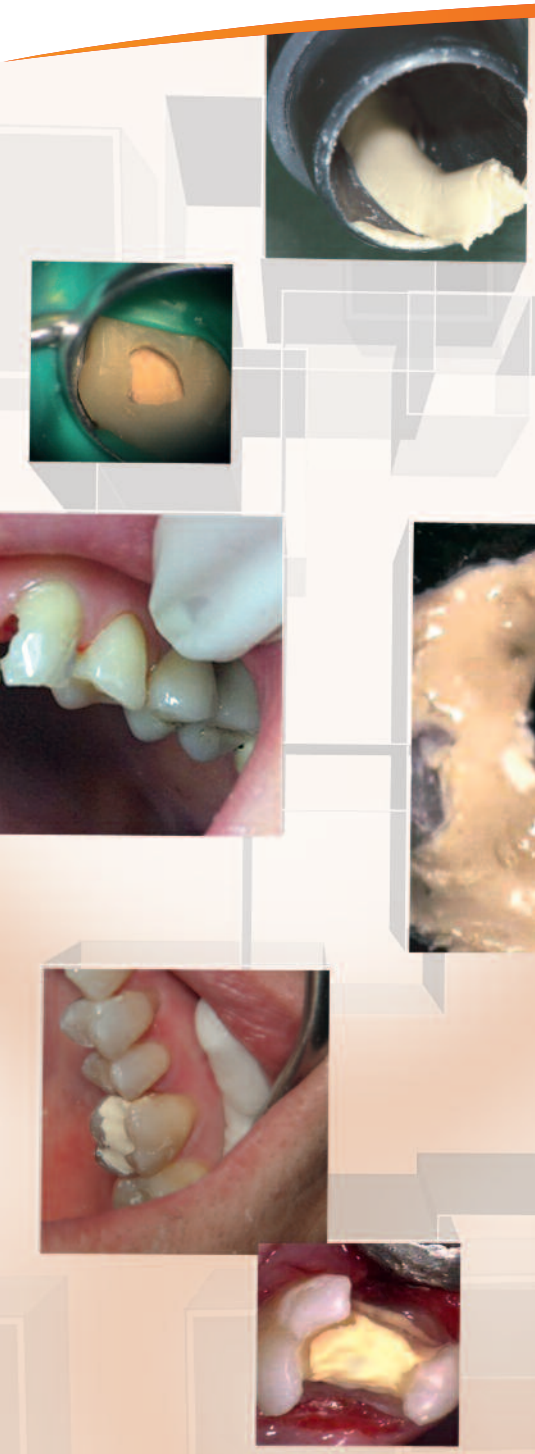
Septodont

Case Studies Collection

No. 03 - October 2012



Focus on Biodentine™

Biodentine™ – an Overview
Dr Till Dammaschke

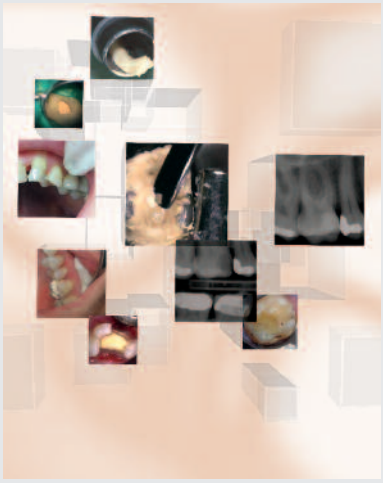
A Clinical Review of 50 Pulp Capping Procedures with Biodentine™
Dr Robert Levin

Successful use of Biodentine™ in two deep cavity cases
Dr Monika Spirollari

Pulp chamber floor perforation treatment with Biodentine™
Dr Godfrey Cutts

septodont

Editorial



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

Septodont has 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*" to share with you their experience and the benefits of using these innovations in your daily practice.
This Collection consists in a series of case reports and will be published on a regular basis.
This third issue is dedicated to Biodentine™, the first and only dentin in a capsule. 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.

This issue features new Biodentine™ case studies written by clinicians from 4 countries: Germany, USA, Albania and UK. It focuses on 3 different indications: direct pulp capping, indirect pulp capping and perforation repair.

They complement the case studies published in the previous issues and illustrate the success of our latest innovation in a growing number of countries.

Content

Biodentine™ - an Overview

Dr Till Dammaschke, Assistant Professor, DDM
University of Münster, Germany

Summary

Biodentine™ is a new biologically active cement which has dentine-like mechanical properties and can be used as a dentine replacement in the tooth crown and root region. The cement consists mainly of a tri- and dicalcium silicate powder, which is mixed with an aqueous calcium chloride solution. As regards biocompatibility, long-term impermeability, antibacterial properties, induction of hard tissue regeneration, stability, low solubility, non-absorbability and ease of handling, Biodentine™ fulfils the requirements found in the literature for a material suitable for these purposes. On the basis of the good material properties of Biodentine™, this cement is an interesting alternative to the conventional materials which were hitherto recommended. Biodentine™ can therefore confer advantages in day-to-day practice and – with correct diagnosis – contribute to the long-term maintenance of the vitality of the dental pulp and to the retention of teeth. However, little scientific data is available at present. The radiopacity of the cement should be improved.

Introduction

With Biodentine™ (Septodont, Saint-Maur-des-Fossés, France), a new biologically active cement, has recently been introduced into the dental market as dentine replacement material. Biodentine™ can be used both on the tooth crown and also in the region of the tooth root; in the crown region as a base, provisional seal, for deep caries therapy, as a cervical filling, for direct and indirect pulp capping and in pulpotomies. In the region of the tooth root, Biodentine™ can be used for the treatment of perforations of the root canal or pulp chamber floor, due to internal and external absorption processes, for apexification and as a retrograde root canal filling material. On the one hand, Biodentine™ serves as a dentine replacement (in the crown region as a base), and on the other hand for maintaining the vitality of the dental pulp or stimulation of hard tissue regeneration, i.e. both tertiary dentine formation and also bone regeneration, e.g. after root end surgery.

Biodentine™ consists of a powder in a capsule and a liquid in a pipette *(Fig. 1a)*. The powder mainly contains tri- and dicalcium silicate, the

Fig. 1a: Biodentine™ (Septodont, Saint-Maur-des-Fossés, France) consists of a tri- and dicalcium silicate powder in a capsule and an aqueous solution of calcium chloride in a pipette.

Fig. 1b: After proper mixing, Biodentine™ is deposited in the capsule in a typical form and has a consistency reminiscent of phosphate cement.

main components of Portland cement, and calcium carbonate. Zirconium dioxide is used as a contrast medium. The liquid is an aqueous solution of calcium chloride, to which a polycarboxylate is added. Powder and liquid are mixed for 30 sec in a capsule in the triturator. During the setting of the cement, calcium hydroxide is formed. In the mixed state, Biodentine™ can be handled for about 12 min and has a consistency reminiscent of phosphate cement *(Fig. 1b)*.

During the hardening phase, the cement must not be subjected to rotatory treatment and should not come into contact with water. Biodentine™ can be applied into the cavity with cement pluggers under light pressure and if necessary occlusally worked with cutting tools. The Biodentine™ filling must not then be polished. With too much pressure or excessive working, destruction of the crystal lattice in the Biodentine™ and hence decreased material strength can result.

Use example – direct capping: *(Fig. 2a-d)*

Use example – perforation repair: *(Fig. 3a-d)*.

Requirements

A suitable material which is indicated for the purposes described in the introduction should have the following properties:

- **biocompatible,**
- **ensure a lasting seal of all cavity margins, preferably by a molecular bond with the dentine,**
- **have a bacteriostatic action or at least not promote bacterial growth,**
- **induce the formation of hard tissue,**
- **stable,**
- **not soluble,**
- **not absorbable,**
- **not moisture-sensitive,**
- **easy to easy to handle, and**
- **radiopaque**

(Motsch 1990, Carr and Bentkover 1998, Dammaschke 2007, Stropko 2009).

Unfortunately, so far no material has been developed which fulfils all these requirements (Motsch

Fig. 2a-d: Use example – direct capping

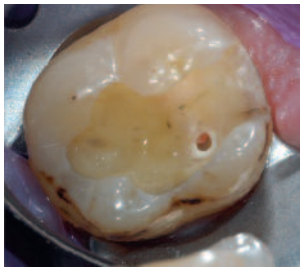


Fig. 2a: Iatrogenic exposure of the dental pulp during the finishing of the cavity after preparation and complete caries excavation on tooth 46 of a 48-year old patient.

