

**An in-vitro comparison of apical microleakage after immediate versus delayed post space preparation using different sealers – A glucose penetration leakage study**

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**Conflicts of Interest:** Nil

**Abstract**

**Aim:** To compare the apical microleakage after immediate versus delayed post space preparation using different sealers under glucose leakage model.

**Methodology:** Ninety single rooted mandibular premolars were selected. The crowns were decoronated at the cemento-enamel junction with a diamond disc to standardise the working length to 15mm. The canals were prepared in a crown down technique upto size 40, 0.04 taper using RACE rotary instruments as master apical file. 3 % sodium hypochlorite and 17 % EDTA were used as irrigants. Teeth were divided into 3 groups. Group 1 was obturated using zinc oxide eugenol sealer and 4% gutta-percha, Group 2 obturated with Adseal and 4% gutta-percha. Group 3 was obturated with RoekoSeal and 4% gutta-percha. Post space was prepared with peeso reamer till size 4. Microleakage evaluation was done using a glucose leakage model. The results were analysed

statistically using Kruskal Wallis and One Way Anova test.

**Result:** The maximum microleakage was found in the Tubliseal group in delayed post space preparation group followed by immediate post space preparation and the least microleakage values was observed in the ReokoSeal group after immediate post space preparation. There was a significant difference of  $p = 0.012$  when we compared all the sealers with respect to immediate post space preparation.

**Conclusion**

- 1) Immediate post space preparation in RoekoSeal group showed less leakage values when compared to other resin sealers
- 2) Immediate post space preparation was more effective than delayed post space preparation.

**Keywords:** Microleakage, post space preparation, Glucose leakage model, Zinc oxide eugenol sealers, resin sealers.

### **Introduction**

Successful endodontic therapy includes obturation of the root canal spaces with an inert filling material and creation of an effective apical seal<sup>1</sup>. The role of obturation in root canal treatment, although is considered secondary to debridement and disinfection, still remains a critical stage for a successful outcome.<sup>2,3</sup> In cases where the restoration of a tooth requires an intra radicular post due to loss of coronal tooth structure, the amount of remaining filling material left in the canal after post space preparation plays a major role in tooth healing and prognosis. Therefore a lot of importance is given to the obturating materials, the method of post space preparation and the timing of post space preparation.

Factors that affect the integrity of the apical seal, while post space is prepared, includes length of gutta-percha to maintain the apical seal, time of removal of the filling material and method of gutta-percha removal.<sup>4</sup> It has been shown that a minimum of 3–5 mm of gutta-percha should remain in the apical portion of the root to maintain an adequate seal.<sup>5</sup>

In terms of post space preparation, the required post space may be prepared either immediately after the completion of the endodontic procedure using hot pluggers or alternatively at a later stage after full setting of the sealer using rotary instruments.<sup>6</sup>

A new method for analysis of endodontic microleakage ; Glucose leakage model, which was based on the filtration rate of glucose along the root canal filling and the amount of leakage was quantified with spectrophotometry was suggested recently using glucose as the tracer. This model is based on measurements of glucose concentrations in an apical chamber using a sensitive enzymatic reaction.

The aim of this study is to compare apical microleakage after immediate versus delayed post space preparation using different sealers.

### **Null Hypothesis**

Null hypothesis states that there is no significant difference in the microleakage with immediate & delayed post-space preparation irrespective of sealers used.

### **Materials and methodology**

90 single rooted mandibular premolars were collected from the Department of Oral and Maxillofacial Surgery, Oxford Dental College, Bangalore and stored in 0.1% thymol solution. The specimens were washed in running water to eliminate thymol residues before initiating the study.

Preoperative mesiodistal and buccolingual radiographs were taken to verify the presence of single canal. The samples were then autoclaved at 121°C, 15 psi pressure for 15 min (CDC guidelines, Kohn et al 2003). The crowns were decoronated at the cemento-enamel junction with a diamond disc to standardise the working length to 15mm.

The canals were prepared in a crown down technique upto size 40, 0.04 taper RACE rotary instruments (FKG, Swiss Endo) to master apical file. Apical patency was maintained with a size 10 K file (Mani, Japan) during instrumentation. Irrigation was performed using 5mL of 3 % sodium hypochlorite (I- Dent Rohini, Delhi, India) and 5 ml of 17 % EDTA (PrevestDenpro Limited, Digiana Jammu, India). External root surface of the coronal parts of the teeth were then cylindrically shaped to obtain better fitting to the plastic tube.

