

Bioceramics, Part 2: The Clinician's Viewpoint



Kenneth A.
Koch, DMD



Dennis G.
Brave, DDS

This is part 2 of a 2-part article series. Part 1 of Drs. Koch and Brave's article was published in the January 2012 issue of *Dentistry Today* and can be found in our archived articles at dentistrytoday.com.

In part 1, we reviewed the physical properties and the ease of use of bioceramics when used as an endodontic sealer. Additionally, we discussed both present and past research as well as sharing the clinical impressions (of its use) by top clinicians. In this article, we will concentrate on the use of bioceramic technology in surgical applications, as well as in various other indications such as pulp capping. However, before we begin a discussion of the clinical techniques, a review of the material itself and some current research (on the use of bioceramics as a repair material) is merited.

A REVIEW AND CURRENT RESEARCH

We are all familiar with the success of mineral trioxide aggregate (MTA) as a root repair and apico retrofilling material. Furthermore, we realize that because MTA is a modified Portland cement, it has some limitations in terms of handling characteristics. It does not come premixed (and therefore must be mixed by hand), is difficult to use on retrofills, and has such a large particle size that it cannot be extruded through a small syringe. Yet it has a number of favorable characteristics including a pH of 12.5 which is significantly antibacterial. However, as we like to say, "the game has changed."

The game changer is, in fact, the EndoSequence Root Repair Material (RRM) (Brasseler USA) which comes either premixed in a syringe (just like BC Sealer (Brasseler USA) (Figure 1), or as a premixed putty (Figure 2). This is a tremendous help not just in terms of assuring a proper mix but also in terms of ease of use. We now have a RRM with an easy and efficient delivery system. This is a key development and a serious upgrade. This allows all clinicians—not just specialists—to take advantage of its properties.

EndoSequence RRM, specifically, has been created as a white premixed injectable



Figure 1. EndoSequence Root Repair Material (RRM).



Figure 3. RRM putty (hot dog shape) on instrument.

cement for both permanent root canal repairs and apico retrofills. As a true bioceramic cement, the advantages of this new repair material are its high pH (pH > 12.5), high resistance to washout, no-shrinkage during setting, excellent biocompatibility, and superb physical properties. In fact, it has a compressive strength of 50 to 70 MPa, which is similar to that of current root canal repair materials, ProRoot MTA (DENTSPLY) and BioAggregate (DiaDent). However, a significant difference with this material is its particle size, which allows the premixed material to be extruded through a syringe rather than inconsistent mixing by hand and then placement with a hand instrument. As previously mentioned, ease of use is a "big deal."

In fact, the highly acclaimed *CLINICIANS REPORT (CR)* recently (November 2011) published their findings on EndoSequence RRM. Some of its noted advantages as a RRM were:¹

- Easier to use and place than previous similar products
- Good dispenser (tip/syringe) for easy dispensing
- Radiopaque



Figure 2. RRM putty.

- Multiple uses for a variety of clinical conditions

- No mixing required.

Furthermore, their final conclusion was that 95% of 19 CR evaluators stated that they would incorporate EndoSequence RRM into their practice. Also, 95% rated it excellent or good and worthy of trial by colleagues.

Another significant piece of research was published in the *Journal of Endodontics* where a research team investigated the antibacterial activity of EndoSequence RRM material against *Enterococcus faecalis*. The aim of this study was to determine whether EndoSequence RRM, either in its putty form or as a syringeable paste, possessed antibacterial properties against a collection of *E faecalis* strains. As a standard, they compared the EndoSequence RRM to MTA. Their conclusion was that EndoSequence RRM, both putty and syringeable forms and ProRoot White (DENTSPLY Tulsa Dental Specialties), demonstrated similar antibacterial efficacy against clinical strains of *E faecalis*.²

This research again validated earlier studies that found that EndoSequence RRM (putty) and EndoSequence RRM (paste) displayed similar *in vitro* biocompatibility to MTA. Additionally, other studies found that the EndoSequence RRM had cell viability similar to ProRoot Gray (DENTSPLY Tulsa Dental Specialties) and ProRoot White MTA in both set and fresh conditions.³

Even more significant research was recently published (January 2012) concern-

continued on page xx

Bioceramics, Part 2...