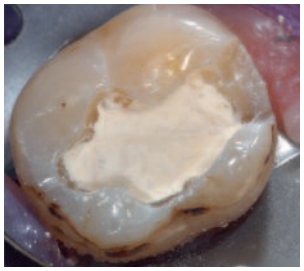


Fig. 2b: Biodentine™ was laid for direct capping and as a base for dentine replacement. The cement was applied into the cavity with a plugger under slight pressure. During the setting phase, Biodentine™ should not be prepared with rotating instruments and water contact should be avoided.

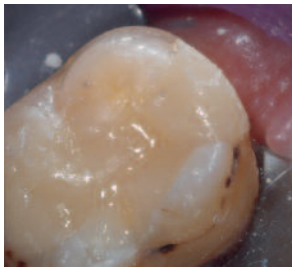


Fig. 2c: After a setting time of Biodentine™ of 12 min, the cavity was covered in the same session with a composite filling (Ceram X; Dentsply DeTrey, Konstanz) in combination with a self-etching dentine adhesive (Optibond XTR; Kerr, Bioggio, Switzerland).

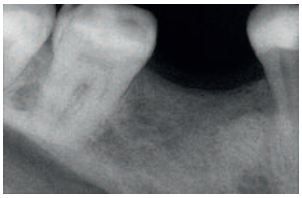


Fig. 2d: A year after direct capping, the radiograph shows no pathological changes apically on tooth 46. A disadvantage of Biodentine™ is however visible on the picture: the radiopacity of the cement is very similar to that of dentine, so that the Biodentine™ layer is not easily differentiated from dentine under the radiographically readily visible composite filling.

1990, Carr and Bentkover 1998, Stropko 2009). Hence in the past many different materials were recommended: for the maintenance of dental pulp vitality above all calcium hydroxide-based preparations (non-hardening suspensions and hardening cements), zinc oxide-eugenol cements, dentine adhesives and cortisone/antibiotic combination preparations (Duda and Dammaschke 2008); for treatments in the region of root dentine (retrograde root canal filling, perforation repair etc.) e.g. amalgam, reinforced zinc oxide-eugenol cements (IRM, Super-EBA), glass ionomer cement and composites (Carr and Bentkover 1998, Bodrumlu 2007, Stropko 2009). In recent years, mineral trioxide aggregate (MTA), a finely ground Portland cement (Dammaschke et al. 2005), has been studied for these applications. It could be shown that MTA shows markedly lower to no cytotoxic effects and better results as regards material properties, biocompatibility and protection against microleakage and thus also clinically better results than the traditional materials (Roberts et al. 2008, Dammaschke et al. 2010). In spite of the many positive properties, MTA also has some disadvantages: handling is somewhat difficult, the setting time is relatively long, the values for compressive and flexural strengths are markedly lower than those for dentine and it is comparatively expensive.

Assessment

As already described, a suitable material for these purposes must fulfil various requirements. Biodentine™ will be examined below on the basis of the previously available literature, as to whether the cement can fulfil these requirements.

Biocompatibility

Laurent et al. (2008) compared the biocompatibility of Biodentine™ with that of ProRoot® MTA and a hardening calcium hydroxide-salicylate ester cement (Dycal®) in various in vitro tests. In the Ames´ Test on four different strains of the bacterium Salmonella typhimurium no mutation could be detected after contact with Biodentine™. An in vitro micronucleus test also showed no structural chromosomal alterations in human lymphocytes. Human dental pulp fibroblasts also showed no significant DNA alterations in single cell gel electrophoresis (Comet Assay). Possible toxicity of Biodentine™ was checked on mouse fibroblasts and human dental pulp fibroblasts by means of the MTT test. The mortality rate of the cells in this was as low as with the ProRoot® MTA, which is known to be biocompatible. Dycal® was significantly more cytotoxic than Biodentine™ or MTA ($p < 0.001$). It can be concluded that Biodentine™ is a biocompatible material which shows no signs of cytotoxicity, genotoxicity or mutagenicity. The cement has no adverse effect on cell differentiation or specific cell functions (Laurent et al. 2008).

To ensure a lasting seal of all cavity margins, preferably by a molecular bond with the dentine

It could be shown that on dentine Biodentine™ causes alkaline corrosion (caustic etching) on the hard tissue, which leads to a so-called “mineral interaction zone”. A diffusion of Biodentine™ up to 10-20 µm into the dentine tubuli could also be observed. Thus a micromechanical anchoring with mineral Biodentine™ tags in the dentine tubuli can form, which contributes to the adhesive properties of Biodentine™. Consequently, dye penetration with silver nitrate at the dentine-Biodentine™ interface is slight (10-15 %) and comparable with results which are attained with dentine adhesives and composites. Due to remodelling processes, the sealing of the dentine by Biodentine™ improves in the course of time (Dejou et al. 2005, Pradelle-Plasse et al. 2009, Watson 2011). From the present results, it can be concluded that Biodentine™ can deposit impermeably onto the cavity walls and prevents microleakage.

Bacteriostatic or at least not promoting bacterial growth

During the setting phase of Biodentine™, calcium hydroxide ions are released from the cement. This results in a pH of about 12.5 and a basification of the surroundings. This high pH inhibits

the growth of microorganisms and can disinfect the dentine (Firla 2011).

Induces the formation of hard tissue

Tricalcium silicate is a main component of Biodentine™, MTA and Portland cement. In addition to their biocompatibility, materials of this type are known to be biologically active (Laurent et al. 2009). Biological activity refers to a positive effect of a medicine or material on living tissue. A material is described as biologically active if it interacts with cells of the human body or has an advantageous action on cells (Hench and West 1996). In studies of biomineralisation, bioactivity mostly refers to the promotion of hard tissue formation which is induced by a material. As regards the biological activity of Biodentine™, it could be shown in vitro that dental pulp fibroblasts form so-called mineralisation nuclei after the cement has been added to the cell medium. These mineralisation nuclei have the molecular characteristics of dentine (Laurent et al. 2008). This indicates a promotion of the transformation of the dental pulp fibroblasts by Biodentine™ to odontoblast-like cells which can then form hard tissue (Laurent et al. 2008). Thus Biodentine™ has been demonstrated to be biologically active (Laurent et al. 2009). In an animal experimental study on rats, it could be unambiguously shown that Biodentine™ can induce the formation of tertiary dentine (response dentine) within two weeks after cavity preparation and indirect capping onto molars with the biologically active cement (Boukpessi et al. 2009). Formation of repair dentine could likewise be observed in pigs after direct capping or after pulpotomy and application of Biodentine™ (Shayegan 2011). Unfortunately, no scientific data are so far available concerning the induction of bone regeneration by Biodentine™. Here there is certainly a need for further research to study the effect of Biodentine™ on bone cells.

Stable

The material properties of Biodentine™ are similar to those of dentine. Both the elasticity modulus of the cement and also the pressure resistance, bending strength and Vickers hardness are comparable with dentine and, except for the Vickers hardness, lie above the values that can be measured on glass ionomer cements. However, Biodentine™ is not as stable as a composite material, so that Biodentine™ is not suitable for a permanent enamel replacement (see Table 1). However, in comparison to other Portland cement-based products, Biodentine™ is stable enough to find use as a temporary filling even in the chewing load bearing region (Pradelle-Plasse et al. 2009, Dammaschke 2011).

Not soluble, not moisture-sensitive, not absorbable

In comparison to glass ionomer cement, Biodentine™ showed fewer dissolution phenomena on the surface in an acid solubility test. On storage of Biodentine™ in artificial saliva, no erosion could be observed; there was rather a deposition of apatite-like calcium phosphate crystals on the surface (Dejou et al. 2005, Firla 2011). Our own studies have shown that the solubility of Biodentine™ is similarly low to that of ProRoot® MTA (unpublished data).

Material	Compressive strength (MPa)	Flexural strength (MPa)	E Modulus (MPa)	Vickers hardness (VH)
Biodentine™	220	34	22.000	60
Dentine	200 – 350	20	15.000 – 20.000	60 – 90
GIC	140 – 180	10 – 21	5.000 – 11.850	60
Composite	290 – 400	100 – 145	12.000 – 16.000	70 – 130

Tab 1: Material properties of Biodentine™ compared to dentine, glass ionomer cement (GIC) and composite. (after: Motsch 1990, Pradelle-Plasse et al. 2009, Firla 2011).