Then the teeth were divided into following groups and subgroups.

Group 1 (n = 30) : positive control group. Teeth were cleaned and shaped with above mentioned protocol and

finally obturated using zinc oxide eugenol sealer (Tubliseal EWT, Sybron Endo) and 4% gutta-percha.

Group 2 (n=30): Teeth were cleaned and shaped with above mentioned protocol and obturated with Adseal (Meta Biomed, Korea) and 4% gutta-percha.

Group 3 (n=30): Teeth were cleaned and shaped with above mentioned protocol and obturated with RoekoSeal (ColteneWhaledent) and 4% gutta-percha.

The above three groups will be further divided into two subgroups each: Group1a, Group 2a, Group 3a (n=15) (immediate post space preparation): Immediate post space preparation with 5mm of remaining apical fill were done using peeso reamers (Mani, Japan) upto size 4.

Group1b, Group 2b, Group 3b (n=15) (delayed post space preparation):

Here the root canal orifices were restored temporarily with Cavit G (3MESPE, Dental AG, Seefeld / Oberbay, Germany) and stored in gauze dampened with sterile saline and enclosed in sealed containers for 7 days to allow for the sealer to set. Delayed post space preparation with 5mm of remaining apical fill was done using peeso reamers (Mani, Japan) up to size 4.

### Microleakage Evaluation

Each root was mounted in a leakage device that had been described by Xu and coworkers. Coronal part of the root was attached to 25cm long glass tube and was connected to the cap of the rubber tube. The assembly was then placed in a sterile 20ml glass test tube with a rubber stop. Leakage at all connections was eliminated by use of cyanoacrylate glue and sticky wax. Glucose solution (1mol/L, pH 7.0), containing 0.2% Sodium Azide (NaN<sub>3</sub>), was injected into the glass tube until the top of the solution was raised 14cm higher than the top of the root, which creates a hydrostatic pressure of 1.5kPa. Glucose that leaked through the root end filling material was

collected in the glass test tube containing 3ml of 0.2% Sodium Azide (NaN<sub>3</sub>).

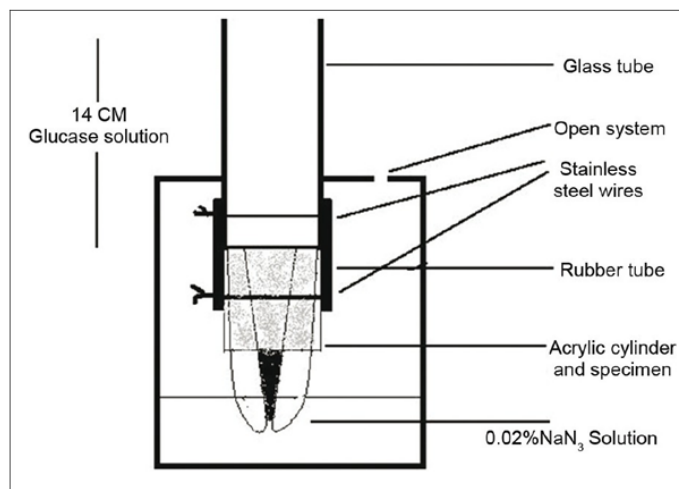


Figure 1

The assembly was placed in an incubator at 100% RH and 37°C throughout the observation period. Leakage was quantified as the amount of glucose that reached the apical reservoir in the glass test tube after 7 days. The amount of glucose was determined by a UV- VIS recording spectrophotometer at 500- nm wavelength.

### Results

The statistical calculations were performed using the software SPSS for Windows (Statistical Presentation System Software, SPSS Inc. 1999, New York) version 19.0. The Kruskal Wallis test and Mann Whitney U tests were employed in the present study for statistical calculations.

### Level of Significance: 0.05

The maximum microleakage was found in the Tubliseal group after delayed post space preparation followed by immediate post space preparation and the least microleakage values was observed in the ReokoSeal group after immediate post space preparation as explained in table/graph

Following statistical data shows microleakage values for both immediate and delayed post space preparation where

Tubliseal showed maximum leakage value (Table 1) and Roekoseal showed minimum leakage (Table 1).

