Novel applications of a bioactive resin in perforations, root resorption and endodontic-periodontic lesions

By Dr Marta Maciak, Poland

During the last decade, a considerable amount of attention has been directed towards the development of so-called bioactive materials. To understand this phenomenon better and to avoid misinterpretation, a condensed review of the literature and an assessment of various definitions need to be considered.

There are already several commercially available dental materials that can be defined as bioactive. For instance, any fluoride-releasing material, calcium silicate- and calcium aluminate-based cements, and calcium-based or calcium-containing materials. Biomaterial scientists in the field of implantology have adopted the word “bioactive” to mean materials that are bound to each other through a biomineralised interface. There appears to be confusion within the dental profession, including among scientists, clinicians and industry persons, to what extent biomineralisation can be achieved with dental materials and which materials can be appropriately termed “bioactive” or “biomineralising.”

Bioactivity has been defined and can be interpreted in various ways. A broad definition that has several meanings is the following: a material that is able to have a biological effect or a material that is biologically active and forms a bond between the tissue and the material. In the field of tissue engineering, the term “bioactivity” is related to the cellular effects induced by the release of biologically active substances and ions from the biomaterial, for example from bioactive glasses both in soft- and hard-tissue engineering applications. In medicine, bioactivity covers all interaction of materials with living cells and tissue, including the effects of pharmaceuticals. In biomaterial science, with bioceramics and bioactive glasses, bioactivity of a material usually denotes that the material is capable of forming hydroxyapatite minerals on its surface in vitro and in vivo.

The following theoretical question should be asked: can a material that releases ions for biomineralisation be considered bioactive or is the substrate on which the biomineralisation occurs bioactive? Thus, bioactivity of dental materials relates to their potential to induce specific and
intentional mineral attachment to the dentine substrate.\textsuperscript{1}

Another definition has been presented in an article by Looi et al.\textsuperscript{2} Bioactivity of a ceramic material is a surface property that provides a bond between the material and living tissues without fibrous encapsulation.\textsuperscript{3}\textsuperscript{4} In yet another definition, bioactivity is described as follows: "A bioactive material is one that forms a surface layer of an apatite-like material in the presence of an inorganic phosphate solution."\textsuperscript{5}

ACTIVA BioACTIVE-RESTORATIVE and ACTIVA BioACTIVE-BASE/LINER (Pulpdent) have been shown to exhibit bioactive properties based on this last definition.\textsuperscript{6} ACTIVA BioACTIVE products are the first dental restins with a bioactive ionic resin matrix. They have a shock-absorbing, rubberized resin component and reactive ionomer glass fillers that mimic the physical and chemical properties of natural teeth. These bioactive materials actively participate in the cycles of ion exchange that regulate the natural chemistry of the teeth and saliva and contribute to the maintenance of tooth structure and oral health. ACTIVA has the strength, aesthetics and physical properties of resin composites and is more bioactive than glass ionomer cements.\textsuperscript{7} ACTIVA seals teeth against micro leakage and its continuous release offers no guarantee of success. Thus consented to a treatment that offered no guarantee of success. Clinical examination showed third-stage lucation and pus in the gingival pocket. A radiograph showed a three-wall infractory pocket (Fig. 10a) reaching the apex of the root. The diagnosis was periapical periodontitis with purulent exudate and root caries on the mesial aspect. The treatment consisted of endodontic and periodontal treatment after a coronal and multiple rinsing with both arches. She complained of pain in the maxillary premolar area. Her medical history did not present any contra-indications to dental treatment.

When the patient was informed that tooth #45 would have to be extracted, she objected and asked if anything could be done to save it, even if only on a temporary basis, as she was reluctant to commit to wearing a removable partial denture. She thus consented to a treatment that offered no guarantee of success.

