

Case Studies *Collection*

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Dentinal bridge formation with Biodentine™

Dr. A. Itri



Tricalcium silicate as cavity base

Dr. A. Segovia Ramírez
Dr. D. Álvarez Rodríguez



Biodentine™ : indirect pulp cap

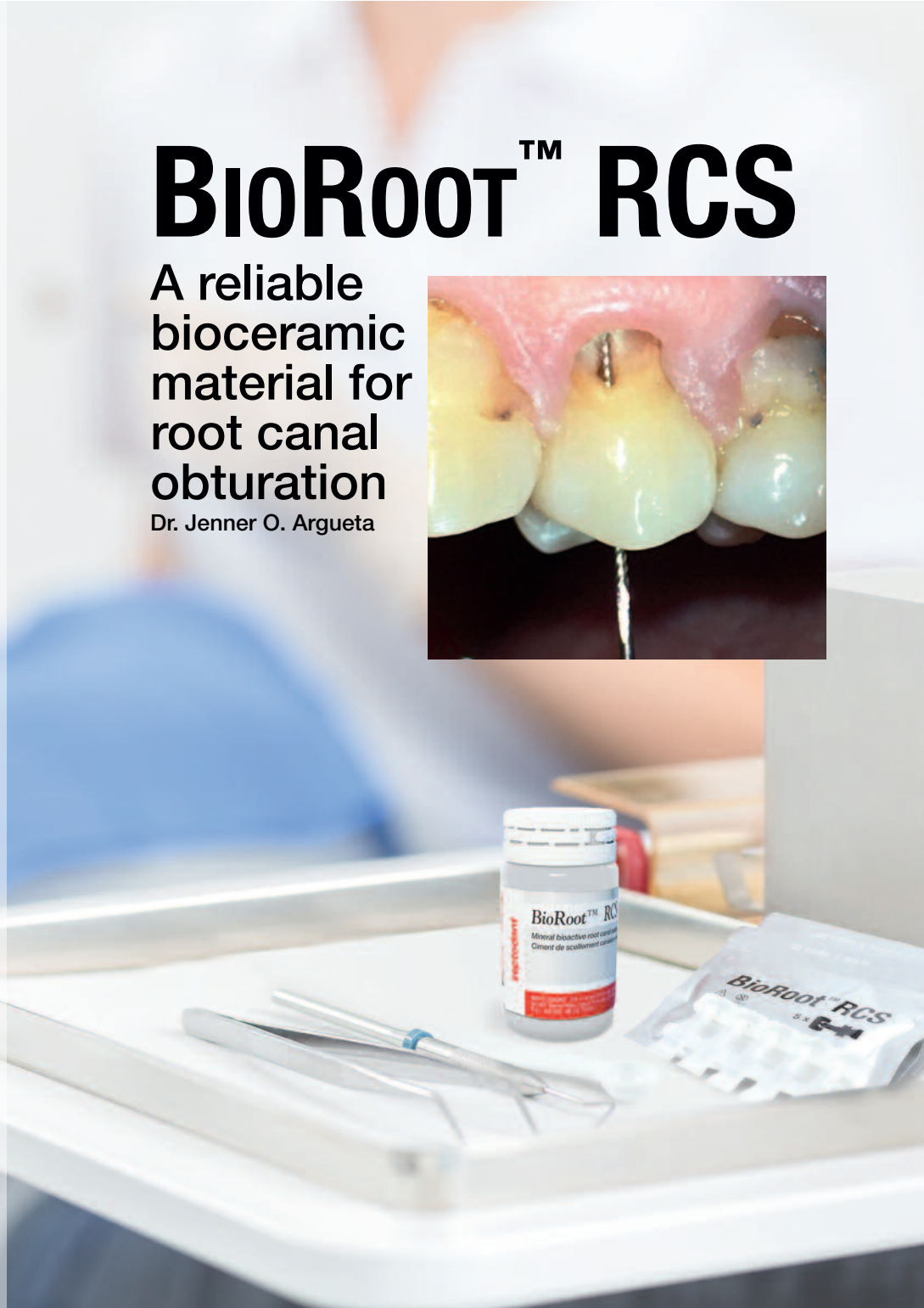
Dr. S. Patel
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BioRoot™ RCS

A reliable bioceramic material for root canal obturation

Dr. Jenner O. Argueta



Editorial



Since its foundation Septodont has developed, manufactured and distributed a wide range of high quality products for dental professionals.

Septodont recently innovated in the field of gingival preparation, composites and dentine care with the introduction of Racegel, the N'Durance® line and Biodentine™, which are appreciated by clinicians around the globe.

Septodont created the “*Septodont Case Studies Collection*” - a series of case reports - in 2012 to share with you their experience and the benefits of using these innovations in daily practice.

Over the past 5 years, authors from more than 15 countries have generously contributed to the success of our magazine that is now distributed on the 5 continents.

Each new issue of the Case Studies Collection is the opportunity to discover new clinical challenges and their treatment solutions.

This 15th issue features three Biodentine™ cases and a new case report on the most recent Septodont Innovation : BioRoot™ RCS.

- BioRoot™ RCS is the new paradigm for endodontic obturations. Its outstanding sealing properties combined with antimicrobial and bioactive properties allow to get a high seal of the endodontium without having to use complex warm gutta techniques.
- Biodentine™, the first biocompatible and bioactive dentin replacement material. Biodentine™ uniqueness not only lies in its innovative bioactive and “pulp-protective” chemistry, but also in its universal application, both in the crown and in the root.

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BioRoot™ RCS, a reliable bioceramic material for root canal obturation

Jenner O. Argueta D.D.S. – M.Sc.

Introduction

During the treatment of root canals it is practically impossible to obtain an environment completely free of bacteria (Markus Haapasalo, Shen, Qian, & Gao, 2010); considering this fact, the root obturation procedure must contain the remaining microorganisms, keeping them deprived of nutrients and of an environment capable of reactivating their metabolism and growth (Simon, 2016; Siqueira, Araujo, & García, 1997).

