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ORIGINAL ARTICLE

Effect of timing of post space preparation on the apical seal when using different sealers and obturation techniques

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KEYWORDS
apical leakage;
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Abstract *Background/purpose:* To prepare the post apace, 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.
Materials and methods: 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. Statistical analysis was performed using the Kruskal–Wallis test and Wilcoxon signed ranks test at $P < 0.001$.
Results: 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 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 ($P < 0.001$).

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Conclusion: To reduce apical leakage, clinicians should use AH plus together with any of the obturation techniques after 7 days of obturation.

Introduction

The use of posts to retain cores in teeth that have undergone extensive loss of coronal structure is generally necessary after root-canal treatment.[1] To prepare the post space, some of the root-canal filling material has to be removed, which can affect the apical seal.[2] During post space preparation, it is important not to disrupt the integrity of the remaining filling material, because it provides an apical seal, which is of primary importance for successful endodontic therapy.[3] The techniques used for removing the filling material vary, but it is recommended that an apical seal of at least 5 mm of gutta-percha be retained.[4–6] Further, the use of a mechanical method is recommended over organic solvents for removing the obturating material.[7]

The outcome of endodontic therapy is affected by the technique used for removing the root-canal filling material and by the amount of root-canal filling material retained; in addition, it is affected by the timing (immediate or delayed) of post space preparation, the type of sealer, and the obturation technique used.[8–11] Results of studies published on the time interval between endodontic treatment and post space preparation are controversial.[8,12,13] Post space preparation may be performed either immediately after completing endodontic treatment or at a later stage after the sealer has completely set. Regardless of whether post space preparation is immediate or delayed, the type of sealer and obturation technique is also crucial during post space preparation. Although in previous studies the type of sealer and obturation technique have been tested separately, there are no published data on the effect of immediate and delayed post preparation and the obturation technique on apical leakage of zinc oxide–eugenol, resin, and methacrylate-based sealers. Therefore, the objective of the present study was to evaluate the effects of immediate and delayed post space preparation on apical leakage using different filling materials and obturation techniques. The null hypothesis tested was that the timing of post space preparation and the obturation technique do not affect the apical sealing ability of different types of root-canal sealers.

Materials and methods

Specimen preparation

In total, 90 decrowned single-rooted human teeth were studied. The lengths of the roots were standardized to 16 mm. The root canals were enlarged using ProFile rotary instruments (Maillefer, Dentsply, Tulsa, OK, USA) with RC-Prep lubrication (Premier Dental Products, Tulsa, OK, USA), until the file 30/0.6 taper reached the working length (1 mm from the apical foramen). The root canals were irrigated with 2 mL of a 5.25% sodium hypochlorite (NaOCl) solution between each file size. To remove the smear layer, the root canals were rinsed with 10 mL of 17% ethylenediaminetetraacetic acid (EDTA) followed by 10 mL of 5.25% NaOCl. The roots were then irrigated with 10 mL of distilled water to avoid prolonged exposure to the EDTA and NaOCl solutions. The canals were subsequently dried with paper points. Thereafter, the roots were categorized randomly into three experimental groups according to the obturation material used: (1) gutta-percha + AH Plus sealer (Dentsply Caulk, Milford, DE, USA) (epoxy resin-based sealers); (2) Resilon + Epiphany sealer (Resilon group) (Pentron Clinical Technologies, Wallingford, CT, USA) (a methacrylate-based resin sealer); and (3) gutta-percha + Sealite Ultra (Pierre Rolland, Merignac, France) (a zinc oxide-eugenol-based sealer). Furthermore, in all groups, specimens were categorized randomly into three subgroups ($n = 10$) according to the obturation technique used: (1) single cone; (2) cold lateral compaction; and (3) System B + Obtura. Post space preparation was performed immediately after root-canal filling in Group 1, after 24 hours in Group 2, and after 7 days in Group 3. For post space preparation, the root-canal filling material was removed using a Gates-Glidden drills (Dentsply-Maillefer, Ballaigues, Switzerland). To preserve the apical seal, 5 mm of the root filling material was retained at the apical level. The same experienced operator prepared all specimens.

Evaluation of apical leakage

A modified fluid transport test was used to measure apical leakage by studying the movement of a tiny air bubble traveling within the constant bore of a 100-μL micropipette. All pipettes, syringes, and plastic tubes used in the system were filled with deionized water. The micropipette was connected to a plastic tube, and this tube was connected to the root by epoxy resin (Pattex; Henkel, Düsseldorf, Germany) (Fig. 1).

Water was drawn back by approximately 2 mm with a microsyringe to introduce a tiny air bubble in the micropipette. The air bubble was adjusted to a suitable position within the micropipette using the microsyringe. Finally, regulated air from a pressure tank at 121.6 KPa (1240 cmH_2O) was applied from the apical ends of the specimens, thereby forcing water through the voids, if any, along the root-canal filling. Displacement of the air bubble caused by water movement in the capillary tube was measured per unit time. The linear displacement of this air bubble was converted to a volume displacement, and was recorded as the amount of fluid transported. Values are expressed in terms of $\mu L/minute/cmH_2O$. The procedures for selection and instrumentation of the specimens used as the positive controls were similar to those used for the