Non-surgical repair of a cervical resorptive defect utilizing a fast set self-curing bioceramic root repair material

**Abstract:**
This paper describes the conservative treatment of a cervical root resorption defect with premixed bioceramic putty. The patient presented with a sinus tract associated with a cervical resorptive defect. Usually these lesions are treated with an external approach that results in destruction of the marginal attachment. After disinfection, a new pre-mixed bioceramic material that does not discolor was used internally to seal the defect. Follow-up shows that the sinus tract is not present and that there is bone fill in adjacent to the bioceramic material. Clinically the tooth has maintained its natural color.

**Key words:**
Cervical root resorption, treatment, repair, pre-mixed bioceramic

**Introduction**
Bioceramics are ceramic materials specifically designed for use in medicine and dentistry. They include alumina and zirconia, bioactive glass, coatings and composites, hydroxyapatite and resorbable calcium phosphates, and radiotherapy glasses (1-5).

Bioceramics are widely used for orthopedic applications (joint or tissue replacement), for coatings to improve the biocompatibility of metal implants, and can function as resorbable lattices that provide a framework that is eventually dissolved as the body rebuilds tissue (4).

There are numerous bioceramics currently in use in dentistry and medicine. Alumina and zirconia are bioinert ceramics used in prosthetics. Bioactive glass and glass ceramics are available for use in dentistry under various trade names. In addition porous ceramics such as calcium-phosphate based materials have been used for filling bone defects. Also some calcium

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«Biologic adaptation of emerging technologies maximises teeth preservation and treatment results. »
silicates (MTA (Tulsa Dental)) and Bioaggregate (DiaDent) have been used in dentistry as root repair materials and for apical root filling materials.

Properties of Endodontic Bioceramic Materials

Endodontic bioceramics are not sensitive to moisture and blood contamination and therefore are not technique sensitive (5). They are dimensionally stable and expand slightly on setting, making them one of the best setting materials in dentistry (5). When set they are hard allowing full compaction of a final restoration and are insoluble over time ensuring the superior long-term seal. The pH when setting is above 12 due to the hydration reaction forming calcium hydroxide and later dissociation into calcium and hydroxyl ions (6). Therefore when unset the material has antibacterial properties. When fully set it is biocompatible and even bioactive. When bioceramic materials come in contact with tissue fluids, they release calcium hydroxide that can interact with phosphates in the tissue fluids to form hydroxyapatite. Few clinicians realize that original MTA is a classical bioceramic material with the addition of some heavy metal. MTA is one of the most extensively researched materials in the dental field (7,8). It has the properties of all bioceramics i.e. high pH when unset, biocompatible and bioactive when set and provides an excellent seal over time. However, it has some disadvantages. The initial setting time is at least 3 hours. It requires mixing (resulting in considerable waste), it is not easy to manipulate and is hard to remove. Clinically, both gray and white MTA stain dentin, presumably due to the heavy metal content of the material or the inclusion of blood pigment while setting (Fig. 1)(9,10).

Finally, MTA is hard to apply in narrow canals, making the material poorly suited for use as a sealer. Efforts have been made to overcome these shortcomings with new compositions of MTA or with additives. However, these formulations affect MTA’s physical and mechanical characteristics.

2nd Generation Bioceramics: Endodontic Pre-Mixed Bioceramics

These products are available in North America as Endosequence® BC Sealer® (BC sealer), Endosequence® Root Repair Material Paste® (BC RRM Paste Syringable) and Endosequence® Root Repair Material Putty® (BC RRM Putty) (Bras- ser, USA Dental LLC, Savannah, GA). They have been used in dentistry as root repair materials and for apical root filling materials (5).

Recently, these materials have also been made available outside North America as Totalfill® BC Sealer®, Totalfill® BC RRM Paste and Totalfill® BC RRM Putty. All three forms of bioceramics are similar in chemical composition (calcium silicates, zirconium oxide, tantalum oxide, calcium phosphate monohydrate, and fillers), have excellent mechanical and biological properties and good handling properties. They are hydrophilic, insoluble, radiopaque, aluminum-free, high pH, and require moisture to set and harden. The working time is more than 50 minutes, and the setting time is 4 hours in normal conditions, depending on the amount of moisture available.

In addition, Totalfill® Fast Set Putty® has recently been introduced into the market that has all the properties of the original putty but has a faster setting time (approximately 20 minutes).