continued from page 00

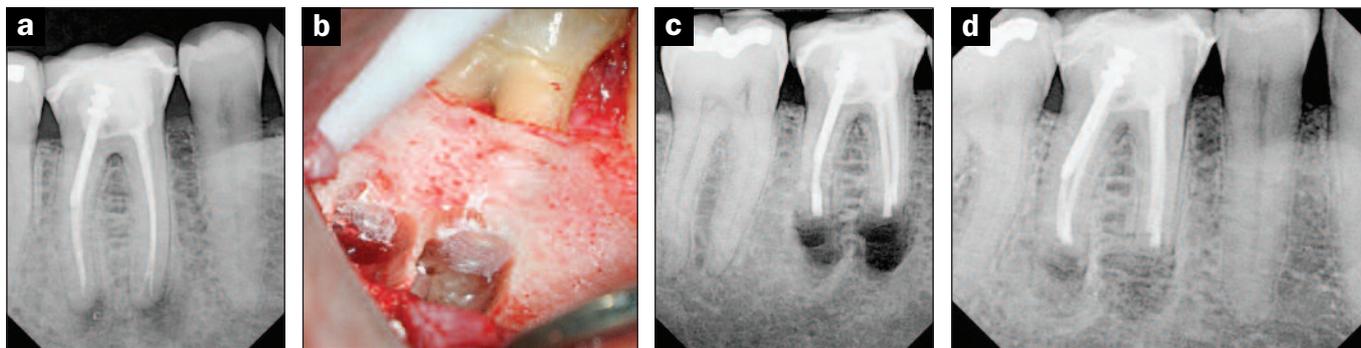
ing bioceramics in general. In a comparison of endodontic sealers, it was demonstrated that in various moisture conditions within a root canal, iRootSP (EndoSequence BC Sealer in Europe) outperformed all the other sealers. The conclusion of the study was that, "Within the experimental conditions of this in vitro study, it can be concluded that the bond strength of iRootSP to root dentin was higher than that of other sealers in all moisture conditions."⁴

As we have mentioned previously, the bioceramic material to use in surgical cases is the EndoSequence RRM and it is available in two different modes; there is a syringeable RRM (very similar to the basic BC Sealer in its mode of delivery), and there is a RRM putty that is both stronger and malleable. The consistency of the putty is similar to Cavit G. The RRM in a syringe is obviously delivered by a syringe tip, but the technique associated with the putty is different.

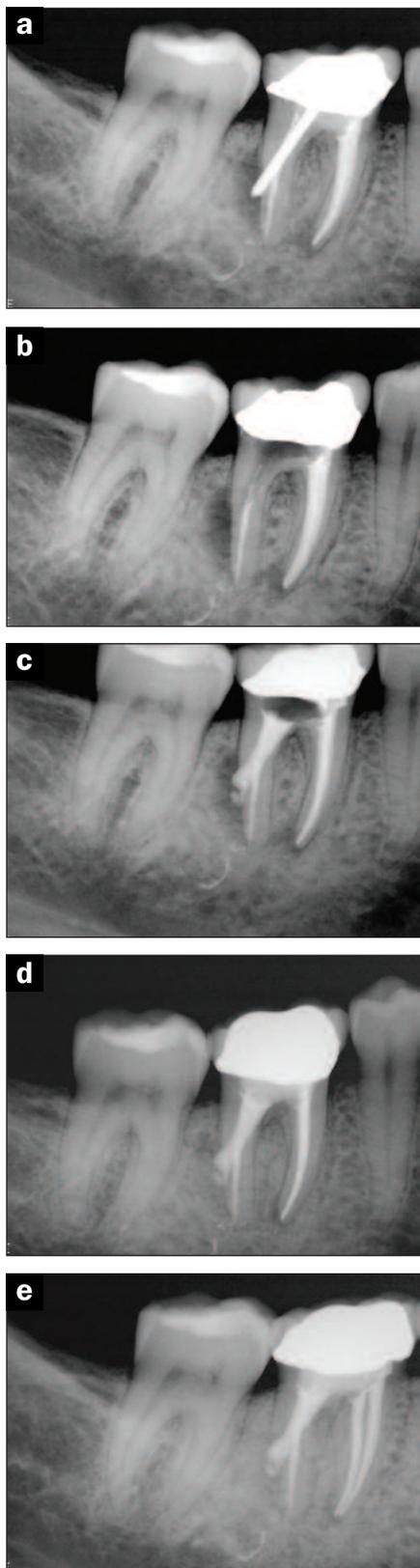
When using the putty, simply remove a small amount from the room temperature jar and knead it for a few seconds with a spatula or in your gloved hands. Then start to roll it into a hot dog shape. This is very similar to creating similar shapes with desiccated zinc oxide eugenol or SuperEBA (Bosworth). Once you have created an oblong shape, you can pick up a section of it with a sterile instrument and use this to deliver it where needed (Figure 3). This is an easy technique for apico retro-fills, perforation repairs, and even for resorption defects. After placing the putty into the apical preparation (or defect), simply wipe with a moist cotton ball and finish the procedure.

