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An Invitro study on comparative evaluation of apical sealing ability of bio root RCS, ah plus and MTA-fill apex root canal sealers in obturated root canals

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Abstract

Background: Prevention of microleakage with sealing of entire root canal system is an important factor for the success of endodontic therapy. Root canal sealer provides bonding between obturating material and dentinal wall of the root canals.

Aim: To evaluate and compare the apical sealing ability of Bio Root RCS, MTA-Fillapex and AH Plus root canal sealers.

Material and methods: Sixty extracted human single rooted teeth were collected for the study. Coronal portion of each tooth was removed at the cemento-enamel junction. All the root canals were prepared with NiTi rotary instruments. The specimens were divided into three groups- Group 1 (Canals obturated using AH Plus sealer); Group 2 (Canals obturated using MTA-Fillapex sealer) and Group 3 (Canals obturated using Bio Root RCS sealer). All the specimens were coated with three layers of colored nail varnish up to 1 mm short of root apices. Apical leakage test was conducted and micro leakage was evaluated under a stereo microscope with 10X magnification. Data were analyzed using One-way ANOVA and Student Newman-Keuls test.

Result: Group 3 specimens showed better apical sealing than Group 1 and Group 2 specimens.

Conclusion: Bio Root RCS sealer has better apical sealing ability than that of MTA-Fillapex and AH Plus sealer.

Keywords: AH Plus, diamond, enamel, MTA, One way ANOVA

Introduction

Root canal sealers play an important role in the success of endodontic root canal therapy. They are used along with an inert biocompatible material to establish an adequate seal of the root canal system. They occupy the space between the obturating material and the root canal walls. They provide an impervious seal and formed a bonding between the obturating material and root canal wall. Ideally, root canal sealers should be inert, biocompatible, nonresorbable, physically stable, insoluble in tissue fluids, radiopaque, non-staining to tooth structure and bacteriostatic. Sealers are designed to improve the seal provided by the obturating material. The sealing ability of root canal sealer depends upon its solubility and to its bonding to dentin and obturating materials used[1]. Flow is another important property of root canal sealer that allows it to fill difficult areas such as narrow irregularities of dentin, isthmus, accessory canals and voids between master cone and accessory cones[2].

Commercially a variety of formulations of root canal sealers are available. Based on their chemical composition root canal sealers are grouped as zinc oxide eugenol-based sealers, calcium hydroxide-based sealers, resin-based sealers, paraformaldehyde sealers, MTA based sealers, glass ionomer-based sealers and Bioceramic based root canal sealers.

AH Plus (Dentsply, DE Trey GmbH) is an epoxy resin-based sealer that has been used most commonly in clinical practices these days. Unlike its precursor product AH26, certain disadvantages such as tendency to discoloration and formation of formaldehyde have been eliminated with AH Plus. It has a minimum working time of 4 hours at 23˚C and a minimum setting time of 8 hours at 37˚C. AH Plus comes in two tubes for manual mixing of pastes A and B and also as AH Plus jet mixing syringe for convenient and faster procedure.

MTA-Fillapex is a Bioceramic endodontic sealer based on MTA and launched in the market in 2010 by Angelus (Londrina/Parana/Brazil). It contains MTA which is more stable than calcium hydroxide that releases calcium ions constantly and maintains a pH that elicits its antibacterial effects. It provides faster tissue recovery due to the presence of MTA and Di salicylate resin. The product is eugenol free and does not discolour the tooth structure. It comes in paste/paste formulation system that allows complete sealing of the entire root canal system including accessory and lateral canals. It has a working time of 35 minutes and an average minimum setting time of 130 minutes (two hours).

Bio Root RCS (Septodont, France) is the newest endodontic root canal sealer based on tricalcic silicate materials benefitting both Active Bio silicate Technology and Bio dentine. It is a mineral-based root canal sealer using tricalcium silicate setting system. It is resin free ensuring zero shrinkage. Due to its great flowability it fills accessory canals and is suitable for use in cold single cone or cold lateral condensation. It has working time of more than 10 minutes and setting time of less than 4 hours.

Materials and Methods

The present study was conducted at the Department of Conservative Dentistry and Endodontics, JNIMS (Jawaharlal Nehru Institute of Medical Sciences) Dental College, Imphal, Manipur, India after taking prior approval from the Ethical Committee of the Institute.

