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Original Research

Sealing ability of BC sealer and AH Plus- An in-vitro study

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ABSTRACT:
Background: A complete root canal filling is substantial for long-term success of endodontic treatment. The present study was conducted to compare sealing ability of BC sealer and AH Plus using SEM and micro-CT. **Materials & Methods:** 50 teeth were instrumented to a size of 40/06 using a crown-down technique. Irrigation was with 2 mL 2.5% NaOCl was employed. Canals were then dried with paper points and samples were randomly divided into two groups. Group I samples were filled with AH Plus Root Canal Sealer and group II samples were filled with EndoSequence BC Sealer. All specimens were scanned using micro-CT and then three from each group were randomly selected for SEM analysis. **Results:** The mean total ROI volume (mm3), object (Dentine) volume (mm3), volume of closed pores (mm3), surface of closed pores (mm2), volume of open pores (mm3) and open porosity (%) at apical third was 7.0 and 7.6, 1.50 and 1.35, 0.155 and 0.115, 0.230 and 0.175, 4.00 and 70 and 73 in group I and II respectively. At middle third, in group I was 7.5, 1.50, 0.370, 0.310, 5.41 and 71.5 and in group II was 7.4, 1.40, 0.400, 0.475, 7.0 and 82.1 respectively. At coronal third, in group I was 7.5, 1.40, 0.65, 0.620, 6.75 and 77 and in group II was 7.6, 1.35, 0.90, 0.810, 6.88 and 80 in group II respectively. A significant difference was observed in apical third (P< 0.05). **Conclusion:** Authors found that both the sealant found to be equally effective.
Key words: Root canal, Sealant, Endodontic

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INTRODUCTION

Root canal treatment without obturation or with improper obturation is termed as incomplete root canal treatment. Ingle and colleagues radiographically studied endodontic success and failure; they indicated that 58% of treatment failures were due to incomplete obturation.[1] The three dimensional (3D) obturation is the primary objective of root canal therapy, the purpose of obturation in turn is to seal all "portals of exit". Obturation impedes any sort communication between periapex, periodontal space and root canal.[2] thus entombing the micro-organisms and preventing re-infection by spread of microbial toxins.

Sealers can be a cause of root canal failure due to microleakage at sealer-dentin or sealer-core material interface.[2,3,4] Bonding of the sealer to the root canal dentin wall and formation of a monoblock can eliminate this drawback.

An ideal endodontic sealer should fulfil all ideal requisites. The tight seal at the apex can be enhanced, sealer bonds chemically to the dentinal wall of root canal, and mild expansion of the sealer improves its adaptation to the canal walls. It should be antibacterial and resistant to dissolution. One of such sealer is bioceramic (BC) sealer.[1]

BC sealer is a recently introduced sealer, composed of zirconium oxide, calcium silicates, calcium phosphate monobasic, calcium hydroxide, and various filling and thickening agents. The material is available in premixed calibrated syringes with intra-canal tips. As a hydrophilic sealer it utilizes moisture within the canal to complete the setting reaction and it does not shrink on setting.

The present study was conducted to compare sealing ability of BC sealer and AH Plus using SEM and micro-CT.

MATERIALS & METHODS

The present study comprised of 50 recently extracted single-rooted, human mandibular premolars. The approval for the study was obtained from institutional ethical clearance and review committee.

All teeth were decontaminated in 5.25% sodium hypochlorite for 2 hours. Preoperative radiographs were obtained in the mesiodistal and buccolingual directions to confirm the presence of a single unmanipulated root canal without root caries. All teeth were decoronated at the cemento-enamel junction, and each root was adjusted to about 12 mm in length. Subsequently, a #10 K-File was inserted into the root canal until the tip was at the apex. The working length was determined by subtracting 0.5 mm from this length.

All teeth were instrumented to a size of 40/06 using a crown-down technique. Irrigation was with 2 mL 2.5% NaOCl was employed. Canals were then dried with paper points and samples were randomly divided into two groups. Group I samples were filled with AH Plus Root Canal Sealer and group II samples were filled with EndoSequence BC Sealer. All specimens were scanned using micro-CT and then three from each group were randomly selected for SEM analysis. Results thus obtained were assessed statistically. P value less than 0.05 was considered significant.

