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# Comparing the Apical Micro-Leakage Caused by Various Endodontic Sealers in the Presence and Absence of Moisture

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Research Article

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## ABSTRACT

**Introduction:** Drying of the canals before endodontic obturation is still up for debate despite the existence of hydrophilic sealers. This investigation compared the apical micro-leakage of the sealers Adseal, RealSeal SybroEndo (SE), EndoSeal Mineral Trioxide Aggregate (MTA) and Tubli-Seal in both dry and moist root canals.

**Materials and methods:** On 90 maxillary canines that had been excised, an experimental study was conducted. The canals were prepared using rotary files. Under both dry and moist root canal conditions, root canals were filled with a single gutta percha cone using one of the four sealers (15 teeth in each group). Except for the positive control group, all root surfaces were painted with oil paint and orifices were sealed with adhesive wax. Teeth were put in methylene blue and then sliced longitudinally after ten days at 100% humidity. By using a stereomicroscope, blue colour permeability was determined in micrometres. Using Statistical Package for the Social Sciences (SPSS) V.18 software, data were analyzed using the t-test, Analysis Of Variance (ANOVA), and Scheffe post hoc test at P=0.05.

**Results:** In the dry groups, the mean apical micro-leakage was considerably reduced (P=0.001). In Adseal and Zinc Oxide Eugenol (ZOE) respectively, there was a minimum and maximum amount of micro leakage. Between dry and damp conditions, EndoSeal MTA did not show a significant difference in apical micro leakage (P>0.05). The RealSeal SE groups had considerably more apical micro-leakage (P=0.001).

**Conclusion:** In dry conditions, Adseal offered the least apical micro-leakage, whereas in moist conditions, Tubli-Seal had the maximum micro-leakage.

Regardless of wetness, EndoSeal MTA provided a reliable apical closure.

**Keywords:** Micro-leakage; Moisture; Resin; Sealer; Extrusion

## INTRODUCTION

The goal of root canal fillings is to close the root canal system and stop the periapex from becoming reinfected. Liquids and moisture can harm a seal's capacity [1,2]. It is possible that the migration of fluids into the apical foramen after drying or the difficulty to adequately dry the apical extension of the root canal with paper points prevents the dentist from entirely drying the root canal space before obturation in some situations [2]. The surface of the root canal dentin becomes contaminated over time as a result of fluid penetrating through the dentinal tubules. Moisture may prevent, delay, or hasten the setting of root canal sealants, which could lead to more leakage.

RealSeal SE is a dual-cure sealer with solubility in alcohol, adhesive capabilities to dentin and enamel, and some studies have been done on it as a root canal sealer.

EndoSeal MTA is a Mineral Trioxide Aggregate (MTA)-based sealer made up of pigments, radiopaque bismuth, nanoparticulated silica, MTA, and resins (salicylate, diluting, natural). The information on its adhesive properties is currently very limited [3,4]. It complies with the ISO 6786 root canal sealers standard and also has all the advantages of MTA.

Different degrees of residual moisture in the root canal have been demonstrated to affect the sealing characteristics of conventional and resin-based sealers, according to several studies on the sealing ability of various sealers [5-8]. There are, however, limited investigations about the apical micro-leakage of the RealSeal SE and EndoSeal MTA sealers compared to other commonly used sealers or about the impact of moisture on the sealers' apical micro-leakage [2-5].

Many researches have shown that the presence of blood and moisture in the canal prior to obturation causes apical micro leakage, however more recent investigations have asserted that leftover moisture has no effect on the mean value of micro leakage. Based on these findings, the current study's objective was to assess the apical seals of the sealers Adseal, RealSeal SE, EndoSeal MTA, and Tubli-Seal in the presence and absence of any remaining canal moisture [9-11].

## MATERIALS AND METHODS

135 extracted teeth from Bengaluru city dental clinics were collected for this experimental study.

### Inclusion criteria

Healthy and anatomically sound maxillary permanent central incisor with no calcification, no fracture or crack in the root canal, no curvatures of root canal were used or resorptions at the apex or inside the root canal.

### Exclusion criteria

Calcified teeth, Incomplete root formation.

### Preparation of the teeth

Teeth were kept moist and free of coarse debris and visibly bloody stains. To lessen bacterial build-up, a liquid chemical germicide was applied, such as sodium hypochlorite (home bleach) mixed 1:10 with tap water. To ensure safe handling, teeth were heat sterilized. To prevent leaks during shipping, teeth were placed in a container that was well-made, had a tight-fitting cover, and was marked with the biohazard sign. Teeth used in preclinical laboratory exercises can be autoclaved without the learning process being negatively impacted. However, autoclave sterilization of extracted teeth does have an impact on dentinal structure to the point where it jeopardizes the study of dental materials.