Sixty extracted human permanent single rooted teeth having completely developed root, straight root, absence of calcified root canal and absence of malformed root were selected for the study. The teeth were immersed into 2% hydrogen peroxide for 15 days to remove the attached necrotic tissue. The root surfaces were then scaled with an ultrasonic scaler (EMS, Mectron) to remove calculus, stain and remaining attached tissue debris. All the crowns of the teeth were removed at the cemento-enamel junction with the help of a diamond disc bur under water coolant spray. Access openings of the canals were prepared. All the canals were instrumented with rotary NiTi instruments till their working length with alternate irrigation of 5.25% sodium hypochlorite and 17% ethylenediaminetetraacetic acid (EDTA). Finally, all the root canals were flushed with distilled water and dried with paper points.

Depending on the type of sealer used during obturation of root canals, the prepared specimens were randomly divided into three groups of 20 specimens each-

Group 1: Canals obturated using AH Plus sealer

Group 2: Canals obturated using MTA-Fillapex sealer

Group 3: Canals obturated using Bio Root RCS sealer

All the canals were obturated with single cone gutta percha point technique using their respective sealers following their manufacturer's instructions for use. The coronal openings of each root canal were sealed with restorative glass ionomer cement (GC Gold Label 9). The specimens were then placed at room temperature for 24 hours to allow setting of the root canal sealers. After 24 hours the specimens were dried sterile absorbent papers. The root surfaces of all the specimens were coated with three layers of colored nail varnish up to 1 mm short of root apex. The nail varnish coatings were completely dried and the specimens were immersed in 2% methylene blue solution for 5 days at room temperature. After removal from the methylene blue solution the specimens were washed under running tap water for 2 minutes and dried. The nail varnish coatings were then scrapped off from the root surfaces with a scalpel. The roots were then split longitudinally parallel to the long axis with a diamond disc under water coolant spray. The depth of dye penetration was examined under a stereomicroscope at 10X magnification and microleakage present in each root canal was evaluated. The depth of dye penetration or microleakage was measured in millimeters.

Results

The results were statistically analyzed using one-way ANOVA and comparisons among the groups were carried out by the Student Newman-Keuls test. The value of statistical significance difference was considered at $P \leq 0.05$. Group 3 showed less microleakage than Group 1 and Group 2 (Table 1). When the mean microleakage values of the three groups were compared (Table 2) there was statistical difference ($P < 0.05$).

Discussion

In an endodontic root canal treatment, a 3-D obturation is necessary for the success of the treatment. In order to achieve such obturation the root canal sealer should provide a strong bond between the obturating material and the root canal walls. It should also seal all the accessory and lateral canals to prevent reinfection thereby preserving the health of the periapical tissues. It is also important to note that not only coronal seal but also apical seal is important for the success of endodontic treatment[3]. In the present study the apical sealing ability of three root canal sealers were evaluated.

Gutta percha is the most commonly used obturating materials in endodontic root canal treatment. Along with gutta percha, root canal sealers of different chemical

compositions are used to seal the root canal space created between the obturating material and canal wall. However different sealers have different physical properties which contribute to the outcome of the treatment[4]. They have different sealing ability and provide varying degree of bonding between the obturating material and dentine of the root canal walls.

Ah Plus is a resin-based sealer developed to overcome the disadvantageous properties of its precursor AH26. Unlike AH26 it does not form formaldehyde and does not stain the tooth structure. It comes in paste/paste system which enables penetration of sealer into the accessory and lateral canals. However the main disadvantage of AH Plus is that it does not release calcium ions. Duarte et al. suggested that addition of 5% calcium hydroxide to AH Plus make it less viscous and increases its alkaline pH and release of calcium ions which exerts antimicrobial activity[5]. MTA-Fillapex and Bio Root RCS are newly developed root canal sealers. Bio Root RCS has outstanding adhesion to dentin and gutta percha points[1]. It is hydrophilic and continues sealing process in the presence of moisture. It has outstanding microleakage resistance due to dentin structure mineralization through formation of hydroxyapatite[6]. It crystalizes inside dentinal tubules creating a three-dimensional seal.