RESULTS

Table I Distribution of samples based on sealers

Groups	Group I	Group II
Sealer	AH Plus root canal sealer	Endo Sequence BC Sealer
Number of tooth	25	25

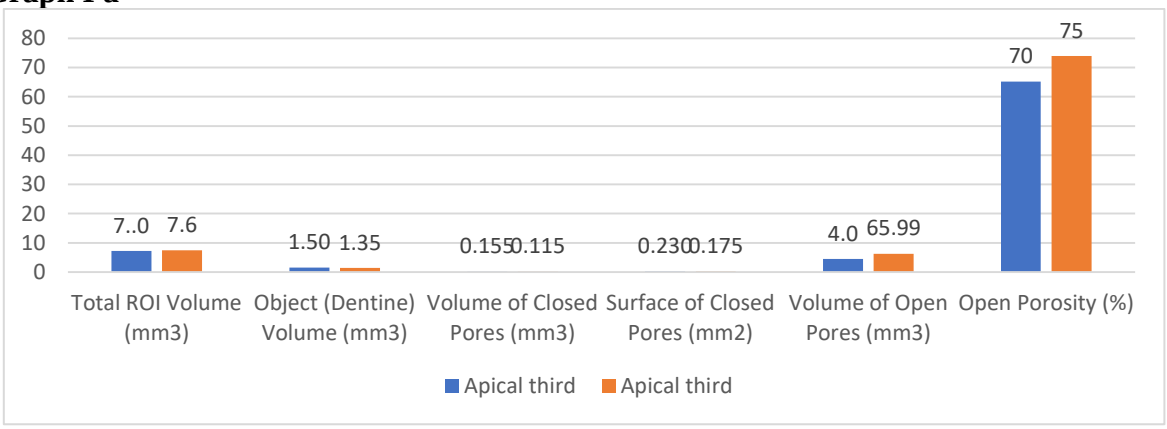
Table I shows that each group comprised of 20 teeth.

Table II Presence of micro pores in root canal system

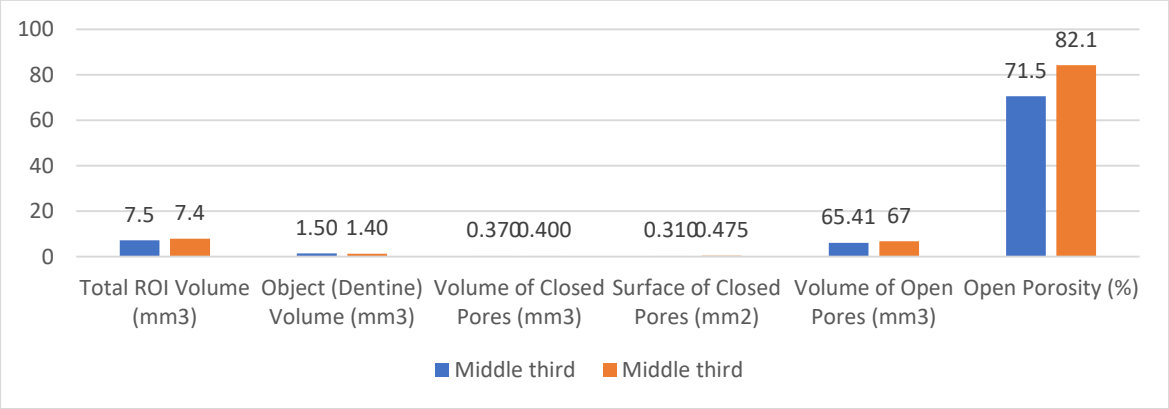
Sections	Groups	Total ROI Volume (mm3)	Object (Dentine) Volume (mm3)	Volume of Closed Pores (mm3)	Surface of Closed Pores (mm2)	Volume of Open Pores (mm3)	Open Porosity (%)	P value
Apical third	Group I	7.0	1.50	0.155	0.230	4.00	70	0.02
	Group II	7.6	1.35	0.115	0.175	5.99	73	
Middle third	Group I	7.5	1.50	0.370	0.310	5.41	71.5	0.08
	Group II	7.4	1.40	0.400	0.475	7.0	82.1	
Coronal third	Group I	7.5	1.40	0.65	0.620	6.75	77	0.09
	Group II	7.6	1.35	0.90	0.810	6.88	80	