Easy to handle

For many indications in which Biodentine™ can be used, mineral trioxide aggregate is at present certainly the material of choice, although MTA is not entirely simple to handle (Gutmann and Lovedahl 2011). Consequently, different devices and techniques have been recommended for the use of MTA in endodontic treatment (Stropko 2009, Gutmann and Lovedahl 2011). Biodentine™ is mostly simpler to use and can often be applied without any problems with simple cement pluggers or a Heidemann spatula. Moreover, at 12 min, the setting time is markedly below that of ProRoot® MTA at about 2.5 h.

Radiopacity

Unfortunately, the radiopacity (according to the manufacturer, the radiopacity corresponds to 3.5 mm of aluminium) of Biodentine™ is in the region of that of dentine so that the cement is not adequately visible in the radiograph *(Fig. 2d and 3d)* and the assessment of correct application appears difficult. The radiopacity of Biodentine™ should therefore be improved.

Conclusion

Overall, Biodentine™ is an interesting, very promising product, which with correct diagnosis can certainly contribute to a high degree to maintenance of the vitality of the dental pulp or to the retention of a tooth. Unfortunately at present little scientific data on Biodentine™ is available. More scientific studies on Biodentine™ are therefore absolutely necessary.

Fig. 3a-d: Use example – perforation repair

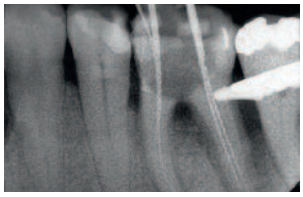


Fig. 3a: In the trepanation and exposure of the root canal entries alio loco, a perforation of the pulp chamber floor occurred on tooth 36 of a 50-year old patient. Presumably caused by the perforation, an incipient interradicular translucence is visible in the radiographs.

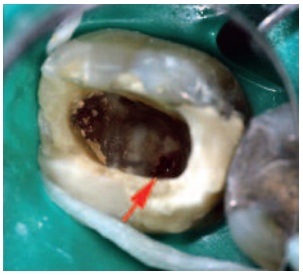


Fig. 3b: The arrow indicates the clinically visible perforation site.

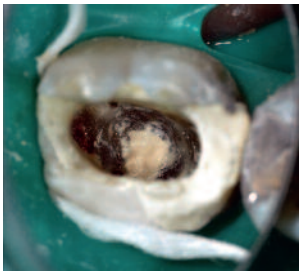


Fig. 3c: The perforation of the pulp chamber floor was covered with Biodentine™ and a root canal treatment performed.

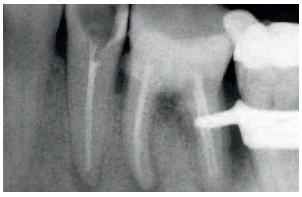


Fig. 3d: One month after the perforation repair with Biodentine™, the interradicular translucence on the radiograph seems reduced. However in this case also, the cement cannot be easily distinguished from the dentine.

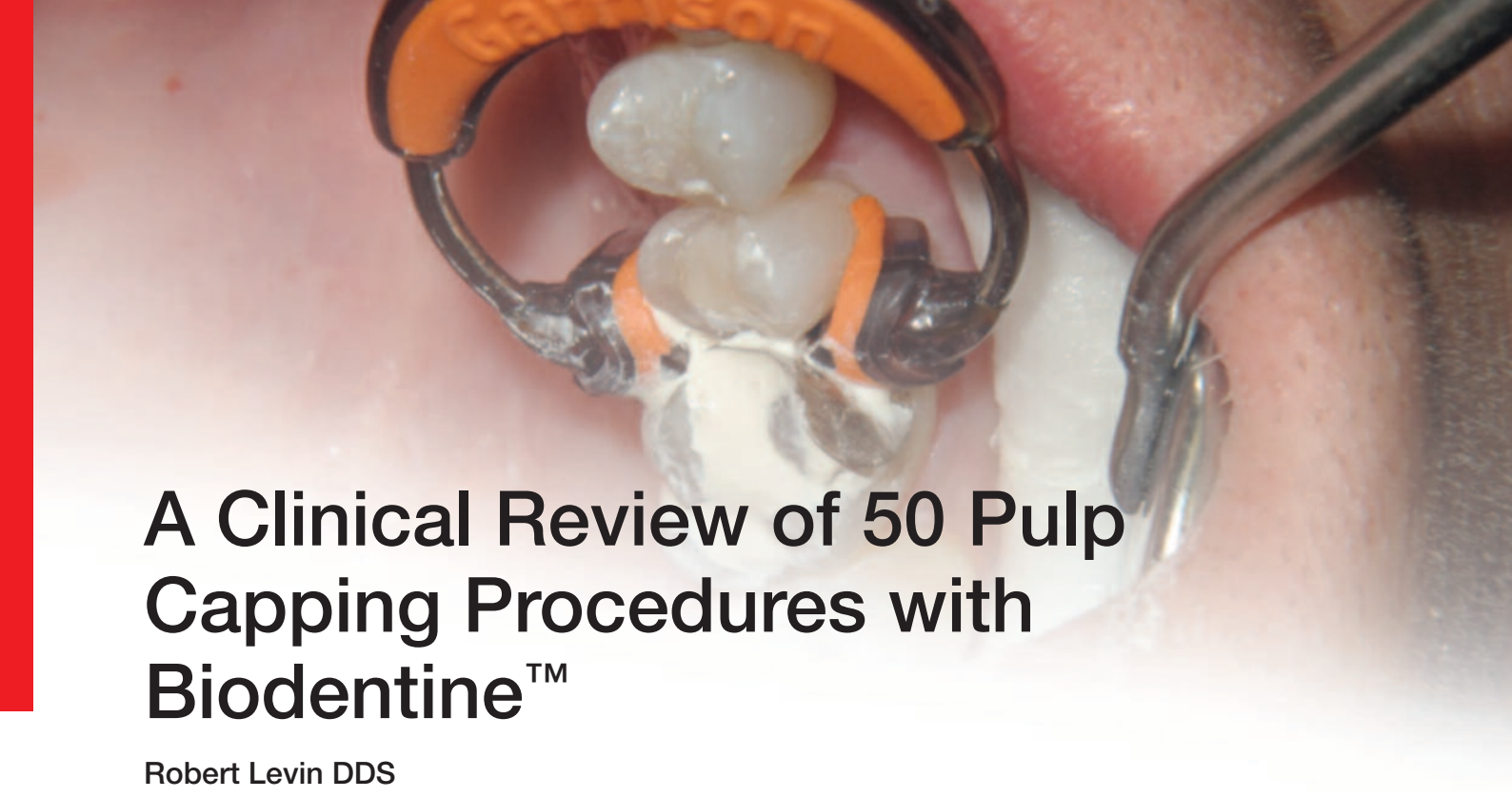
Dr Till Dammaschke, Assistant professor, DDM
Department of Operative Dentistry - University of Münster, Germany
Albert-Schweitzer-Campus 1, building W30 - Waldeyerstr. 30 - 48149 Münster - Germany
Phone +49-251-8347035 - Fax +49-251-8347037 - tillda@uni-muenster.de

Born 1965. 1986 study of sociology, politics and history at Georg-August University Göttingen. 1987-1993 study of dental medicine at Georg-August University Göttingen. Since 1994 scientific assistant with Prof. Dr. med. dent. K. Ott in the Polyclinic for Dental Care at the Westphalia Wilhelms University Münster. 1996 doctorate at the Georg-August University Göttingen. Since 1998, Assistant Medical Director at the Polyclinic for Dental Care at the Westphalia Wilhelms University Münster. DGZ prize 2000. “Endodontics” prize-winner 2000 and runner-up in 2010. Year’s best scientist prize at DGZMK 2004. DGZ prize 2004. Since November 2002 on the Advisory Board of the Journal “Endodontie”. Since 2005 Chairman of “AGET Study Group” Münster. 2007 Appointment to the Academic Board. 2008 Postdoctoral qualification. 2009 Appointment to the Senior Academic Board.

Source: all illustrations are from the author (Till Dammaschke).

