A comparative evaluation of the sealing ability of 2 root-end filling materials: an in vitro leakage study using *Enterococcus faecalis*

Uma Nair, DMD, MDS,[a] Simon Ghattas, DMD,[b] Mohamed Saber, BDS,[b]
Marianella Natera, DDS,[b] Clay Walker, PhD,[c] and Roberta Pileggi, DDS, MS,[d] Gainesville, FL
UNIVERSITY OF FLORIDA

Objective. The purpose of this study was to evaluate the sealing ability of EndoSequence Bioceramic Root-end Repair (BCRR) material when compared with white mineral trioxide aggregate (WMTA).
Study design. Forty single-rooted teeth were instrumented, obturated with gutta-percha, root-end resected, and retrofilled with 2 different materials: white ProRoot MTA (WMTA) (n = 15) and BCRR (n = 15). Unfilled specimens (n = 10) received no retrofill and were used as controls. All groups received *E. faecalis* in a created reservoir coronal to the root filling and the presence of microleakage was evaluated by counting the colony-forming units from each specimen. The results were analyzed with 1-way analysis of variance.
Results. There was no significant difference in leakage between the 2 experimental groups, but there was a significant difference with the control ($P \leq .05$).
Conclusions. This study suggests that BCRR is equivalent in sealing ability to WMTA when used as root-end filling material in vitro. **(Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2011;112:e74-e77)**

Nonsurgical endodontic treatment has a high success rate.[1,2] Adequate preparation and obturation of the root canal system is key to endodontic success.[3,4] Surgical intervention is indicated when orthograde retreatment fails or is contraindicated. The objective of periapical surgery is to eliminate diseased tissues and obtain an apical seal to prevent the ingress of residual irritants into the periradicular area.[5] Resection and retrograde preparation of the root canal is followed by placement of a material to seal the apical canal anatomy.[5] The ideal materials for root-end fillings should be biocompatible, insoluble, dimensionally stable, and, perhaps most importantly, be able to seal the root canal system.[6] An array of restorative materials has been adapted for root-end filling, such as amalgam, composite, glass ionomer, and super-EBA.[7] Mineral trioxide aggregate (MTA) was introduced specifically for root-end filling and perforation repair.[7,8] It is rapidly becoming the "golden" standard for root-end filling materials.[9] MTA demonstrates superior sealing ability and biocompatibility compared with other materials[9–11]; however, poor handling characteristics, initial looseness, and slow setting time make MTA difficult to use.[12]

The manufacturer of a novel material, EndoSequence BioCeramic Root-end Repair (BCRR), claims comparable physical and mechanical properties to MTA but with superior handling and setting characteristics. Leakage remains a priority when evaluating new retrograde filling materials.[13–15] Based on this premise, the aim of this study was to compare, in vitro, the microleakage of BCRR material with MTA as retrograde filling materials using a bacterial leakage model. The null hypothesis (H_0) was that there was no statistically significant difference in bacterial leakage between the 2 materials.

MATERIAL AND METHODS

Tooth selection and orthograde procedures

Forty intact, single-canal, freshly extracted human teeth with mature apices were selected for this study. Initial radiographs were obtained for all teeth. A low-speed diamond saw (NSK Z500 brushless motor; Brasseler USA, Savannah, GA) was used to decoronate the teeth to standardize specimen length (12.96 ± 0.37 mm). Working length was determined by placing a #10 file into the canal until it was visualized at the apex and then subtracting 1 mm. Apical preparation was then completed with Profile GT files (Dentsply, Tulsa Den-

[a]Assistant Professor, Department of Endodontics, College of Dentistry, University of Florida.
[b]Fellow, Department of Endodontics, College of Dentistry, University of Florida.
[c]Professor, Department of Oral Biology, College of Dentistry, University of Florida.
[d]Associate Professor and Chair, Department of Endodontics, College of Dentistry, University of Florida.
Received for publication Nov 22, 2010; returned for revision Jan 13, 2011; accepted for publication Jan 22, 2011.
1079-2104/$ - see front matter

doi:10.1016/j.tripleo.2011.01.030

tal Specialties, Tulsa, OK) to a size 40/0.06. The canals were irrigated with 6.15% sodium hypochlorite (NaOCl; Chlorox, The Chlorox Co, Oakland, CA) and lubricated with EndoGel (Jordco Inc., Beaverton, OR) throughout the mechanical preparation. The canals were dried with medium paper points (Henry Schein, Inc., Melville, NY).

