Full Pulpotomy with Biodentine in Symptomatic Young Permanent Teeth with Carious Exposure

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Abstract

Introduction: This prospective study evaluated the outcome of Biodentine (Septodont, Saint Maur des Fosses, France) pulpotomy in young permanent teeth with carious exposure. **Methods:** Twenty permanent molar teeth in 14 patients with carious pulp exposure were treated with Biodentine pulpotomy. The age of the patients ranged from 9–17 years (12.3 ± 2.7 years). A preoperative pulpal and periapical diagnosis was established. After informed consent, the tooth was anesthetized, isolated via a dental dam, and disinfected with 5% sodium hypochlorite before caries excavation. Full pulpotomy was performed by amputating the exposed pulp to the level of the canal orifices, hemostasis was achieved via a cotton pellet moistened with 2.5% sodium hypochlorite, a 3-mm layer of Biodentine was placed as the pulpotomy agent, a Vitrebond liner (3M ESPE, St Paul, MN) was applied, and the tooth was subsequently restored. Postoperative periapical radiographs were taken after placement of the permanent restoration. Clinical and radiographic evaluation was completed after 6 months and 1 year postoperatively. Pain levels were scored preoperatively and 2 days after treatment. Statistical analysis was performed using the Fisher exact test. **Results:** Clinical signs and symptoms suggestive of irreversible pulpitis were established in all teeth and symptomatic apical periodontitis in 14 of 20 (70%). Two days after treatment, all patients reported complete relief of pain. All teeth were clinically successful at 6 months and 1 year postoperatively. Radiographically, immature roots showed continued root development; dentin bridge formation was detected in 5 of 20 teeth. Seven of 7 teeth with preoperative periapical rarefaction showed signs of healing; 1 tooth had signs of internal root resorption at 1 year with an overall success rate of 95% (19/20). **Conclusions:** Young permanent teeth with carious exposure can be treated successfully with full pulpotomy using Biodentine, and clinical signs and symptoms of irreversible pulpitis are not a contraindication. *(J Endod 2018;44:932–937)*

Key Words

Biodentine, deep caries, irreversible pulpitis, pulpotomy, young permanent teeth

Significance

Pulpotomy in carious young permanent teeth is increasingly adopted. Clinical evaluation of new calcium silicate–based materials is required for evidence-based clinical practice.

The current improved understanding of pulp tissue healing and regeneration together with the use of biologically active endodontic materials have directed attention toward preserving pulp vitality via minimally invasive endodontic techniques of vital pulp therapy (VPT) (1, 2). According to the American Association of Endodontists *Glossary of Endodontic Terms*, full pulpotomy involves the removal of the coronal portion of the vital pulp as a means of preserving the vitality of the remaining radicular portion; it may be performed as an emergency procedure for temporary relief of symptoms or as a therapeutic measure that will require the application of a biocompatible capping material.

The presence of spontaneous or severe preoperative pain does not always indicate that the pulp is not capable of repair (3, 4), and deep carious lesions are not unconditionally related to an irreversible pattern of pulpal injury (5, 6). Several clinical studies reported a successful medium- to long-term outcome of VPT in symptomatic permanent teeth with carious exposure, particularly young or immature teeth, and recommended the procedure as an alternative to root canal therapy (RCT) in vital teeth (7–9).

Currently, mineral trioxide aggregate (MTA) is considered the optimum material for use in VPT of permanent teeth (10–12). However, some practitioners report subjective difficulty in the handling and mixing of MTA in addition to reports of tooth discoloration after its use, which results in patients' dissatisfaction (13). Consequently, newer calcium silicate–based materials that retain the desirable properties of original MTA but with easier handling and without tooth discoloration have been introduced into the market. Biodentine (Septodont, Saint Maur des Fosses, France) consists of a powder and liquid; the powder contains tricalcium silicate, calcium carbonate, and zirconium oxide as the radiopacifier (14). Biodentine has several advantages, including good sealing ability, adequate compressive strength, a relatively short initial setting time (ie, 12 minutes), and the promotion of reparative dentin formation with a positive effect on vital pulp cells (14, 15).

Three recent clinical trials compared Biodentine with MTA in pulp capping of carious exposures with a high success rate approaching 100% at the 1-year follow-up in asymptomatic teeth of young patients (16, 17) and in mature teeth with a clinical diagnosis of reversible pulpitis (18). Although the use of Biodentine in full

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pulpotomy was limited to case reports in traumatized teeth (19), the aim of this study was to prospectively evaluate the clinical and radiographic outcome of full pulpotomy using Biodentine in young permanent teeth with carious exposure and clinical signs and symptoms of irreversible pulpitis.

