Vital pulp therapy with Biodentine™ in two immature, traumatized teeth

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Introduction

If pulp vitality in a young, permanent tooth is lost before root formation is completed, the clinician is confronted with a tooth that is more prone to fracture in case of a trauma, due to the presence of a root with very thin dentinal walls. In addition, the affected tooth might exhibit a poor crown-root ratio. Therefore, it is of utmost importance that pulp vitality should be preserved in an immature tooth with pulp involvement.

According to the definition of the AAE, the American Association of Endodontists, vital pulp therapy is a procedure to encourage apexogenesis.

The requirements for a successful vital pulp therapy are a the presence of a non-inflamed or a reversibly-inflamed pulp, the ability the control the hemorrhage, the use of a biocompatible and bioactive pulp capping material and the creation of a bacteria-tight seal.

Over the course of time, several materials have been used as pulp capping agents. Calcium hydroxide has traditionally been the material of choice, followed by Mineral Trioxide Aggregate (MTA). MTA is described as a first generation bioactive material. It has many advantages, but also some disadvantages.[1, 2] The initial setting time is at least 3 hours. It is not easy to manipulate, resulting in considerable wasted material, and is hard to remove. Clinically, both gray and white MTA stain dentin, presumably due to the heavy metal content of the material or the inclusion of blood pigment while setting.[3, 4] Efforts have been made to overcome these shortcomings with new compositions of MTA[5-7] or with additives.[8, 9] However, these formulations affect MTA's physical and mechanical characteristics.

Bioceramics are inorganic, non-metallic, biocompatible materials that have similar mechanical properties as the hard tissues they are replacing or repairing. They are chemically stable, non-corrosive, and interaction well with organic tissue. Bioceramic materials used in endodontics can be categorized by composition, setting mechanism and consistency. There are sealers and pastes, developed for use with gutta-percha, and putties, designed for use as the sole material, comparable to MTA. Biodentine™ is a calcium silicate cement that was developed as a dentine substitute in deep cavities. Comparable to MTA, Biodentine™ is biocompatible and in contact with vital tissues it has been demonstrated to be bioactive and suitable to be used as a pulp capping agent.[10, 11, 12] It has a higher compressive strength than MTA[12] and most glass ionomer cements, a higher flexural strength and flexural modulus than MTA Angelus[12] and can be applied in a bulk on dentin without any conditioning.[13, 14] The material sets in 12 minutes and is capable to withstand deterioration when used as a temporary filling for up to 6 months.[15]

In the opinion of the author, bioceramic materials have several advantages over MTA. In general, bioceramic materials have better clinical handling properties. The difficulties in handling of MTA have been frequently reported by clinicians.[16] Another drawback of MTA is the potential for staining dentin, which has been shown in several in vitro studies,[4, 17, 18] clinical investigations[19, 20] and case reports,[3, 21] which have shown that both white and gray MTA cause discoloration. To date, there have been no reports of staining of dentin by Biodentine™ or comparable bioceramic products, which has also been the experience of the author.

Several studies report that bismuth oxide, which acts as a radiopacifier in MTA as a

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Figure 1a: Preoperative radiograph of #21 showing an immature tooth with an open apex and a complicated crown fracture.
Figure 1b: Clinical picture showing a complicated crown fracture in #21.

radiopacifier,[22, 23] may increase the cytotoxicity of MTA, because bismuth oxide does not encourage cell proliferation in cell culture.[24] Biodentine™ contains zirconium oxide as opacifier.

Case reports

Patient #1 was a 7-year old female who suffered a traumatic dental injury to tooth #21 three days earlier. Her main complaints were sensitivity to warm and cold, and her medical history was noncontributory. Clinical examination revealed a crown fracture with pulp exposure of tooth #21 (Fig. 1a). Radiographically, #21 had an open apex and no peri-apical pathosis (Fig. 1b). The diagnosis was a complicated crown fracture with reversible pulpitis of tooth #21

Treatment options were discussed with the patient and her parents, and a partial pulpotomy was selected as the treatment of choice. The fragment was stored by her parents, but due to the subgingival fracture site (Fig. 1c) and missing tooth structure in the fragment itself (Fig. 1d), it was not possible to re-attach the fragment to the tooth. Local anesthesia was administered (Septanest N, Septodont, Saint-Maur-des-Fossés, France) and a partial pulpotomy was carried out with a new diamond bur in a high speed handpiece with copious water cooling. Since it was not possible to apply a rubber dam, utmost care was taken to keep a dry field and prevent saliva to contaminate the pulp tissue after the Cvek pulpotomy. A cotton pellet soaked in sodium hypochlorite 5% was applied on the pulp stump with