The majority of modern obturation techniques involve the use of gutta-percha combined with sealing cement; the latter is used with a view to filling in the interface between the root dentin and the gutta-percha. Cement fluidity is an important factor in ensuring that it will reach the areas of the canal that cannot be accessed with root-shaping instruments, but are receptive to chemical disinfection processes applied by means of the various irrigation techniques (Siqueira, Rocas, Favieri, & Lima, 2000). It is advisable to use a minimal amount of sealing cement in proportion to the amount of gutta-percha used, when resin-, zinc oxide-eugenol-, or calcium hydroxide-based cements are to be used, since the use of substantial amounts of cement generates the possibility of degradation

and leakage, which may lead to bacterial recontamination, and thus causing over time the failure of the endodontic treatment (Simon, 2016).

Of the obturation techniques discussed in the literature, single-cone obturation is one of the most sensitive to post-operative leakage since the gutta-percha cones used with the instrumentation system are not perfectly compatible with the final shape of the root canal (Schäfer, Köster, & Bürklein, 2013).

Due to the variability of gutta-percha cones and the irregularities specific to root canal systems, the sealing cement used must be physically stable, must provide good apical sealing, and must have the ability to set in the presence of the moisture present in dentin and periradicular tissues. Single-cone obturation is one of the simplest and quickest methods to use, but is very questionable if applied with non-bioceramic cements, since the presence of large amounts of sealant in the obturation may cause leakage problems over time (Simon, 2016).

Bioceramic cements are an interesting option for the use of the single-cone technique; their physical characteristics render them capable of providing a stable three-dimensional seal in the

necessary time frame (Daculsi, Laboux, Malard, & Weiss, 2003), all without the need for compaction procedures, whether warm or cold. These materials are able to set in humid environments; this point has major relevance considering the fact that dentin has a moisture content of approximately 20%, and that work in moisture-saturated environments is a constant in the dental profession (K. Koch, Brave, & Nasseh, 2010).

Bioceramic cements are divided into three basic groups.

- 1: Bioinert high strength cements;
- 2: Bioactive cements that form chemical bonds with mineralized tissue; and
- 3: Biodegradable materials that integrate actively with the body's metabolic processes (K. Koch & Brave, 2009).

Due to their high stability and sealing properties, bioceramic cements can be used in combination with gutta-percha as part of a single-cone technique, or directly inside the root canal to seal their entire length. Though bioceramic cement may function as an obturation material, it is advisable that a gutta-percha cone be used to

convey it to the inside of the canal and hold it in position at working length or one millimeter short, to leave a route for re-treatment, if necessary in the future. This last procedure would be a real challenge for the operator if no access route were available for re-treatment. The single-cone obturation technique can be used safely in combination with bioceramic cements, due to their previously mentioned physical and dimensional stability, good sealing properties, antibacterial potential, biocompatibility, and bioactivity capable of stimulating periapical tissue repair (Trope & Debelian, 2014).

BioRoot™ RCS is a relatively new bioceramic cement based on tri-calcium silicate, zirconium oxide as a biocompatible radio-opacifying material and a hydrophilic polymer to improve its adhesion properties; the liquid mostly contains water with calcium chloride as a setting modifier (Nakov et al., 2015). The working time is approximately 15 minutes and the total setting time is 4 hours within the root canal (Simon, 2016). Next, we present a clinical case performed using BioRoot™ RCS as a root filling cement.

Clinical Case

A 45-year-old patient reported the loss of a cervical restoration in tooth 12, the caries present in the area was removed to verify the extent of the lesion (*Fig. 1*). Thermal sensitivity tests and periapical radiographs were performed (*Fig. 2*). In consideration of all the signs and symptoms



Fig. 1: Cervical cavity after elimination of carious lesion; the root canal was exposed during mechanical tissue removal.



Fig. 2: Initial x-ray - note the periapical areas shown.

present, a diagnosis of pulpal necrosis with asymptomatic apical periodontitis was made. The root canal treatment was performed in one session, first restoring the cervical cavity with resin-reinforced glass ionomer (*Fig. 3*). To prevent the restoration material from causing an obstruction within the duct, a No. 20 k-file was placed in the cervical radicular area (*Fig. 4*). With the operating environment properly prepared to achieve good isolation, the canals were permeabilized to a #15.02 hand file with the pulp chamber filled with EDTA 17% Gel (MD-Chel-cream) after said chamber was first disinfected with sodium hypochlorite 5.25%. The canal system configuration was determined to be Vertucci Type IV (Altunsoy, Nur, Aglarci, Colak, & Gungor, 2014).

Mechanized instrumentation was performed with TF Adaptive files using adaptive motion, after determining the working length using the Rotor electronic apex locator. During the procedure, a #25.06 instrument was separated in the apical region of the palatal canal (*Fig. 5*); the latter was bypassed and then obturated using the hydraulic condensation technique (J. Koch & Brave, 2012) using BioRoot™ RCS as a sealing cement. The last x-ray shows cement puffs in both roots (*Fig. 6 and 7*). The patient was asymptomatic during the postoperative period. At the re-evaluation appointments, healing was observed to be ongoing at 5 months (*fig. 8*) and complete healing was observed at the final re-evaluation, performed 9 months after the initial procedure was completed (*fig. 9*).



Fig. 3: Photograph of the restoration in the cervical area prior to the root canal treatment.



Fig. 4: Placement of a K-file in the buccal canal prior to obturation placement in the cervical region; the instrument was put in place to keep the pathway permeable.



Fig. 5: Separated instrument in the palatal canal; this was bypassed prior to the final obturation.