Studies on Endodontic Pre-Mixed Bioceramic materials To date, more than 50 studies have been performed on Pre-mixed Endodontic Bioceramic materials. The vast majority of these studies have shown that the properties conform to those expected of a bioceramic material and are similar to MTA.

Case Report A 29 year old Caucasian female presented pointing to Tooth 11 complaining that her tooth was mobile and pus was present in her gum. Her medical history was non-contributory. Her dental history was that she had had root treatment on the Tooth 11 years previously. The tooth had become discolored, about 4 years previously and bleeding with hydrogen peroxide performed. Clinical and radiographic examination revealed a sinus tract that traced to a resorptive defect in the cervical area of the tooth (Figure 1).

With the patients input and consent a treatment plan was devised to perform a retreatment on Tooth 11 and then surgically remove the resorptive defect. The patient understood that due to the position of the defect that the prognosis was fair.

The retreatment was initiated by removal of as much gutta-percha as possible and disinfecting the root canal. Bleeding was seen from the resorptive defect. The canal and the defect were filled with calcium hydroxide and the access sealed with IBR (Figure 2).

Two weeks later the patient presented asymptomatic. The sinus tract had disappeared and the resorptive defect was free of active bleeding. The retreatment was continued and calcium hydroxide placed into the root canal. Since the resorptive defect was dry and accessible, it was decided to fill the resorptive defect with BC putty from an internal approach (Figure 3).

When the patient returned in another two weeks the sinus tract was still not present, the bioaggregate was fully set and appeared to be sealing well. The root canal was completed using the access cavity sealed with a bonded resin (Figure 4).

At the six month and fifteen month follow-up the patient was asymptomatic. Probing was normal and sinus tract was not present. Bony fill in of the resorptive defect was seen (Figure 5).

Discussion Cervical root resorption is extremely difficult to treat. In most cases, it requires treatment from an external approach because it is so difficult to get a good seal between the external surface where the resorptive tissue originates and the inner resorptive defect. The external approach is usually very destructive to the attachment apparatus and sometimes actually shortens the life of the tooth.

The bioaggregate putty is easy to manipulate and was able to flow into the defect when it was free of blood. The material uses the body fluids to set and its slight expansion on setting provides an excellent seal.

Therapeutic seal and bioactive nature of the bioceramic material explains the bone fill into the resorptive defect against the BC material.

References

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Irrigation dynamics in root canal therapy

By Prof. Anil Kishen, Canada

Irrigation dynamics deals with the patterns of irrigation flow, penetration, exchange and the forces produced within the root canal system. Current modes of endodontic irrigation include the traditional syringe needle irrigation, positive pressure methods, such as apical negative-pressure irrigation or sonic irrigation, and ultrasound-guided irrigation. Since the nature of irrigation influences the flow of irrigant up to the working length (WL) and interaction of irrigant with the canal wall, it is mandatory to understand the irrigation dynamics associated with various irrigation techniques.

Endodontic irrigants are liquid antimicrobials used to disinfect and conditioned the root canal walls within the root canal. The process of delivery of endodontic irrigants within the root canal is called irrigation. The overall objectives of root canal irrigation are to (1) remove the necrotic tissue, inactivate endotoxins, and dissolve tissue remnants and the smear layer and chemical debris in the root canals, as well as to (2) allow the flow of irrigant into the dentinal tubules, across the root canal system, in order to detach the biofilm and housed organisms from the root canal walls (physical effects).

While the chemical effects will be influenced by the concentration of the antimicrobial and the duration of action, the physical effectiveness will depend upon the ability of irrigation to generate optimal streaming forces within the entire root canal system. The final efficiency of endodontic disinfection will depend upon both the chemical and physical effectiveness.[5] It is important to realise that even the most effective irrigating solution may be of no use if it cannot penetrate the apical portion of the root canals (chemical effects).

Syringe irrigation

Irrigation methods are categorised as negative-pressure, negative-negative, or negative-pressure, according to the mode of delivery employed.[4] In positive-pressure techniques, the pressure difference between the pressurised container (e.g. a syringe) and the root canal in negative-pressure techniques, the irrigant is delivered passively near the canal orifice and a suction tip (negative-pressure) placed deep inside the root canal creates a pressure difference. The irrigant then flows from the orifice towards the apex, where it is evacuated.

The understanding of the irrigation dynamics associated with syringe-based irrigation was very important for improving its effectiveness in clinical practice.

