

Comparative Evaluation of Microleakage of Endodontic Sealer: An *Ex Vivo* Study

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Abstract

Aim: This study evaluated microleakage of endodontic sealers under stereomicroscope using 4 sealers: MTA, AH Plus, Apexit, and ZOE. **Materials and Methods:** Eighty extracted human mandibular premolar were used in this *in-vitro* study. Sealers tested for microleakage in this study were zinc oxide eugenol-based sealer, AH Plus, MTA-based sealer fillapex, calcium hydroxide-based sealer apexit. All the specimens were examined under stereomicroscope for microleakage and the obtained data were statistically analyzed using one-way ANOVA test and Tukey's multiple comparison tests using the software GraphPad Prism 7.02. **Results:** The MTA-based sealer showed the least dye leakage and the highest leakage was seen in zinc oxide eugenol-based sealer. **Conclusion:** Bio ceramic sealers being hydrophilic show better sealing ability compared to resin-based and eugenol-based sealers.

Keywords: Microleakage, Stereomicroscope, Sealers

INTRODUCTION

At the preparation phase of the root canal treatment, the main purpose is the complete removal of necrotic debris and also shaping the canals to facilitate the insertion of the obturation material into the canal. After cleaning and shaping of the root canal, all the efforts are directed toward achieving an appropriate apical seal.^[1] It is very important to access the best apical seal for the reduction of the amount of microleakage and potential treatment failure. Lack of an appropriate apical seal has been reported as the most common reason for root canal therapy failure.^[2] Apical seal failure allows the remained substances in the canal to pass the apical foramen and to reach the periapical tissue. Effective sealing of endodontic material should provide conditions that interrupt the contact between substances and the apical foramen toward the surrounding periapical tissue. Sealers with gutta percha are utilized to attain the highest apical seal. The endodontic textbooks suggest to completely dry the root canals to seal off the canal spaces. This leads to good adhesion of sealers to dentinal wall canal and obturation materials.^[3]

MATERIALS AND METHODS

Eighty periodontally involved and caries free mandibular first and second premolars were collected from a pool of extracted teeth stored in 10% formalin.

Clinical crowns were sectioned at the cemento-enamel junction using a high speed airoter handpiece. The working length was determined by subtracting 0.5 mm from length at which a no. 15K file will appear at the apical foramen.^[4]

The 80 samples were randomly allocated to one of the group, each group consisting of 20 samples each. Group A – MTA-based sealer Fillapex, Group B – Epoxy resin-based sealer AH plus (Dentsply), Group C – calcium hydroxide-based sealer apexit, and Group D – ZOE.

The root canal was biomechanically prepared using step-back technique and were be obturated with gutta percha using the lateral condensation technique.

Two coatings of nail varnish were put over the external root surfaces of the samples after they had dried for 2 min, with the exception of the apical 2 mm, where dye could now enter the accessory and lateral canals. For 72 h, the samples were submerged in newly made 1% methylene blue dye. After 3 days, the nail polish was scraped off the root surface. The roots were

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then longitudinally sectioned and stereomicroscopically imaged at a 30X magnification to examine the vertical dye penetration. The evaluation of microleakage connected to various root canal sealers and the micrometer measurement of dye penetration.

Statistical analysis

To test for microleakage, Kolmogorov–Smirnov and Shapiro–Wilk tests were performed to determine the normality of the data. Both the tests showed no significant differences and hence confirmed that the data obtained were normally distributed.

RESULTS

When scores were compared between the groups, Score 1 was found to be highest in the Fillapex group with 13 (65%) of the subjects presenting it. Score 3 was least in Fillapex while it was of the greatest percentage in ZOE group with 17(81.0%) of the sample demonstrating it. This was significant at $P = 0.000$ as shown in Table 1.

