for success of endodontic treatment. This can be achieved via prevent transmission of microorganism and their toxin between the root canal system and periapical area. The properties of sealers like adhesion, solubility, and setting could affect sealing process. In this study, the apical sealing ability of three types of sealers based on different properties was evaluated and compared using dye penetration method. Although sealing process influenced by inherited properties of the sealer however other factor inside canal could strongly govern their property and subsequently sealing behavior which is the moisture condition. Single obturation technique was followed in this study after canal preparation with rotary system rather than standared lateral compaction technique due to the limited information available associated using different types of sealers with this increasable used technique [4].

The result of microleakage comparison between different sealer types show similar leakage behavior under both condition of moisture. The Bioceramic achieves the best value in resistance to dye leakage than ZOE sealers but not different than epoxy. This result consistent with previous study. Endosequence BC sealer is a premixed calcium phosphate silicate based sealer dispersed in water miscible condition which hardens on exposure to moisture in root dentin. Hegde V and Arora S in a study demonstrated lower apical leakage values in the hydrophilic sealers. Based on the above explanation the superiority in microleakage resistance should be decreases when sealer applied inside dry canal due to incomplete hardness process influenced by lack of water. However this was not the case a reason could be related to the protocol followed in dryness of the canal in this study which may not completely extract the water content from inside the tubules with sufficient remnants to complete reaction process that already initiated during mixing procedure [5].

Statistical comparison between the conditions of obturation for each type of sealer showed that there was only significant differences in bioceramic sealer. Canals obturated with bioceramic sealer show less leakage when canal left with greater amount of final irrigating solution due to insertion of single paper point. Endosequence sealer composed mainly of calicium silicate which requires the presence of water to harden thus it is adapted to moisture. With deep penetration into dental tubule could form a strong tag through hydroxyapatite enhance a chemical bond with the dentin. This setting mechanism has capability to form a powerful monoblock in contrast to epoxy resin and zinc oxide eugenol sealers. The moisture condition does not affect other sealers types investigated in this study a reason probably related to their setting mechanism that not dependent on the existence of water. Epoxy reaction based on chemical additional reaction between epoxides group and amine to form polymer resin through polymerization mechanism while ZOE based on between euginol liquid with zinc oxide powder to form amorphous gel. The Epoxy show moderate sealing less than Bioceramic probably due to the polymerization shrinkage but still superior to ZOE due to poor adhesion property to dentin and it is high permeable.

Conclusion

Within the limits of this study, none of tested sealers completely prevents microleakage. Bioceramic was superior to the other types. Moisture condition affects sealing ability of Bioceramic sealer but not other types.

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