Endodontic treatment was performed on 2 July 2014 with a Hyflex file of size 25.04 (CERLION) and the SAF System (Sherrant Nova) and XP-endo Finisher (Kytex blanco, Hahnkentra). It was immediately placed, following which the pulp chamber was filled with ACTIVA. After 20 seconds, the restoration was light cured from three different directions for 20 seconds each. The final result can be seen on a radiograph from 13 February 2018. Complete bone healing adjacent to the recession area was observed (Fig. 8). While the radiograph shows the fibre post, the collagen sponge and ACTIVA BioACTIVE CEMENT do not possess sufficient radiopacity to be seen on a radiograph.

Case 3
A 63-year-old female patient presented for dental treatment. A panoramic radiograph (Fig. 9) revealed a heavily restored dentition with single crowns, a three-unit bridge and multiple restorations on the maxilla and mandible. The diagnosis was periapical periodontitis with granulation tissue in the canal. During subsequent visits, the canal was filled with 40% citric acid (Cerkamed) and 2% chlorhexidine (Cerkamed). The borders of the perforation were refreshed with a carbide bur, and then the pulp chamber was etched with 37% orthophosphoric acid for 10 seconds, followed by a thorough rinse. Through the perforation, a collagen sponge (ANTENNA, Molteni Dental) was applied to support the ACTIVA BioACTIVE/BASE/LINER and to protect the underlying bone defect. The sponge was not visible on the radiograph. The canal orifices were protected with cotton pellets and the entire pulp chamber was treated with a dentine bonding agent (Dentinastic Uno, Pulpdent), which was light cured, and then covered with ACTIVA BioACTIVE/BASE/LINER, covering the floor of the pulp chamber (Fig. 2).

The tooth was closed with G2Z glass ionomer (Bide Dental) as a temporary filling. The patient was pain-free within two days. A follow-up radiograph taken on 3 November 2015 (14 days postoperatively) showed the beginning of the healing of the bone in the furcation area (Fig. 3).

Case 2
A 16-year-old patient was referred with root resorption of tooth #21. A CBCT scan and radiograph (Figs. 4 & 5) taken on 30 March 2017 clearly demonstrated the root resorption. Note the temporary filling in the pulp chamber. The patient’s medical history was non-contributory. The diagnosis was maxillary internal and external root resorption.

After removal of the temporary filling, infiltrated granulomatous tissue was seen within the canal. In spite of the fact that the apical portion of the canal was calcified, it was located. The canal was shaped and dried with the Self-Adjusting File (SAF System (ReDent Nova) and XP-endo Finisher (Kytex Dentaire), and flushed with 5.3% sodium hypochlorite (NaOCl), 17% EDTA (Cerkamed) and metronidazole (Polpharma). As a first temporary canal filling, Dexadent (Che- me-Hettmer) was applied for one week to treat the inflammatory tissue in the canal. During subsequent visits, the canal was mixed with 40% citric acid (Cerkamed) and 2% chlorhexidine (Cerkamed). A second temporary filling of Multi-Cal (Pulpdent) mixed with 5% calcium hydroxyapatite (liquid) was inserted into the canal. Initially, the temporary dressing was replaced every two weeks to accomplish removal of granulomatous tissue and to stimulate bone regeneration. Over the course of about seven months, a reduction of the bone lesion was observed, as evidenced by radiographs (Fig. 6) and CBCT and under high magnification.

The final treatment after approximately 11 months (Fig. 7) consisted of cleaning the canal with the XP-endo Finisher and EDTA and 2% chlorhexidine solution. The resorption area was plugged with a collagen sponge (Antenna) to provide support for ACTIVA BioACTIVE CEMENT and to prevent it from flowing beyond the root structure. A dentine bonding agent (All Bond Universal, Bisco) was applied to the canal space, but not polymerised, just slightly air-dried, and the root was filled from the apex to the pulp chamber with ACTIVA BioACTIVE/BASE/LINER. A fibre post (Kytex blanco, Hahnkentra) was immediately placed, following which the pulp chamber was filled with ACTIVA. After 20 seconds, the restoration was light cured from three different directions for 20 seconds each. The final result can be seen on a radiograph from 13 February 2018. Complete bone healing adjacent to the recession area was observed (Fig. 8). While the radiograph shows the fibre post, the collagen sponge and ACTIVA BioACTIVE CEMENT do not possess sufficient radiopacity to be seen on a radiograph.