Table II, graph Ia, b, c shows that mean total ROI volume (mm3), object (Dentine) volume (mm3), volume of closed pores (mm3), surface of closed pores (mm2), volume of open pores (mm3) and open porosity (%) at apical third was 7.0 and 7.6, 1.50 and 1.35, 0.155 and 0.115, 0.230 and 0.175, 4.00 and 5.99 and 70 and 73 in group I and II respectively. At middle third, in group I was 7.5, 1.50, 0.370, 0.310, 5.41 and 71.5 and in group II was 7.4, 1.40, 0.400, 0.475, 7.00 and 82.1 respectively. At coronal third, in group I was 7.5, 1.40, 0.65, 0.620, 6.75 and 77 and in group II was 7.6, 1.35, 0.90, 0.810, 6.88 and 80 in group II respectively. A significant difference was observed in apical third (P< 0.05).

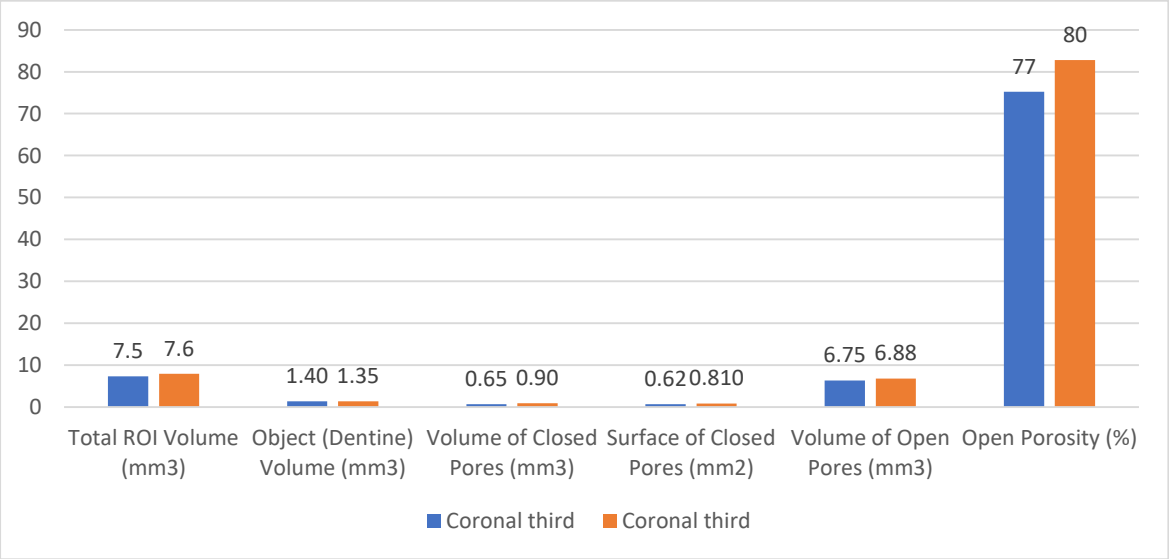
Graph I a



Graph I b



Graph I c



DISCUSSION

Due to the complexity of root canal systems, pulp tissue and inorganic debris remain in areas instruments and irrigation solutions cannot easily access after root canal treatments.7 Thus, microorganisms surviving in the root canal will subsequently grow and spread to the periradicular areas between the sealer and dentin. Permanent coronal restorations also provide seals equally as important as the apical seal after the root canals are filled.8 When insufficient coronal sealing occurs or the root canal remains open (e.g., when sealing is delayed for permanent fillings, broken fillings, or secondary caries formation; etc), oral bacteria will access the apical foramen.9

A complete root canal filling is substantial for long-term success of endodontic treatment. The obturation is classically performed using gutta-percha and different types of root canal sealers. The root canal sealers fill the gaps between gutta-percha cones and the dentine walls. Therefore, these materials should present adequate physical properties.10 Among the important physical properties to a proper obturation, the flow of endodontic sealers allows their deeper penetrability into the irregularities of the root canal system, which contribute to own interlocking between sealer and dentine.11,12 Therefore, the flow of endodontic sealers may be evaluated by the ISO 6876/2012 standard, which recommend that the materials have a minimum of 17 mm of flow. However, the main limitation of this conventional test is its incapability to evaluate also the filling ability of the materials.13 The present study was conducted to compare sealing ability of BC sealer and AH Plus using SEM and micro-CT.