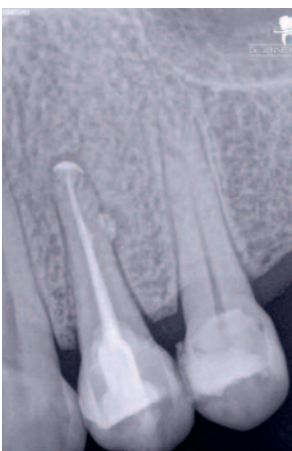


Fig. 6: Final x-ray taken at an orthoradial angle; cement puffs can be observed in the periapical regions.



Fig. 7: Final mesial x-ray; the separated instrument included in the final obturation can be observed.

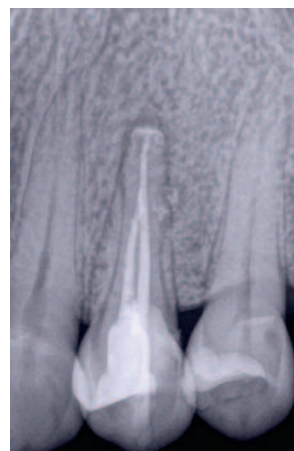


Fig. 8: Re-evaluation at 5 months, the periapical areas are seen to be in the process of healing; part of the cement has been resorbed by the organism.



Fig. 9: Re-evaluation at 9 months, apical lesions have completely healed. There has been partial resorption of the apically extruded cement.

Discussion

Root canal treatment is performed in view of avoiding periradicular lesions or otherwise of promoting an adequate environment for the body to be able to heal the existing lesion or pathology (Peters, 2004); the use of cements to seal the interface between tooth and gutta-percha is of crucial importance in achieving the objective mentioned earlier. Bioceramic cements such as BioRoot™ RCS are made from a combination of silicate and calcium phosphate; the bonding of these components provides physical and biological properties such as: Alkaline PH, anti-bacterial activity and bio-compatibility (Candeiro, Correia, Duarte, Ribeiro-Siqueira, & Gavini, 2012). Another advantage of this type of material is its ability to form hydroxyapatite and even bring about bonding between dentin and root canal obturation material during the setting process (Loushine, Bryan, & W., 2011). The latter characteristic is of high importance in repair processes, since, as can be observed in the present case, the release of ions linked to mineralization processes may promote the complete and relatively rapid healing of the periapical lesions. The biocompatibility of the cement is also apparent in this case: despite

the puffs that were produced because of the obturation technique used, the patient remained completely asymptomatic and symptom-free. One of the most common techniques of root obturation using bioceramic cements is to place small amounts of cement into the canal, bringing it up to the proper length using paper tips; the use of paper tips also has the advantage of eliminating the excess moisture present in the cement and limiting the apical pressure exerted. After the cement has been placed as desired, a gutta-percha cone is inserted to constitute the central part of the obturation (M. Haapasalo, Parhar, Huang, Way, & James, 2015).

BioRoot™ RCS has been increasingly popular since its introduction, and has become one of the materials of choice in cases of open apices and extensive periapical lesions; its popularity is due in large measure to its excellent biocompatibility, remarkable sealing properties, hydrophilicity, and its capacity to promote both healing and tissue mineralization (Simon, 2016) (J. D. Koch & Brave, 2012). Together these properties make BioRoot™ RCS a very interesting option when choosing an obturation technique.



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Dentinal bridge formation: clinical results after Biodentine™ removal

Angelo ITRI, D.D.S.

Introduction

Vital Pulp Therapy (VPT) is a biologic and conservative treatment modality to preserve the vitality and function of the coronal or remaining radicular pulp tissue in vital permanent teeth (Akhlaghi et al. 2015). In this conservative therapy group there are: indirect pulp capping, direct pulp capping, miniature pulpotomy and full pulpotomy (Ghoddusi et al. 2014) . When one of these therapy modalities are performed, the most important biological target is dentinal bridge formation. Dentinal Bridge is a new reaction tissue that preserves pulp vitality and protects it from abnormal and continuous physical stimuli (cold, hot, percussion); it is due to a series of inflammatory responses leading to the formation

of a hard-calcified dentin. This tissue was observed for the first time after calcium hydroxide application on a pulp exposure; owing to a high pH (12,5) calcium hydroxide causes liquefaction necrosis of the superficial pulp, removing up to 1,5 mm of the inflamed tissue. This is followed by neutralization of toxicity in the deep layers with coagulative necrosis. Clinically, dentinal bridge formation is valued by Rx analysis where the pulp chamber is reduced after 3-6 months from VPT therapy.

The aim of this article is to demonstrate a real dentinal bridge formation after complete Biodentine™ removal.

Clinical Case

A 29 year-old female patient with no systemic disease came to my office to restore 2.1 element where was a carious process on the mesial side (Fig. 1).

No spontaneous pain. Her dentist had made a conservative therapy two times in 4 months where the direct restoration had an incorrect adhesion. After a clinical analysis of Rx, cold, electric and percussion tests, a carious process

close to the pulpal horn was detected (Fig.2 - 3). After obtaining the patient's consent, local anaesthesia was performed (Articaine HCL 4% and 1:200000 adrenaline, Septanest, Septodont), the carious dentine was completely excavated and the pulp was exposed (fig 4-5-6-7).

A miniature pulpotomy by low speed hand-piece was performed and Biodentine™ (Septodont) (Fig.8) was placed.



Fig. 1: Preoperative clinical photograph of carious process on 2.1 and 1.1.

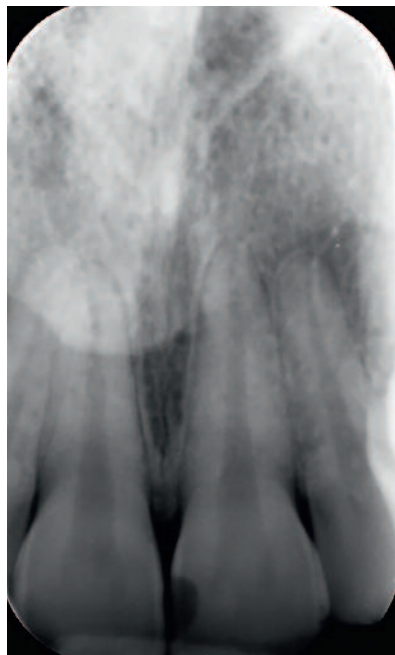


Fig. 2: Preoperative Rx of carious process on 2.1 and 1.1; the pulpal horn was very close to the carious process.

