

SEALING ABILITY OF TWO COMMONLY USED ROOT CANAL SEALERS WITH AND WITH OUT SMEAR LAYER

ABSTRACT

AIM: The aim of current research was to find out the sealing ability of two commonly used sealers in the presence and absence of smear layer at different time interval. **MATERIAL AND METHODS:** Total of 180 single rooted vital teeth were used. Transversal section was made with the help of digital slow speed cutting saw to divide the root and crown part. After removal of crown roots part was instrumented and prepared. The 180 teeth were randomly divided into two equal groups (n=90) 1 and 2. In group 1 the smear layer was kept intact but it was removed from group 2 with EDTA (17%). Group 1 was then divided into two sub-groups, A1, A2. Group 2 was again separated into two sub-groups, B1 and B2. Each sub-group contained of 45 samples. In sub-groups A1 and B1, AH Plus sealer, in sub-groups A2 and B2, Ketac-endo sealer and cold lateral condensation technique was used for obturation with gutta percha. All samples were kept in an incubator at 37°C for 24 hours, with help of nail polish/varnish all samples root surfaces was painted only excluding apical area after words each sub group were further divided in to three groups of 15 to represent immersion periods of 7,15 and 30 days. All samples were then kept in 5 % methylene blue dye solution at 37o c for their respective time periods. After specific time period, the roots of every group were cut longitudinally and evaluate under a stereomicroscopes to evaluate apical micro leakage in millimeter. Data was subjected to Repeated measure ANOVA with post-hoc analysis using Tukey and bonferroni tests. **RESULTS:** Overall analysis indicated significant reduction in sealing ability canals in with and without smear layer over different time periods (p <0.0001). **CONCLUSION:** Current study has concluded that AH plus sealer provides significantly better seal in the absence of smear layer than in the presence of smear layer in addition it gave better seal than Ketac-Endo sealer in the absence and presence of smear layer.

FATIMA, Nazish*
HUSSAIN, Mehwish**

KEYWORDS

Methylene blue dye. Mickroleakage. Smear layer. Gutta percha.
Cold lateral condensation. AH plus sealer. Ketac-Endo sealer.

INTRODUCTION

The aim of root canal treatment is the eradication of all microorganisms with three-dimensional obturation of root canal system along with a hermetic seal.¹ When root canal system opened in oral cavity oral flora gain access to apical area and developed radicular lesions due to passage of irritants start from root canal systems in to the periradicular area².

For perfect root canal treatment different type of sealers was used with Gutta percha. Since 1867 Gutta percha has been the ideal for obturation as it is least allergic, toxic and irritating in comparison to it different obturating materials (e.g silver cones/points) not succeed to give expected seal against long term bacterial attack.³ As only use of Gutta percha could not create the required hermetic seal. Root canal sealer is used in combination to gutta percha to achieve absolute and three-dimensional obturation.⁴ The role of sealers is to grease the master cone and aid its positioning into the canal because gutta percha lack elasticity.⁵

Instrumentation during root canal creates a layer of organic and inorganic substance called the smear layer it also contain bacteria and their by-products. It can stop the diffusion of intracanal medicaments into dentinal tubules and affects the attachment of filling materials to canal walls.⁶ Although literature reported controversial finding

regarding the desirability to preserve the smear layer in adhesive dentistry, in endodontic, its elimination is considered to be beneficial and highly desirable.³ Cengiz et al. (1990) suggested that adhesive forces produced between the dentinal tubules and the material result in capillary action as a result of this capillary action smear material is diffused in to dentinal tubules.⁷ This packing phenomenon by capillary action was also defined by Aktener et al. (1989), who explain that the use of surface-active reagents in the canal during endodontic instrumentation increase Penetration up to 110 μm .⁸

Various studies advised the removal of smear layer at the same time as others researches claimed intact smear layer increase adaptation of root filling material with canal wall. George et al concluded that smear layer may act as a substrate for microorganism, permit their deeper diffusion in the dentinal tubules similarly according to Yang & Bae It can work as a obstacle between filling materials and the canal wall and therefore compromise the creation of a satisfactory seal^{9,10}. On the other hand Galvan et al concluded that less mickrolekage is observed the presence of smear layer as compared those without smear layer.¹¹

Evans and Simon reported that insignificant difference was observed on apical seal in presence or absence of smear layer.¹² There was need of further research with

accurate approach and clear methodology due to controversies in reported literature.

The aim of current research was to check the effect of the presence or absence of smear layer on the sealing ability of the two commonly used sealers at different time interval.

MATERIAL AND METHODS

One hundred and eighty freshly extracted single rooted vital teeth were selected for the study. The teeth included in this study had no caries or restorations and were those indicated for extraction for periodontal reason. Storage and handling of extracted teeth were done according to ISO/TS 11405. Hard and soft deposits were removed with ultrasonic scalers. The teeth were stored in 0.1% buffered thymol solution.