Literature

1. Bodrumlu E. Biocompatibility of retrograde root filling materials: A review. Aust Endod J 2008;34:30-35.
2. Boukpessi T, Septier D, Goldberg M. VI-2-2-2 Animal studies. In: Goldberg M (ed.) Biocompatibility or cytotoxic effects of dental composites. Coxmoor, Oxford 2009, pp 200-203.
3. Carr GB, Bentkover SK. Surgical endodontics. In: Cohen S, Burns RC (eds.) Pathways of the pulp. 7th ed. Mosby, St. Louis 1998, pp 636.
4. Dammaschke T. Reaktionen der Rattenpulpa auf drei verschiedene Dentinadhäsive sowie ProRoot MTA im Vergleich zu Kalziumhydroxid bei der direkten Überkappung. Habilitationsschrift, Westfälische Wilhelms-Universität, Münster, 2007.
5. Dammaschke T. Dentinersatz. Dent Mag 2011;28(2):30-34.
6. Dammaschke T, Gerth HUV, Züchner H, Schäfer E. Chemical and physical surface and bulk material characterization of white ProRoot MTA and two Portland cements. Dent Mater 2005;21:731-738.
7. Dammaschke T, Wolff P, Sagheri D, Stratmann U, Schäfer E. Mineral trioxide aggregate for direct pulp capping: a histologic comparison with calcium hydroxide in rat molars. Quintessence Int 2010;41:e20-e30.
8. Déjou J, Raskin A, Colombani J, About I. Physical, chemical and mechanical behavior of a new material for direct posterior fillings. Eur Cell Mater 2005;10(Suppl 4):22.
9. Duda S, Dammaschke T. Maßnahmen zur Vitalerhaltung der Pulpa. Gibt es Alternativen zum Kalziumhydroxid bei der direkten Überkappung? Quintessenz 2008;59:1327–1334, 1354.
10. Firla MT. Dentin-Ersatzmaterial auf Basis der Active Biosilicate Technology. DZW Kompakt 2011; 58(1):10-12.
11. Gutmann JL, Lovedahl PE. Problem-solving challenges in periapical surgery. In: Gutmann JL, Lovedahl PE (eds.) Problem solving in endodontics. 5th ed., Elsevier Mosby, Maryland Heights 2011, p 351.
12. Hench LL, West JK. Biological application of bioactive glasses. Life Chem Reports 1996;13:187-241.
13. Laurent P, Aubut V, About I. VI-2-2-1 Development of a bioactive Ca3SiO5 based posterior restorative material (Biodentine™). In: Goldberg M (ed.) Biocompatibility or cytotoxic effects of dental composites. Coxmoor, Oxford 2009, pp 195-200.
14. Laurent P, Camps J, de Méo M, Déjou J, About I. Induction of specific cell responses to a Ca3SiO5-based posterior restorative material. Dent Mater 2008;24:1486-1494.
15. Motsch A: Die Unterfüllung – eine kritische Diskussion der verschiedenen Zement and Präparate. In: Akademie Praxis and Wissenschaft in der DGZMK (Hrsg.) Neue Füllungsmaterialien – Indikation and Verarbeitung. Carl Hanser, München 1990, S. 35 – 54.
16. Pradelle-Plasse N, Tran X-V, Colon P. VI-2-1 Physico-chemical properties. In: Goldberg M (ed.) Biocompatibility or cytotoxic effects of dental composites. Coxmoor, Oxford 2009, pp 184-194.
17. Roberts HW, Toth JM, Berzins DW, Charlton DG. Mineral trioxide aggregate material use in endodontic treatment: A review of the literature. Dent Mater 2008;24:149-164.
18. Shayegan A. persönliche Mitteilung 2011.
19. Stropko JJ. Micro-surgical endodontics. In: Castellucci A (ed.) Endodontics. Vol. III. Edizioni Odontoiatriche Il Tridente, Florence 2009, pp 1118-1125.
20. Watson T. persönliche Mitteilung 2011.



A Clinical Review of 50 Pulp Capping Procedures with Biodentine™

Robert Levin DDS
Private practice Huntington Beach, California, USA

A clinical review of 50 teeth with direct and indirect pulpcaps utilizing the tricalcium silicate filling material by Septodont: Biodentine™

Methodology

Teeth were selected as presented in a private practice. Subject teeth were tested for percussion sensitivity using a mirror handle. Subject teeth were tested for cold response using Endo Ice (Hygenic). Subjects were also interviewed as to a history of pain or sensitivity prior to the dental visit. The teeth that were selected and tested had Radiographic decay near or at the nerve. Decay was initially removed with a slow speed round bur and the deeper decay was removed with a spoon till either the nerve was encountered or healthy hard shinny dentine was encountered. As a clinician an effort was made not to disturb pupal tissue any more than necessary. At the same time decay and chalky dentine was removed irrespective of its proximity to the pulpal tissue. The teeth were immediately filled with Biodentine™. Isolation was simply achieved with cotton rolls only. Sectional matrix and toffelmire matrix with a wedge were used for proximal preps.

Background

As a general dentist practicing in Huntington Beach for 25 years, I am always on the lookout for products and services that will make my job easier with better and more predictable outcomes. I received a trial pack of Biodentine™ for evaluation in March 2010. My clinical success with pulp capping prior to using Biodentine™ was at best 50/50. Clinically I have used MTA (mineral trioxide aggregate), Calcium Hydroxide preparations (like, Dycal®), Glass Ionomer Bases and other bonding procedures and have never had predictable results. I found in my hands MTA difficult to work with and place. Calcium Hydroxide preparations can also be difficult to place and retain on an affected area. The bottom line is if I hit the pulp removing decay on an asymptomatic tooth the most predictable procedure in my practice was to begin Root Canal Treatment. Although RCT is a predictable method of saving a tooth it should be avoided if possible, due to expense, and possible risk of tooth loss long term due to fracture or re-infection.

Biodentine™ is a tricalcium silicate close to MTA but not the same. Like MTA, Biodentine™ is bioactive and biocompatible in that both have been shown to induce secretion of reactionary dentin and pulpal healing[1]. MTA use began in the 1990's at Loma Linda University mainly as root repair and apico-filling material. Many studies have since shown MTA to be a predictable pulp capping material[2][3]. Both MTA and Biodentine™ have great sealing capacities unlike Calcium Hydroxide preparations[4][5]. The composition of the two materials is slightly different. MTA and Biodentine™'s two major components are tricalcium silicate and dicalcium silicate. MTA has 21.6% bismuth oxide to give the material radiopacity. Biodentine™ uses Zirconium Oxide to give radiopacity. Biodentine™ is not as radiopaque as MTA, but still visible on the radiograph.

Biodentine™ sets in 12 minutes. MTA sets in 2 hours. To achieve the 12 minute setting time, control of the particle size and the addition of calcium chloride and water reducing agents were used along with calcium carbonate as a filler. The bottom line is that Biodentine™ can be used as a bulk fill restorative and pulp capping agent with no preliminary conditioning of the prep site enabling a much easier pulp capping technique. Biodentine™ is an engineered pure material without the trace minerals found in Portland cement. MTA has a sandy texture whereas Biodentine™ has a creamy stone like texture. Biodentine™ has physical properties similar to dentine and Glass Ionomers[6].

Both MTA and Biodentine™ form Calcium silicate gel and Calcium Hydroxide upon setting. Calcium Hydroxide has been shown to be a potent inhibitor of endotoxins and gram negative bacteria[7]. Both Biodentine™ and MTA have been shown to form a physicochemical bond to dentine[8][9]. In my opinion there are several reasons why clinicians are shying away from doing routine pulp capping procedures:

1. Previous failures and a perception that all pulp capping procedures will eventually lead to root canal therapy.
2. The relatively high cost of MTA and difficulty of manipulation and placement.
3. Lack of knowledge of the clinical success rates of MTA and Biodentine™. MTA in one study showed a 97.96% success over a nine year span[10]. That is a very predictable outcome for any dental procedure.

Results

Biodentine™ was placed on a total of 50 teeth from a total of 45 patients between March 2010 and April 2011. During this time frame I have placed Biodentine™ in more than 50 teeth. For the purpose of this review only teeth where I anticipated an exposure and documented percussion, cold test, and history of pain are included. I have documented a total of 4 failures, which represents all of the failures during this time frame.

It is much easier to discuss my failures than my successes. Success is being defined as conti-

(1) Patrick Laurent,Virgine Aubut, Imad About,. VI-2-2-1 Development of a Bioactive Ca3SiO5 based posterior restorative material(Biodentine™). Laboratoire IMEB,Faculte' d'Odontologie, Universite'de la Mediterrane'e, Marseille, France.