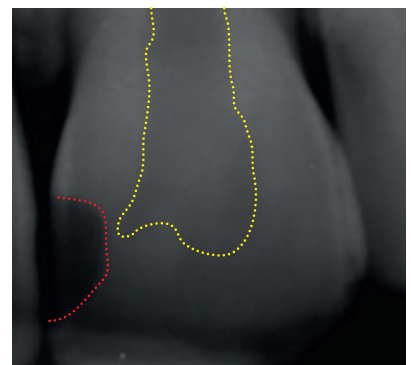


Fig. 3: Magnification: yellow line is the pulp chamber contour; red line is the cavity contour. It shows that the carious process is 1mm close to the pulpal horn.



Fig. 4: Preoperative clinical photograph. The carious process looks very small and simple to achieve restorative success.



Fig. 5: A steel matrix protect element 1.1 during carious excavation. Presence of deep carious process under the initial cavity.



Fig. 6: Pulpal exposure (palatal view).



Fig. 7: Pulpal exposure (occlusal view).



Fig. 8: Biodentine™ in situ during VPT procedure.

To improve hardness resistance a thin Equia Coat (GC) layer was applied on Biodentine™ restoration (Fig.9). Cold, Electric and Percussion Analysis were performed at 7,14,30,60,90, 180 and 360 days (table 1). After 360 days second restorative step was performed (fig. 10).

After obtaining the patient's consent, local anaesthesia was performed (Articaine HCL 4% and 1:200000 adrenaline, Septanest, Septodont), and the Biodentine™ restoration was completely

removed to observe dentinal bridge type formation (Fig.11). In this case a complete Biodentine™ removal was performed only to value real dentinal bridge formation; clinically this procedure is absolutely unnecessary to achieve clinical success. A composite direct restoration (ASTERIA) was performed on 2.1 and 1.1 elements (fig.12a, 12b, 12c).

No apical suffering signs were detected (Fig.13) and clinical tests were normal (Table 1).



Fig. 9: Biodentine™ after equia coat layer application.

tooth 21	electric	cold	percussion
pre op	17	+	-
7 days	17	++	-
14 days	11	++	-
30 days	18	++	-
60 days	10	++	-
90 days	10	+	-
180 days	15	+	-
360 days	15	+	-

Table 1: clinical tests



Fig. 10: Biodentine™ after 13 months (palatal view).



Fig. 11: Dentinal Bridge Formation after Biodentine™ removal.



Fig. 12c: Direct composite restoration of 2.1 and 1.1.

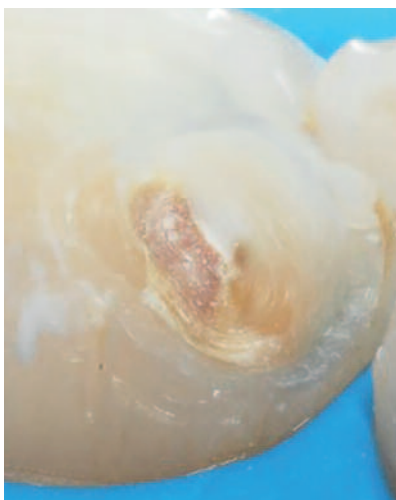


Fig. 12: Dentinal Bridge Formation after Biodentine™ removal (Fig. 11 magnification).



Fig. 12a, 12b: Direct composite restoration of 2.1 and 1.1.

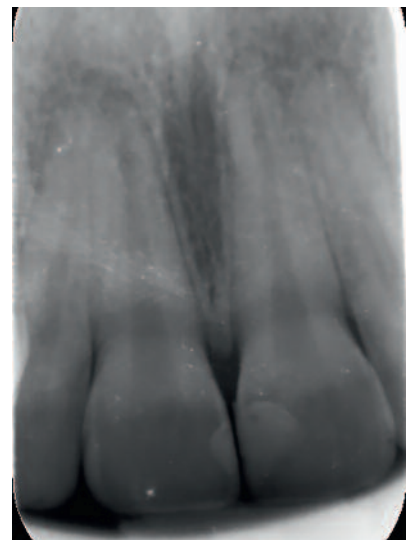


Fig. 13: rx analysis post op.

Discussion

Clinical practice success on VPT procedure is made when no spontaneous pain is present. Dausch et al. (1952) demonstrated that, after a pulp amputation and calxyl application, clinical success was 98% while histologically only 76%. Dentinal bridge formation is an important Rx success parameter. In recent articles, dentine bridge formation was evaluated. Nowicka et al. (2015) performed on 44 third molars without carious process a voluntary pulp exposure and analysed dentinal bridge thickness and density after application of four types of materials. The results show that Biodentine™ and MTA resulted in the formation of bridges with a significantly higher average volume compared with Single Bond Universal.

Only The CBcT offers a correct volumetric Rx analysis of dentinal bridges, but in common practice a 2D evaluation had never been made. Dentinal Bridge is made of colliquative and/or liquefaction necrosis processes. This events create a hard tissue layer that protect the residual pulp tissue by chemical-physical stimulus. When a VPT is performed and a restoration is made, an empty space is present between a pulp capping material and a dentinal bridge caused by superficial pulp destruction (Franz et al. 1984). Dentine fragments, which are displaced into the pulp during cavity preparation, are acting as initial loci for mineralization or pulp stone formation (Mjor et al. 1991).

