
Sealing efficiency of BeeFill 2in1 and System B/Obtura II versus single-cone and cold lateral compaction techniques

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Objective. The objective of this study was to investigate the sealing properties of 2 warm vertical compaction techniques (BeeFill 2in1, System B/Obtura II) in comparison with single-cone and cold laterally compacted gutta-percha.

Study design. The root canals of single-rooted human teeth were prepared by using Mtwo rotary files and divided into 4 groups (n = 10/group) with respect to the filling technique tested: Group 1, cold laterally compacted gutta-percha + AH-26; Group 2, single-cone tapered Mtwo gutta-percha + AH-26; Group 3, System B/Obtura II + AH-26; Group 4, BeeFill 2in1 + 2seal. The leakage of specimens was measured using a fluid-filtration method after 1 and 2 weeks. The data were analyzed statistically with 2-way repeated measures ANOVA ($P = .05$).

Results. After 1 week, the System B/Obtura II group showed the greatest amount of leakage ($P < .05$) compared with the other test groups that had similar levels of fluid conductance ($P < .05$). By the end of the second week, the BeeFill group yielded the greatest amount of leakage ($P < .05$). Compared with their 1-week values, the fluid conductance of all test groups decreased significantly ($P < .05$).

Conclusion. The apical sealing efficiency of System B/Obtura II and BeeFill were inferior to the other obturation techniques after 2-week fluid conductance testing in vitro. (*Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2009; 108:e51-e55)

Subsequent to a proper cleaning and shaping of the root canal system, complete filling with a biologically inert and dimensionally stable material is a major objective of root canal treatment.¹ Today, it is well-recognized that apical foramen and most of the lateral or accessory canals located in the apical region of the root serve as a portal of exit for the bacteria toxins and provide a favorable route for leakage.² Thus, the integrity of the

root canal filling in the few apical millimeters is considered to be a crucial factor in the success of endodontic therapy.³

Among a plethora of materials/techniques introduced to date, cold laterally compacted gutta-percha in combination with an endodontic sealer remains the most widely accepted and used obturation technique.⁴ However, studies have shown that this standard approach fails to provide a fluid-tight seal of the root canal system,^{5,6} for reasons such as the lack of surface adaptation, incorporation of apical voids, and resorption of the sealer component with time.⁷ Many attempts have been made to resolve this problem through variations in obturation techniques. Among these, noncompaction, single-cone filling of root canals has been introduced to minimize the sealer component through the use of gutta-percha cones that closely match the geometry of nickel-titanium instrumentation systems.⁸ These cones ensure 3-dimensional obturation of the root canal over its entire length without necessitating accessory cones or the time spent on lateral condensation.⁹

Warm vertical compaction is another approach in which plasticized gutta-percha can be condensed into root canal irregularities, thus replicating the intricacies of the root canal system.¹⁰ Over the years, several attempts have been made to improve and simplify this technique. Developed by Buchanan,¹¹ System B (Ana-

Donation of the BeeFill 2in1 and Mtwo instruments by Sarp Dental (VDW Antaeos) is acknowledged gratefully.

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Received for publication Apr 15, 2009; returned for revision Jul 24, 2009; accepted for publication Jul 27, 2009.

1079-2104/\$ - see front matter

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doi:10.1016/j.tripleo.2009.07.057

lytic technology, Redmond WA) uses heated pluggers to thermoplasticize and downpack the gutta-percha at the apical third. The remaining part of the root canal is then backfilled using Obtura II (Obtura Corp, Fenton, MO), which delivers thermoplasticized gutta-percha that is compacted vertically by pluggers. BeeFill 2in1 (VDW, Munich, Germany) is a recently introduced warm vertical obturation system that includes downpack and backfilling equipment in one unit. Despite commercial claims with regard to its efficacy in providing a tightly sealed root canal filling, scientific data on the sealing properties of BeeFill 2in1 are still lacking. Consequently, the purpose of this study is to compare the apical sealing efficacy of the BeeFill 2in1 system with System B/Obtura II single-cone and cold laterally compacted gutta-percha filling techniques at 1 and 2 weeks in vitro. The null hypothesis tested was that there were no differences in the apical seal of root canals filled with the tested endodontic filling techniques.

