Apical Closure in Apexification: A Review and Case Report of Apexification Treatment of an Immature Permanent Tooth with Biodentine

Karla Vidal, DDS, Gabriela Martin, DDS, PhD,† Oscar Lozano, DDS,* Marco Salas, DDS,‡ Jaime Trigueros, DDS,§ and Gabriel Aguilar, DDS‖*

Abstract

Materials such as calcium hydroxide paste and mineral trioxide aggregate are used in apexification treatment of immature permanent teeth, but the search for improved materials with higher characteristics of biocompatibility results in different materials. Biodentine is a tricalcium silicate cement that possesses adequate handling characteristics and acceptable mechanical and bioactivity properties. This report describes the case of a 9-year-old boy who was referred to the Department of Dental Clinic of Querétaro Autonomous University of Mexico. One month prior the patient had suffered a dental trauma of his upper left central incisor and had been treated by another dentist. The clinical diagnosis was previously initiated therapy and symptomatic apical periodontitis. The treatment was apexification with Biodentine. At follow-ups performed at 3, 6, and 18 months after treatment the tooth was asymptomatic. The cone-beam computed tomography scan at 18-month postoperative follow-up revealed continuity of periodontal ligament space, absence of periapical rarefactions, and a thin layer of calcified tissue formed apical to the Biodentine barrier. On the basis of sealing ability and biocompatibility, apexification treatment with Biodentine was applied in the present case report. The favorable clinical and radiographic outcome in this case demonstrated that Biodentine may be an efficient alternative to the conventional apexification materials. *(J Endod 2016;42:730–734)*

Key Words

Apexification, bioactivity, Biodentine

Apexification treatment of immature permanent teeth with pulp necrosis is an endodontic procedure to achieve apical closure (1). For many years, calcium hydroxide paste was used to induce a calcified barrier followed by root canal therapy (2) until 1993 when mineral trioxide aggregate (MTA) became the chosen material to induce the formation of the apical barrier (3) because of its sealing properties and biocompatibility (4). Several studies demonstrated its capacity to induce odontoblastic differentiation (5), good radiopacity, low solubility, high pH (6, 7), expansion after setting (8), and antimicrobial activity (9). However, the prolonged setting times, handling difficulties, and possible coronal staining associated with MTA (10, 11) had led to a search for other alternative materials. In recent years there has been a persistent search for improved biocompatible materials applicable to endodontic practice, such as calcium silicate cements.

In 2009 Biodentine (Septodont, St Maur des Fosses, France) was introduced as a tricalcium silicate cementum. Biodentine is supplied in individual powder capsules composed of tricalcium silicate, calcium carbonate, and zirconium oxide that are mixed with liquid containing water, calcium chloride to accelerate setting, and modified polycarboxylate as a plastifying agent (12–14). The powder is mixed with the liquid for 30 seconds with an amalgamator. Biodentine possesses adequate handling characteristics because of its excellent viscosity and short setting time, which is about 12 minutes. This material can be used for substitution of dentin in coronal restorations, pulp linings, pulpotomies, reparation of root perforations, internal and external resorptions, formation of apical barriers in apexification treatment, regenerative procedures, and as retrofilling material in endodontic surgery (15). Regarding its mechanical properties and biocompatibility, Camilleri et al (15) have reported superior results compared with MTA, because greater apposition of hydroxyapatite was observed on the Biodentine surface when exposed to tissue fluids (15). These biological properties, together with the good color stability of the product (16), its lack of genotoxicity (17), and low cytotoxicity (18), make it an ideal material for use in endodontic practice. Biodentine preserves gingival fibroblast viability (19), with stimulation of tertiary dentin formation (12–14), induction of pulp cell differentiation toward odontoblastic cells in culture (13), and formation of mineralized tissue similar to that formed when using MTA (14). In contrast, a possible disadvantage of Biodentine is its low radiopacity (12, 13).

Most studies involving calcium silicates have focused on pulp therapies such as direct linings and pulpotomies in human and animal models (20–22). To our knowledge, there is little clinical evidence of the effect of Biodentine on the

From *Medical Research, University of Querétaro, Querétaro, Querétaro, Mexico; †Endodontic Department, Dentistry School, National University of Córdoba, Córdoba, Argentina; ‡Biomedical Sciences, University of San Luis Potosí, San Luis Potosí, San Luis Potosí, Mexico; §Odontology Research, Latin University, Celaya, Guanajuato, Mexico; and ‖Private Practice, San Miguel de Allende, Guanajuato, Mexico.

Address requests for reprints to Dr Karla Vidal, Medical Research, University of Querétaro, Clavel No. 200 Fraccionamiento Prados de la Capilla, CP 76176, Querétaro, Qro, Mexico. E-mail address: karelivg@gmail.com

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formation of apical barriers in immature necrotic teeth. The present clinical case is a report of a symptomatic immature permanent tooth #9 with pulp necrosis and apical periodontitis that was treated after the apexification procedure with Biodentine.