Irrigant flow during syringe irrigation

The flow of irrigant is influenced by its physical characteristics, such as density and viscosity.[5] These properties for the commonly used endodontic irrigants are similar to those of distilled water.[6, 7] The surface tension of endodontic irrigants and its decrease by surfactants have also been studied extensively. The rationale of this combination is that it may significantly affect (a) the irrigant penetration into dentinal tubules and access to the root canal(s),[9, 10] and (b) the dissolution of pulp tissue.[10] However, it is noted that surface tension would only influence the interface between two immiscible fluids, and not between the irrigant and dental fluid.[3, 11] Experiments have confirmed that surfactants do not enhance the ability of sodium hypochlorite to dissolve pulpal tissue.[12, 13] The ability of chelating agents to remove the smear layer[14, 15]

The type of needle used has a significant effect on the flow patterns formed. While, for open-ended needles, or channels through the canal wall, parameters such as depth of needle insertion and size or taper of the prepared root canal have only a limited influence.[16–19] Generally, the available needles can be classified as closed-end and open-ended needles. In the case of open-ended needles (flat, bevelled, notched), the irrigant stream is intense and extends along the root canal. Depending upon the root canal geometry and the depth of needle insertion, reverse flow of irrigant occurs near the canal orifice.[5] In the case of closed-ended needles (side-vented), the stream of irrigant is directed towards the canal orifice. Examples have explored the limitations in the irrigant refreshment and flushing efficiency when used close to the WL and ensuring adequate space around the needle for reverse flow of irrigation. The side-vented needles, a higher maximum flow rate, a larger sheath of irrigant, without any irrigant extrusion have demonstrated maxima.[20, 21] Conclusions of this study have demonstrated that the mechanical debridement efficacy.

In open-ended needles, an area of increased irrigant shears stress develops apically to the needle tip. In contrast, for closed-ended needles, a higher maximum shear stress is generated near their tips, on the wall facing the needle outlet.[34] Thus, in open- and closed-ended needle irrigation, optimum debridement is expected near the tips of the needle.[16, 17] Consequently, it is necessary to move the needle inside the root canal, so that the limited area of high wall shear stress involves as much of the root canal wall as possible. The maximum shear stress decreases with an increase in canal size or taper. Thus, lower wall shear stress values are observed in 1 mm short of the WL, so that optimum irrigant exchange can be ensured.

The apical negative-pressure irrigation did not generate marked wall shear stress values, but allowed the flow of irrigant consistently up to the WL. It was the safest mode of irrigation when used close to the WL. The passive ultrasonically assisted irrigation generated the highest wall shear stress. The technique does not require any specific equipment, can be used to remove the microorganisms, in the root canal with the irrigation device close to the WL. This finding highlights the advantages of apical negative-pressure irrigation to be safely used at the WL, circumventing the issues of vasoconstriction.

The overall conclusion is that it may significantly affect (a) the irrigant penetration into dentinal tubules and access to the root canal(s),[9, 10] and (b) the dissolution of pulp tissue.[10] However, it is noted that surface tension would only influence the interface between two immiscible fluids, and not between the irrigant and dental fluid.[3, 11] Experiments have confirmed that surfactants do not enhance the ability of sodium hypochlorite to dissolve pulpal tissue.[12, 13] The ability of chelating agents to remove the smear layer[14, 15]

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Conclusion

The requirements of adequate irrigant penetration, irrigant depth of penetration, concentration, and minimum risk of apical extrusion oppose each other, and a subtle equilibrium is required during irrigation. Ideally, in a canal enlarged to size 50 or 55 and taper 04.04 or 06, an open-ended needle should be placed or 3 mm short of the WL, to ensure adequate irrigant exchange and high wall shear stress, while reducing the risk of apical extrusion. In the case of a closed-ended needle, placement should be within 1 mm short of the WL, so that optimum irrigant exchange can be ensured. The apical negative-pressure irrigation produced the lowest wall shear stress. This decrease in the overall negative-pressure rate could be attributed in part to the reduction in the flow rate with this irrigation system. Passive ultrasonically assisted irrigation, when compared with other irrigation methods, showed the highest wall shear stress along the root canal wall, with the highest turbulence intensity travelling coronal from the ultrasonic tip position. However, the irrigant displayed by this method has important implications with respect to its ability to permit better interaction between the irrigant and the root canal wall, and to potentially enhance the interaction of irrigants with intra-canal biofilm.[5, 35] (Figs. 1a–d & 2a–d).

