

Review Article

Post space preparation and obturated material to preserve the apical seal after root canal treatment: A review of literature

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ABSTRACT:

The post space preparation of root canals filled with a GP/epoxy resin sealer be performed prior to extensive epoxy conversion in order to avoid potential microfractures of the sealer during GP removal using a rotary instrument. Solano et al. suggested immediate post space preparation following root canal obturation in clinical practice because the clinician is intimately familiar with the root canal anatomy. However, such post space preparation procedures involving drilling and rinsing with water may dilute the uncured epoxy resin and potentially damage the apical seal

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INTRODUCTION

Proper root canal preparation, disinfection and an effective apical sealing guarantees a long-term successful endodontic treatment. There has been an increase on the emphasis on failure caused by apical leakage. A sealer associated with gutta-percha is generally used to achieve an impervious apical seal. The sealer serves as a lubricant when inserting the gutta-percha point as a filling material to fill the irregularities of the preparation, and sealer is necessary as the gutta-percha does not bond spontaneously to the dentinal walls of the prepared canal. Gutta-percha has remained the material of choice to obturate the root canal. But different types of sealers are present in the market which can be used with Gutta percha for obturation. Some

endodontically treated teeth require post and core due extensive loss of tooth structure.¹⁻⁴

REVIEW OF LITERATURE

Kalra PK ET AL (2009) in their study assessed the microleakage when immediate and delayed post space preparations were done using resin sealers. Immediate post space preparations showed lesser apical leakage as opposed to delayed post space preparation. Immediate post space preparation done using AH Plus sealer showed the least amount of dye penetration of at the end of 24hrs. This is significantly less than that of delayed post space preparation using AH Plus sealer. (p=0.000). It is also the least amount of dye penetration observed amongst all the groups. Delayed post space preparation done using AH Plus sealer showed dye penetration which was significantly more

than immediate post space preparation. Immediate post space preparation done using RC Seal sealer showed a mean dye penetration that was significantly less than that of delayed post space preparation using RC Seal sealer ($p=0.000$). Though RC Seal showed higher mean leakage than AH Plus in both immediate ($p=0.136$) and delayed ($p=1.000$) groups, the leakage between the two were not significantly different. The negative control group showed no leakage at all. The positive control showed maximum dye penetration.⁵

Zmener O et al (2010) investigated the sealing properties of root fillings with resin-coated gutta-percha cones and a methacrylate-based resin endodontic sealer with and without an accelerator component in root canals subjected to immediate or delayed post space preparation. Forty-eight extracted human teeth with single straight root canals were treated endodontically. Specimens were then assigned to four groups of 10 teeth each ($n= 10$). After autoclaving, the following operative procedures were carried out under strict aseptic conditions. In Group 1 the root canals were filled with resin-coated gutta-percha cones and a methacrylate based resin endodontic sealer (EndoREZ). Post space preparations were performed 2 minutes after the sealer had set. In Group 2 the root canals were filled as in Group 1 but with the addition of a chemical accelerator. The post space preparations were also performed 2 minutes after the sealer had set. Groups 3 and 4 were filled as in Groups 1 and 2 respectively, however the post space preparations were done 7 days after the root canal filling was completed. One positive and one negative control tooth per group was added. All specimens were subjected to a coronal bacterial leakage of *E. faecalis* during a 60-day period using a dual chamber microbial leakage model. No significant differences ($P> 0.05$) in bacterial leakage were observed between Groups 1 and 2 and between Groups 3 and 4. However, Groups 1 and 2 differed significantly from Groups 3 and 4 ($P< 0.05$).⁶

BARROS J et al (2013) conducted a study to evaluate the integrity of the apical seal in root filled teeth following immediate post space preparation and after eight days. Forty extracted single-rooted human teeth were instrumented and filled, using lateral condensation technique, with gutta-percha and Sealapex® sealer (Kerr-Sybron, Scafati, Italy). The teeth were randomly assigned to four groups: group I (GI) with seventeen teeth (immediate post space preparation), seventeen in group II (GII) (delayed post space preparation) and three teeth in each control group, group III (GIII) positive control and group IV (GIV) negative control. In GI and GII, the post space was prepared with ProTaper Universal® retreatment files (Dentsply/ Maillefer, Ballaigues, Switzerland). After the post space preparation, all specimens were coated, except for two apical millimeters, immersed in methylene-blue dye for eight days, and then sectioned longitudinally. The extent of staining was examined under a stereomicroscope. In GI there was an average

apical leakage of 7,42 mm, while in GII it was 6,82 mm. There were no statistically significant differences between groups I and II ($p>0.05$). The timing of post space preparation, in teeth filled with Sealapex® sealer (Kerr-Sybron, Scafati, Italy), did not affect the apical sealing ability.⁷

