



A Comparative Evaluation of Apical Leakage using Three Root Canal Sealants: An *in vitro* Study

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ABSTRACT

Aim: Apical leakage is one of the drawbacks leading to endodontic failure. Various root canal sealants have been tried in endodontics. The present study was conducted to compare root canal sealants such as Endorez, Realseal, and Metaseal in preventing apical leakage.

Materials and methods: Sixty mandibular single-canal premolars were divided into three groups of 20 each. Group I teeth were sealed with Endorez, group II teeth with Realseal, and group III teeth with Metaseal. After completing endodontic treatment in all teeth and sealing with above sealants, glucose leakage value was assessed at 1st, 8th, and 15th day.

Results: At day 1 [mean \pm standard deviation (SD)], leakage was 0.416 ± 0.011 in group I, 0.234 ± 0.09 in group II, and 0.328 ± 0.19 in group III. On 8th day, it was 2.124 ± 0.108 in group I, 0.624 ± 0.102 in group II, and 1.31 ± 0.24 in group III. On 15th day, it was 5.178 ± 0.125 in group I, 3.122 ± 0.150 in group II, and 4.25 ± 0.28 in group III. The mean apical leakage in all groups in different days was statistically significant ($p < 0.05$).

Conclusion: Endorez sealant showed highest apical leakage, whereas Realseal had minimum leakage. There was significant increase in leakage in all groups with the progression of time.

Clinical significance: With the advent of different root canal sealants, the success rate of the root canal-treated teeth can be confirmed.

Keywords: Endorez, Endoseal, Realseal, Sealant.

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INTRODUCTION

The purpose of any endodontic therapy is proper cleaning, shaping, and obturation of canals. The ability of obturating materials determines the outcome of the treatment. Apical seal plays an important role in deciding the success of the root canal-treated teeth. Properly sealed apex prevents bacterial growth and apical irritation. It should be capable of preventing direct communication between apical area and oral cavity, thus ensuring sufficient lateral and apical seal. Poorly sealed apical canals lead to failure of the treatment.¹

Different obturating materials have been used in the past. Recently, Endorez root canal sealer is getting publicity in the field of endodontics. This is widely used nowadays with enhanced root canal sealing ability. When considering its properties, the thixotropic ability makes its capability to seal the canals effectively. This enhances its capacity of sealing lateral canals and dentinal tubules. One of the biggest advantage of it is the less operative time. It is second-generation dual-cure resin-based sealer. Urethane dimethacrylate is one of its component.²

Realseal is methacrylate resin-based sealer. It is third-generation dentin resin composite sealer. It has better seal because of its ability of forming solid, continuous seal from one dentinal tubule to the other. Milestones have

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been placed in endodontics, with the advent of fourth-generation root canal sealer. Metaseal is commercially used with sealing ability of radicular dentin efficiently. This sealer promoted formation of hybrid dentin.³

Various studies have been performed in the past that compare one sealer with the other. Arora et al⁴ performed a study of comparison of different root canal sealers and found that all sealers had a sort of leakage in different postoperative days. The present study was conducted to comparatively evaluate the capacity of Endorez, Realseal, and Metaseal in preventing apical leakage.

MATERIALS AND METHODS

The present *in vitro* study was conducted in the Department of Endodontics. It comprised 60 freshly extracted permanent mandibular first premolars. Teeth with incomplete root formation, root resorption, and extensive carious lesion were not considered.

Teeth were divided into three groups of 20 teeth each. In group I, obturation was done with Endorez sealer (Ultradent) and Endorez points; in group II, obturation was done with Realseal (Sybron) and resilon points; and in group III, obturation was done with Metaseal (Sybron) with gutta-percha points.

Access Opening and Obturation

In all teeth, a single-line straight access opening was done using files and reamers. A size 10 K file was used for working length assessment. 1 mm apical distance was subtracted from working length of root canal. Dentsply endo motor was used in preparing the canals. Protaper files system including shaping files such as S1 and finishing files till F3 were used in sequence. The canals were prepared till size 30. Care was taken to avoid ledge formation during instrumentation. Simultaneously, NaOCl was used as an irrigant during procedure. 1 mL of the solution was used every time between each instrument. After obtaining canal size of size 30, 5 mL of NaOCl (5.25%) followed by 5 mL of 17% ethylenediaminetetraacetic acid was used. Care was taken to prevent development of smear layer. After this, canals were dried using paper points of size 30. Master point mixed with sealer was fitted into the canals. Accessory points were used in tight sealing of canals. After obturation, coronal sealing was done with light cure glass-ionomer composite for 30 seconds. All specimens were stored in humidity of 100% at temperature of 37° in incubator for 24 hours.

Measurement of Apical Leakage

Glucose leakage (mmol/L) model as described by Xu et al⁵ was used to evaluate the apical leakage. At day 1, 8, and 15, the concentration of leaked glucose was measured

using glucose kit in spectrophotometer at 320 nm wavelength. Results thus obtained were subjected to statistical analysis for correct inferences using Statistical Package for the Social Sciences. Chi-square test and Fisher's exact test were used; p-value < 0.05 was considered significant.

RESULTS

Group I comprised 20 teeth in which Endorez sealer was used, group II comprised Realseal sealer (20), and group III comprised Metaseal sealer (20) (Table 1). Table 2 shows that at day 1 (mean \pm SD) leakage was 0.416 ± 0.011 in group I, 0.234 ± 0.09 in group II, and 0.328 ± 0.19 in group III. On 8th day, it was 2.124 ± 0.108 in group I, 0.624 ± 0.102 in group II, and 1.31 ± 0.24 in group III. On 15th day, it was 5.178 ± 0.125 in group I, 3.122 ± 0.150 in group II, and 4.25 ± 0.28 in group III. The mean apical leakage in all groups in different days was comparatively statistically significant ($p < 0.05$).