In present study, group I samples were filled with AH plus root canal sealer and group II samples were filled with EndoSequence BC sealer. Huang et al14 twenty-four single-root human mandibular premolars were selected and instrumented with nickel-titanium rotary file and the final file size was #40/06. They were then randomly allocated into 2 groups, and all samples were filled with single cone gutta-percha (#40/06) and one of the tested sealers (AH Plus and EndoSequence BC sealers). All specimens were scanned using micro-CT and then three from each group were randomly selected for SEM analysis. According to SEM, both root canal sealers showed sufficient adaptation to

dentin along the whole length of the root canal, though the coronal sections presented superior sealing than the apical sections. Micro porosity analyses revealed that the volume of closed pores and the surface of closed pores had the largest values in the coronal sections, followed by the middle and the apical sections for both sealants ($p<0.05$). However, no significant difference was observed for those two parameters between AH Plus and EndoSequence BC sealers in any of the three sections ($p>0.05$), whereas they were larger in the apical section when the AH Plus sealer was used. By using the single cone technique, neither EndoSequence or AH Plus provides a porosity-free root canal filling. The EndoSequence BC sealer may have similar sealing abilities regarding the whole root canal as the AH Plus sealer. A better sealing effect could be obtained in the coronal and middle sections of a root canal than the apical part by using the tested sealers.

We found that mean total ROI volume (mm3), object (Dentine) volume (mm3), volume of closed pores (mm3), surface of closed pores (mm2), volume of open pores (mm3) and open porosity (%) at apical third was 7.2 and 7.4, 1.52 and 1.41, 0.153 and 0.121, 0.235 and 0.182, 4.50 and 6.26 and 65.2 and 73.9 in group I and II respectively. At middle third, in group I was 7.3, 1.45, 0.361, 0.324, 6.12 and 70.5 and in group II was 7.9, 1.34, 0.409, 0.435, 6.87 and 84.2 respectively. At coronal third, in group I was 7.3, 1.36, 0.63, 0.631, 6.34 and 75.2 and in group II was 7.9, 1.31, 0.87, 0.772, 6.77 and 82.8 in group II respectively. Faria-Júnior et al15 evaluated the flow rate of the Acroseal, AH Plus, Endomethasone N, Sealapex, and ActiV GP according to the standards of the ISO specification 6876/2001. A volume of 0.05 mL of the cement mixed according to the manufacturer's recommendations was placed on a glass plate. At 180±5 s after the commencement of mixing, the second glass plate was placed on top of the sealer, followed by the weight of mass approximately 100 g to make a total mass on the plate of 120±2 g. Ten min after the start of mixing, the weight was removed and the value of the diameter of the compressed disc of sealer was measured. The mean of three such determinations for each sealer was taken as the flow of the material. The results obtained were: Acroseal 21.24 mm, AH Plus 22.72 mm, ActiV GP 24.90 mm, Endomethasone N 18.76 mm, and Sealapex 25.15 mm. Conclusion: Only the Endomethasone N did not conform to ISO Specification that requires that a sealer shall have a diameter of not less than 20 mm. The Sealapex achieved the greatest flow, but it did not differ from Activ GP and AH Plus ($P>0.5$).

Torres et al16 evaluated the flow and filling ability of AH Plus, Endofill and Sealapex by conventional methodology and micro-CT. The flow of the sealers was analyzed according to ISO 6876/2012 and complemented by the area evaluation. Glass plates were manufactured with diameters of 1×1×2 mm and 1×1×1 mm (length, width and height), with a central cavity and four grooves in the horizontal and vertical directions. Each material was placed in the central cavity. Another glass plate and a metal weight were placed on the cement and kept for 10 minutes. The glass plate/sealer set was scanned using micro-CT. The flow was calculated by linear measurement of the material in the grooves. The central filling (mm3) was calculated in the central cavity and the lateral filling was measured up to 2 mm from the central cavity. All evaluated sealers presented flow according to ISO 6876 standards. The materials showed central cavity filling capacity higher than 80% and lateral filling greater than 75%. There was no difference in flow (mm and mm2) and in the filling ability (mm3) provided by the materials ($p>0.05$).

CONCLUSION

Authors found that both the sealant found to be equally effective.

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