Chen G (2013) conducted a study to compare the effect of different post-space preparation time intervals on the apical sealing ability of filling material using two different extended setting time root canal sealers. A total of 100 single-canal teeth were incrementally cleaned with crown-down instrumentation using K3 rotary nickel-titanium instruments and randomly divided into four groups. There were 30 teeth in the experimental groups (Groups 1–3) and 10 teeth in the control group (Group 4). We obturated the teeth using a warm gutta-percha vertical compaction technique with pulp canal sealer (Group 1), Tubli-Seal EWT (Group 2), and pulp canal sealer EWT (Group 3). We then stored all the specimens in 100% humidity at 37°C for 1 week. We used heated pluggers to create post space at three different intervals postobturation (i.e., immediately after obturation, on Day 3, and on Day 7), leaving 5-mm gutta-percha filling at the apices. We then immersed the teeth in 2% methylene blue solution for 72 hours, and finally sectioned them longitudinally into two halves. The amount of apical dye leakage was measured under a stereomicroscope. The results showed no significant difference in dye leakage between the standard and extended working time root canal sealers. Apical leakage tended to increase more severely in Group 1 at the three different intervals was considered.⁸

Dhaded N et al (2013) evaluated the influence of immediate and delayed post space preparation on sealing ability of Resilon-Epiphany and Gutta percha-AH plus. Eighty extracted permanent maxillary central and lateral incisors were decoronated. Roots canals were prepared and obturated. Samples were divided into four groups depending on the time of post space preparation and obturated material. Group I and II: Immediate and delayed post space preparation respectively with Gutta percha/AH plus as obturating material. Group III and IV: Immediate and delayed post space preparation with Resilon/Epiphany as the obturating material. The samples were kept in methylene blue dye, sectioned and then measured under stereomicroscope and studied under SEM. There was significant difference found between immediate and delayed post space preparation in Resilon-Epiphany group as well as in AH plus-GP group. Difference in the sealing ability of the two materials was seen in delayed group. No statistically significant result was found between the two obturating materials when post space was prepared immediately.⁹

Rita C et al (2014) compared the apical sealing ability of AH Plus and Gutta Flow sealer at three different lengths of remaining gutta-percha after post space

preparation. 100 freshly extracted human maxillary anterior teeth were decoronated, biomechanically prepared and were randomly divided into six experimental groups and two control groups. The root canals were obturated using AH Plus sealer in first three groups and Gutta Flow sealer in other three groups. The positive control group was filled with lateral compaction of gutta-percha without sealer. In the negative control group, Canals were left unfilled. After one week, the post spaces were prepared to a depth that left 3, 4 and 5 mm of gutta-percha apically in groups 1, 2, 3 respectively and 4, 5, 6 respectively and the coronal parts of the canals were sealed with Glass Ionomer Cement. The apical leakage was assessed through dye penetration observed under a stereomicroscope and the obtained data was statistically analyzed. AH Plus recorded a slightly higher mean microleakage compared to GuttaFlow, but the difference was not statistically significant. The interaction of the sealer and the length of remaining apical Gutta-percha on microleakage was not statistically significant. Irrespective of the type of sealer used, a 5 mm length of remaining apical gutta-percha filling provides a better seal than 3 mm and 4 mm.¹⁰