Endodontic access was prepared; pulp tissue was removed with the help barbed broach (xxfine, Maillefer Switzerland). Canal orifice was located by using manual canal finder and working length was calculated using size 15 K file (MANI). It was inserted into canal to verify the patency until it was visible at the apical foramen and then subtracting 1mm. Periapical X-Ray (Kodak) was taken to check the patency of the root canal and to calculate working length.

Transversal section were made with digital low speed cutting saw at cemento-enamel junction, where the rubber stop was

adjusted in level with the coronal cut end of the root. Measurement was taken to obtain the root length. The same procedure was followed for all the samples.

Canal preparation was done using step-back technique. During preparation 5.25% sodium hypochlorate (NAOCL) was used as irrigant for all specimens. The root canal was alternatively irrigated after each file with 1ml of 5.25% NaOCl (sultan Healthcare inc, USA) using a 27-gauge endodontic needle. The canals were instrumented up to master apical file size 35.

After completion of the instrumentation, the samples were divided into two main groups with ninety samples in each group. The groups were identified by labeling them as Group A (samples with smear layer) and Group B (samples without smear layer). All samples in Group A were washed with a final flush of 5.25% NaOCl solution to keep the smear layer intact. At the same time as the Group B specimens irrigated with a final flush of 10 ml of 17% EDTA (Ethylenediaminetetraacetic acid) solution to remove the smear layer. After final irrigation the canals were subsequently dried with sterile paper points (K-Dent Co, Korea).

The samples in Group A were divided into two sub groups as A1 (AH Plus sub-group), A2 (Ketac-endo sub-group) with each subgroup consisting of fifteen (15) samples. The samples in Group B) were divided into two

sub-groups as B1 (AH Plus sub-group), B2 (Ketac-endo sub-group consisting of fifteen (45) samples).

All the samples in sub-groups were obturated with cold lateral condensation technique according to ANSI/ADI specification No 57.

The sealers were mixed according to manufacturer recommendations. A standardized master gutta percha cone (K-Dent Co, Korea) was placed into the root canal up to the working length and the tug back was verified, for each sample. The master cone was laterally condensed by inserting a finger spreader between it and the root canal wall.

The spreader was rotated to 180° several times before disengaging it from the canal. The voids created by the spreader were filled by condensing an auxiliary gutta-percha point. The procedure was repeated until gutta-percha points could not be introduced more than 3mm in into the root canal. Post obturation radiographs were taken for all samples to assess the quality of obturation and corrections were made where needed through reobturation or by addition of additional gutta percha cones. After completion of obturation excess gutta-percha was then removed with the hot plastic instrument and the remaining was condensed with endodontic plugger size 4.

The access cavity of all teeth filled with Ketac Molar (3M ESPE AD, Germany) to ensure a coronal seal. All the specimens were placed

in distilled water and stored at 37°C in an incubator (Memart, Germany) for 24 hours to allow the sealer to set. After 24 hour samples was blotted dry and coated with nail polish (Diana of London,UK), except for the apical 2 mm so the tracer could penetrate the canal via the apical region only. Two coats were given to each specimen.

At this step each sub group of 45 further divided in to three groups of 15 to represent immersion time period of 7, 15 and 30 days.

The specimens were then suspended upright in separate airtight containers containing 10 ml of 5% solution of Methylene blue dye (MERCK) and kept in an incubator at 37°C for respective time periods. After specified storage samples were removed from the dye, and washed under running tap water.

The specimens were then dried with air syringe and the nail polish scrapped off with a scalpel. The roots were cut longitudinally and both the root sections of each tooth were viewed under a stereomicroscope (Motic DMW 143. PAL SYSTEM, Hong kong) at 30X magnification to evaluate apical microleakage. Data were entered in MS Excel then exported to IBM SPSS v. 21 for the analysis.

Measurements were presented in terms of mean with standard deviation. Repeated Measures ANOVA with post-hoc analyses using Tukey and Bonferroni tests were used to assess changes in sealing ability over different period of time and among groups respectively.

P value less than 0.05 were considered to show significant difference in observations.

RESULTS

Overall analysis indicated significant reduction in sealing ability of root canals in with and without smear layer over different time periods ($P < 0.0001$) as shown in table 1.

Nevertheless, subgroup analyses revealed that in group smear layer significant reduction was observed in A1 ($P < 0.0001$), however, there was no significant change in group A2 ($P = 0.868$). Similar panorama was observed in the group without smear i.e. sealing ability reduced significantly in B1 ($P < 0.0001$) but no significant reduction was observed in subgroup B2 ($P = 0.347$) as shown in table 2. GroupWise comparison indicated that there was significant difference in A and B, A1 and A2, A1 and B1, A2 and B2 and A2 and B2 at different storage times under observation. However, A1 and B2 did not show significant change in sealing ability when accounted for overall performance and on 15th day. Similarly, differences in observations of B1 and B2 were not significant on 7th day and 15th day as shown in table 3.