Angiogenesis is essential for pulp wound-healing process because blood vessels play an important role in nutrition and oxygen supply, as a conduct for transport of metabolic waste, pulp homoeostasis and metabolism, and stem/progenitor cell

migration (Nakashima et al. 2005). A correct material choice in VPT is very important to improve cells vitality. In recent research has been demonstrated that Biodentine™ caused a cytotoxic effect similar to MTA, suggesting that it may be considered an alternative in pulp-capping treatment (Poggio et al. 2015).

Dentinal Bridge formation time is 90 days (Hørsted et al. 1981). In my clinical practice, in Rx analysis the dentinal bridge presence is clear after 180-360 days. This observation highlights that a dentinal bridge is one of the parameters of a VPT follow up, but the clinical waiting period observation is about 1 year.

Matsuo et al. (1996) demonstrated that dentinal bridge formation was not clearly detected in Rx analysis and in his study, he did not include reparative dentine formation as a criterion for success and observational period was more variable (3 to 24 months).

Hyper-sensitivity after VPT procedure has never been present in a period of about 30-40 days. This characteristic is due to presence of the inflammation that is a prerequisite for tissue healing and pulp regeneration (Goldberg et al. 2015).

Conclusion

VPT success in clinical practice depends on many factors. A correct material choice is helpful to achieve pulp vitality and dentinal bridge formation after a pulp capping procedure.



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Angelo Itri graduated in 2009 and works as a general dentist in his office. He won 2010 Duillo research award in Genoa. In 2012 He was a supervisor at Bioengineering University of Genoa. Dr. Itri is actively involved in research since 2006, focusing on dental implants, dental materials and prosthodontics. He participates in national and international dental conferences.

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Tricalcium silicate as cavity base: clinical case report

Alberto Segovia Ramírez, D.D.S.
Deicy Álvarez Rodríguez, D.D.S.

Abstract

Dental cements are used as linings for the protection of the pulp dentine complex. In 1970, Wilson and Kent developed the glass ionomer in order to restore class III and V cavities. In 2009 Septodont developed a material to replace dentine whose active ingredient is pure tricalcium silicate. It has characteristics such as biocompatibility, antibacterial action, mechanical strength,

short setting time, easy handling, repair of pulp dentine, marginal adaptation and sealing. One of the indications of Biodentine™ is base for pulp protection and the regeneration of secondary dentine. A case report is presented in which tricalcium silicate is used as a base in tooth number 48, restored with resin.

Introduction

In dentistry there is a wide range of dental materials that have been modified over time in line with clinical demands, the objective being to achieve uniform biological, physical and chemical characteristics of teeth.

In order to understand the mechanics of the materials and choose the best ones, depending on the circumstances and needs of each patient,

it is important to have detailed knowledge of his/her histology and dental physiology.

The histogenetic classification of dentine is split into three types:

1. Primary dentine
2. Secondary dentine
3. Tertiary dentine (1)

Some dental cements are able to induce tertiary

dentine or repair, such as calcium hydroxide, glass ionomer and mineral trioxide aggregate (MTA).

A new dental material now exists whose characteristics induce secondary dentine: pure tricalcium silicate marketed by the company Septodont under the name of Biodentine™.

The indications of dental cements are:

- Cementing agents
- Pulp protection agents (2)

For pulp protection, the following have to be taken into account:

1. Chemical protection
2. Electrical protection
3. Thermal protection
4. Pulp medication
5. Mechanical protection (3)

BASE

This is a cement applied as an insulating layer, acting as medication. It is inserted in the deepest part of the preparation to protect pulp tissue from thermal or chemical aggressions. Another of its functions is to protect pulp capping against different types of aggression (2).

This one has a thickness of 1-2 mm, being thicker than most liners. Its function is thermal insulation and it acts as a substitute for dentine, creating mechanical support for the restoration due to the distribution of tension on the dentine surface, achieving dental rigidity as well as being biocompatible. (3) (4) (5) (6) (7) (8)

At present, the two materials most used as bases are: glass ionomer and pure tricalcium silicate.

GLASS IONOMER

Developed in 1970 by Wilson and Kent.

The characteristics of glass ionomers are:

- Biocompatibility.
- Chemical and/or physical-chemical adhesion to enamel, dentine and cement.
- Fluoride release.
- Compressive strength: 90-230 MPa.
- Low microfiltration due to the thickness of the film.

An ionomer in powder form contains silicate glass powder, lanthanum, strontium, barium and zinc oxide.

The liquid of the ionomer is an aqueous solution consisting of water and polyalkenoic or tricarboxylic acid;

1. tartaric acid
2. itaconic acid
3. maleic acid (9) (10)

The classification of the glass ionomers according to their indication is as follows:

- Type I: crowns, bridges and the cementing of orthodontic bands (luting cement)
- Type II a: Aesthetics of restorative cements
- Type II B: Reinforcement of restorative cements
- Type III: cement liners, bases

The use of glass ionomer is a solution for pulp protection due to its characteristics. The disadvantage is its solubility. (9)

PURE TRICALCIUM SILICATE

In 2009 Septodont launched Biodentine™ on the market as a “dentine replacement”.

The properties of pure tricalcium silicate are the following:

- Repair of the pulp dentine complex.
- Short setting time.
- Antibacterial properties.
- Biocompatibility.
- Bond strength.
- Easy to handle.
- Marginal adaptation and sealing capacity. (11)(12)(13)

The material comes in capsules (powder) and pipettes (liquid). This presentation makes it easier to handle. The capsules contain a hydrophilic powder with the following composition: tricalcium silicate ($3\text{CaO}\cdot\text{SiO}_2$) [primary nucleus], dicalcium silicate ($2\text{CaO}\cdot\text{SiO}_2$) [second nucleus], and also calcium carbonate (CaCO_3) and zirconium dioxide (ZrO_2). The pipette contains calcium chloride dihydrate ($\text{CaCl}_2\cdot 2\text{H}_2\text{O}$), which speeds up setting time and improves the physical properties of the material. The pipette also contains a hydrosoluble polymer, introduced to reduce the viscosity of the material. This increases

the material's resistance over a short period as well as facilitating its handling. The pipette also contains water (H₂O). (11) (12) (13)

Pure tricalcium silicate is marketed as Biodentine™ by Septodont.