DISCUSSION

By obstructing oral cavity and periradicular tissue connection and encasing any remaining bacteria following chemomechanical preparation, root canal obturation seeks

to prevent intracanal bacterial recolonization.^[5] Furthermore, apical obturation prevents seeping of periradicular tissue fluids into the canal, which could maintain the viability of the remaining bacteria, and consequently, prevent the healing of the periapical lesion.^[6]

The materials used for this procedure, ideally, should have the best sealing ability with no microleakage and they should also possess properties like biocompatibility with peri radicular tissues, should be non-resorbable, non-toxic, dimensionally stable, impervious to dissolution or breakdown by the tissue fluids, and capable of being adapted as closely as possible to the dentinal walls of the root end preparation exhibiting no/or minimal microleakage so as to prevent penetration of tissue fluids into root canal or leakage of microorganisms and/or their toxins through the apical foramina into the surrounding tissues.^[7]

In the present study, among the four sealers, tested MTA showed the least microleakage [Figure 1]. MTA based sealers have been reported to deposit calcium phosphates in the form of apatite and carbonated apatite when in contact with simulated body fluid. These materials had similar sealing properties to epoxy based sealer and pulp canal sealer when evaluated using the fluid filtration system.^[8] Although, these MTA-based sealers have excellent biological properties, the sealer does not bond to either dentin or gutta-percha which may be the reason for increased leakage. The MTA plus sealer's brief working period led to an unsatisfactory covering of the canal during subsequent lateral compaction.^[9]

The sealing and adhesion capabilities of ZOE-based sealers to dentin have been demonstrated to be subpar.^[10] Moreover, the solubility is higher in an aqueous environment, causing zinc eugenolate to dissociate into zinc hydroxide and eugenol.^[11] It was demonstrated that a ZOE-based sealer displayed less leakage when it was applied to a completely dried canal. MTA based sealers have been reported to deposit calcium phosphates in the form of apatite and carbonated apatite when in contact

Table 1: Inter group comparison of endodontic sealers

Groups	Score 1 n (%)	Score 2 n (%)	Score 3 n (%)	Total n (%)
Fillapex	13 (65.0)	4 (20.0)	3 (15.0)	20 (24.4)
AH Plus	4 (20.0)	12 (60.0)	4 (12.1)	20 (24.4)
Apexit	1 (4.8)	11 (35.5)	9 (42.9)	21 (25.6)
ZOE	0 (0.0)	4 (19.0)	17 (81.0)	21 (25.6)
Total	18 (22.0)	31 (37.8)	33 (40.2)	82 (100)
Chi-square test	45.660			
Df	6			
P-value	0.000*			

Mean scores between groups

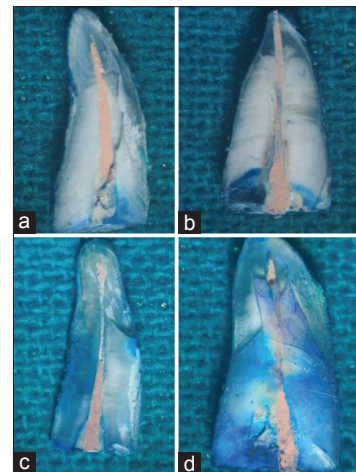
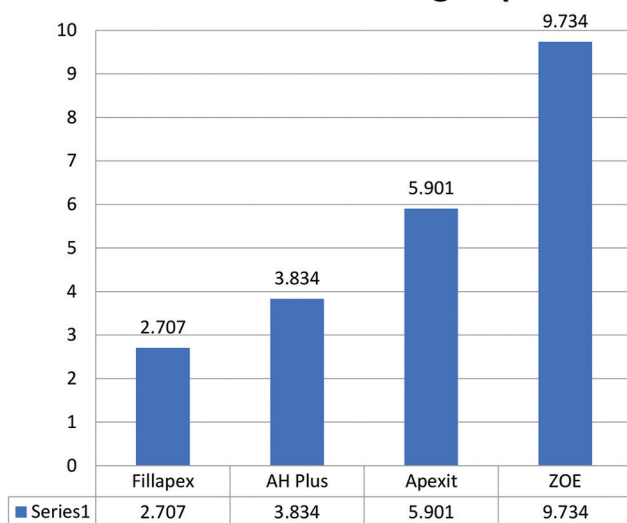


Figure 1: Stereomicroscopic image of the samples (a) Group A, (b) Group B, (c) Group C, and (d) Group D

with simulated body fluid.^[12] These materials had similar sealing properties to epoxy based sealer and pulp canal sealer^[13] when evaluated using the fluid filtration system.

In the present study, 1% of methylene blue was used as it was most commonly used concentration Ahlberg *et al.*, studied the linear leakage patterns of two dyes, MB and India ink.^[14] According to the research, MB has a low molecular weight that is comparable to bacterial toxins and is superior in terms of penetration.

CONCLUSION

After comparing the stereomicroscopic images on basis of the scoring criteria, MTA-based sealer fillapex showed the minimum leakage as compared to the other endodontic sealers.

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