DISCUSSION

For examination of apical leakage dye penetration is one of the most common technique.¹³ Other in vitro techniques to

evaluate obturating materials include bacterial penetration¹⁴ dye penetration^{15,16} isotope penetration¹¹ scanning electron microscopy (SEM),¹⁷ electrochemical method,¹⁸ fluorometry,¹⁹ staining method and liquid pressure method.^{20,21} However literature showed no significant between these techniques.

Methylene blue dye in five percent (5%) concentration was used as a leakage marker as it is easily noticeable in visible beam, extremely dissolved in water, capable to disperse without any difficulty, and is not engrossed by dentine matrix apatite crystals.²² In 82% of leakage researches in endodontic, dye or radioisotope penetration technique have been used.²¹

Cold lateral condensation technique was employed because it is stand to be the Gold standard as well 5.25% sodium hypochlorite (NAOCL) was used as irrigation solution in this study to improve the resistance of filled canals to bacterial leakage.^{3,6} The sealers used were epoxy amine resin and glass ionomer-based namely AH Plus and Ketac-endo. Among the different sealers being available in our market AH plus and Ketac-endo sealers are acceptable and commonly used because of being low cost and efficient.

In the current study study more mickrolekage was observed in group A (presence of smear layer) as compare to group B (Absence of smear layer) the results are in

agreement with Koch et al.²³ As smear layer has an irregular thickness and dimensions for

the reason that a huge part of it contains water so it result in greater mickoleakage.⁶

Table 1. Mean leakage values with standard deviation at different time intervals.

GROUPS	SUB GROUPS	At 7th Day	At 15th Day	At 30th Day	P Value
With Smear Layer (A)	A1	3.49 ± 0.15	2.71 ± 0.16	2.33 ± 0.17	<0.0001
	A2	3.91 ± 0.25	3.9 ± 0.23	3.9 ± 0.22	0.868
	Total	3.70 ± 0.29	3.31 ± 0.63	3.11 ± 0.82	<0.0001
Without Smear Layer (B)	B1	2.7 ± 0.16	2.32 ± 0.18	1.61 ± 0.21	<0.0001
	B2	2.98 ± 0.44	2.95 ± 0.44	2.93 ± 0.37	0.347
	Total	2.84 ± 0.36	2.63 ± 0.46	2.27 ± 0.73	<0.0001
Overall		3.23 ± 0.54	2.97 ± 0.64	2.69 ± 0.88	<0.0001

Table 2. Comparison based according to different time interval.

Comparison w.r.t. Days	A	B	A1	A2	B1	B2
7th Day vs 15th Day	<0.0001	<0.0001	<0.0001	>0.999	<0.0001	0.713
7th Day vs 30th Day	<0.0001	<0.0001	<0.0001	>0.999	<0.0001	0.791
15th Day vs 30th Day	<0.0002	<0.0001	<0.0001	>0.999	<0.0001	>0.999

Table 3. Comparison with respect to groups.

Comparison w.r.t. Groups	Overall	At 7th Day	At 15th Day	At 30th Day
A vs B	< 0.0001	< 0.0001	< 0.0001	< 0.0001
A1 vs A2	<0.0001	< 0.0001	< 0.0001	< 0.0001
A1 vs B1	<0.0001	< 0.0001	< 0.0001	< 0.0001
A1 vs B2	>0.999	< 0.0001	0.063	< 0.0001
A2 vs B1	<0.0001	< 0.0001	< 0.0001	< 0.0001
A2 vs B2	<0.0001	< 0.0001	< 0.0001	< 0.0001
B1 vs B2	<0.0001	0.029	0.034	< 0.0001

With respect to time interval no significant difference was observed in A2 and B2 groups. This results is in agreement with Oliver and Abbott, Timpawat and Sripanaratanakul and Tzanetakis et al these researches concluded no insignificant difference in apical seal at different time interval.²⁴⁻²⁶

In group A1 and B1 significant difference was seen as different time intervals Leakage reduced with increasing immersion

time it might be attributed to initial setting of sealers result in more mickro leakage.

The mean leakage in case of Ketac-endo was higher in presence and absence of the smear layer in contrast to AH plus and this difference was statistically significant because Ah plus having superior bond to dentine as its epoxy group form a covalent bond with amine of collagen.²⁷

CONCLUSION

Within the limitation of study we concluded: (1) all specimens exhibited microleakage to some extent. Group A showed more microleakage as compare to group B ($p < 0.0001$); (2) with respect to time interval Group sub group A1 and B1 show significant reduction in microleakage but sub group A2 and B2 showed no significant reduction in microleakage.

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