Different methods have been advocated to assess the sealing ability of endodontic root canal sealers. Assessment of the depth of penetration of dye solution is the most commonly used method to evaluate the apical leakage of root canal sealers. The dye solution commonly used is methylene blue at different concentrations because it has a low molecular weight and capable of penetrating deep along the root canal filling material[7]. Another method employed to assess apical leakage of root canal sealers is the glucose leakage model as described by Xu et al. In the absence of smear layers, root canal sealers penetrated into dentinal tubules to provide an impervious seal[8]. In the present study, 5.25% sodium hypochlorite solution along with 17% ethylenediaminetetraacetic acid (EDTA) has been used to remove the smear layers.

In the present study the specimens obturated using Bio Root RCS sealer (Group 3) showed comparatively less microleakage than the specimens obturated using MTA-Fillapex sealer (Group 1) and AH Plus sealer (Group 2). There was a statistically significant difference when the three groups were compared. Group 2 showed less microleakage than group 1.

The main factor contributing to higher microleakage of AH Plus sealers may be due to C-factor (configuration factor) which is the ratio of bonded to unbonded surface areas of cavities. In long, narrow root canals the C-factor is extremely high which resist in relieving the polymerization shrinkage stresses created during setting of the resin sealer[9]. However, even the best available sealer showed apical leakage. This may be due to reduced effective removal of smear layer by the irrigating solution, preventing deeper penetration of root canal sealers into dentinal tubules creating increased shrinking stress at the apical region. This stress has resulted in creating rotational forces which results in movement of gutta percha breaking the adhesive bond at the sealer interface, resulting in apical leakage.

Conclusion

The result of the present study demonstrated that Bio Root RCS sealers provide better apical sealing ability than that of AH Plus sealers and MTA-Fillapex sealers. However, further studies on comparison of sealing abilities of different root canal sealers are required.

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References

1. S. Desai, N. Chandler, 2009. "Calcium hydroxide-based root canal sealers: a review," Journal of Endodontics, vol. 35, no. 4, pp. 475–480.

2. G. T. D. M. Candeiro, F. C. Correia, M. A. H. Duarte, D. C. Ribeiro-Siqueira, G. Gavini, 2012. "Evaluation of radiopacity, pH, release of calcium ions, and flow of a Bioceramic root canal sealer," Journal of Endodontics, vol. 38, no. 6, pp. 842–845.

3. De Almeida WA, Leonardo MR, Tanomaru Filho M, Silva LA, 2000. Evaluation of apical sealing of three endodontic sealers. Int Endod J; 33:25-7.

4. Orstavik D, Kereker K, Eriksen HM, 1981. Clinical performance of three endodontic sealers. Int Endod J: 14:27-34.

5. Duarte M.A.H., de Oliveira Demarchi A.C., Moraes I.G., 2004. Determination of pH and calcium ion release provided by pure and calcium hydroxide containing AH Plus. Int Endod J; 37: 42-45.

6. Dimitrova-Nakov S, Uzunoglu E, Ardila-Osorio H, Baudry A, Richard G, Kellerman O, Goldberg M, 2015. In vitro bioactivity of Bio root™ RCS, via A4 mouse pulpal stem cells. Dent Mater. Nov;31(11):1290-7.

7. Schafer E, Olthoff G, 2002. Effect of three different sealers on the sealing ability of both Thermafil obturators and cold laterally compacted Gutta-Percha. J Endod; 28:638-42.

8. Xu Q, Fan B, Fan MW, Cheung GS, Hu HL, 2005. A new quantitative method using glucose for analysis of endodontic leakage. Oral Surg Oral Med Oral Pathol Oral Radiol Endod; 99:107-111.

9. Tay FR, Lou shine RJ, Lambrecht's P, Weller RN, Pashley DH, 2005. Geometric factors affecting dentin bonding in root canals: a theoretical modelling approach. J Endod.;31:584-9.

Legend Tables

Table 1: One way ANOVA test

Groups	Mean ± Standard Deviation	Standard error of mean	F* - value	P- value	Significance
Group 1	5.71 ± 0.80	0.32	122.73	< 0.05	Highly significant
Group 2	2.08 ± 0.24	0.10			
Group 3	1.51 ± 0.21	0.08			
* One way ANOVA test					

Table 2: Comparison of mean values of microleakage using student Newman-Keuls test

Groups	P* - value	Significance
Group 1 and Group 2	< 0.05	Significant
Group 2 and Group 3	< 0.05	Significant
Group 1 and Group 3	< 0.05	Significant
*Student Newman-Keuls test		