Instructions for use: put 5 drops from the pipette in the capsule and close the capsule. Put it in the triturator for 30 seconds, then open the capsule to work with the material, with a setting time of 6-12 minutes. (11)

Its properties, biocompatible with dentine and the periodontal ligament, increase its initial mechanical resistance of 131.5 MPa. During the month this figure increases and stabilizes, reaching a mechanical resistance similar to that of dentine (297MPa). Other calcium-based cements do not achieve this. (12) (13)

According to studies made on tricalcium silicate, this cement is not cytotoxic, mutagenic, sensitizing or irritating. (Zhou et al, 2013; Rodriguez

et al, 2014). Its alkaline pH is 12.3, i.e. it has an antibacterial function (12)

Garrido M. et al. presented a biocompatibility study comparing Biodentine™, MTA, zinc oxide and eugenol, in subcutaneous tissue. The biocompatibility of pure tricalcium silicate was demonstrated with a slight to insignificant inflammation over 14 days. (14)

The indications for tricalcium silicate are:

- Base in deep cavities
- Direct restoration
- Indirect restoration
- Direct pulp lining after exposure due to caries
- Direct pulp capping following a dental trauma
- Repair of perforation in root canals or pulp chamber floor
- Retrograde endodontic surgery
- Pulpotomy in temporary molars
- Apexification.

Report of a clinical case

Male patient, 36 years of age, comes for consultation (revision). Suffers discomfort when eating sweet foods in a localized and spontaneous manner.

In the physical examination, pigmentation in the vestibular groove of tooth 48 is observed. Vitality tests positive without pulp disorder in teeth 47 and 48.

In the X-ray scan a two-dimensional image with a radiolucent lesion is observed, apparently around the pulp chamber. Two well-defined roots are observed without any periapical disease in tooth 48 (*Fig. 1*).

Diagnosis: caries in the vestibular sulcus of tooth 48.

Treatment: resin in tooth 48.

In the operative procedure the patient was anaesthetized with 2% Mepivacaine using the trunk technique. Three cartridges were infiltrated, complete insulation performed, followed by a removal of the caries with a 330 bur. Once the

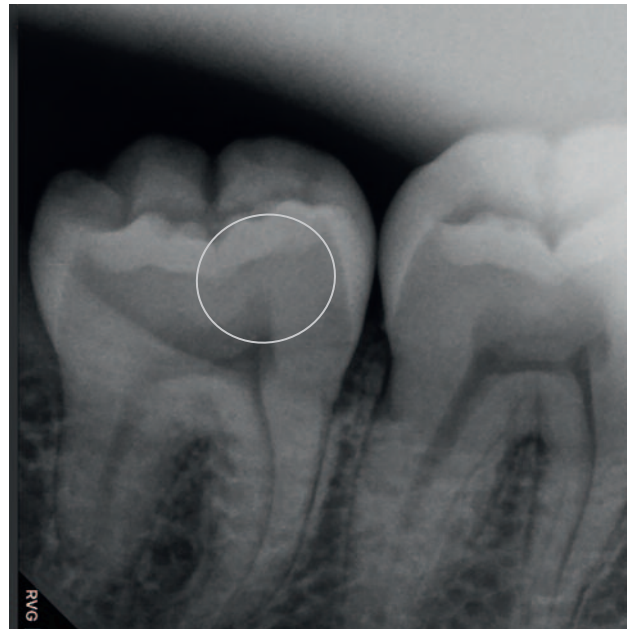


Fig. 1: (9 April 15) Initial X-ray.

cavity was prepared, Biodentine™ was inserted (Figs. 2, 3, 4).

Five drops from the pipette were introduced into the capsule (Biodentine™). (Figs. 5, 6, 7) The capsule was placed in the triturator for 30 seconds and the tricalcium silicate inserted into the cavity. (Figs. 8, 9). We filled with resin

(IPS Empress) A2 dentine and A2 enamel in tooth 48. (Figs. 10, 11, 12) and took the final periapical X-ray and bitewing with the parallel plane technique (Fig. 13).

Control X-rays were taken at 1 year and 17 days after the treatment (Figs. 14, 15) and vitality tests were performed, with positive results.



Fig. 2: Removal of caries - tooth 48.



Fig. 3: Removal of caries -tooth 48.



Fig. 4: Removal of caries - tooth 48.



Fig. 5: The pipette is opened (Biodentine™).



Fig. 6: Five drops from the pipette are placed in the capsule.



Fig. 7: Capsule closed for later mixing in the triturator.

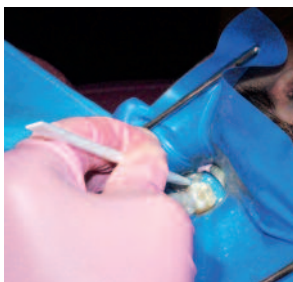


Fig. 8: Transfer of the tricalcium silicate to the deep cavity.



Fig. 9: Placement of the tricalcium silicate in the deep cavity as a base.



Fig. 10: A2 resin (IPS Empress) on the base.



Fig. 11: A2 resin (IPS Empress) on the base.



Fig. 12: Final restoration.

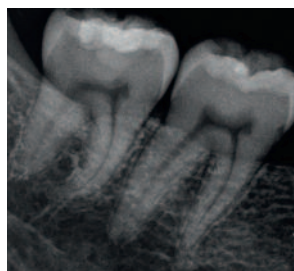


Fig. 13: (9 April 15). Final X-ray.

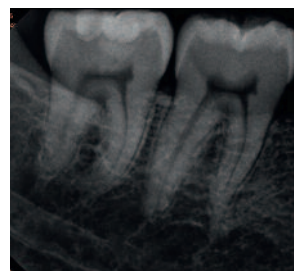


Fig. 14: (26 April 16). Control X-ray at 12 months and 17 days.



