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COMPARATIVE EVALUATION OF APICAL SEALING ABILITY OF AH PLUS, ENDOSEQUENCE RCS & ENDOREZ AS ROOT CANAL SEALERS.- AN IN VITRO STUDY

Dental Science

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ABSTRACT

A sealer fills the microscopic gaps and the irregularities of the root canal system and bonds the core material to root canal walls. Sealers routinely used in endodontics do not meet one or more requisites of ideal root canal sealers.

Aim: To evaluate and compare the apical sealing ability of AH plus, EndoSequence BC RCS, and EndoREZ sealer using stereomicroscope.

Materials And Methods: 75 freshly extracted human permanent maxillary anterior teeth with fully developed root apices were selected for the study. Decoronated samples were prepared using Rotary Pro taper files and were randomly divided into 3 groups of 25 samples each and obturated by lateral condensation and 6% gutta percha and respective sealers and then stored at 37◦ C for 24 hrs. The roots were coated with nail varnish until the apical 2 mm and then suspended in 1% methylene blue for 72 hours. Then the roots were rinsed for 15 minutes under tap water and were split longitudinally parallel to the long axis with a diamond disc using a water coolant and then horizontally markings were made at 2, 4 and 6 mm from the apex. The depth of dye penetration was examined under stereomicroscope and associated microleakage with respective groups was calculated.

Results: Vertical dye penetration in all three groups showed dye penetration and was not statistically significant. Horizontal dye penetration at predetermined levels in all three groups was statistically significant.

Conclusion: Bioceramic sealer sealed the root canal better compared to AH Plus Sealer but the hermetic seal obtained was equivalent to that of EndoREZ. Within the limitations of this in-vitro study a better three dimensional sealing was achieved with both EndoSequence BC Sealer and EndoREZ.

KEYWORDS

sealer, apical seal, microleakage

Introduction:

Sealers play an important role in success of root canal treatment and failure of the treatment can occur due to microleakage at sealer-dentin or sealer-core material interface.[1,2] Commercially varieties of endodontic sealers are available and depending upon their chemical composition classified into different groups. Recently introduced sealers like EndoRez, Bioceramic sealers have improved handling properties, hydrophilic, biocompability etc.

AH plus is two paste system based on Epoxy resin sealer. It is less tooth staining less toxic and highly biocompatible. Component A is composed of Epoxy resins, Calcium tungstate, Zirconium oxide, Silica, Iron oxide pigments. Component B contains Amines, Calcium tungstate, Zirconium oxide, Silica ,Silicone oil.[3]

EndoREZ is resin-based root canal sealer, having urethane dimethacrylate resin as active ingridient.[4,5] It is a hydrophilic, chemical or dual-curing setting and composed of zinc oxide, barium sulfate, resins, and pigments in a matrix of urethane dimethacrylate. It can be used with gutta-percha but when used with resin-coated gutta-percha it forms a monoblock.[6]

Bioceramics are uniquely designed ceramic materials composing Zirconium oxide, calcium silicates, calcium phosphate monobasic, calcium hydroxide, filler and thickening agents.[7] It has several advantages such as improved biocompatibility, excellent sealing ability, high pH which accounts for its antibacterial activity, non-shrinkable and non-resorbable property, improved convenience and delivery, ease of application and increase in strength of root following obturation[8].

It is a premixed sealers due to which problems such as insufficient and non homogeneous mix are avoided. They have ability to form hydroxyapatite and hydrophilic in nature ,utilizes moisture present within the canal for its setting and it does not shrink on setting .The chemical bond formed between the filling material and the dentin walls eliminates the presence of any space between the dentinal walls and the sealer.[9] Particle size of Bioceramic sealers is very fine particle size-less than 2 µ that can be delivered with a 0.012 capillary tip.[8]

Thus this study was aimed to evaluate the apical sealing ability of newly introduced bioceramic sealer i.e. EndoSequence BC Sealer and two commonly used sealers - AH Plus and EndoRez using Stereomicroscope.

Materials And Method:

The present study was conducted in the Department of Pedodontics and Preventive Dentistry, Rural Dental College, Pravara Institute of Medical Science (DU) Loni. Ethical clearance for the study was obtained from the Institutional Ethical Review Board and Research Committee at Rural Dental College and Hospital, Loni. This study included 75 freshly extracted human permanent maxillary single rooted teeth which were indicated for extraction .