(2) George Bogen,DDS, Jay S. Kim, PHD and Leif K. Bakland,DDS. Direct Pulp Capping with Mineral Trioxide Aggregate An observational study. J Am Dent Assoc. vol 139,No 3 305-315 2008 American Dental Association

(3) Mente J, Geletneky B, Ohle M, Koch MJ, Friedrich Ding PG, Wolff D, Dreyhaupt J, Martin N, Staehle HJ, Pfefferle T. Mineral trioxide aggregate or calcium hydroxide direct pulp caping: an analysis of the clinical treatment outcome. J Endod. 2010 May;36 (5):806-13

(4) N.K. Sarkar,R.Caicedo,P.Ritwik,R. Moiseyeva, and I. Kawashima. Physicochemical Basis of the Biologic Properties of Mineral Trioxide Aggregate. JOE Vol31 Number 2, February 2005 pgs 97-99

(5) TranV, Pradelle N,ColonP . Micro Leakage of a new restorative calcium based cement (Biodentine™). Oral Presentation PEF IADR Sept 2008 London

(6) Nelly Pradelle-Plasse (university Paris 7 Denis Diderot & LGPM, Ecole Centrale de Paris) France, Xuan-Vinh Tran (University of Medicine and Pharmacy, Ho Chi Minh city, Vietnam), & Pierre Colon (University Paris 7 – Denis Diderot &LGPM, Ecole Centrale de Paris). France.

(7) Zahed Mohammadi, DMD, MSD. Endotoxin in Endodontic Infections: A Review. J CDA March 2011 153-158

(8) N.K. Sarkar,R.Caicedo,P.Ritwik,R. Moiseyeva, and I. Kawashima. Physicochemical Basis of the Biologic Properties of Mineral Trioxide Aggregate. JOE Vol31 Number 2 , February 2005 pgs 97-99

(9) Biodentine™ labeled with Florescein dye which has moved from the cement into dentine tubules. Notice the plugs of material in the tubule openings. Courtesy Dr. Amre Atmeh, Kings College London.

(10)George Bogen,DDS, Jay S. Kim, PHD and Leif K. Bakland,DDS. Direct Pulp Capping with Mineral Trioxide Aggregate An observational study. J Am Dent Assoc. vol 139,No 3 305-315 2008 American Dental Association

nued lack of sensitivity or pain, lack of percussion sensitivity, and normal cold response and lack of apico radiolucency.

My second placement of Biodentine™ was my first failure. Patient had direct carious exposure, history of pain, and moderate percussion sensitivity. Patient returned two days later in acute pain. The second failure was on the mesial gingival of #15. No percussion sensitivity, normal cold test, no history of pain, and direct pulp cap. After repeated attempts over an 11 month period, I was finally able to contact the patient to schedule his final restoration. Patient returned with food trapped, in pain and had picked out the Biodentine™ from his tooth. Similarly my third failure was on tooth #31, a direct pulp cap. The patient returned 8 months later with a large DOB which broke one month prior to coming to my office. He was to have #32 extracted prior to restoring #31 and had delayed having it done. The final failure during this time frame was #19 DO- patient had slight percussion sensitivity, a normal cold test, with a history of pain. This patient was back within a week to begin RCT. My most recent failure was #19 MO. The patient had normal cold response, normal percussion, but history of pain the prior week and was back 3 days later in acute pain.

Of the remaining 46 teeth, 37 were direct exposures with obvious pulpal issues. Nine of the teeth were indirect exposures in that the dentine appeared pink after thorough excavation of caries. All of these 46 teeth were asymptomatic and had normal cold and percussion test results. A total of 10 crowns were placed, 2 Glass Ionomer restorations, and 32 composite restorations. Two of the remaining 46 teeth have not yet been restored for various reasons.

Discussion

After placing Biodentine™ in over 100 teeth in the last 2 years it has become obvious that asymptomatic teeth (without signs of pulpitis) will remain vital and lack post- operative pain - irrespective if pulp was exposed or not. I have also observed that asymptomatic teeth do not have bleeding issues. There is slight to no bleeding of pulpal tissue as long as careful excavation of caries is observed *(fig.1)*. All of the teeth that have had either a history of pain or percussion sensitivity have failed. In fairness it is possible that a percentage of symptomatic teeth may remain vital. In most cases I would start RCT in symptomatic teeth and not try Biodentine™. My total sample size for symptomatic teeth is 3 and all 3 have failed. With that said, with asymptomatic teeth (with the exception of 2 non-compliant patients), i have had 100% success in my practice so far.

The length of my experience with Biodentine™ is relatively short, but others have paved the way with MTA and Biodentine™[11][12]. These

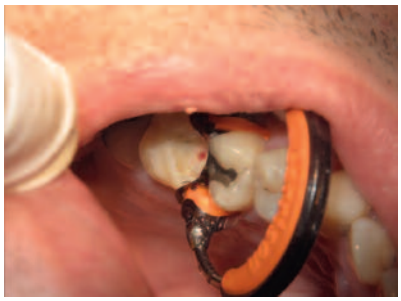


Fig.1: Note lack of bleeding

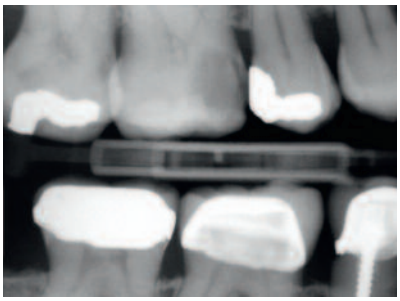


Fig. 1a: Preop BiteWing

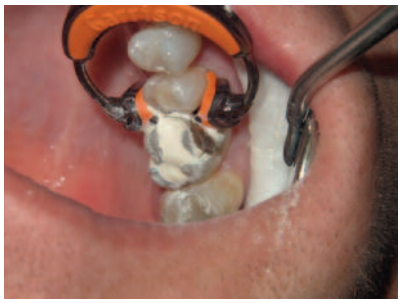


Fig. 1b: After placement Biodentine™ while setting

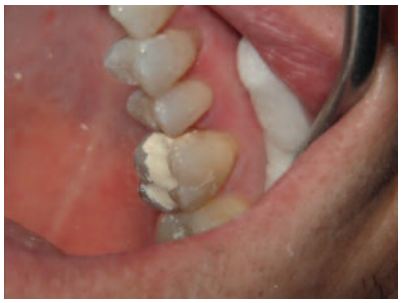


Fig. 1c: Band remove and carved

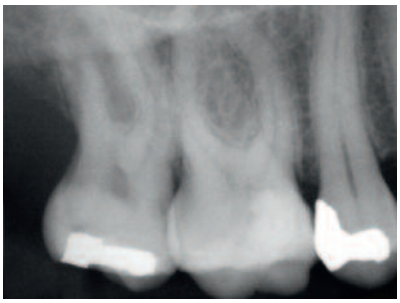


Fig. 1c: Final radiograph 3 months

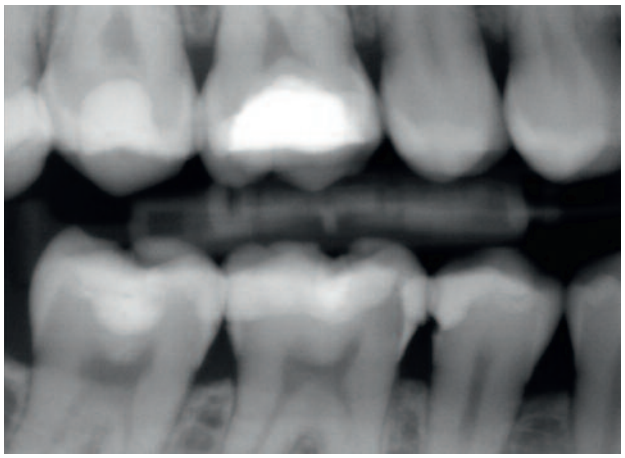


Fig. 2a: note mesial decay #30

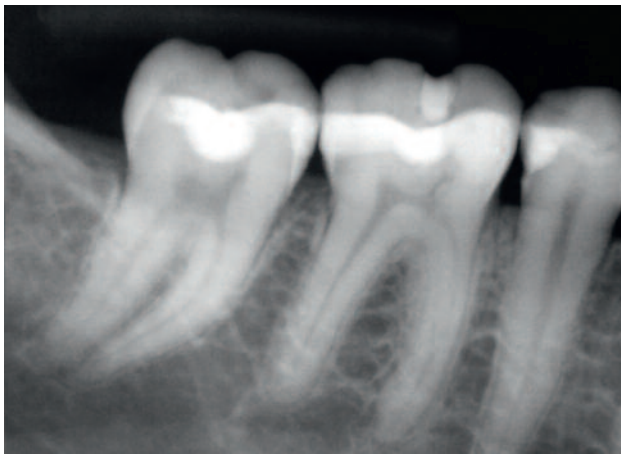


Fig. 2b: note Biodentine™ encroachment on mesial pulp horn

teeth seem to be maintaining vitality in that they still have a normal cold test and lack of percussion sensitivity.