	Groups	Number	Mean	SD	Min	Max
Immediate	Tubliseal	15	17.63	2.66	15.00	20.90
	Adseal	15	5.66	1.06	4.62	7.00
	Roekoseal	15	4.25	.66	3.69	5.01
Delayed	Tubliseal	15	20.74	1.72	18.31	22.31
	Adseal	15	17.0	2.0	14.98	19.01
	Roekoseal	15	16.12	1.92	14.05	18.69

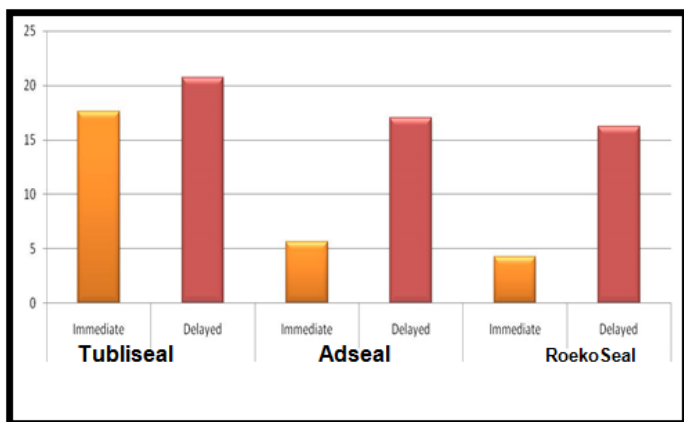
	Groups	Number	Mean	SD	p-value
Tubliseal	Immediate	15	17.63	2.66	0.114
	delayed	15	20.74	1.72	
Adseal	Immediate	15	5.66	1.06	0.029*
	delayed	15	17.0	2.0	
Roekoseal	Immediate	15	4.25	.66	0.028*
	delayed	15	16.12	1.92	

Table 1: shows inter group comparison of the microleakage values for both immediate and delayed post space preparation.

\*p-value is significant at the 0.05 level

Table II shows intra sub group comparisons for group 1 (Tubliseal), 2 (Adseal), and 3 (RoekoSeal). Adseal and RoekoSeal shows a significant difference for the microleakage values between immediate and delayed post space preparation with p=0.029 for group 2 and p= 0.028 for group 3 respectively.

**Graph 1: Intra sub group comparisons**



Graph 1 shows intra sub group comparisons for group 1(Tubliseal), 2 (Adseal), and 3 (RoekoSeal). Adseal and RoekoSeal show a significant difference for the microleakage values between immediate and delayed post space respectively.

**Discussion**

A three-dimensional obturation of root canal space along with complete coronal and apical seal is one the most important aims of root canal treatment. Since microorganisms may remain in the root canal system after instrumentation, a tight apical seal is desired to prevent bacteria and their by-products from invading the apex creates a favorable biological environment for healing to take place.<sup>7</sup> The sealing ability of the sealers used plays an important role in achieving this goal.<sup>8</sup>

In the present study, we evaluated the immediate and delayed post preparation at the apical end of three different resin sealers. Most common and traditional sealer, i.e zinc oxide eugenol based sealer (Tubliseal) was used as control group in this study. Even though zinc oxide eugenol sealers is most commonly used and time tested, these had a disadvantage of not being chemically bonding with the root dentine and posses very low tensile strength. To overcome these draw backs several sealers have been introduced replacing the traditional ones such as resin based sealers and calcium hydroxide based sealers that had better bonding to root dentin and high tensile strength.<sup>9</sup>

Adseal a Bis-GMA resin-based sealer which contains a dual-cure resin with a resin matrix containing Bis-GMA, ethoxylatedBis- GMA, urethane dimethacrylate (UDMA) and hydrophilic difunctionalmethacrylates gaining popularity due to its optimal characteristics. Its working time according to the manufacturer’s instructions and ISO 6876:1986 is 35 min after mixing and its setting time is 45

min. It has superior flow properties when compared to conventional zinc oxide eugenol sealers.

RoekoSeal, a silicone-based material, is a relatively new sealer. It is a highly bio-compatible polydimethylsiloxane-based root canal sealer. The working time is 15-30 minutes. It has mechanical adhesion to root canal wall due to expansion on setting. Furthermore, the manufacturer claims that RoekoSeal is thixotropic, so the sealer becomes less viscous under pressure and flows into the dentinal tubules. In contrast to other sealers, RoekoSeal does not shrink but actually expands (0.2% by volume).