Methodology:

Seventy-five extracted human permanent maxillary single rooted teeth with fully developed straight roots, root surface free of cracks, caries, resorptive defects were included in the study. Using ultra sonic scaler debris from the root surface were removed. For disinfecting the teeth, they were placed in 3% sodium hypochlorite for two hours and after that they were stored in saline. All the teeth were decoronated 12 mm from the apex with a diamond disc using a water coolant and access cavity was made with a round bur. After preparing glide path with hand instrumentation K-files # 15,20 (DENTSPLY) and EDTA(RC prep), teeth were then prepared using crown-down technique with Rotary Pro taper files (Dentsply Maillefer) to F3 till the working length eleven

millimeter .During filing copious irrigation was done using 3% sodium hypochlorite and 17% EDTA liquid alternatively. Final irrigation was done with normal saline. Sterile absorbent paper points were used for drying the canals.

Grouping of the samples:
Based on the sealers to be used for obturation, the prepared specimens were divided into three groups of twenty-five samples each by simple random sampling method -

Group A: Teeth obturated using AH plus as sealer.
Group B: Teeth obturated using EndoSequence BC as sealer.
Group C: Teeth obturated using EndoREZ as sealer.

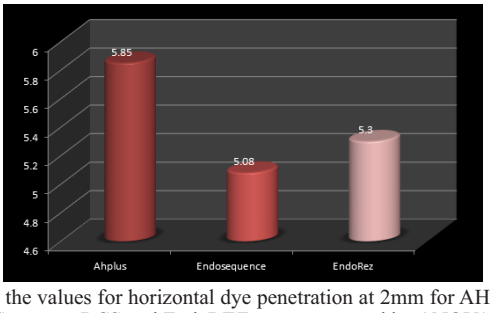
The teeth in all the groups were obturated by lateral condensation method using 6% tapered Gutta Percha cones with respective sealers following manufacturer's instructions and the coronal openings of all the specimens were sealed with glass ionomer cement [restorative type (Type 2) (GC Gold Label)]. The samples were stored in Incubator at 37°c for 24 hours to allow setting of the sealers. After 24 hrs, the samples were dried with sterile cotton and gauze piece and two layers of coloured nail varnish were applied on the surface except apical 2mm. After complete drying of these layers of varnish the teeth were suspended in freshly prepared1% methylene blue for 72 hours. Then the roots were washed under running water for 15 minutes and the varnish layers were scrapped off with scalpel blade and the roots were split longitudinally parallel to the long axis with a diamond disc using a water coolant and markings were made at 2, 4 and 6 mm from the apex. The depth of dye penetration was examined under stereomicroscope at 10X magnification and microleakage associated with different root canal sealers was evaluated and values were obtained in units. These values were then converted to millimetres for vertical dye penetration and micrometers for horizontal dye penetration, using the following standard formulae –

$$\frac{\text{No of Units}}{\text{Eye Piece Magnification X Zoom Magnification}} = \text{Value in millimetres}$$

$$\frac{\text{No of Units X 1000}}{\text{Eye Piece Magnification X Zoom Magnification}} = \text{Value in micrometers}$$

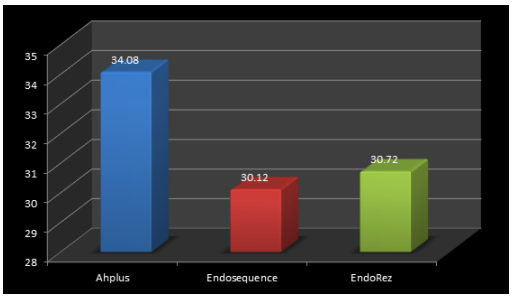
Results:
The intergroup comparison for vertical dye penetration among all three groups - AH plus , EndoSequence and EndoREZ was statistically not significant by using ANOVA test (p value = 0.09). [Graph 1]

Graph 1: Intergroup comparison of vertical dye penetration ratio (mm) among three groups by using 'ANOVA' test.



When the values for horizontal dye penetration at 2mm for AH plus, EndoSequence RCS and EndoREZ were compared by ANOVA test , they were statistically significant (p = 0.01) [Graph 2]

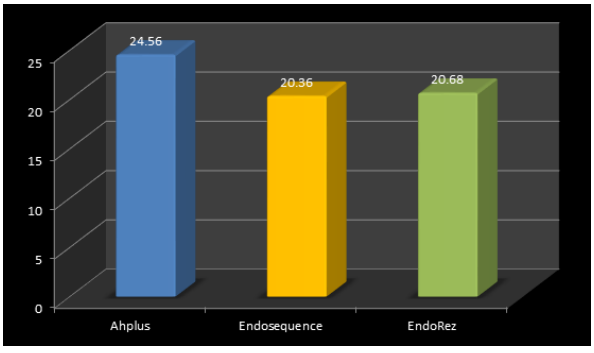
Graph 2: Intergroup-comparison of horizontal dye penetration ratio (µm) among three groups at 2 mm by using 'ANOVA' test.



