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Comparison of push out bond strength of different endodontic sealer to root dentin - An in-vitro study

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Abstract

Aim: Compare the push-out bond strength to root dentin of two root canal sealers: epoxy resin-based sealer (AH Plus), and Bio ceramic sealer (Bio Root RCS).

Methods: Thirty extracted single-root human teeth of similar sizes and circular canals were used. Irrigation (2.5% sodium hypochlorite (NaOCl)-17% ethylenediaminetetraacetic acid (EDTA). After obturation with guttapercha using the respective sealer, roots were sectioned at 2 levels – apical and middle third of root canals and push-out bond test assessed using universal testing machine. Two-way analysis of variance (ANOVA) and the post-hoc Tukey test were used for the analysis of the data with a significance level of 5%.

Results: AH Plus presented significantly higher bond strengths ($p<0.05$) than the other sealers, while Bio Root RCS showed the lowest bond strengths ($p<0.05$)

Conclusions

AH plus sealer group showed the higher push out bond strength than BioRoot RCS, Middle segment of each test group demonstrated the highest mean bond strengths than the Apical segments.

Keywords: Bio Root RCS, EDTA, NaOCl

Introduction

The success of endodontic treatment depends on debridement, elimination of pathogenic organism, and complete sealing of the root canals preventing the entry of bacteria from the oral environment and spreading it to the periapical tissues.[1] Mechanical instrumentation along with proper disinfecting solutions and use of intracanal medicaments considerably reduces the microbial loads within the infected canals.[2]

Traditionally used root canal sealers are zinc oxide eugenol, calcium hydroxide, and resin-based sealers. Newer root canal sealers are constantly being developed to provide improved properties.[3]

The hermetic seal between the canal wall and core filling material is achieved by sealer which is critical for preventing root canal infection due to regrowth of microorganism or newly gained infection by apical or coronal leakage. The bacterial tight seal achieved by endodontic sealer is therefore a major aspect for assessing the properties of various endodontic sealer.[4]

AH Plus is an epoxy resin-based sealer used frequently as a reference material because of reduced solubility, long-term dimensional stability, and greater retention to root dentin.[2]

BioRoot RCS is a recently launched hydraulic tricalcium silicate-based sealer containing tricalcium silicate, zirconium oxide, etc. Due to prolonged release of Ca+ ions after setting and alkalinity of the sealer, it possesses high antimicrobial and low cytotoxic property promoting endodontic and periodontal regeneration. It has gained popularity because of its ability to seal in presences of hydrophilic atmosphere by mineralization and apatite deposition at canal wall interface [5]

Sodium hypochlorite (NaOCl) is commonly used in concentrations between 0.5% and 6%. It is a potent antimicrobial agent, killing most bacteria instantly on direct contact. It also effectively dissolves pulpal remnants and collagen, the main organic components of dentin.Sodium Hypochlorite is the only root-canal irrigant of those in general use that dissolves necrotic and vital organic tissue. It is difficult to imagine successful irrigation of the root canal without Sodium hypochlorite[6].

Chelating agents remove the smear layer from the root canal and potentially allow better dentinal tubule penetration of root canal sealers as well as demineralizing and softening dentine. In order to obtain the maximum effect during and after instrumentation, it is necessary to use chelating agents in conjunction with a tissue solvent. An effective method to remove the organic and inorganic remnants is to irrigate the root canal with EDTA followed by NaOCl [7]. The use of EDTA and sodium hypochlorite (NaOCl) alternately has been proved efficient in removing endodontic smear layer for many years [8] Sealer penetration into the dentinal tubules improves the seal ability because of an increase of contact surface between filling material and dentin[9]. The bond strength of sealers to dentin is important for the maintenance of integrity of seal Numerous studies have proved that irrigation with 5% NaOCl solution during 3 min PUI could remove more smear layer EDTA is normally used in a concentration of 17% and can remove the smear layers when in direct contact with the root canal wall for less than 1 minute.

The present study was designed to compare and to evaluate the push- out bond strength of two different endodontic sealers are namely AH plus sealer, BioRoot RCS with sodium hypochlorite and EDTA as irrigating solutions

Material and method

Thirty single rooted, circular canal that are caries free, indicated for extraction due to orthodontic reasons and periodontal problems were collected from Department of Oral and Maxillofacial surgery, M.R. Ambedkar dental college and Hospital Bangalore-Karnataka, India with patients consent. OSHA guidelines were followed in collecting and storage of sample. The samples were divided into 2 groups (n=15) according to the sealer used and common irrigating solution:

IRRIGANT: 2.5% naocl + 17% EDTA

GROUP I: AH PLUS sealer

GROUP II: BIOCERAMIC sealer

Preparation of the samples

The study samples were decoronated apical to the cement enamel junction to standardize the canal length to 14 mm measured from the tip of the root to the cement-enamel junction with a diamond disc under water coolant mounted on a straight micro motor handpiece. The prepared teeth were stored in normal saline solution until use. The samples were then mounted in a putty impression material in order to stabilize the samples for ease of working and to ensure standardization in procedure.