There is a bit of a learning curve in using the material as it needs to be handled gently. Care should be taken not to have too much moisture present as it will affect the surface. I have not used a rubber dam to isolate or sodium hypochlorite to sterilize the teeth. The calcium hydroxide in the setting reaction acts as an bacteriostatic interface due to its pH of 12.5[13]. What bleeding I do get is easily controlled by pressing a cotton pellet onto the site. It is a common indication to use sodium hypochlorite to dissolve the tissue in root canal systems; however, I am not sure that I want to expose vital tissue of the pulp to the sodium hypochlorite if I don't need to. Many other researchers have advocated the use of sodium hypochlorite to control bleeding. I only point this out because I have been getting favorable results without its use. I have since used sodium hypochlorite in an asymptomatic case to control bleeding that was more than normal and resulted in Biodentine™ extruding into the the pulp horn *(fig.2)*. However, to date of this article, this tooth is still doing well.

Conclusion

Biodentine™ is a viable and predictable alternative to RCT in teeth with carious exposures and that lack pulpitis symptoms. Biodentine™ can be used as bulk fill, simplifying a pulp capping procedure. There is no need to carefully place the Biodentine™ on the pulp exposure. The clinician need only fill the entire prep with Biodentine™ thereby sealing the tooth from additional exposure. Hopefully Biodentine™'s lower cost and ease of use will encourage the general dentist as well as the Endodontist to make Biodentine™ pulp capping procedures a routine viable option to RCT.

Dr. Robert Levin
Clinical Instructor in the Practice Dynamics, Community Dentistry and faculty for Mobile Dental clinic within the USC School of Dentistry in 1985.
Started Allcoast Dental in 1986 where he still practices. Dr. Levin was among the first evaluators of Biodentine™ in the US.

(11) George Bogen,DDS, Jay S. Kim, PHD and Leif K. Bakland,DDS. Direct Pulp Capping with Mineral Trioxide Aggregate An observational study. J Am Dent Assoc. vol 139,No 3 305-315 2008 American Dental Association.
(12) Till Dammaschke, Biodentine™ A New Bioactive Cement For Direct Pulp Capping. Assistant professor, DDM - Department of operative Dentistry , Waldeyer.30 48149 Munster, Germany.
(13) Zahed Mohammadi, DMD, MSD. Endotoxin in Endodontic Infections: A Review. J CDA March 2011 153-158.

Successful use of Biodentine™ in two deep cavity cases

Dr. Monika Spirollari
Private practice, Tirana, Albania

Biodentine™ has been implemented in our daily practice for a year and a half. During this period of time, we used it in about 50 different patients in varied indications with very positive results.

The indications for which Biodentine™ can be used are the following:

- **Pulp protection on direct and indirect pulp capping**
- **Pulpotomy**
- **Managing perforation of pulp floor**
- **Managing perforation of root canals**
- **Internal and external resorption**
- **Apexification in immature teeth**
- **Retrograde root canal filling**

One of the most helpful indications for Biodentine™ is its use in very deep cavities for which very often clinicians wonder if they should go or not to root canal treatment.

Facing the dilemma: keeping or removing the pulp?

As we know, one of the most important factors that preserve the long term vitality of the pulp is the material that is going to be used under the composite filling.
So far, we have used Calcium hydroxide, Glass-ionomer cements as bases in deep cavities. In most cases it turned out to fail and the pulp vitality was not preserved. As for pulp exposures, we didn't even give a try to direct pulp capping given the unpredictability of the outcome.
In this context, we have tried Biodentine™, a

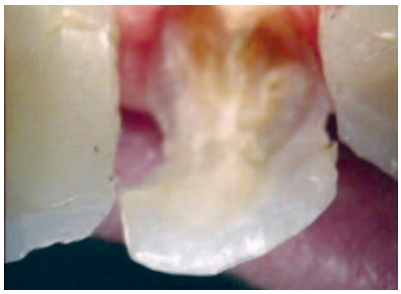


Fig. 1

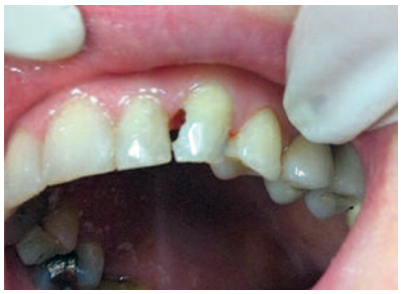


Fig. 2

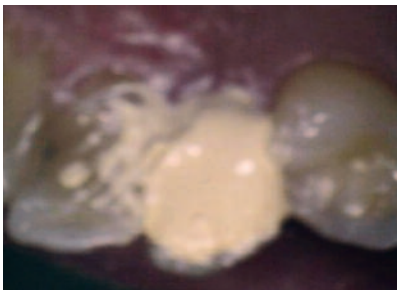


Fig. 3

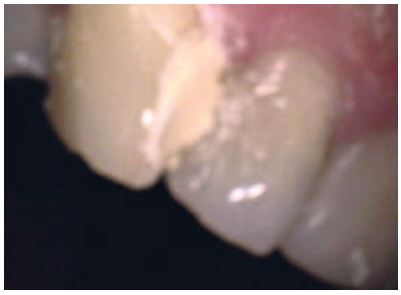


Fig. 4

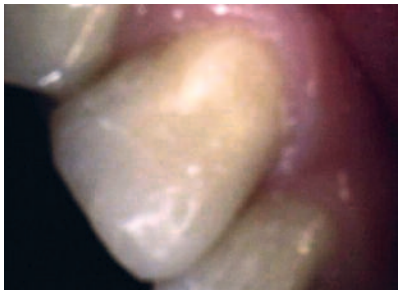


Fig. 5

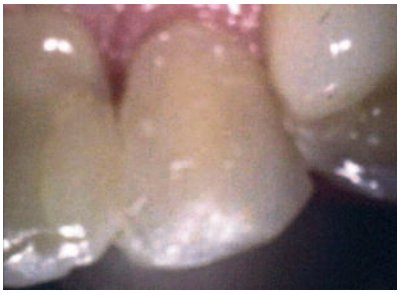


Fig. 6

new calcium silicate dentin substitute, whose advantages are numerous. It is easily and precisely mixed thanks to the capsule triturated 30 seconds on a mixing machine. The capsule and the pipette avoid mixing it by hand on the mixing pad, and therefore keep the material clean from cross contamination.
Its setting time is 12 minutes, which gives us ample time to work and completely fill the prepared cavity. After 12 minutes, Biodentine™ mechanical properties are high enough to leave it as a temporary material, before the patient is called back and the final restoration is placed.
A week later we reduced Biodentine™ down to a dentin substitute level by removing the first millimeters using a diamond bur. It is important to mention that at this time Biodentine™ is almost as strong as dentin and cuts like dentin.
A year and a half follow-up showed that none of our patients came back in the office with complications so far.
In 80 % of them we have done the vitality test, which gave a positive result.