It is widely accepted and recommended that 5 mm root canal filling should be retained after post space preparation to avoid compromising the apical seal. Therefore, 5 mm of apical gutta-percha filling was left in each specimen in this respective study.<sup>10</sup> The integrity of apical seal is proportional to the amount of remaining filling materials.

The fluid filtration method, which was developed by Derkson et al for measuring dentin permeability,<sup>11</sup> and later modified by Wu et al to evaluate endodontic leakage, that was based on the filtration rate of glucose along the root canal filling and amount of leakage was quantified with spectrophotometry. Glucose, was thought to be more clinically relevant than other tracers used in microleakage tests. enzymatic glucose oxidase method was chosen because it provided the ultimate degree of specificity and high sensitivity when compared with other methods, such as copper or ferric cyanide methods.<sup>12</sup> With this model it was possible to quantify the endodontic microleakage continuously over time. The amount of leakage was cumulative value of the leaked glucose. In our study on comparison of immediate post space preparation vs delayed, we found that there is a statistical significant difference between the mean immediate value obtained by

Resin sealers and Tubliseal. The mean value of group 1(Tubliseal) and group 2 (Adseal) were 5.66 mmol/L and 17.63mmol/L respectively. Our result indicates that immediate post space preparation of Adseal has less microleakage value when compared to a zinc oxide based sealer.

Both Adseal and Roekoseal have lower values of microleakage. But when both group 2 (Adseal) and group 3 (RoekoSeal) of immediate post space preparation was compared there was no significant difference. The mean values for Adseal (5.66mmol/L) and RoekoSeal (4.25mmol/L) respectively and  $p = 0.497$ .

In this respective study the delayed post space preparation showed more leakage as compared to the immediate post space preparation irrespective of sealers used. The resin sealers, Adseal and RoekoSeal showed less leakage when compared to conventional zinc oxide eugenol sealers. The group 1 showed highest leakage with a mean value of 20.74 and group 2 (17.00) and group 3 (16.12) respectively.

The above mentioned results can be explained by the hypothesis that when a post space was prepared immediately after filling, the sealer was still within its working time, allowing the sealer to set without introducing microcracks.<sup>26</sup> Whereas in delayed post space preparation, it was possible that the rotational effect of burs could cause movement of gutta-percha, thus breaking the bond at the sealer dentine interface.<sup>1,26</sup> Some authors reported that there was no significant effect of immediate or delayed post space preparation on the apical seal.<sup>74,75</sup> However, there is little published data on the effect of immediate or delayed post space preparation using resin sealers.<sup>39</sup> In this respective study, an intra sub group comparisons between three resin sealers after immediate and delayed post space preparation of Tubliseal, Adseal and RoekoSeal was done. When Tubliseal was considered

a comparison between immediate and delayed post preparation was done. The mean leakage value for immediate and delayed post space preparation was 17.63mmol/L and 20.74mmol/L respectively. So the  $p = 0.114$  which was not significant.

So when the immediate post space preparation was carried out after light curing with a LED curing light; the penetration of LED light decreased in the apical portion of the canal. Hence, the setting reaction in the apical third of the canal is predominantly chemical. Therefore resin tags were not completely polymerized by the time the post space preparation commenced because the sealer takes approximately 30 min to set in an anaerobic environment. The resin tags, which were probably still in the pre-gel stage were therefore able to re-adapt to the dentinal walls and polymerize. The flow of the incompletely cured material can fill any gap, void or disturbance caused by the preparation before setting occurs.<sup>39</sup>

FundaKontCobankara et al conducted a study on effect of immediate and delayed post preparation on apical microleakage by using Methacrylate-based EndoREZ sealer, immediate post space preparation provided better sealing than delayed post preparation at the apical end, regardless of using the EndoREZ accelerator.

### Conclusion

In our respective Invitro study, evaluation of microleakage was done using glucose leakage model. The results of the study indicated that the resin sealer showed similar level of leakage with respect to immediate and delayed post space preparation during the observation time. Thereafter, the greatest amount of leakage was observed with Tubliseal. Adseal and Roekoseal showed similar behavior of long-term seal; although RoekoSeal seemed to perform better, the difference was not significant. With our glucose leakage model, both immediate and delayed post space

preparation showed apical leakage of which former was found better.

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