Case Report

A 9-year-old boy was referred to the Dental Clinic of Querétaro Autonomous University of Mexico for the treatment of tooth #9. One month prior the patient had suffered a dental trauma, and tooth #9 had been treated by another private practice dentist. The patient reported pain on mastication in the maxillary left incisor. Clinical examination showed that tooth #9 had a complicated oblique fracture of the crown, and the probing depth was within normal limits (Fig. 1). Sensitivity tests (heat, cold, and electrical pulp testing) of the tooth gave no response. The tooth was tender to percussion, and mobility grade I was observed. A periapical radiograph of the tooth showed that the coronal fracture appeared to reach the distal pulp horn of tooth #9, and no radiolucency was observed at the periapical area of the root. The root apex was not fully formed (Fig. 1). The clinical diagnosis of tooth #9 was previously initiated therapy and symptomatic apical periodontitis. The apexification treatment was explained to the patient's parents, and the decision for apexification instead of revascularization was made primarily because the diameter of the open apex was not more than 1 mm, which may be difficult to induce bleeding. Another reason was that the radiographic analysis comparing both central incisors showed that root's length and thickness of walls were similar for both teeth. The apexification treatment with Biodentine was elected with the informed consent of patient's parents.

First Session

Local anesthesia with 3% mepivacaine (Scandonest; Septodont) was administered, and after isolation with a rubber dam, the material that had been placed by another dentist was removed. The previous access cavity was rectified by using an Endo-Z drill (Dentsply Maillefer, Ballaigues, Switzerland), and #15 K-file was introduced into the canal to ensure the patency of the canal. Reciproc R25 (VDW GmbH, Munich, Germany) was used in brushing motion only to remove possible remnant tissue in dentinal walls. The canal was irrigated with copious amounts of 2.5% sodium hypochlorite ultrasound activated irrigation with negative apical pressure by using EndoVac (Kerr Corporation, Orange, CA) system and dried with NaviTip tips (Ultradent, South Jordan, UT). A calcium hydroxide (CH) paste (Metapex; Meta Biomed, Chungju, Korea) was placed into the apical portion of canal with a spiral lentulo as intracanal medication. The access cavity was closed with a cotton pellet and glass ionomer. The patient was scheduled for a second visit after 2 weeks.

Second Session

The tooth was asymptomatic during the entire postoperative period, and the temporary filling was intact. Local anesthesia was accomplished with 3% mepivacaine (Scandonest). After isolation with rubber dam, the glass ionomer and cotton pellet were removed from the access cavity. A copious amount of 2.5% sodium hypochlorite ultrasound activated irrigation with negative apical pressure by using EndoVac system was used to remove the CH paste from the canal. A final rinse of 17% EDTA for 1 minute was performed. The canal was dried with NaviTip tips (NaviTip FX Tips; Ultradent Products Inc), and a small piece of absorbable collagen membrane (Gelfoam; Pfizer Inc, Groton, CT) was placed at the apical portion of the canal. The membrane was introduced thorough the root canal and gently compacted by using prefitted hand pluggers slightly beyond the apex to achieve a matrix. Biodentine was prepared according to the manufacturer's instructions. The powder was mixed with 5 drops of liquid and activated in the dental triturator for 30 seconds. It was carried into the canal with an amalgam carrier and condensed with hand pluggers to form apical plug of 5 mm in thickness. The excess material from the walls was removed with paper points, and after 12 minutes, the rest of the canal was obturated with thermoplasticized gutta-percha and AH Plus resin sealer (Dentsply De Trey, Konstanz, Germany) by using the continuous heat wave technique (B&L Alpha II and Beta; B&L Biotech, Inc, Fairfax, VA). The access cavity was closed temporarily with glass ionomer (Fig. 2). After 1 week, the glass ionomer was replaced by a bonded resin restoration (Filtek Z350XT; 3M ESPE Dental Products, St Paul, MN).

Follow-up

At follow-ups performed at 3, 6, and 18 months (Fig. 3) after treatment the tooth was asymptomatic, and the color of the crown did not

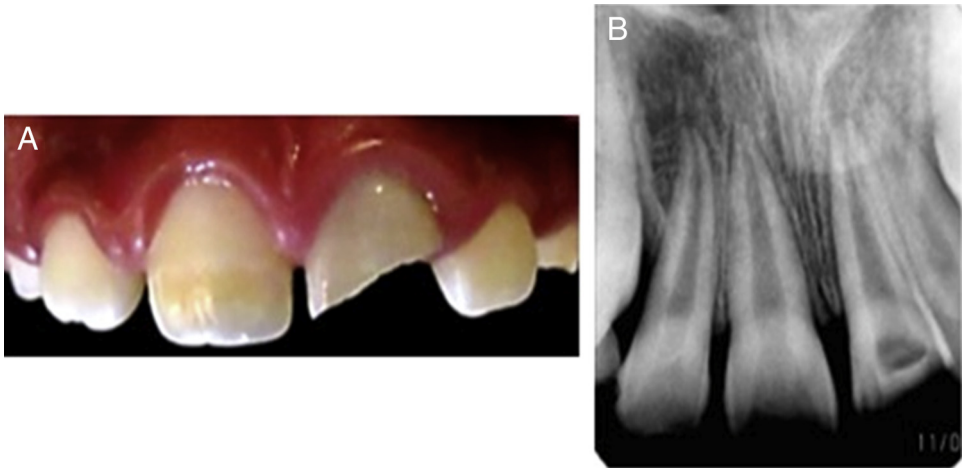

Figure 1. (*A*) Preoperative intraoral view and (*B*) preoperative radiograph.