Regenerative Endodontic Therapy in a Single Visit Using Platelet-rich Plasma and Biodentine in Necrotic and Asymptomatic Immature Molar Teeth: A Report of 3 Cases

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Abstract

This report describes 3 successful single-visit regenerative endodontic therapy cases using platelet-rich plasma (PRP) and Biodentine (Septodont, Saint Maur-des-Fossés, France) for 3 immature mandibular molar teeth, all with necrotic pulp, in 2 children aged 8 years and 1 aged 9 years. Three teeth were separately diagnosed as having a necrotic pulp. After preparation of the access cavity under rubber dam isolation, the necrotic pulp was removed, and each canal was irrigated with 2.5% sodium hypochlorite, sterile saline, and 17% EDTA solutions. Freshly prepared PRP was injected into each canal up to the cementoenamel junction, and Biodentine was placed directly over the PRP clot. Each access cavity was then restored with composite resin. Follow-up clinical examinations revealed negative responses to cold and electric pulp tests. None of the treated teeth were sensitive to percussion or palpation and did not respond to cold or electric pulp tests. For each tooth, a mandibular first molar. During clinical examination, the teeth were not sensitive to percussion or palpation and did not respond to cold or electric pulp tests. For each tooth, a coronal seal (ie, the absence of bacteria and necrotic pulp tissue and the presence of a scaffold and tight coronal seal) that promotes repopulation of stem cells, regeneration of pulp tissue, and continuation of root development (4). Platelet-rich plasma (PRP) has been suggested as an ideal biomaterial for improving treatment results because it releases many growth factors and acts as a scaffold (5). Successful revascularization of infected immature teeth after autologous PRP transplantation has been reported (6, 7).

Biodentine (Septodont, Saint Maurdes Fossés, France) is a calcium silicate–based material that has drawn attention in recent years and has been advocated for use in various clinical applications, such as root perforation, apexification, resorptions, root-end filling, pulp capping procedures, and dentin replacement. The setting period of the material is as short as 9 to 12 minutes. This shorter setting time is an improvement over other calcium silicate materials including MTA (8).

The purpose of this report was to describe 3 successful single-visit regenerative endodontic therapy cases using Biodentine as a new endodontic biomaterial and PRP as a scaffold material in 3 mandibular permanent molar teeth, all asymptomatic with necrotic pulp.

Treatment Procedures

Three patients (2 girls both aged 8 years and 1 boy aged 9 years) were referred to the pediatric dentistry clinic for endodontic management of immature permanent mandibular first molars. During clinical examination, the teeth were not sensitive to percussion or palpation and did not respond to cold or electric pulp tests. For each tooth, a common diagnosis of pulp necrosis was made on the basis of clinical findings. Periodontal examination revealed physiologic mobility and normal probing depth (<3 mm) around the teeth. Radiographic examination showed healthy periapical tissues. Taking into consideration the incomplete root development with wide open apices

Key Words

Biodentine, platelet-rich plasma, regenerative endodontics, single visit

Significance

This report shows that single-visit regenerative endodontic therapy may be successful in an immature tooth with necrotic pulp and asymptomatic after careful case selection.
regenerative endodontic therapy of the affected mandibular molars was considered. After a comprehensive discussion of the risks and possible outcomes of this treatment and the treatment plan in case of failure, regenerative endodontic therapy was approved by the patients’ parents, who then provided written consent.

To avoid repeated descriptions of the same treatment, the procedures for each of the 3 cases are summarized as follows. An inferior alveolar nerve block injection with 2% mepivacaine (Citanest; AstraZeneca, London, UK) without a vasoconstrictor was used to anesthetize each tooth. Each tooth was then isolated with a rubber dam. The endodontic access cavity was prepared using a diamond-coated fissure bur (Diatech, Heerbrugg, Switzerland) and a high-speed handpiece with copious water spray. On entering the pulp chamber, necrotic tissue in the mesial and distal canals was observed. The working lengths were determined by an apex locator (Propex Pixi; Dentsply Maillefer, Ballaigues, Switzerland) and confirmed by placing size 20 K-files in the canals and taking a periapical radiograph. None of the canals were instrumented; they were irrigated with 2.5% sodium hypochlorite (NaOCl) (20 mL), sterile saline (10 mL), and 17% EDTA (10 mL) and then gently dried with sterile paper points.