Case Report no.1

The first patient is 40 years old. Tooth number 23 had an old filling, which needed to be changed. After removing it, resulted a very deep cavity.
As you can see from the picture only the buccal wall was left. We decided to use Biodentine™ and completely fill the cavity with it. After one week, keeping Biodentine™ as a temporary filling material, the patient came back in the office in order to have the final restoration placed.
With a diamond bur we reduced the superior part of the Biodentine™ filling and bonded N'Durance® composite on top of it as a final esthetic and functional restoration.
During the year following the Biodentine™ + N'Durance® restoration placement the patient regularly returned to the dental practice, for other treatments. In every session we checked the pulp state with a vitality test. The test result was positive. *(Fig.1 to 6)*

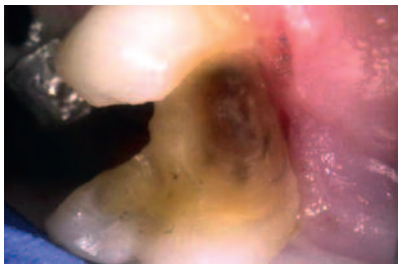


Fig. 7

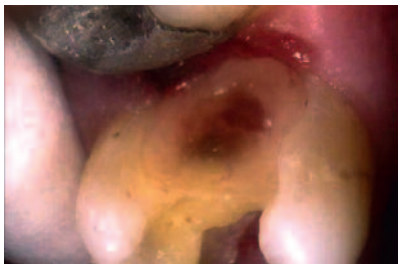


Fig. 8

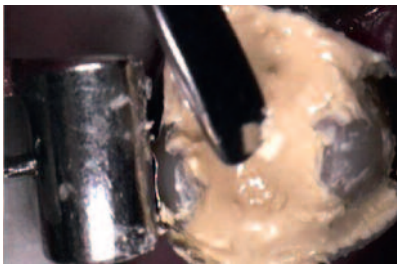


Fig. 9

Case Report no.2

The second case is a 32-year old girl. She wanted to have the amalgam filling on tooth number 17 removed. After removing the amalgam you can see from the pictures how huge was the cavity. For sure our choice was Biodentine™. Biodentine™ was used to completely fill the cavity and was kept as a temporary filling for two weeks. First couple of days some sensitivity was observed, which disappeared after a few days.
The definitive composite restoration was placed two weeks later and the vitality test showed to be positive 16 months later. *(Fig.7 to 14).*

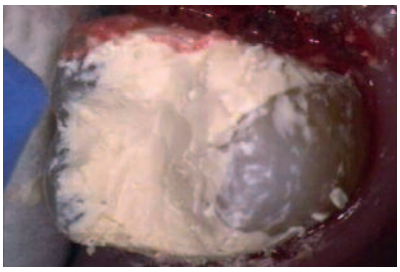


Fig. 10

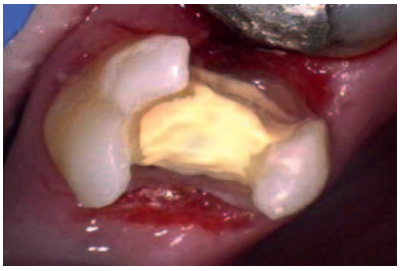


Fig. 11

Conclusion

Calcium silicate-based cement (Biodentine™) is suitable as a dentine replacement, whenever original dentine is damaged. Our experience of using Biodentine in a general practice showed that Biodentine is the best choice for maintaining the pulp vitality because of the following advantages:

- **Positive effect on vital pulp cells**
- **Stimulates tertiary dentin formation**
- **Antibacterial properties**
- **Produces tight seals**
- **Short time for setting**
- **Very biocompatible**
- **Mechanically strong**
- **1 week to 6 months to final restoration**

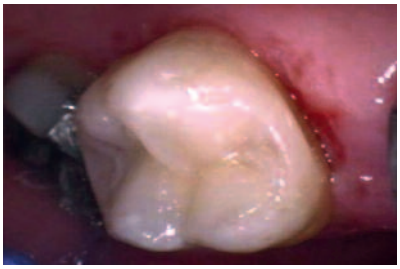


Fig. 12

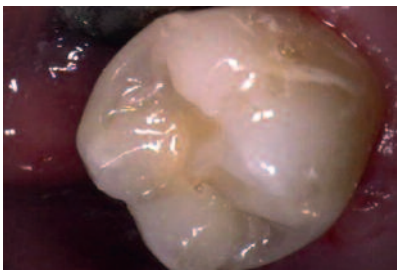


Fig. 13

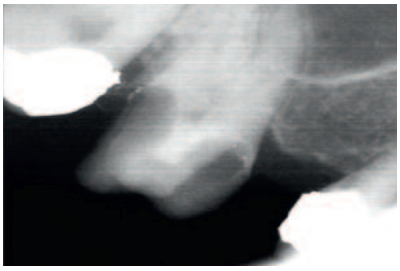


Fig. 14

Dr. Monika Spirollari
Studied dentistry at the university “Carol Davila”, Bucharest, (Romania).
She works as a general dentist to a private practice “PRODENT”, in Tirana.
Rr.” Abdyl Frasheri” , Pallati “Hekla”, Kati III, Tirana, Albania.
arkonda @yahoo.com

Pulp chamber floor perforation treatment with Biodentine™

Dr Godfrey Cutts
Private practice, Nuneaton, United Kingdom

Case no.1 - Patient 49 year old male

Initial endodontic treatment was performed to 26. The tooth was isolated with rubber dam and the operating microscope was employed throughout the treatment. Working lengths were established with an apex locator and the canals instrumented with RaCe Ni-Ti to ISO 35 .04 taper. Irrigation with 3% NaOCl 17% EDTA and irrisafe passive ultrasonic irrigation (PUI). Obturation with Kerr RC sealer GP SystemB and Obtura was completed.

It was observed that the floor of the pulp chamber had an abnormal honeycomb appearance.

The access cavity was restored with GIC.

Some four months after completion of treatment the tooth became tender to percussion (TTP). The buccal and palatal gingivae were inflamed and tender and the furcation was probable to 5mm.

The tooth was isolated with rubber dam; the access cavity re-opened which revealed that the floor of the pulp chamber had an extensive defect which was bleeding freely. The access cavity was irrigated with 3% NaOCl and haemostasis obtained. Biodentine™ was mixed according to the manufactured instructions was placed passively onto the floor of the pulp chamber using a ball ended burnisher and allowed to set for ten minutes. Endodontic sponge was placed on the set Biodentine to prevent occlusal pressure on the Biodentine and the access cavity temporised with IRM.

The case was reviewed after three months, the symptoms had completely resolved and the access cavity was permanently restored with bonded composite.

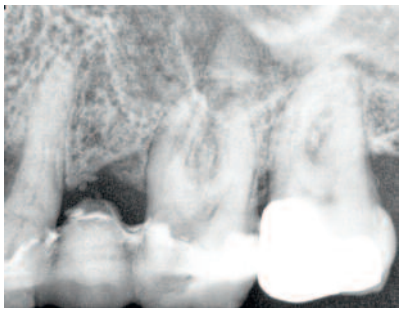


Fig. 1: Pre-operative radiograph

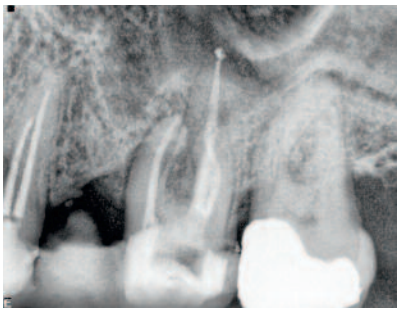


Fig. 2: Completed endodontic treatment

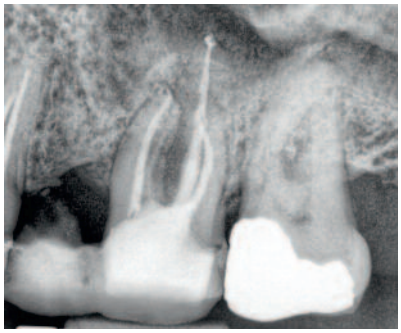


Fig. 3: Post placement of Biodentine

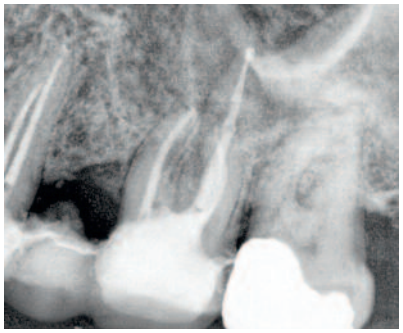


Fig. 4: 3-month review

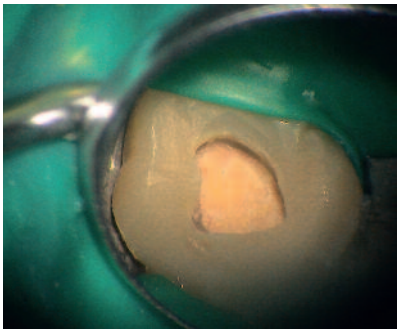


Fig. 5: Biodentine™ within the access cavity

Case no.2 - 44 year old male referred by his dental practitioner for possible endodontic treatment to 36

The patient stated that a previous dental practitioner had attempted endodontic treatment and had advised him that treatment was not possible and that the tooth should be extracted. The tooth had a temporary restoration and was symptomatic.