As evidence of how beautifully this technique works, we would like to show again the following surgical case by Dr. Ali Nasseh in Boston, Mass. This case is so significant because it beautifully demonstrates the extraordinary capability of bioceramics, when used as a repair material. The radiographs display amazing healing and bone fill in (in less than 6 months) especially in the mandible (Figures 4a to 4d)!

While Dr. Nasseh has published some wonderful cases with bioceramics in both magazines and on his Web site (nasseh.net), the question we must ask ourselves is, "What has been the experience of other top clinicians?" Let's begin with a perforation repair case from Dr. Art Lane in Fla. We'll let



Figures 4a to 4d. Molar. (Courtesy of Dr. Ali Nasseh, Boston, Mass.)



Figures 5a to 5e. (Courtesy of Dr. Arthur Lane, Aventura, Fla.)

Art describe the situation:

"All too often, endodontic teeth are condemned, the tooth extracted, and a bridge or implant placed without a thorough evaluation of the possibilities to retreat and salvage a tooth that appears to have a poor prognosis. This case is representative of an open minded dentist and patient who were willing to think outside the box and to trust the endodontist."

A MINI CASE REPORT

"A 50-year-old female presented to our office with a chief complaint of dull ache in a tooth that had received root canal treatment 2 years previously. She also complained of swelling and sensitivity of the 'gum area' when she rubbed her finger over the tooth. Her dentist told her that her symptoms were related to a post perforation and she was sent to our office for evaluation.

"Clinical examination revealed tenderness to palpation on the distal aspect of the buccal gingival. There was no probing in the gingival sulcus and the tooth was not sensitive to percussion. Radiographic examination revealed tooth No. 30 to have quite an extensive post perforation as well as bone loss along the distal aspect of the root.

"The patient was advised of the risks, alternatives, and benefits of treating this tooth and expressed a desired to maintain it. We then proceeded with the appropriate treatment to repair the post perforation.

"The tooth was isolated with a rubber dam and the access cavity filling material was removed and dissected from around the post. With the aid of ultrasonics and the Masserann Kit, the post was uneventfully removed. The post perforation area was lavaged with sodium hypochlorite and the BioLase MD was used to further disinfect the defect. EndoSequence Root Repair Putty was used to seal the perforation utilizing a small Messing gun. A moist cotton pellet was placed over the EndoSequence RRM and then Cavit was used to seal the access cavity. One week later, a permanent composite filling was placed.

"We had the patient return on a regular basis and noticed, almost immediately, resolution beginning. As one can see from the radiographs, we now have total resolution of the post perforation defect.

Periodic radiographs will continue to be taken" (personal communication with Dr. Lane, November 2011, Aventura, Fla) (Figures 5a to 5e).

This is extraordinary healing and demonstrates how dedication to the preservation of the natural dentition can actually pay off in big dividends for the patient.

Another wonderful example of how this material works for lateral perforations (whether iatrogenic or natural) is the following case done by Dr. Brad Trattner of Md. The history of this case follows, in Brad's words:

A MINI CASE REPORT

"A patient presented with a sinus tract over tooth No. 8 that was traced with gutta-percha to a lateral periapical lesion on the mesial aspect of the tooth. A flap was reflected during endodontic microsurgery revealing a bony lesion, with an associated lateral canal on the mesial. A preparation was made with the Varios 350 ultrasonic and we then filled the preparation with EndoSequence RRM. A decision was made to use the EndoSequence RRM due to its ease of use and physical properties. (Ease of placement, manipulating ability, cleanup and working time are paramount with microsurgery.)