The intergroup comparison of AH plus and EndoSequence by applying unpaired 't' test for horizontal dye penetration at 2mm was statistically significant (p=0.02). The dye penetration was statistically not significant among AH plus and EndoREZ(p= 0.063) whereas the comparison among EndoSequence and EndoREZ was also statistically not significant (p= 1.00).

Mean values for horizontal dye penetration at 4 mm for AH plus, EndoSequence RCS and EndoREZ were 24.56 (SD ± 5.5), 20.36 (SD ± 7.56),20.68 (± 5.66) respectively. The intergroup comparison of horizontal dye penetration at 4 mm for all three groups by ANOVA test was statistically significant (p = 0.03).[Graph 3]

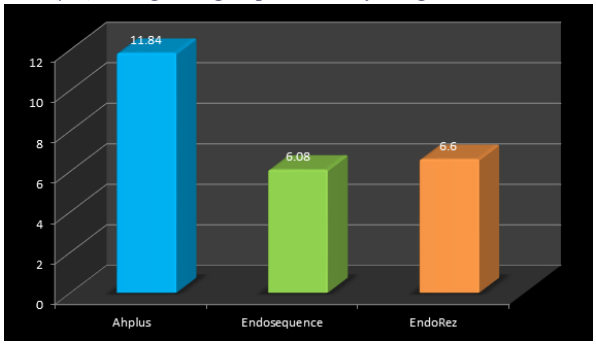
Graph 3: Intergroup-comparison of horizontal dye penetration ratio (µm) among three groups at 4 mm by using 'ANOVA' test.



But when unpaired 't' test was applied , the intergroup comparison of AH plus and EndoSequence (p =0.066), AH plus and EndoREZ(p = 0.102) and EndoSequence and EndoREZ (p = 1.00) were statistically not significant .

Mean values for horizontal dye penetration at 6 mm for AH plus, EndoSequence RCS and EndoREZ were 11.84(SD ± 5.87), 6.08(SD ± 4.01) and 6.60(SD ± 4.53) respectively. The intergroup comparison of horizontal dye penetration at 6 mm for all three groups by ANOVA test was statistically significant (p = 0.001 [Graph 4]

Graph 4: Intergroup-comparison of horizontal dye penetration ratio (µm) among three groups at 6 mm by using 'ANOVA' test.



The Intergroup comparison by unpaired 't' test for horizontal dye penetration at 6mm of AH plus and EndoSequence was statistically significant (p = 0.000). Intergroup comparison of AH plus and EndoREZ was also statistically significant (p = 0.001) but when compared Intergroup comparison of EndoSequence and EndoREZ was statistically not significant (p = 1.000).

Discussion:
The goal of a root canal filling is to obturate the complete root canal system and produce an damp proof apical seal. Endodontic failure can occur due to incomplete obturation, which may permit penetration of microorganisms and toxins. Materials used for obturation of a root canal are core - gutta percha mainly and other is the sealer.

The most difficult area to clean is the apical end of the root canal and therefore it can be reservoir of the residual bacteria causing possible treatment failure. [10,11]Microliekage of sealer can be evaluated by number of methods like dyes, radioisotopes, bacteria and their products (endotoxins), methodologies include fluid filtration and dye extraction.[12] Linear measurement of dye penetration is the most

commonly implementated method to evaluate microleakage due to its ease of performance .Molecular size of methylene blue dye is similar to bacterial by-products such as butyric acid ,due to this reason it is commonly used dye .[13] Methylene blue passes along air-filled gaps by capillary action, whereas in water-filled gaps, it passes by diffusion.

Various types of Sealers are- Eugenol based, Non Eugenol, Resin, Calcium hydroxide, Glass ionomer cement and most recent being Calcium silicate sealers.

Some sealers have additional benefit of their antimicrobial property and recently some are regenerative. Thus this study was planned .