The primary irrigating solution to effectively dissolve organic materials and destroy germs is Sodium Hypochlorite 5.25% (NaOCl). As a final rinse, Ethylene Diamine Tetra Acetic acid (EDTA) is required to get rid of the smear layer. However, it has been employed multiple times in this protocol to guarantee that the dentinal tubules are open to ensure that NaOCl will adequately reach every area of the root canal system. Between these two irrigants, saline is utilized to prevent a chemical reaction. Root canal instrumentation using with K3 Rotary System®(SybronEndo, Orange, CA, USA) in the sequences #25/0.8, #30/0.6, #25/0.4, and #25/0.2 (crown- apex direction), set in motion by an Endo Standard Pro Torque® motor (Dentsply, Rio de Janeiro, RJ, Brazil) at 250 rpm speed. Four successive #25 paper points were inserted into the canal for five seconds each to verify that the canal had dried.

The teeth were divided into one control group with ten teeth and eight test groups randomly, each having fifteen specimens.

### Application of sealers

The four tested sealers were Adseal, RealSeal SE, EndoSeal MTA, and Tubli-Seal. All sealers were prepared according to the manufacturer's instructions. After root canal preparation, the root canals were sealed using sealants that were prepared and applied in accordance with the manufacturer's instructions using a lentulo spiral #40 (Dentsply/Maillefer, Ballaigues, Switzerland). Using a gutta gauge (Dentsply/Maillefer), gutta-percha cones #55 (Coltène/Whaledent) were adjusted to fit at working length with tug back. Visible sealer extrusion from the apical foramen was noted. As the syringe was gradually retracted, the sealer was allowed to fill the canal until it was released through the aperture. In the RealSeal SE sealer group, the specimens were light-cured for 40 seconds. Two layers of nail polish were applied to every tooth except for the apical 1 mm of the root tip. The apical foraminal region of the negative controls was coated fully.

The same procedure was repeated for another four groups in moist condition. For wetting the canal, a 25 gauge needle was used and saline was used to irrigate the canal and wet the canal. Five teeth as a positive control and five teeth as negative controls remained unfilled after canal preparation.

The access cavities were filled with Glass Ionomer cement (GIC) (GC, India). The sealers were allowed to set for seven days in 100% humidity at 37°C. To finish the sealer setting reaction, the specimens were kept in an incubator for

seven days at a controlled temperature of 37°C with 100% humidity. The samples were after then submerged in methylene blue for three days.

### Measurement of leakage

The roots were sectioned longitudinally to enable stereomicroscopic imaging of the vertical dye penetration. The evaluation of microleakage related to various root canal sealers and the measurement of dye penetration achieved in micrometers. From the root apex to the farthest coronal extent, the linear dye penetration was evaluated using a stereomicroscope (Labo Med CMZ4, India), at 40 X magnification. Evaluation was done on the dye penetration's depth. All methods were carried out in accordance with relevant guidelines and regulations. All experimental protocols were approved by the institutional and licensing committee. Informed consent is not needed as it is an *in vitro* study (Figure 1).

**Figure 1.** Stereomicroscope imaging of the vertical dye penetration (Labo Med CMZ4, India).


### Statistical analysis

ANOVA was used to evaluate the data and a P value of 0.05 or below in the Graph Pad Prism software's multiple comparison tests was regarded as statistically significant.

## RESULTS

Mean total apical micro-leakage of all study sealers was 331.86 ± 137.45 µm (dry canal groups, 298.49 ± 143.63 µm; moist canal groups, 351.76 ± 152.38 µm). The least rate of apical micro-leakage was seen in Adseal sealer (136.49 ± 33.67 µm) and the highest apical micro-leakage was related to Tubli-Seal sealer (554.79 µm ± 68.19 c µm). Adseal sealer had the lowest rate of apical micro-leakage in dry and wet canals.

Comparing the tested sealers, the ANOVA test revealed statistically significant variations in the rate of apical micro-leakage ($P<0.001$). Except for EndoSeal MTA sealer, which had no statistically significant difference in the mean apical micro-leakage rate between the two conditions ($P=0.23$), all sealers had mean apical micro-leakage that was

significantly lower under dry canal conditions compared to that under moist canal conditions. In dry or damp conditions, there are statistically significant differences between various sealers. Additionally, the Scheffe multiple comparisons test revealed that there was no significant difference between EndoSeal MTA and RealSeal SE among the moist canal groups (P=0.151). The percentage of dye penetration in the positive control group was 100%, while there was none in the negative control group (Table 1).