Nagas E et al (2016) in their study prepared the post space, some of the root-canal filling material has to be removed, which can affect the apical seal. The aim of this study was to compare the effect of immediate post space preparation to that of delayed post space preparation on apical sealing using three different endodontic sealers and obturation techniques. In total, 90 decrowned single-rooted human teeth were studied. After root canals were prepared with 0.06 tapered nickel–titanium rotary files to size 30, the roots were categorized randomly into three experimental groups according to the obturation material: (1) AH plus/gutta-percha; (2) Sealite Ultra/gutta-percha; and (3) Epiphany/Resilon. Furthermore in all groups, specimens were categorized randomly into three subgroups according to the obturation technique ($n = 10$): (1) single cone; (2) cold lateral compaction; and (3) System B + Obtura. After root-canal filling, post space preparation was immediately performed in Group 1, after 24 hours in Group 2, and after 7 days in Group 3. Apical leakage was measured using the fluid-filtration method. Regardless of the obturation technique and sealers used, significantly better ($P < 0.001$) sealing was achieved at the apical ends using delayed post space preparation than with immediate post space preparation. The obturation techniques tested did not significantly affect leakage values. The following statistical ranking of fluid filtration values was obtained for the obturation materials: Epiphany/Resilon > Sealite Ultra/gutta-percha > AH plus/gutta-percha ($P < 0.001$). To reduce apical leakage, clinicians should use AH plus together with any of the obturation techniques after 7 days of obturation.¹¹

Prabeesh Padmanabhan, Joydeep Das, R. Veena Kumari, P. R. Pradeep, Ankur Kumar, Sneha Agarwal (2017) compared the effect of immediate versus delayed post space preparation on the apical seal using four different sealers. Teeth were biomechanically prepared and obturated with single cone gutta-percha and 4 sealers were used. Teeth were divided randomly into eight groups, post spaces were prepared using Gates Glidden drills immediately for group I, III, V and VII. For groups II, IV, VI and VIII prepared after storage of the specimens in 100% humidity for one week. The samples were kept in methylene blue dye, centrifuged at 3000 rpm for 3 min sectioned and then measured under stereomicroscope for apical leakage. All the specimens showed dye leakage, and a statistically significant difference was seen among all the groups except Gutta flow.¹²

Kim HR (2017) conducted a study to determine the optimal timing for post space preparation of root canals sealed with epoxy resin-based AH Plus sealer in terms of its polymerization and influence on apical leakage. The epoxy polymerization of AH Plus (Dentsply DeTrey) as a function of time after mixing (8, 24, and 72 hours, and 1 week) was evaluated using Fourier transform infrared (FTIR) spectroscopy and microhardness measurements. The change in the glass transition temperature (T_g) of the material with time was also investigated using differential scanning calorimetry (DSC). Fifty extracted human single-rooted premolars were filled with gutta-percha and AH Plus, and randomly separated into five groups ($n = 10$) based on post space preparation timing (immediately after root canal obturation and 8, 24, and 72 hours, and 1 week after root canal obturation). The extent of apical leakage (mm) of the five groups was compared using a dye leakage test. Continuous epoxy polymerization of the material with time was observed. Although the T_g values of the material gradually increased with time, the specimens presented no clear T_g value at 1 week after mixing. When the post space was prepared 1 week after root canal obturation, the leakage was significantly higher than in the other groups ($p < 0.05$), among which there was no significant difference in leakage. Poor apical seal was detected when post space preparation was delayed until 1 week after root canal obturation.¹³

CONCLUSION

The standard root canal obturation materials are a combination of sealer with a central core material, which has, thus far, generally been gutta-percha (GP). Various chemical formulations have served as bases for sealers such as zinc oxide-eugenol, glass-ionomer, silicone, and epoxy or methacrylate resin. Among them, epoxy resin-based sealers are popular due to their low solubility, apical seal, and micro-retention to root dentin. AH Plus (Dentsply DeTrey, Konstanz, Germany) is an epoxy-amine resin-based sealer that has become popular among dental clinicians due to its

excellent properties, including adhesion to dentin and good sealing ability. After root canal therapy, the placement of a post and core is often necessary when the coronal tooth structure is inadequate for retaining the crown. The integrity of the remaining obturating material, which provides an apical seal, should not be disrupted during post space preparation. However, it often deteriorates, causing endodontic treatment failure as a result of reinfection. When a rotary instrument is introduced into the canal to remove GP, the rotational forces may affect the integrity of the remaining obturating material depending on the rigidity of the sealer, thereby possibly breaking the root canal wall-GP interface. According to the manufacturer, AH Plus has a setting time of 8 hours. However, little research has been done on the extent of epoxy polymerization as a function of time, which may affect the bonding integrity to the GP and/or root canal wall when the post space is prepared.

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