Ten specimens were designated as controls: positive and negative, 5 each. The remaining specimens were obturated with the continuous wave technique. A 0.06-taper Autofit GP cone (Analytical Technology, Glendora, CA) was fitted to working length. Cone fit and length were verified radiographically. The tip of the cone was coated with AH plus sealer (Dentsply Maillefer, Tulsa, OK) before obturation. A suitable size system B plugger (SybronEndo, Glendora, CA) was used to downpack the gutta percha at 5 mm short of the working length. The remainder of the canal was backfilled with thermoplasticized gutta percha using Obtura III (Obtura-Spartan, Fenton, MO).

Retrograde procedures

The apical 3 mm of all specimens was resected, under water spray, at a 90-degree angle to the long axis of the root using a #330 fissure bur (Brasseler USA) mounted in a high-speed handpiece (KaVo Dental Corporation, Charlotte, NC). The apical ends of the roots were prepared with the KiS ultrasonic tips (Obtura-Spartan). A cylindrical preparation, 3 mm deep, was created and rinsed with saline and dried with paper points. Suitable size microplugger (Obtura-Spartan) was selected.

Unfilled control specimens (n = 10) were set aside and received no retrofill; the remaining specimens were randomly assigned to 1 of 2 experimental groups (n = 15) according to retro-filling material:

- BCRR: EndoSequence BioCeramic Root-end Repair (Brasseler USA)
- MTA: white ProRoot MTA (Dentsply, Tulsa Dental Specialties)

All materials were prepared according to manufacturers' instructions and condensed in the retropreparations using microplugger. Adequacy of root-end fillings was verified radiographically both buccolingually and mesiodistally. All specimens were then stored in a humidifier for 7 days to ensure complete setting of the materials.

Bacterial leakage model

The experimental set-up used to evaluate the bacterial microleakage was adapted from a previous study.[16] Two millimeters of gutta percha was removed from the coronal portion of the obturated root canals to create a reservoir for the bacteria (*Enterococcus faecalis*). In the experimental and positive control groups, a double layer of nail varnish was used to seal the entire specimen surface except for the apical and coronal aspects; the specimens of the negative control groups were completely covered.

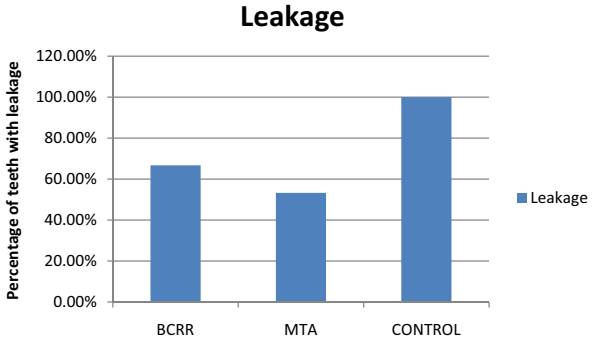

Fig. 1. Comparison of percentage of samples with bacterial leakage using WMTA, BCRR, and the positive control.

Then, 100 μL of trypticase-soy broth was pipetted into Eppendorf tubes. Specimens were mounted inside the tubes. Five microliters of *E. faecalis* suspension was dispensed into the previously prepared reservoir. The tubes were incubated in an anaerobic chamber (10% H_2, 10% CO_2, and balance N_2) at 37°C for 7 days. The broth from each tube was serially diluted 10-fold and plated on trypticase-soy blood agar and incubated again for another 5 days under identical conditions. The microleakage was confirmed by the presence of active bacterial growth.

Statistical analysis

Quantitative data were tabulated and analyzed using SPSS 16 (SPSS, Inc., Chicago, IL) software. The results were analyzed using 1-way analysis of variance and Tukey's post hoc tests for significant differences between groups. Level of significance was set at P less than or equal to .05.

RESULTS

The specimens in the negative control group showed no bacterial growth (0%), whereas the positive control group demonstrated distinct bacterial growth (100%). There was no significant difference ($P < .05$) in the number of samples that leaked in the MTA (53.3%) and the BCRR groups (66.7%) (Fig. 1).

DISCUSSION

Based on the results of this experiment, the hypothesis was accepted. Perhaps the most important predictor of success for periapical surgery is the sealing of the