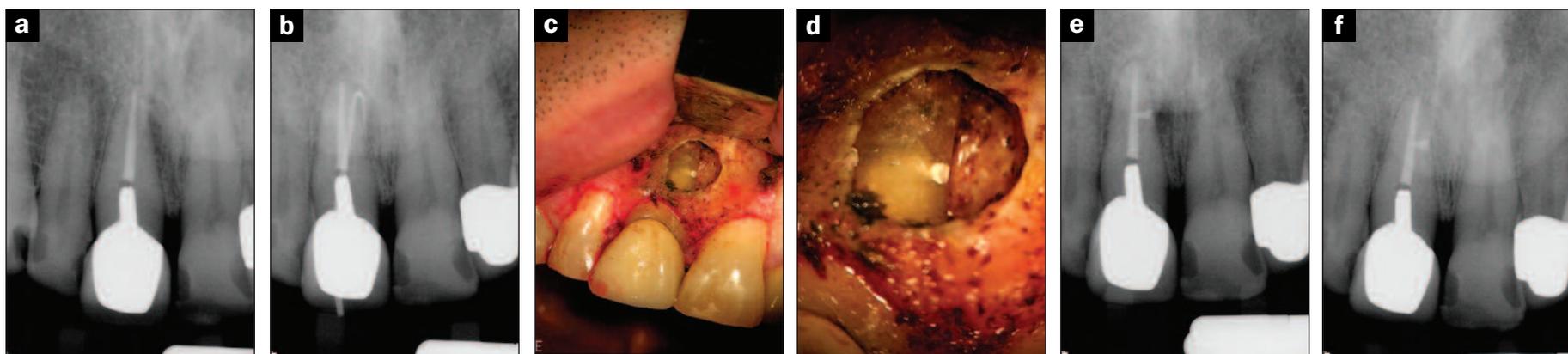
"A one-year follow up shows complete radiographic healing with an intact periodontal ligament" (personal communication with Dr. Trattner, November 2011, Baltimore, Md) (Figures 6a to 6f).

Even further proof of the outstanding physical properties of bioceramics, as well as its ease of use, can be seen in the following 2 cases contributed by Dr. John Gatti of Lees Summit, Mo.

CASE 1

"A 78-year-old male presents with a long history of pain, swelling, and drainage of exudates from the buccal vestibule. Chronic periapical infection of his left maxillary incisor present with several considerations concerning both diagnosis and surgical treatment. The proximity of

continued on page xx



Figures 6a to 6f. (Courtesy of Dr. Brad Trattner, Baltimore, Md.)

Bioceramics, Part 2...

continued from page 00

the nasopalatine foramen can often mimic pathology. However, in this case, there is clear apical destruction of this previous endodontically treated tooth complicated by a cast post and core with an extended clinical PFM crown. Additionally, resorption of the apical root and obliteration of the periodontal ligament space is observed. Surgical considerations include the severe expansive exostosis being mindful during the flap reflection not to destroy the very thin friable tissue covering the exostosis... Upon reflection of the flap, exposure and removal of the exostosis was essential in gaining access to the defect. The resorbed root tip was exposed and inflammatory tissue removed. Root resection was performed microscopically to visualize the intact circumferential root structure with no root fracture being detected. Ultrasonic canal preparation and debridement also removed all of the previous gutta-percha filling material. The injectable bioceramic RRM was an excellent match for sealing the open canal space due to the expansive and hydrophilic properties associated with the bioceramic material. Note the proximity of the EndoSequence RRM to the existing post. This ability to 'flow' the material from the apex to the cast post ensures the capability to generate an excellent seal" (Figures 7a to 7e).

CASE 2

"A previously attempted endodontic procedure on tooth No. 19 was accessed with improper angulation resulting in a distobuccal perforation (defect) at the level of the crestal bone as well as over instrumentation of the distal canal. Upon initial access opening, blood was rapidly filling the chamber and diminishing the ability to visualize the size and location of the defect. It was determined that the profuse bleeding was not coming from the pulp tissue and a hemostatic agent was uti-

lized to isolate the defect. The defect was then appropriately sealed (using the EndoSequence Root Repair putty) which allowed for the chamber to be completely unroofed, thereby exposing the other canals. At that time, it was clear that the distal canal had also been over instrumented during the previous access. The remaining canal system was thoroughly cleansed and shaped using the EndoSequence rotary instrumentation system and was ultimately obturated utilizing a hydraulic condensation technique with the bioceramic sealer.

"At the completion of obturation, the injectable bioceramic RRM was placed over the distal buccal defect, as well as in

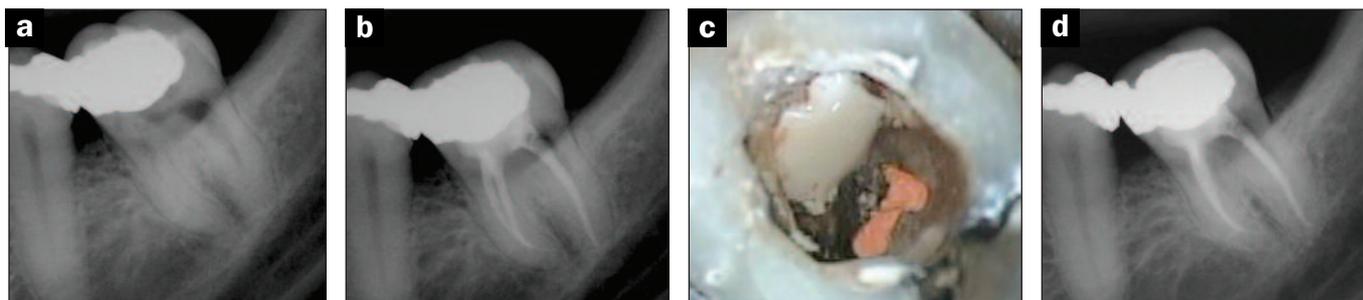
seal. Our 8-month recall shows no degradation in bone support (especially in the periradicular region with excellent tissue health), normal probing, and totally asymptomatic.