Fig. 15: (26 April 16). Control X-ray at 12 months and 17 days.

Discussion

It is very important to know the biological, mechanical, physical and chemical characteristics of dental materials in order to use them correctly and obtain benefits in the medium and long terms.

Previously, if one had a deep cavity in operative restorations the Sandwich technique was used, consisting of indirect pulp capping and a liner

to protect the pulp cap. (10)

Nowadays, one of the best pulp capping and lining materials is tricalcium silicate (Biodentine™), with verified positive results. This facilitates a single-step clinical approach - indirect pulp cap and liner at the same time - that makes the operative process easier and reduces the time involved.

Conclusion

At 12 months and 17 days the patient is asymptomatic. There are no clinical signs nor symptoms of pulpal necrosis and the tooth is vital. We observed the restorative material by X-ray (radio-paque). The success obtained in this clinical

case is due to knowledge and selection of the most appropriate material. Pure tricalcium silicate is ideal for use as substitute for dentine, providing protection and vitality to the pulp.



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Single visit indirect pulp cap using Biodentine™

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Louise Vincer - BDS, MFDS.

Introduction

This case describes a novel indirect pulp capping approach to managing gross caries in a healthy tooth. The importance of a thorough clinical examination, including a CBCT scan, is explained. The rationale for single visit use of Biodentine™ is described.

The function of a vital dentine-pulp complex includes dentinogenesis throughout life and in response to injury. The pulp also contains circulating immune cells designed to confront bacterial challenges, and proprioceptive mechanisms to protect against excessive occlusal loading.(1) Indirect pulp capping is indicated on a tooth with a carious lesion in close proximity to the pulp either being asymptomatic or showing signs and/or symptoms of reversible pulpitis. The tooth may be restored permanently, or re-entered 6 months later (stepwise excavation).(2) Indirect pulp capping has been shown to have a better prognosis than direct pulp capping.(3) There is good evidence to show that, at the advancing front of a carious lesion, considerable

demineralization of dentine occurs prior to bacterial invasion.(4) A clinical study by Mertz-Fairhurst et al demonstrated that partial caries removal and sealing with composite resulted in the arrest of carious lesions without any signs or symptoms of pulpitis after 10 years.(5) Partial caries removal is the preferred treatment as long as the restoration may be well sealed on a caries-free enamel-dentine junction.(6) From the available literature it seems that a single visit procedure is preferred not only for patient convenience, but also because it has a comparable outcome to complete caries excavation.(3,5,6)

Until recently, calcium hydroxide has been the gold standard pulp capping material for vital pulp therapy.(3) However, it is subject to degradation over time and does not adhere well to dentine, and also has tunnel defects forming within the hard tissue barrier.(7) These properties could allow microleakage and failure of the vital pulp therapy. The introduction of bioactive calcium silicate materials such as mineral trioxide aggregate (MTA, Angelus Soluções Odontológicas,

Londrina, Brazil) and Biodentine™ (Septodont, Saint Maur des Fosses, France) offer advantages over calcium hydroxide. Biodentine™ has been shown to induce mineralization within the dentine⁸ and is able to induce hard tissue

barrier formation.⁽⁹⁾ It is also suitable as a long-term provisional direct posterior restoration.⁽¹⁰⁾ This case report details the use of Biodentine™ as an indirect pulp capping material with partial caries removal performed in a single visit.

Clinical Case

A fit and healthy 24-year-old male presented for a routine dental check-up complaining of a “chipped” lower left molar tooth. He had no other symptoms. The patient had a Class 3 skeletal base and edge-to-edge incisal relationship. This resulted in no anterior guidance, and the LL8 being in occlusion with the opposing UL7.

Clinical examination revealed a cavitated carious lesion associated with the LL8 (*Fig. 1a, 1b*). There were no signs of endodontic or periodontal disease associated with the lower left molar teeth. All the lower left molar teeth responded positively to thermal (EndoFrost Roeko, Coltène Whaledent, West Sussex, UK) and electric (Vitality scanner, SybronEndo, Peterborough, UK) pulp testing.

A periapical radiograph revealed extensive distal and occlusal caries in very close proximity to the root canal system of the LL8 (*Fig. 2a*). A diagnosis of gross caries was made for LL8. After discussing the various treatment options, the patient consented to a single visit indirect pulp capping procedure. A Cone Beam CT (CBCT) scan confirmed that there were no signs of periapical pathology associated with the LL8 (*Fig. 2b, 2c*).



Fig. 1a



Fig. 1b

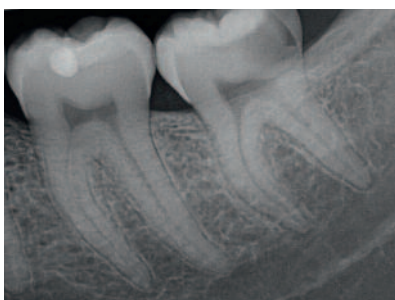


Fig. 2a



Fig. 2b

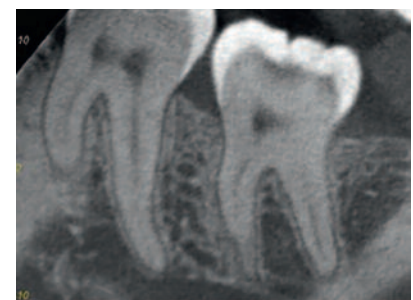


Fig. 2c

The tooth was anaesthetized, and rubber dam applied. The dento-enamel junction was cleared of all caries, leaving stained affected dentine over the axial wall of the pulp chamber. A 3 mm layer of Biodentine™ was applied over the affected layer of dentine, followed by glass ionomer cement (Fuji IX, GC Corporation, Tokyo, Japan). The tooth was then permanently restored

with a direct composite resin restoration Filtek Supreme XTE (3M ESPE, St Paul, USA) (Fig. 3 a–3d). The patient was reviewed one year later. The patient reported that the tooth was asymptomatic. Clinically and radiographically there were no signs of endodontic disease associated with LL8, and it responded positively to vitality testing (Fig. 4a, 4b).