In both the experimental groups, the coronal orifice was then sealed with sticky wax. This was done to achieve a close mode of irrigation. During instrumentation of all canals, 2ml of NaOCl (2.5%) and 17% EDTA was used as an irrigant using 30 gauge side vented needle for 1 minute. For each group, 5 ml of irrigating solution (2.5%NaOCl+17%EDTA) will be used for 2 minutes using conventional irrigation method followed by 5 ml 0.9 % saline for 2 minutes using an endodontic irrigating needle. Root canals will be dried with paper points and then sealer will be mixed according to manufacturer's directions and will be introduced into canal using lentilospiral instrument. Both the groups will be obturated with gutta percha with single cone technique using the respective sealers AH Plus sealer, BioRoot RCS .The obturated teeth will be allowed to set for 1 week before push out assessment in 37°C with 100% humidity in an incubator

Discussion

The success of endodontic treatment depends on various factors such as chemomechanical preparation, obturation, and ultimately postendodontic restoration. The main goal of this treatment is to eliminate microbial entity and prevent future occurrence of re-infection by achieving hermetic seal.9 Gutta-percha is a biocompatible material to fill radicular space whereas sealer is essential to aggregate the filling material, maintain compact mass without voids, adhere it to the canal wall, and provide single unit configuration.[10]

Push-out bond strength test was used in this study because it is easy to reproduce, to interpret and they record, at even low levels, the bond strength to dentin[11]. Many advantages of this method were reported including the possibility of placing the sealer in direct contact with the intracanal dentin walls, instead of a flat coronal dentin surface, which presents a different tubule arrangement pattern. Additionally, when the specimen is filled with sealer, the material accommodates to the canal shape and penetrates into the dentinal tubules, promoting mechanical retention similar to that of clinical conditions [10].

In the present study, specimens obturated using AH plus sealer, which is an Epoxy, based endodontic sealer, it is believed that homogeneous polymerization occurs, leading to higher mean values of bond strength along the canal root. Along with that chemical polymerization occurs at a low rate, delaying the gel point state and allowing for shrinkage stress relaxation, and avoiding a decrease in bond strength. This is in accordance with the study conducted by Wunderlich Rocha et al[12]

The superior results of AH Plus may be due to better adhesion to root dentine and deeper penetration into dentinal tubules (Lee et al. 2002, Mamootil & Messer 2007).AH Plus has the highest push-out bond strength under all conditions. This result is similar to the studies conducted by (Ersahan & Aydin 2010, Amin et al. 2012, Nagas et al. 2012)

In the present study Group II in which BioRoot RCS was used had Less push out bond strength compare to AH Plus sealer .It is a recently launched hydraulic tricalcium silicate- based sealer containing tricalcium silicate, zirconium oxide, etc. Due to prolonged release of Ca+ ions after setting and alkalinity of the sealer, it possesses

high antimicrobial and low cytotoxic property promoting endodontic and periodontal regeneration. It has gained popularity because of its ability to seal in presences of hydrophilic atmosphere by mineralization and apatite deposition at canal wall interface Endodontic sealers based on tricalcium silicate or containing calcium silicate formulations were recently introduced with a view to transferring the well- documented biocompatibility and bioactivity of di- and tricalciumsilicate cements to root canal sealers. The release of calcium hydroxide from di- and tricalcium silicate cements due to hydration and the contact with phosphate from tissue fluids leads to a precipitation of calcium phosphate or calcium carbonate on the material's surface[13] .

Also, the formation of hydroxyapatite on a calcium silicate sealer's surface after contact with phosphate hasbeen reported[14]. This is the reason for the bioactive potential of tricalcium and dicalcium silicate materials and sealers. Furthermore, calcium silicates form an interfacial layer at the dentin wall denoted as"mineral-infiltration zone". The alkaline caustic effects of the calcium silicate cement's hydration products degrade the collagenous component of the interfacial dentin[15],.This degradation leads to the formation of a porous structure that facilitates the permeation of high concentrations of Ca2+, OH−, and CO32− ions, leading to increased mineralization in this region[16], . This chemical interaction at the interfacial dentin along with a micromechanical interaction by tag-like structures is mainly the reason for measurable adhesion between calcium silicate-based materials and dentin,[17]

Result

Two-way analysis of variance (ANOVA) and the post-hoc Tukey test were used for the analysis of the data with a significance level of 5%. The test results demonstrate that the Group AH Plus showed significantly highest mean Pushout Bond strength as compared to Biorrot RCS group at P=0.04 respectively.

Conclusion

AH Plus sealer shows the high push out bond strength when compare with Bio ceramic (Bio Root RCS) sealer.

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