**Table 1.** Mean apical micro-leakage (measured in micrometers) compared between four sealers tested in both dry and wet circumstances.

| Condition | Adseal | RealSeal SybroEndo | EndoSeal MTA | Tubli-Seal | P-value | Total |
|---|---|---|---|---|---|---|
| Dry | 118.8 ± 25.49$^{a}$ | 261.47 ± 28.51$^{b}$ | 342.26 ± 63.81$^{c}$ | 479.00 ± 34.43$^{d}$ | <0.001 | 298.49 ± 143.63 |
| Moist | 158.13 ± 28.8$^{a}$ | 316.63 ± 21.77$^{b}$ | 376.59 ± 86.13$^{b}$ | 554.79 ± 68.19$^{c}$ | <0.001 | 351.76 ± 152.38 |
| P-value | 0.02 | <0.001 | 0.23 | 0.04 | - | - |
| Total | 136.49 ± 33.67 | 283.67 ± 37.48 | 357.45 ± 76.24 | 529.24 ± 63.17 | - | - |
| **Significance:** Different letters in each row show statistical significant differences between groups at α=0.05 | | | | | | |

## DISCUSSION

To stop the communication of root canal contents with periapical tissue, the root canal must be sealed apically by the sealer. In order to achieve a hermetic closure of the root canal, the features of sealers such as flow, consistency, setting characteristics, solubility, and adhesion to root canals are crucial [12,13].

According to the findings of the current investigation, the Adseal group saw the lowest rate of micro-leakage in both dry and wet environments, whereas the Tubli-Seal group experienced the highest rate. Additionally, there was no statistically significant difference between apical microleakage in dry and moist conditions in the EndoSeal MTA group. It has been proven that Adseal has a better apical seal than EndoSeal MTA in earlier studies [11,14-16].

Although Adseal exhibited the lowest rate of apical microleakage in the research, both with and without moisture [14,17-19]. This variation may be caused by how sealers are applied and handled differently by different people. The quantity of moisture present in the root canal may also be a confusing element that influences apical microleakage. The root canals' level of moisture before filling treatments may also have an impact on the quality of adhesion between the dentin in the canals and the sealers [20-23].

In spite of the fact that clinicians' opinion about degree of moisture may differ greatly, a number of manufacturers advise maintaining the root canals moist in order to benefit from the hydrophilic properties of their sealers. However, they do not offer precise clinical guidance for achieving the level of moisture remaining that is ideal for their products [24, 25].

According to Nagas, et al., the amount of residual moisture has a substantial impact on how well root canal sealers adhere to radicular dentin. It could be desirable to leave canals just a little moist before filling with the tested sealers,

such as Adseal and EndoSeal MTA moisture resulted in lower microleakage for Adseal and higher values for Tubli-Seal, according to research by Roggendorf, et al. [6,11].

They claimed that as moisture acts as a lubricant for these sealers and facilitates a better adhesion to the root canal wall, the root canal dentin's complete drying may have negatively impacted the penetration of linear dye [26, 27].

A single gutta-percha cone was employed with the sealers in the current process. After one day in a moist environment, Khalilak, et al., comparison of Resilon and Epiphany sealers with gutta-percha and Adseal sealer found no significant differences; however, after three weeks, the Adseal group's micro-leakage was significantly lower, which is consistent with the results of the current study. The results of tests conducted in both damp and dry environments showed that the Adseal sealer had the lowest micro-leakage and that the kind of moisture (5.25% hypochlorite or blood) had no discernible impact on the rate of sealer micro-leakage. Jinah, et al., research showed that the type of sealer employed and the moisture level of the root canals at the time of obturation had a big impact on leakage and sealing ability [18,19]. Therefore, drying procedures according to sealer types are a crucial stage in endodontic treatment and shouldn't be skipped [28,29].

The chemical makeup of the Adseal group, which permits complete setting of the sealer even in moist conditions, is the cause of the low micro-leakage. This assumption, however, needs to be treated with caution because the moist conditions in the current investigation significantly affected the chemical reaction of the sealer, resulting in apical microleakage of Adseal between the dry and moist groups [30, 31].

## CONCLUSION

Within the constraints of the current study, EndoSeal MTA was the only sealer among all sealers that did not significantly differ in micro-leakage whether wet circumstances were present or not, supporting the claims of its maker. Similar research should be carried out in situations where there is serum or blood in the root canals being investigated in order to more closely mimic the clinical setting. Additional studies examining the impact of various root canal moisture concentrations on the apical seal may produce insightful results. Mean micro-leakage in Adseal sealer group in both moist and dry conditions was significantly lower than that of other sealers. Maximum micro-leakage was seen in the Tubli-Seal group under moist conditions. Overall, moisture had a negative effect on the apical seal, except for EndoSeal MTA sealer.

## DECLARATIONS

### Conflict of interest

I have no conflicts of interest to disclose.

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## Ethical clearance

Not applicable as humans were not involved in the study. It's an *in-vitro* study.

## Author contribution

I as the single author confirm sole responsibility for the following: study conception and design, data collection, analysis and interpretation of results, and manuscript preparation.

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