Materials and Methods

Ethics approval was obtained from the institutional ethics and research committee (13/95/2016). Children and adolescents referred to the graduate endodontic clinic for management of symptomatic permanent teeth with deep caries were included in the study. All patients and guardians were informed of the risks and benefits of the procedure and signed an informed consent form. Inclusion criteria included patients with deep caries in a permanent molar tooth exposing the pulp or extending ≥two thirds into the dentin on the periapical radiograph, with complete or incomplete radicular growth and preoperative symptoms suggestive of irreversible pulpitis defined as spontaneous pain or pain exacerbated by cold stimuli and lasting for a few seconds to several hours interpreted as lingering pain compared with the control teeth (20) and that could be reproduced using cold testing. A preoperative pulpal and periapical diagnosis was established after clinical examination and cold testing (Endo-Ice; Hygenic Corp, Akron, OH), and periapical radiographs were taken using film holders (Dentsply Rinn, Elgin, IL) and the paralleling technique. The periapical index was used to score cases with periapical rarefaction during diagnosis and the follow-up periods (21). Numeric rating and visual analog scale questionnaires were used to record pain intensity before treatment.

After clinical and radiographic examination, the tooth was anesthetized using articaine 4% with adrenaline 1/100,000 (Septodont, Saint-Maur-des-Fosses Cedex, France), and, subsequently, it was isolated using a dental dam. Then, the tooth surface was disinfected with gauze soaked in 5% sodium hypochlorite (NaOCl) before caries excavation. The cavity was prepared using a sterile high-speed fissure bur under water coolant, caries was excavated using a large low-speed round bur, and the cavity was rinsed with 2.5% NaOCl. The exposed pulpal tissue was amputated with a high-speed diamond bur to the level of the canal orifices. Bleeding from the canal orifices was assessed, and hemostasis was achieved by the application of a cotton pellet moistened with 2.5% NaOCl for 2 minutes with a dry pellet on top and repeated if required up to 6 minutes; the bleeding time was recorded. Subsequently, Biodentine was mixed according to the manufacturer's instructions and placed in a 3-mm layer above the pulp tissue using an amalgam carrier and gently packed using a condenser. After 12 minutes of waiting for the initial setting, a layer of resin-modified glass ionomer liner (Vitrebond; 3M ESPE, St Paul, MN) was applied, and the tooth was restored with glass ionomer cement and a stainless steel crown, amalgam, or resin composite. Treatment was performed under the supervision of a specialist endodontist by 1 graduate student who was calibrated by performing the treatment on nonstudy participants for 1 year before the study, and stainless steel crowns were placed at the pediatric graduate clinic within a week. A postoperative periapical radiograph was taken after permanent restoration placement. Two days after pulpotomy, patients or guardians were contacted by phone to record pain intensity.

The patients had clinical and radiographic evaluation after 6 months and 1 year postoperatively according to Zanini et al (22). All teeth were examined clinically for any signs or symptoms of pathosis, including pain experience, discomfort, soft tissue swelling, sinus tract, probing pocket depth, integrity of the coronal restoration, coronal discoloration through visual perception of the shade of the treated tooth compared with adjacent teeth, and mobility. The case was considered clinically successful if there was no history of spontaneous pain or discomfort except during the first few days after treatment and there was a functional tooth with no pain or discomfort on chewing or eating, no tenderness to percussion or palpation, normal grade I mobility, and normal soft tissues around the tooth with no swelling or sinus tract. The case was considered radiographically successful if there was no intraradicular pathosis, there was no internal resorption or root resorption, the periapical index was <3 or there was a reduction in the PAI score if rarefaction was present preoperatively, and there was continuation of root development in immature roots. Radiographs were also evaluated for the presence of dentin bridge formation subjacent to the pulpotomy material.

Radiographs were evaluated under optimum viewing conditions by an experienced endodontist at 2 separate occasions and by a specialist in oral and maxillofacial radiology followed by conjoint reevaluation in case of disagreement. The Cohen kappa coefficient of agreement index was used to calculate intraobserver and interobserver reliability. The quality of the coronal restoration was checked, and the restoration was repaired if deemed necessary.

Data Analysis

The Fisher exact test was used to compare the outcome between cases with different baseline characteristics; significance was set at $P < .05$.

Results

Results of the Cohen kappa statistics showed good intraobserver and interobserver agreement. The observers scored a range of 0.85–0.9 for reliability. The Fisher exact test did not show statistically significant differences between the treated teeth with regard to sex, periapical status, restoration type, and the number of missing walls. Because only 1 treatment procedure was performed and all cases were successful except 1, no regression analysis was appropriate at these recall periods.

Fourteen patients with 20 teeth and age ranging from 9–17 years (12.3 ± 2.7) were included in the study. Baseline characteristics of the study participants are included in Table 1. On presentation to the clinic, 5 of 20 (25%) of the patients reported severe spontaneous pain scoring 9 to 10 (on a scale of 0–10), and 100% had a history of severe lingering pain after cold drinks, which was reproduced by cold testing. According to the American Association of Endodontists diagnostic terminology, the preoperative diagnosis of the treated teeth was symptomatic irreversible

TABLE 1. Baseline Characteristics of Study Participants

Sex	Percussion sensitivity	Apical rarefaction	Caries	Root maturity	Caries exposing pulp	No. of missing walls	Restoration
Females 10	Yes 14	Yes 7	Primary 17	Mature 17	Yes 16	One 7	Stainless steel crowns 7
Males 10	No 6	No 13	Recurrent 3	Immature 3	No 4	Two 9	Amalgam 8
						Three 4	Composite 5
Total 20 teeth							