MATERIALS AND METHODS

Specimen preparation

Periodontally involved, freshly extracted upper lateral incisor human teeth were cleaned of adhering soft tissue and debris, and examined under a stereomicroscope ($\times 40$) to confirm the absence of cracks. Radiographs were obtained from the buccolingual and proximal aspects with a view to discarding teeth with 2 root canals. Selected teeth ($n = 50$) were stored in an aqueous solution of 0.5% chloramine-T at 4°C before experiments (a maximum of 1 month).

The crowns were sectioned below the cementoenamel junction to adjust the length of all roots to a standardized length, which was 15 mm. Thereafter, pulp remnants were removed using broaches and K-type files (Dentsply Maillefer, Ballaigues, Switzerland). The root canals were instrumented with Mtwo rotary files at 250 rpm (VDW, Munich, Germany) in the following sequence: #10.04, #15.05, #20.06, and #25.06. In accordance with the manufacturer's recommendation, each Mtwo file was used at the full working length (1 mm from the apical foramen) with a gentle in-and-out motion for 15 seconds in conjunction with RC-Prep lubrication (Premier Dental Products, Norristown, PA). The root canals were irrigated with 10 mL 2.5% sodium hypochlorite (NaOCl) between each file size. Following completion of the preparation, the canals were irrigated with 10 mL 17% EDTA followed by 10 mL 5.25% NaOCl. Finally, the roots were irrigated with 10 mL distilled water to avoid the prolonged effect of EDTA and NaOCl solutions. The canals were subsequently dried with paper points.

Obturation procedures

Following the cleaning and shaping procedures, prepared roots were randomly divided into 4 groups ($n = 10/\text{group}$) based on the obturation technique used and the teeth were immediately obturated as follows:

- Group I (cold lateral compaction technique): A #02/25 gutta-percha cone (Diadent, Seoul, Korea) was fitted into the root canal at the working length and checked for tug-back. AH-26 sealer (DeTrey Dentsply, Konstanz, Germany) was prepared according to the manufacturer's instructions and applied into the root canal using a K-file size 25 with a counter-clockwise rotation. The apical part of the master gutta-percha cone was coated with sealer and gently inserted into the root canal until the working length was reached. Accessory gutta-percha cones (#02/20, Diadent) were laterally compacted until the finger spreader penetrated into the coronal one third of the root canal. Following obturation, the excess gutta-percha was removed using a hot excavator. After the removal of excess gutta-percha, the root canals were compacted vertically with pluggers.
- Group II (single cone technique with tapered Mtwo gutta-percha): A size 25/.06 tapered Mtwo gutta-percha cone was fitted into the root canal at the working length and checked for tug-back. AH-26 sealer and the gutta-percha cone were applied into the root canal as with group 1. Excess gutta-percha was removed with a hot excavator.
- Group III (System B/Obtura II warm vertical compaction technique): AH-26 sealer was prepared and applied as with groups 1 and 2. The apical third of a size 25/.06 tapered Mtwo gutta-percha was coated with AH-26 and fitted to the working length. A rubber stopper, approximately 4 to 5 mm shorter than the working length, was placed on a 0.06 taper/0.40 tip System B plugger. With System B set at 200°C, the heated plugger was activated for cutting the excessive gutta-percha, and the cooling gutta-percha was vertically compacted with the plugger. Obtura II was used for the backfill obturation of root canals. The heat setting was adjusted to 200°C after which a 23-gauge needle was used to deliver the gutta-percha into the root canal. The heated gutta-percha was vertically compacted with size 1/2, 2/3, and 3/4 pluggers (Maillefer, Ballaigues, Switzerland).
- Group IV (BeeFill 2in1 warm vertical compaction technique): A size 25/.06 tapered Mtwo gutta-percha was fitted 0.5 mm short of the working length with tug-back. The canal walls were coated with a thin layer of sealer (2seal; VDW). The trimmed gutta-percha cone was coated with sealer and placed into the canal 0.5 mm short of the working length.

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