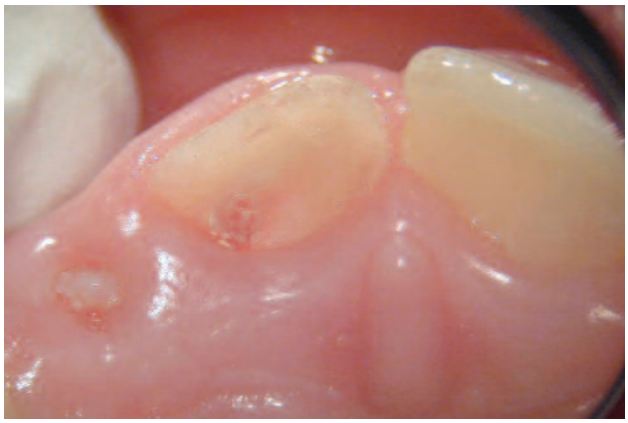


Figure 1c: The palatal aspect of the fracture site, covered with plaque.

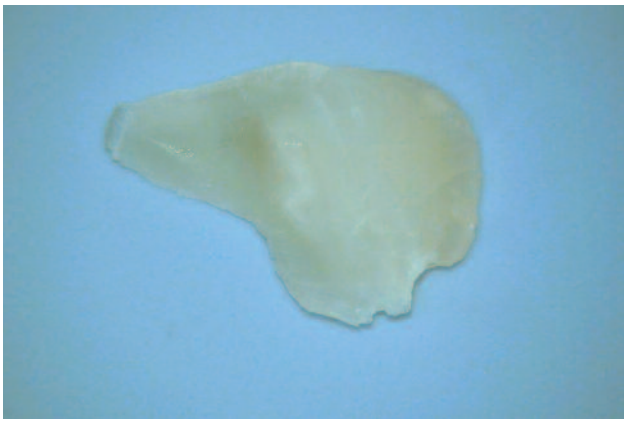


Figure 1d: Photograph of the fragment, showing an oblique fracture line with the palatal outline below the gum line

Figure 1e: After a partial pulpotomy was carried out, a cotton pellet soaked in NaOCl 5% was applied to the pulp stump to stop the bleeding.
Figure 1f: Clinical picture showing the hemorrhage was controlled.
Figure 1g: Biodentine was used as a pulp capping material.

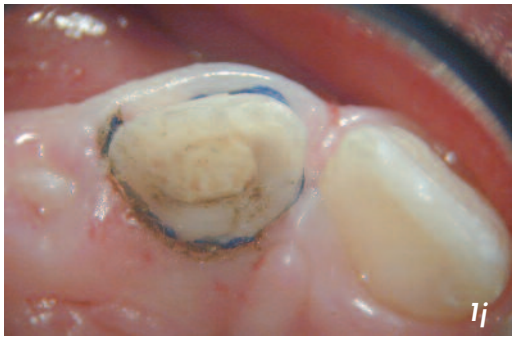


Figure 1h: Postoperative radiograph of the pulp cap with Biodentine, showing a material with moderate radiopacity.
Figure 1i: After one week, the Biodentine had not washed out.
Figure 1j: A retraction cord was packed into the sulcus to obtain a dry field and expose the subgingival margin of the palatal fracture site.

Figure 1k: Postoperative radiograph showing the teeth restored with composite resin.
Figure 1l: Clinical picture of the restoration of composite core material layered with a micro-filled composite at the buccal site.
Figure 1m - n: Recall radiograph at 6 and 12 months, showing continued root formation.

moderate pressure (Fig. 1e). After five minutes, the bleeding had stopped (Fig. 1f), and Biodentine™ (Septodont, Saint-Maur-des-Fossés, France) was applied as a pulp capping material to a thickness of approximately 3 mm with a Dovgan MTA carrier (Hartzell and Son, Concord, CA) (Fig. 1g-h). After the material had set in approximately 20 minutes, it was used as a temporary restoration. This is one of the advantages of the use of Biodentine™ over MTA, and makes it the material of choice in these type of cases. The patient was rescheduled for a second visit. After one week, the patient returned and was asymptomatic. The Biodentine™ had fully set and had not washed out (Fig. 1i). A gingivectomy was carried out, and a retraction cord (Gingibraid, van R, Oxnard, CA, USA) was packed into the