Epoxy resin based AH series of root canal sealers is popularly used in clinics due to its properties like dimensional stability, sufficient flow, good biocompability and radiopacity. AH Plus that also contains adamantine.[4] AH plus is successor of AH 26 in Epoxy resin RCS and is less cytotoxic as compare to its counterpart.[14] But when compared to Bioceramic it is more cytotoxic as AH Plus releases formaldehyde on setting.[15]Due to better penetration in micro-irregularities, increased mechanical interlocking is observed between AH Plus and root dentin.[16,17] But it was observed that the bond present between sealer and gutta percha is weak allowing fluid leakage at this interface.[18]

Recently introduced EndoSequence BC Sealer is Calcium Silicate based Bioceramic sealer which sets in the presence of water.[19] It is available in premixed single paste form, this causes mix to be uniform for all the dispenses and flow of this sealer is appreciated in all the lateral and accessory canals. This Bioceramic sealer is biocompatible ,hydrophilic and on setting it can expand upto 0.2% on completion of setting reaction forming a 'self .[10] This expansion enhances bond between the sealer to root canal walls chemical and micromechanical mechanism. In addition to this, high pH (12.8) during the initial 24 hours of the setting process provides additional benefit of antibacterial property. [20]

EndoREZ is a hydrophilic, two-component, dual-cured and which can be used gutta-percha or with resin-coated gutta-percha but formation of monoblock is the benefit of later one . Deep resin tags formed upto the depth of 500 µm or more help enhance bonding and the clinical success of obturation.[21] Oxygen liberated during NaOCL irrigation can inhibit polymerization, thus it is important to thoroughly flush the root canal with EDTA after the use of NaOCL, followed by sterile saline or 2% chlorhexidine[21].

The result of present study showed that, the dye penetration occurred in all three sealers but was least for Bioceramic sealer <EndoREZ sealer < AH Plus and there was insignificant (p = 0.09) difference found between all these sealers when linear apical leakage was measured from the apical end towards the coronal third of the methylene blue dye penetration . At the markings of 2mm, 4mm and 6mms the horizontal penetration of the dye was measured from root canal walls upto the extent of dye penetration in the dentinal tubules. At 2mm the results were not significant due to approximity of the dentin, but at 4mm and 6mm there was a significant ($p<0.03$) difference between the results for horizontal dye penetration

When Zmener and Banegas compared for methylene dye leakage between and AH Plus for apical and coronal, they reported no statistically significance.[22] Orucoglu et al observed that less apical leakage in Diaket as compare to EndoREZ and AH Plus by using the fluid filtration method in.[23] Neto et al reported better sealing with AH Plus than EndoREZ and AH 26 by using a single cone technique.[24] Huang et al showed that the calcium hydroxide sealers were least toxic or damaging to primary human PDL cultures and V79 cells when compared with MBRS, zinc oxide-eugenol sealers.[25] In toxicology study carried out by Louw, Becce, and Pameijer on EndoREZ, it was found that EndoREZ was mildly irritating, yet within acceptable standards.[21]

Suprit Pawar [26] assessed microleakage of EndoSequence bioceramic (BC) sealer, AH Plus and Epiphany and noticed that BC sealer and Epiphany sealer sealed the root canal better compared to AH Plus sealer. Similarly in our study AH plus showed high dye penetration as compare to EndoREZ and EndoSequence.

Narasimiah Kumar[27] studied the apical sealing ability and adaptation of EndoREZ and AH plus to dentin. Both sealers showed apical leakage but statistically difference was not significant where as depth of penetration was more in EndoREZ as compare to AH plus. Similarly in our study, differences of dye penetration in AH plus and EndoREZ group at 4mm level were statistically not significant.

Kumar et al[28] evaluated the apical sealing ability and adaptation of three resin-based sealers to the dentine. Observations revealed that GP and Epiphany had the least amount of microleakage followed by AH plus and EndoREZ showed maximum dye leakage. His SEM observations showed better dentin adaptability in Epiphany followed by AH plus and EndoREZ. But in our study EndoREZ showed lesser dye penetration as compared to AH plus.

Thus present study showed that the dye leakage occurs in all three sealers used but EndoSequence RCS showed least dye leakage. Although not very drastically varying differences were observed, based on the values obtained we could state that, EndoSequence RCS is better sealer in circumstances compared to EndoREZ and AH plus.

Conclusion:

The present comparative study demonstrated -

- The newly introduced Bioceramic sealer -EndoSequence RCS seals the root canal better compared to AH Plus Sealer and EndoREZ.
- The hermetic seal obtained with Bioceramic sealer - EndoSequence RCS was equivalent to that of EndoREZ.
- A better three dimensional sealing can be achieved with both EndoSequence BC Sealer and EndoREZ.

Furthermore, extensive research involving use of tracers like various other dyes, radioisotopes, bacteria and their products, such as endotoxins is required to prove the sealing ability of these sealers. Also other methodologies like fluid filtration and dye extraction method can be followed.

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