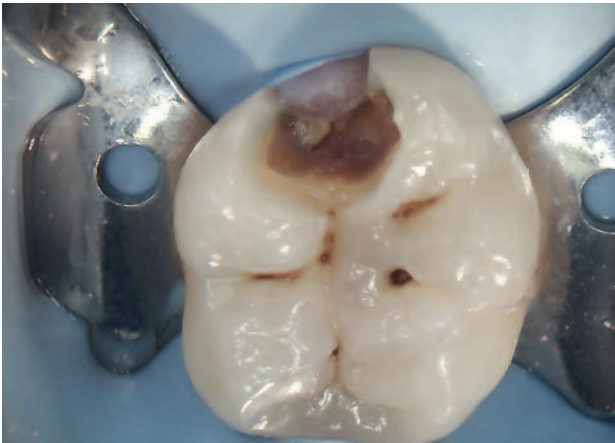


Fig. 3a

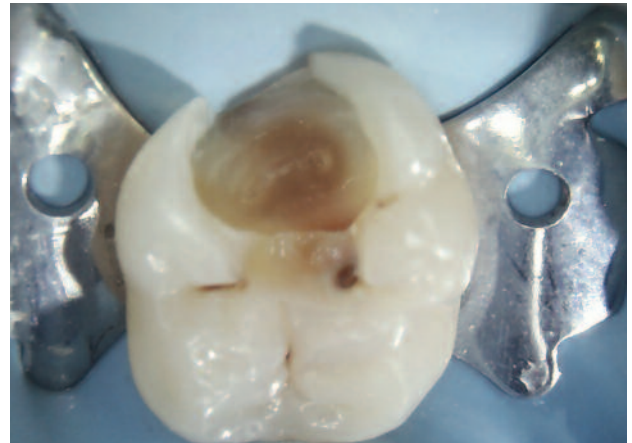


Fig. 3b

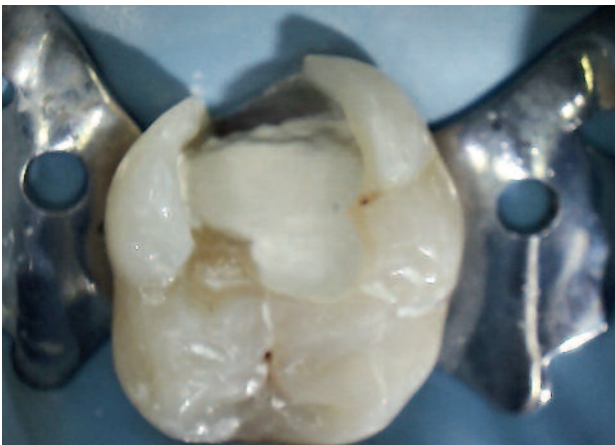


Fig. 3c



Fig. 3d



Fig. 4a

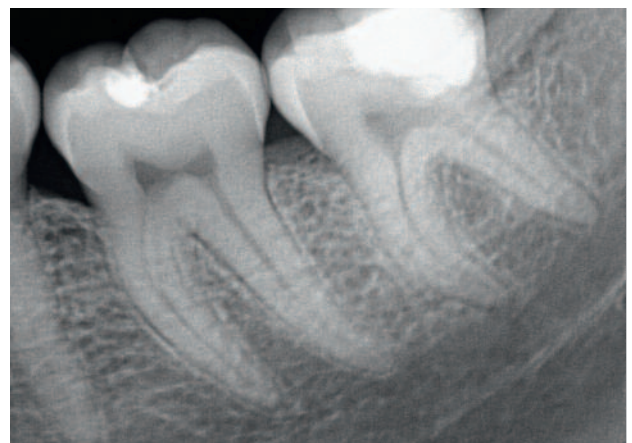


Fig. 4b

Discussion

To the authors' knowledge, this is the first case report of a single visit Biodentine™ indirect pulp cap. This is a promising technique with many advantages. Performing the treatment in a single session by sealing the affected dentine is less traumatic to the pulp, and is also more efficient for both the patient and practitioner. A two-stage indirect pulp cap requires re-accessing the tooth, multiple appointments and potentially further mechanical trauma to the pulp.

The use of CBCT has been shown to be effective in the diagnosis and management of endodontic problems.^{11,12} CBCT has a higher sensitivity for detection of early periapical change¹³ and periapical lesion detection than radiographs.^{13,14} This is because periapical lesions are not visible on radiographs unless they perforate the junction between the cancellous bone and cortical plate, ie the cortical plate acts as anatomical noise masking the changes in the underlying cancellous bone.⁽¹⁵⁾

In this case a pre-operative CBCT scan was taken to confirm that there was no periapical radiolucency associated with the LL8. A recent

prospective clinical trial study identified that the presence of a pre-operative lesion which was only detectable on the CBCT scan, and not the periapical radiograph, had a negative effect on the outcome of indirect pulp capping.^(15,16)

Maintaining pulp vitality helps to improve the long-term prognosis of a tooth. It is well established that endodontic treatment mechanically and bio-chemically weakens tooth structure. It has been shown, using micro CT, that access cavity preparation and caries removal can remove up to 20% volume of tooth structure.^(17,18) Sodium hypochlorite has been shown to reduce elasticity and flexural strength of dentine.⁽¹⁹⁾ Following root canal treatment, a cuspal coverage restoration is required for posterior teeth in order to reduce the likelihood of a fracture due to the loss of proprioception and weakening of the tooth structure.^(1,20) Ultimately, the strength of a tooth is proportional to the bulk of remaining dentine ⁽²¹⁾ and performing an indirect pulp cap in this case has preserved tooth structure and maintained vitality of the pulp and longevity of the tooth.

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