"Note: It is clear from the preoperative radiograph that this case was difficult from its inception. The mesial canals in the radicular area show unusual anatomy. A questionable prognosis was explained to the patient prior to treatment of this case. However, the patient wanted to attempt to save the tooth. Although many factors help determine endodontic success, one major factor which will significantly increase the success rate of endodontically treated teeth is the conser-

of pulp caps or other pulpal therapies (eg, pulpotomies). Previously, many specialists considered MTA to be the ideal material for a direct pulp cap because it did not seem to engender a significant inflammatory response in the pulp. Unfortunately, due to price concerns and difficulty of placement, this methodology was not universally accepted. However, we now have a true bioceramic material (EndoSequence RRM) that comes premixed in a syringe (stored at room temperature) and costs far less per application. It is also far easier to use! Hopefully, this will lead to an increased use of bioceramics in our pediatric patients and



Figures 7a to 7e. (a) pre-op; (b) pre-op exostosis (microscope); (c) exposed resorbed root tip; (d) bioceramic root repair material injected in retro-prep; (e) post-op. (Courtesy of Dr. John Gatti, Lees Summit, Mo.)



Figures 8a to 8e. (a) pre-op; (b) obturation before repair; (c) bioceramic perforation repair; (d) recall at 8 months. (Courtesy of Dr. John Gatti, Lees Summit, Mo.)

the entire distal orifice which previously had been over instrumented. The hydroxyapatite by-product of the bioceramic material will help form a bond with the previously placed putty and the dentinal wall. Not only does this help fill in the defect but there have been recent reports in the literature that the bioceramic material may indeed strengthen the remaining tooth structure. A core was then placed over the material insuring an excellent

seal. Our 8-month recall shows no degradation in bone support (especially in the periradicular region with excellent tissue health), normal probing, and totally asymptomatic. (Figures 8a to Figures 8e).

PEDIATRIC AND ADOLESCENT APPLICATIONS FOR BIOCERAMICS

One of the other significant benefits of having bioceramics come premixed in a syringe is the ability for all dentists to now easily treat young patients in need

help these patients save their teeth. All dentists can benefit from this upgrade in technique.

The technique itself for a direct pulp cap with the bioceramic RRM is as follows. Isolate the tooth under a rubber dam and disinfect the exposure site with a cotton ball and sodium hypochlorite. Apply a small amount of the RRM from the syringe or, take a

continued on page xx

Bioceramics, Part 2...

continued from page 00

small amount of the RRM putty from the jar, and place this over the exposure area. Then, cover the bioceramic repair material with a compomer or glass ionomer restoration. Following the placement of this material, proceed with the final restoration, including etching if required.

CLOSING COMMENTS

So, what have we accomplished in these 2 articles? We have demonstrated that the use of bioceramic technology can benefit all practitioners, in both surgical as well as nonsurgical endodontics. In the authors' opinion, it is the material of choice based on both its physical and chemical properties. More importantly, its ease of use allows all dentists to get exceptional endodontic results. The ultimate beneficiary is, of course, your patient. ♦

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Dr. Koch is the founder and past director of the new program in postdoctoral endodontics at the Harvard School of Dental Medicine. In addition to having maintained a private practice limited to endodontics, he has written numerous articles on endodontics and he lectures worldwide. He is a cofounder of Real World Endo and can be reached via the Web site realworldendo.com.

Dr. Brave is a Diplomate of the American Board of Endodontics and is a member of the College of Diplomates. In endodontic practice for more than 25 years, he has lectured extensively on endodontics and holds several patents, including the VisiFrame. Formerly an associate clinical professor at the University of Pennsylvania, Dr. Brave currently holds a staff position at the Johns Hopkins Hospital. He is a cofounder of Real World Endo and can be reached at realworldendo.com.

Disclosures: Drs. Koch and Brave are cofounders of Real World Endo and are the developers of the EndoSequence System.

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continued on page xx