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COMPARATIVE EVALUATION OF LATERAL PENETRATION DEPTH OF ROOT CANAL SEALERS UNDER CONFOCAL LASER SCANNING MICROSCOPE

Dental Science

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ABSTRACT

AIM: This in vitro study was conducted to evaluate the lateral depth of penetration of zinc oxide eugenol (with grossman formula),AH Plus (Dentsply)and Bioceramic sealers(smart paste bio) into the dentinal tubules using confocal laser scanning microscope.

MATERIALS AND METHODS: Thirty nine recently extracted single-rooted mandibular premolars were taken. The working length was determined. Chemomechanical preparation done using k file to apical size 30. Between each instrument, the canal was irrigated with 5ml of 3%NaOCl.Three teeth were reserved as control and were not subjected to any procedure.In the rest of the samples, the canal were irrigated with 5ml of 3%sodium hypochlorite followed by 5ml of 17%EDTA and as a final rinse,5ml of 2%chlorhexidinewas used.Then the canals were dried with sterile paper points.The samples were divided into 3 groups (12 samples per group) based on the sealers used and were obturated with guttapercha cones using lateral condensation technique. All the sealers were mixed individualy with rhodamineB dye before obturation. Sections were prepared from middle third of the root for observation under confocal laser microscope

RESULTS: Bioceramic sealer(smart paste bio) resulted in greater sealer penetration into dentinal tubules compared to AH plus and zinc oxide eugenol sealers.

KEYWORDS

rhodamineB dye, sealer penetration, confocal laser scanning microscope

INTRODUCTION

Endodontic success is achieved by three dimensional hermetic seal in the main canal and the lateral dentinal tubules[1].In india most commonly used system to obturate root canal space is lateral condensation or the single cone technique.In both the techniques guttapercha is used with different root canal sealers available for obturation. Regardless of the obturation techniques gutta percha has no adhesive property[2]Good sealer penetration into the dentinal tubules with tight adaptation is therefore mandatory to prevent microleakage ,reinfection and aid in endodontic success[6,19,20].Various sealers exhibit different physiochemical properties which influences the penetration depth and interfacial adaptation[3].Untill today no endodontic sealer has proven to achieve all the properties of ideal endodontic sealer.In this study we have evaluated the penetration depth of Zinc oxide eugenol, AH plus(Dentsply) with newer endodontic sealer ,Bioceramic sealer(smart paste bio) under confocal laser scanning microscope.

METHODOLOGY

Thirty nine recently extracted single-rooted mandibular premolars were taken .The working length was determined. Chemomechanical preparation done using k file to apical size 30. Between each instrument, the canal was irrigated with 5ml of 3%NaOCl.Three teeth were reserved as control and were not subjected to any procedure.In the rest of the samples, the canal were irrigated with 5ml of 3%sodium hypochlorite followed by 5ml of 17%EDTA and as a final rinse, 5ml of 2%chlorhexidinewas used.Then the canals were dried with sterile paper points.The samples were divided into 3 groups (12 samples per group) based on the sealers used and were obturated with guttapercha cones using lateral condensation technique. All the sealers were mixed individualy with rhodamineB dye before obturation. Sections were prepared from middle third of the root for observation under confocal laser microscope .

The specimens were grouped as follows ,Group1:Zinc Oxide Eugenol sealer, Group 2:AH Plus sealer,Group3:Bioceramic sealer The samples were mounted flat on glass slab and viewed under confocal laser scanning microscope to determine the sealer penetration depth into the dentinal tubules [fig 1].

RESULTS

Sealer penetration depth was measured in micrometer using confocal laser microscope.The values are given in Table 1.

Table 2 shows the mean penetration depth of the experimental sealers. Table 3 shows sealer penetration into dentinal tubules(inter group comparison)

STATISTICALANALYSIS

For sealer penetration measurement,One way analysis of difference (ANOVA) was used to study the overall mean within groups. The mean and standard deviation were calculated. The p- value showed significant difference among the groups [Table 3].

DISCUSSION

Quantification of sealer penetration depth was carried under confocal laser scanning microscope.

It has no special specimen processing step and the observations can be made close to normal conditions.Moreover CLSM works on noninvasive approach and has less potential to produce technique artifacts[18].CLSM offers a lot of advantage over SEM (scanning electron microscope), these include the ability to control depth of field, elimination or reduction of background information away from the focal plane (which leads to image degradation), and the capability to collect serial optical sections even from thick specimens[6]Scanning electron microscopic observation requires additional gold sputtering of the samples which is time consuming[18].