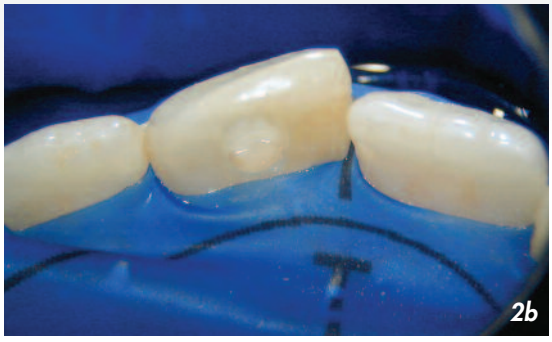
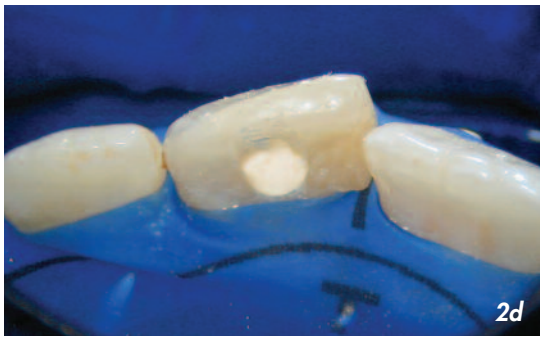
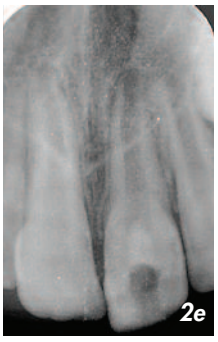
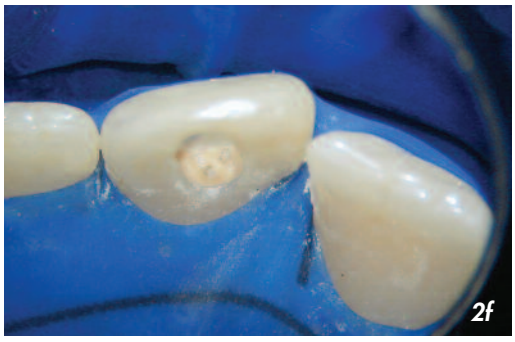


Figure 2a: Preoperative radiograph of 21 showing a class IV restoration of composite resin and an immature root with an open apex.
Figure 2b: After a partial pulpotomy was carried out, a cotton pellet soaked in NaOCl 5% was applied to the pulp stump to stop the bleeding.
Figure 2c: After a couple of minutes, the bleeding had stopped, which is indicative of healthy pulp tissue.







Figures 2d - e: Biodentine was used as a pulp capping material.
Figure 2f: Photograph of the set Biodentine.

Figure 2g: Postoperative radiograph showing the pulp-capped tooth restored with a composite resin.
Figure 2h-i: At 6 and 18 months respectively, the patient was asymptomatic and the recall radiographs showed continued root development.

sulcus (Fig. 1j). Then a build-up of composite core material was placed (Luxacore; DMG, Hamburg, Germany), which was cut back on the buccal site and layered with a micro-filled composite (Filtek Supreme Ultra Universal Restorative, 3M ESPE, St. Paul, MN, USA) (Fig. 1k-l). Follow-up after 6 (Fig. 1m) and 12 months (Fig. 1n) showed a healthy tooth in full function with continuous root development.

Patient #2 was an 8-year old male who was referred for advice and possible treatment of tooth #21. His medical history was noncontributory. Some months ago, he sustained an uncomplicated crown fracture of # 21. His dentist made a restoration of composite resin, that had to be replaced 5

times, because it came loose every single time. For one week, the patient had experienced severe sensitivity to hot and cold food and drinks. Clinical testing confirmed that tooth #21 was very sensitive to cold. A radiographic examination revealed that #21 had an open apex and no peri-apical pathosis (Fig. 2a). The diagnosis was an uncomplicated crown fracture with a reversible pulpitis in tooth #21.

Treatment options were discussed with the patient and his parents, and a partial pulpotomy was selected as the treatment of choice. Local anesthesia was administered (Septanest N, Septodont, Saint-Maur-des-Fossés, France), rubber dam was applied (Optradam, Ivoclar Vivadent, Schaan, Lichtenstein) and a partial pulpotomy was carried out with a new diamond bur in a high speed handpiece with copious water cooling. A cotton pellet soaked in sodium hypochlorite 5% was applied on the pulp stump with moderate pressure (Fig. 2b). After five minutes, the bleeding had stopped (Fig. 2c), and Biodentine™ (Septodont, Saint-Maur-des-Fossés, France) was applied as a pulp capping material to a thickness of several mm with a Dovgan MTA carrier (Hartzell and Son, Concord, CA) (Fig. 2d-e). A moist cotton pellet was introduced on top of the Biodentine™, the access cavity was filled with a temporary filing, and the patient was rescheduled for a second appointment. After a week the patient returned asymptomatic. The Biodentine™ had fully set (Fig. 2f) and a build-up of composite core material was placed in the endodontic access cavity (Luxacore; DMG, Hamburg, Germany), with a top layer of a hybrid composite (Tetric Ceram, Ivoclar Vivadent, Schaan, Lichtenstein) (Fig. 2g). At the 6-month (Fig. 2h) and 18-month recall (Fig. 2i), the tooth was asymptomatic and showed apical maturation and continuous root development.

Conclusion

The author has presented 2 cases in which Biodentine™ was successfully used as a pulp capping material in an immature tooth with pulp involvement. In both cases, treatment provided elimination of symptoms and continuation of root formation. In addition, no signs of discoloration were noticed after 6, 12 and 18 months respectively.

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