Editorial note: A list of references is available from the publisher.
FKG Dentaire: Advocating for more conservative and successful endodontic treatment

By FKG

Dubai, UAE: Cutting edge endo instruments and continuous investments in research and development has resulted in booming FKG Dentaire sales globally. Thinking of the box, willing to create a new path and focus on preventive dentistry and focusing on the interests of both the patient and the dentist has led to the latest launch of FKG’s latest endo products: XP-endo Finisher and BT-Apisafe.

In order to help practitioners optimise their skills and utilise these new technologies developed by its engineers and top endodontists, FKG Dentaire has set-up several Training Centers around the globe. The first one opened in Dubai (UAE) in 2015, as well as the one in Oslo (Norway) in partnership with Dr Gilberto Debeirian (Endo’Inn), followed by La Chaux-de-Fonds (Switzerland) in 2016. The latest training centre was inaugurated last year in Mexico (Tutores Dentales).

In 2016, following the success of the training center in Dubai and the desire to increase its teaching capacity, FKG Dentaire has decided to upgrade its Dubai Center. In addition to an increased number of work stations, partnerships have been established with other leading endodontic manufacturers like Global Microscope, Rki, as well as several other world renowned dental companies.

The Dubai Center started its 2016 activities by receiving groups of dentists and endodontists from Greece and Poland trained by Dr Bartosz Cerkaski (Poland) and Dr Andreas Krokidis (Greece).

Partnerships have been created with different continuing education organizations like CAPPMEA (UAE). Next Level Endodontics (Pr Martin Trope and University of Pennsylvania faculty (U.S) and others to organize specialized trainings to fit to the level of any dentist willing to push his/her knowledge and improve outcomes.

The next date to save is the AEEDC (2-4 February 2016) in Dubai. FKG Dentaire will have a major stand on the Swiss Pavilion (Booth N° 8E10) and has brought top endodontic lecturers to Dubai:

• On February 2nd, Pr Martin Trope will lecture on “Modern Endodontics: Theory to Practice” and will do a three hour Advanced Specialty Course.

• On February 3rd, Pr Martin Trope and Pr Roger Rebeiz will discuss in a joint lecture apical limit, apical enlargement, canal shape and obturation techniques.

• On February 4th, Pr Roger Rebeiz will lecture on “Treatment infected root canals and periradicular radiolucency lesions” and will do a three hour Advanced Specialty Course.

Pr Roger Rebeiz (Lebanon), Dr Mohammed Mahmoud Ibrahim (Egypt) and Dr DianeFarhang (UAE) will alternate lead hourly free workshops to demonstrate the unique properties of FKG’s latest endodontic instruments at the FKG Dentaire booth.

Dental professionals who desire to be informed of FKG Dentaire new products and events, or eager to join our Endo training can visit www.fkg.ch and follow FKG Facebook page www.facebook.com/FKGDentaire.

FKG Dubai Training Center opens to Eastern European and Greek clients

By Dental Tribune MEA/CAPPMEA

Dubai, UAE: FKG Dentaire Middle East, Africa and India office welcomed 50 Endodontists all the way from Poland and Greece for two days in Dubai. A combination between high level endo-training and leisure as the attendees were invited by Magdalena Uhlmann, FKG Area Sales Manager Eastern Europe, Balkans and Scandinavia together with distributors Multidental-Med (Poland) and Dental Expert (Greece).

The Swiss manufacturer is famous for the development and production of dental products for dentists, endodontists, and laboratories. Founded in from the heart of the watchmaking industry in Switzerland, FKG has a reputation for top quality products which includes various international certifications.

On 15th of January 2016, the regional MEA team led by Alexandre Mulhauser (Middle East, Africa and India Director) and Olivia Mulhauser (MEA and India Office Manager & Sales Assistant) hosted a group of 50 dental professionals from Poland and Greece who were invited to a FKG dedicated and tailor-made event organized by Magdalena Uhlmann as well as Multidental-Med and Dental Expert.

The program of the delegation included two speaker presentations by Dr. Andreas Krokidis who lectured as part I of the morning session on “I Race: From glide path to 3-D obturation in a predictable and safe way”, Dr. Bartosz Cerkaski, Poland lectured the second part of the morning session on “NITI Sequences selection strategies for safe and precise root canal preparation and obturation”. The afternoon session followed, with a hands-on course on the ITrace, BT-Race and TotalFIHR BC SealerTM provided by the expertise of both lecturers and clinicians, Dr. Bartosz Cerkaski and Dr. Andreas Krokidis.

Finally, Thursday 14th of January 2016, concluded the 2-day endo-training, with a yacht trip out into the waters, organized by the FKG team as a thank you for participation to the two groups and lecturers.