All the sealers were mixed according to the manufactures instructions and labeled with RhodamineB isothiocyanate fluorescent dye to facilitate the observation. Since there was no specific method devised to incorporate this dye into the dentinal sealers in the literature,[6,9]in this current study to maintain the standard amount of dye mixed,10 parts of sealer was manually mixed with 1 part of dye powder so that approximate concentration of 0.1% of the dye was obtained.The quantity of dye mixed with the sealer was negligiblethat it will not alter the physio chemical properties of sealer.[6,9]

Irrigation regime used in this study was similarto the clinical situation as recommended by Zehnder 2006where intermittent rinse with saline was used between the irrigants -3%sodium hypochlorite,17%EDTA and2%Chlorhexidinegluconate.[3,11,12,13]

Lateral compaction technique was used to obturate the samples as adding a core of laterally condensed guttapercha gives better control of obturation and helps to press the sealer into the dentinal tubules.[5,9,14,15] Three teeth served as negative control.The control teeth were neither irrigated with the standardised irrigation protocolnor obturated. Sections from the middle third of the root was used for observation in this study.[7,16]Cross section of the root was used in this study because in longitudinal sections overall penetration of the sealers into the dentinal tubules cannot be viewed.[10]

Zinc oxide eugenol and AHplus sealers showed a minimum penetration depth of 91.20um and 71.56 um and a maximum penetration depth of 257.55um and 158.66 um respectively. The penetration depth of Bioceramic sealer obtained from this study shows a minimum depth of 238.59um and a maximum depth of 409.67 um. The intra and inter group comparison was significant [Table3].

The results of the study show that the Bioceramic sealer has equal and highest penetration depth compared to other two sealers.Additional observation was that bioceramic sealer showed high penetration depth in all the samples.

Zinc oxide eugenol sealer showed deeper penetration (159.21±95.23 micrometer) than AH plus sealer (115.49±43.17micrometer) in contrast to previous studies by Chadha et al, Chandra et al and kokkas[5,6,8].In those studies it was reasoned out that capillary action played a major role in the deeper penetration of AH plus sealer.[5,6,8]White et al found that both Zinc oxide eugenol and AH plus sealer had equal penetration[6]. On the other hand, Vassiliadis et al in his landmark in vivo study on the penetration of zinc oxide eugenol sealer found that the sealer penetrated to a maximum of 900micrometer [14].Silicone oil being one of the components of AH plus sealer may be responsible for its hydrophobicity. This may give the possible explanation for the minimum penetration depth of AH plus sealer[5,15]. In thecase of zinc oxide eugenol sealer, its penetration was profoundly influenced by the filling technique,particle size and flow[10,15].Other possible reasons the different result between zinc oxide eugenol and AH plus sealer penetration depth in the current study may be possibly due to film thickness, flow and viscosity of the sealer mix used in the obturation[4,5].

Bioceramic sealer sets in the presence of dentinal tubule fluid.It was also found that Bioceramic sealer exhibited better adaptation to dentinal walls and penetration into dentin tubules (323.35±86.32 micrometer). This study results coincides with Roula El Hachem[17]. They produce non resorbable hydroxyapatite during setting reaction forming a chemical bond with dentin walls.This may be the cause for the better adaptation and penetration of bioceramic sealer over zinc oxide eugenol and AH plus sealers observed in the current study.

CONCLUSION

1. Bioceramic sealer displayed better tubular penetration followed by Zinc oxide Eugenol and AH Plus(Bioceramic sealer >ZnOEu> AH plus).
2. For all the sealers, smear layer removal from the canal increased the tubular penetration.

Table 1: sealer penetration depth into dentinal tubules in micrometer

Sample no	Group 1(zinc oxide eugenol sealer)	Group 2 (AH plus Sealer)	Group 3 (Bioceramic Sealer)
1.	97.36	87.44	264.67
2.	91.2	97.79	272.23
3.	94.08	84.62	238.59
4.	111.4	72.32	389.88
5.	110.61	71.56	296.57
6.	181.97	152.26	400.32
7.	142.67	128.21	409.67
8.	148.68	147.08	387.83
9.	244.34	134.78	320.51
10.	254.44	158.66	275.29
11.	257.55	155.61	342.45
12.	176.21	95.5	282.15

Three teeth assingned as control (to check for smear layer removal) was neither subjected to irrigation protocol nor obturated.

Table 2: Sealer penetration into dentinal tubules

SEALERS	MEAN±STANDARD DEVIATION
ZINC OXIDE EUGENOL	159.21±95.23
AH PLUS	115.49±43.17
BIOCERAMIC SEALER	323.35±86.32

Table 3: Sealer penetration into dentinal tubules inter group comparison

SEALER	Mean ± Standard Deviation	p-value	Overall p - value
Zinc Oxide Eugenol	159.21±95.23	0.369	0.000
Ahplus	115.49±43.17		
Bioceramic	323.35±86.32	0.000	
Zinc Oxide Eugenol	159.21±95.23		
Bioceramic	323.35±86.32	0.000	
Ahplus	115.49±43.17		

p-value<0.05 is significant

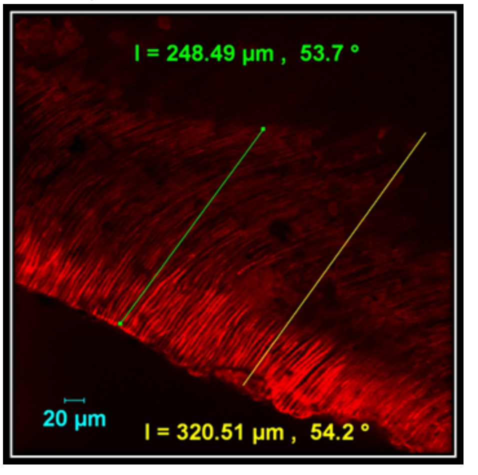

Fig 1:sealer Penetration Depth Under Confocal Laser Microscope

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