DISCUSSION

Microleakage is penetration of ion, bacteria, and fluids into interface of tooth and filling material. It should be limited so that tooth remains for longer period of time without any complication.⁶ A fluid tight apical seal is mandatory for the success of any endodontic-treated teeth. Poor apical seal promotes penetration of irritants from apical area into the root canals. Hence, for ensuring better treatment outcome, root canal sealers of good quality are required.⁷

Roy et al⁸ in their study analyzed the apical sealing ability of Resilon/epiphany system and included 42 teeth in their study, which were divided into four groups. Group I teeth were those which were obturated with Resilon, group II teeth with gutta-percha. Group III consisted of positive control and group IV had negative control teeth. Methylene blue dye was used to assess the binding ability of obturating material with the dentinal walls and Resilon group showed better results as compared with gutta-percha. Authors found that endodontic leakage is a threat to the endodontic treatment success.

Table 1: Distribution of teeth

	Total—60		
Group I (20)	Group II (20)	Group III (20)	
Endorez	Realseal	Metaseal	

Table 2: Comparison of apical leakage (mean \pm SD) in all groups

Days	Group I	Group II	Group III	p-value
1st	0.416 ± 0.011	0.234 ± 0.09	0.328 ± 0.19	0.01
8th	2.124 ± 0.108	0.624 ± 0.102	1.31 ± 0.24	0.001
15th	5.178 ± 0.125	3.122 ± 0.150	4.25 ± 0.28	0.05

Muliyar et al⁹ in their review article on microleakage in endodontics concluded that obturation should be three-dimensional. Bacteria and their products may be viable in root canals as well as in apical region, hence a properly sealed apex is necessary to prevent transfer of all irritants in both directions. Thus, root canals need to be packed tightly with a good obturating material to ensure prevention of secondary caries and marginal discoloration.¹⁰

In this study, we included mandibular permanent first premolars which were extracted recently because of either bone loss or due to orthodontic purpose. We excluded those which had caries or root resorption. Arora et al⁴ in their study also included mandibular single canal premolars in determining the apical leakage using three resin-based root canal sealers. However, Dultra et al¹¹ in their study included maxillary permanent canines to evaluate the sealing ability of four resin-based root canal sealers, such as Endofil, Endorez, AH Plus, and epiphany.

Maryam Ehasni et al¹² also assessed the apical leakage using different endodontic sealers. In this study, freshly extracted maxillary permanent incisors were selected which were divided into four groups in which different sealers (AH26, Excite DSC, MTA Fillapex, and ZOE) were used. Authors found that microleakage was maximum in moist canals, whereas dry canals did not show any obvious leakage. Minimum leakage was observed in AH 26 and maximum in ZOE, whereas significantly higher in excite DSC group. Authors concluded that in the presence of moisture in the form of saliva or blood, the better outcome cannot be ensured. Thus, canals should be properly dried before obturation.

Cobankara et al¹³ in their study compared four endo sealers, such as AH Plus, RoekoSeal, Ketac-Endo, and Sultan. In their study, 40 maxillary anterior teeth were selected in which above four sealers were used. After performing all the steps, mean leakage was evaluated after 1, 2, and 3 weeks. Sultan showed maximum leakage among all. With the progression of time such as after 3 weeks, there was significantly higher leakage as compared with after 1 and 2 weeks.

Mohan et al¹⁴ in their study used fluorescent microscope in analyzing ability of Guttaflow, Roekoseal, and Endoflux sealers. In this study, 70 single-rooted teeth were selected and divided into five groups. Group I had negative control teeth, group II had positive control teeth that were only instrumented, group III was sealed with Guttaflow, group IV was sealed with Roekoseal, and group V was sealed with Endoflux sealers. Propidium iodide dye was used to see dye penetration and was found that all the three groups showed similar results. The different among three groups were nonsignificant.

İnan et al¹⁵ analyzed electrochemical method and dye penetration to see the sealing ability of different sealers. In their study, 132 teeth were divided into six groups. Groups I and IV were restored with Thermafil, groups II and V with System B, and groups III and VI with cold lateral condensation (CLC). Apical leakage was assessed using electrochemical method in groups I, II, and III, while with dye penetration method in groups IV, V, and VI. Thermafil exhibited least microleakage, whereas CLC showed highest. Group II filling showed moderate leakage.

In this study, we divided teeth into three groups. In group I, Endorez sealer, in group II Realseal sealer, and in group III Metaseal sealer were used. In this study, we analyzed the apical leakage in 60 extracted permanent premolars that were sealed with these sealers. This is in agreement with Miletic et al.¹⁶ We found that in group I, leakage was 0.416 ± 0.011 , 0.234 ± 0.09 in group II, and 0.328 ± 0.19 in group III on 1st day. As days progressed, it became 2.124 ± 0.108 in group I, 0.624 ± 0.102 in group II, and 1.31 ± 0.24 in group III on 8th day. It was 5.178 ± 0.125 in group I, 3.122 ± 0.150 in group II, and 4.25 ± 0.28 in group III on 15th day. This is in agreement with Oksan et al.¹⁷

Root canal sealers are to maintain the integrity of the canals and to inhibit leakage especially at apex. Different sealers have different properties.^{18,19} Not a single one has all the desired qualities. Hence, selection becomes important to avoid postoperative complications.^{20,21} The limitation of the study is that only glucose leakage value was assessed, whereas propidium iodide dye could provide more useful results using phase contrast and fluorescent microscope.

CONCLUSION

Endorez sealant showed highest apical leakage, whereas Realseal had minimum leakage. There was significant increase in leakage in all groups with the progression of time.

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