The pre-operative radiograph indicated apical periodontitis and a perforation of the floor of the pulp chamber.

Upon investigation there was a perforation of the floor of the pulp chamber into the furcation mesial to the distal root and the distal canal had not been identified *(Fig 6 & 7)*. The canals were instrumented, cleaned and obturated *(Fig 8)*.

The perforation was dried with large paper points and Biodentine was packed into the defect and allowed to set for 12 minutes *(Fig 9 & 10)*. Since a bonded amalgam core was to be placed GIC was placed above the Biodentine to prevent displacement of the Biodentine.

The post-operative radiograph demonstrates repair of the perforation.

The patient will be reviewed in six months.

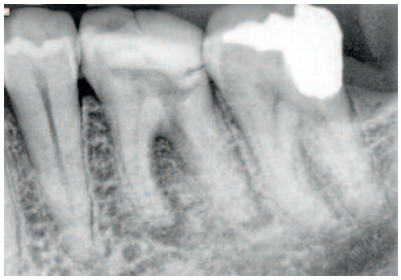


Fig. 6

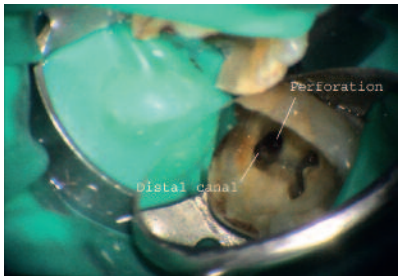


Fig. 7

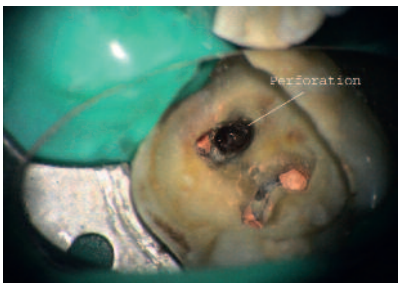


Fig. 8

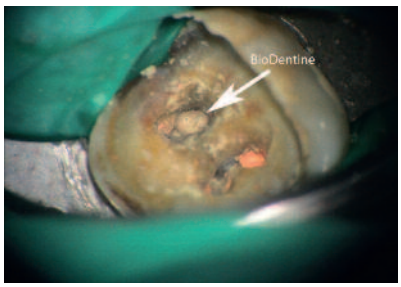


Fig. 9

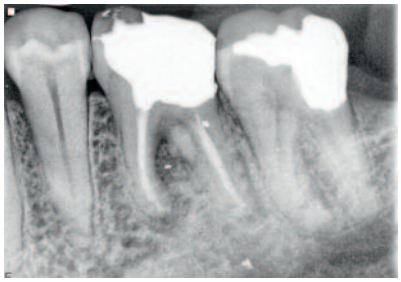
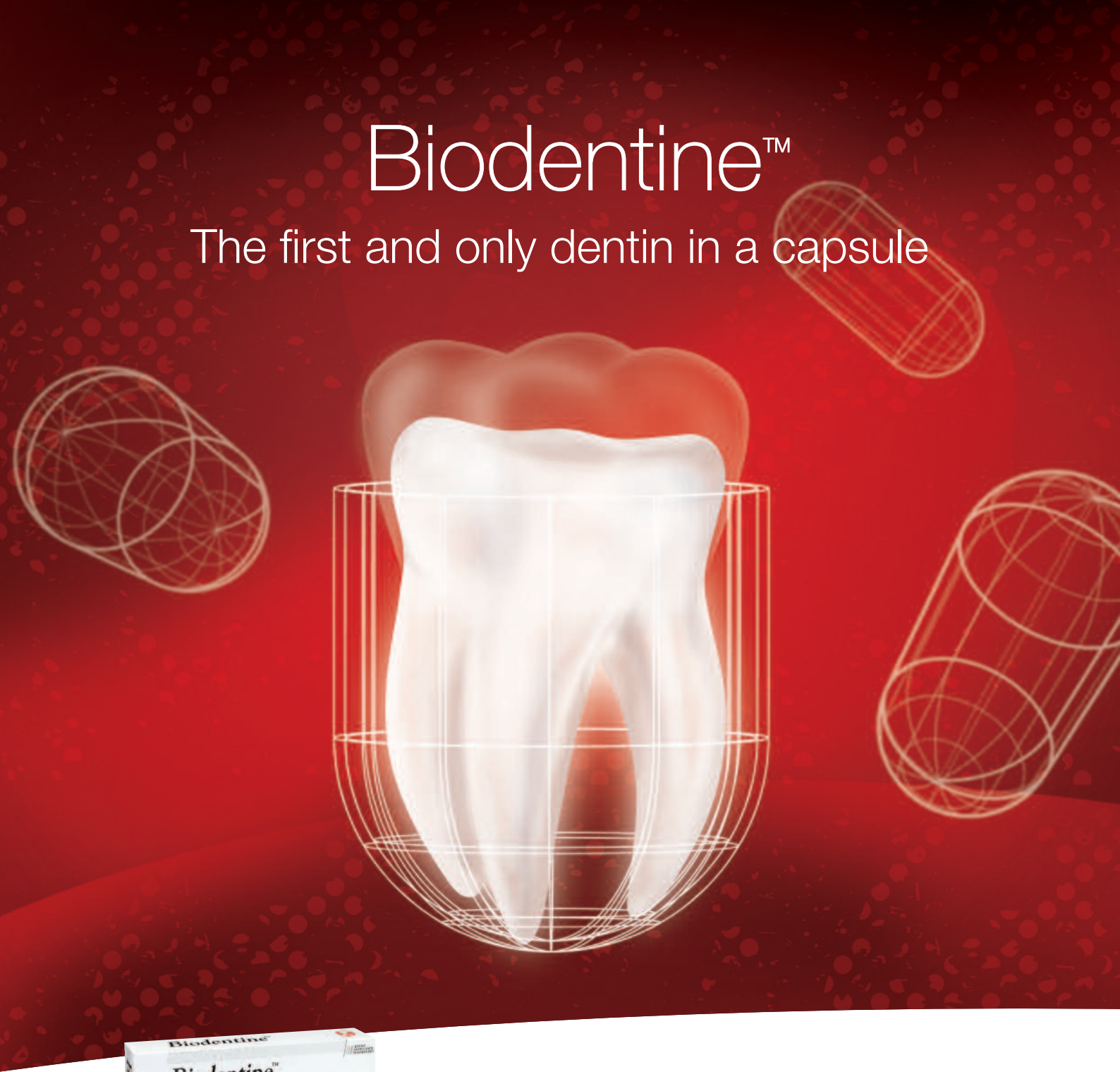


Fig. 10

Godfrey Cutts LDS Dunelm.
Graduated from the Sutherland Dental School, Newcastle upon Tyne in 1961.
In general practice as a GDP in Nuneaton Warwickshire from 1964 until the present day.
In 1968 the practice was sold to Oasis Dental Care and has held posts with the company as Clinical Director and Clinical Advisor.
Has a special interest in endodontics and has attended numerous courses including those held at the Eastman Dental Institute and is a member of the British Endodontic Society attending their meetings on a regular basis. In the past eight years he has organised and lectured at hands on courses for GDP's at venues around the country.
Has an active interest in developing new instruments, materials and protocols for their use to enhance treatment outcomes.
In 2005 he filmed and produced the instructional DVD for the use of RaCe Ni-Ti files.
Currently he has a successful endodontic referral practice, treating some 500 cases a year, where practitioners from some fifty miles around refer patients for initial treatments, re-treatments and apical micro-surgery.
godfrey@gcutts.co.uk

Biodentine™

The first and only dentin in a capsule



ACTIVE BIOSILICATE TECHNOLOGY

As the **first all-in-one** biocompatible and bioactive **dentin substitute**, Biodentine™ fully replaces dentin wherever it's damaged.

Biodentine™ helps the remineralization of dentin, preserves the pulp vitality and promotes pulp healing. It replaces dentin with similar biological and mechanical properties.

Improving on **Biodentine™** clinical implementation, you can now bond the composite onto Biodentine™ in the same visit and perform the **full restoration in a single session**.

To enjoy the clinical benefits of the first and only dentin in a capsule, ask your dental distributor for Biodentine™.

Learn more with the Biodentine™ brochure

septodont

septodont

The Dental Pharmaceutical Company

INNOVATIVE, SAFE AND EFFECTIVE SOLUTIONS FOR DENTISTRY WORLDWIDE