The tooth was closed with G2Z glass ionomer (Bide Dental) as a temporary filling. The patient was pain-free within two days. A follow-up radiograph taken on 3 November 2015 (14 days postoperatively) showed the beginning of the healing of the bone in the furcation area (Fig. 3).

Case 1
A 28-year-old female patient was referred and presented with pain of tooth #46. The referral letter stated that endodontic retreatment was needed and the perforation had been closed with MTA. The patient was in considerable pain when eating and when closing her mouth. Her medical history did not present any contraindications to dental treatment.

The clinical examination showed a temporary filling in tooth #46. A radiograph taken on 20 October 2015 showed extrusion of MTA into the furcation, as well as a boney defect (Fig. 1). Perforation of the floor of the pulp chamber was diagnosed.

Upon removal of the temporary filling, a large amount of purulent exudate filled the pulp chamber and was evacuated. After the MTA had been removed, the perforation was flushed with metronidazole (liquid, Polpharma) and 2% chlorhexidine (Cerkamed). The borders of the perforation were refreshed with a carbide bur, and then the pulp chamber wasetched with 37% orthophosphoric acid for 10 seconds, followed by a thorough rinse. Through the perforation, a collagen sponge (ANTENNA, Molteni Dental) was applied to support the ACTIVA BioACTIVE/BASE/LINER and to protect the underlying bone defect. The sponge was not visible on the radiograph. The canal orifices were protected with cotton pellets and the entire pulp chamber was treated with a dentine bonding agent (Dentastic Uno, Pulpdent), which was light cured, and then covered with ACTIVA BioACTIVE/BASE/LINER, covering the floor of the pulp chamber (Fig. 2).

The tooth was closed with G2Z glass ionomer (Bide Dental) as a temporary filling. The patient was pain-free within two days. A follow-up radiograph taken on 3 November 2015 (14 days postoperatively) showed the beginning of the healing of the bone in the furcation area (Fig. 3).
Five quick questions with Dr Jorge Vera

By Dental Tribune International

Dental Tribune International asked Dr Jorge Vera five quickfire questions about his background in dentistry and what inspires him to practice every day. In the interview, Vera also shed some light on his favourite products that he uses in his private practice and provided some useful tips for aspiring endodontists.

Dr Vega, what is your background in endodontics?

After finishing my DDS in Mexico, I did my endodontic programme in endodontics at Tufts University School of Dental Medicine in Boston in the US, from 1991 to 1993, helping to teach in the undergraduate clinic and doing many research projects under a great team consisting of Dr Joseph Tenca, Robert White and Melvin Goldman. Since I got my certificate, I have been teaching and working in Mexico.

What are your three favourite things about endodontics?

Firstly, I like the challenge of properly diagnosing and treating aetiological and dental pain, and, of course, relieving the affected patients. And then being able to treat symptomatic and previously endodontically treated teeth with retreatment techniques using CBCT, the microscope or endodontic microsurgery, and returning them to functionality. Lastly, the tremendous load of basic science that endodontists must carry requires continuous study to better perform clinically in fields like pharmacology, physiology and others.

Which endo products couldn’t you do without and why?

I would not be able to work without rotary/reciprocating instruments as a conservative way. Also, the use of hydraulic calcium silicate/phosphate cements and CBE for many cases.

What inspires you in your day-to-day work?

Being able to bring new techniques, devices and materials into my practice about which I have learnt in lectures and courses. Documenting their use and eventually seeing those patients on which they were used, heal and remain functional for a long time. I also enjoy preparing lectures for students and peers on those same topics.

Thank you very much for the interview.