After irrigation and drying, the apical tissue was irritated using a #20 K-file. However, in all cases, adequate bleeding was observed in the root canal. Therefore, it was decided that regenerative endodontic therapy should be performed using PRP as a scaffold. Ten milliliters of whole blood was drawn by venipuncture of the antecubital vein in each patient’s right arm. A blood sample from each patient was first centrifuged at 2400 rpm for 10 minutes to separate PRP and platelet-poor plasma from the red blood cells and then at 3600 rpm for an additional 10 minutes to further separate PRP from the platelet-poor plasma. The PRP was then injected into the canal space up to the level of the cemento-enamel junction. Several minutes were allowed for clot formation.

Three milliliters of Biodentine were then placed directly over the PRP clot of each tooth. Each access cavity was restored using composite resin (3M ESPE; Filtek, St Paul, MN) (Fig. 1).

**Follow-up Examination**

The patients were examined every 3 months during an 18-month period. At all subsequent recall visits, the teeth were not sensitive to percussion or palpation and not responsive to thermal and electric pulp tests. Periodontal examination revealed physiologic mobility and normal probing depth around the teeth. Radiographic examination at 18 months revealed the absence of periapical lesions and evidence of thickening of the canal walls and apical closure of all teeth (Fig. 1).

**Discussion**

Despite the dramatic increase in the number of published regenerative endodontic case reports, it has become clear that no standardized protocol for these procedures has been established. In the present cases, regenerative endodontic procedures were completed during a single visit because teeth were asymptomatic and without periapical lesion. Shin et al (9) published a case report of successful single-visit regenerative endodontic therapy of an immature permanent tooth with a chronic apical abscess. They stated that a single-visit revascularization procedure has some advantages. It eliminates subsequent appointments to access the root canal environment, thus reducing the possibility of further bacterial contamination of the root canal. It also diminishes the detrimental consequences of poor patient compliance with regular follow-up evaluation.
In all 3 of the present cases, removal of necrotic tissue from the root canal was accomplished by gently irrigating the root canal with 20 mL 2.5% NaOCl because NaOCl is a potent antimicrobial agent and effectively dissolves necrotic and organic tissue. Higher concentrations of NaOCl negatively affect the survival of stem cells of the apical papilla (10). Additionally, chlorhexidine can inhibit the survival of stem cells of the apical papilla (11). Therefore, we did not choose chlorhexidine as an irritant although it is an effective irritant against microorganisms.

The use of EDTA as an intracanal irrigation solution during regenerative endodontic procedures is recommended to facilitate cell survival, especially stem cells (11). In the present cases, 17% EDTA was used as a final irrigant before the placement of PRP. This step may result in the release of growth factors from dentin, which is necessary for signal cell differentiation (12).

In each case, we observed inadequate bleeding in the root canal after irrigation with a K-file beyond the apex to induce bleeding. Therefore, PRP was used as a scaffold because it has been shown to have physiologic concentrations of various beneficial growth factors and to promote survival, differentiation, and proliferation of stem cells in vitro (13, 14). In addition, it is an autologous material that can be easily obtained from patients undergoing a regenerative procedure. In a previous case report (6), PRP was used instead of whole blood in a maxillary premolar with necrotic pulp and an open apex. The treated tooth was clinically asymptomatic 5½ months later and radiographically showed resolution of the periapical lesion, further root development, and continued apical closure.

The importance of a bacteria-tight coronal seal for successful regenerative therapy is well-documented. MTA has been used as the coronal barrier on blood clots (15, 16). The sealing ability of MTA makes it a suitable biomaterial for sealing a blood clot and preventing bacterial leakage over time (17). Biodentine is composed of biocompatible material (18) and has good sealing ability (19). Biodentine offers advantages over MTA including a faster setting time and a higher push-out bond strength at 24 hours (20, 21). Additionally, unlike MTA, Biodentine has the advantage of being tooth colored (22) and prevents crown discoloration that MTA causes at the orifice of the pulp. In the present cases, Biodentine was used as a barrier material, and final restoration was performed using composite resin in the same appointment.

Some teeth treated using a regenerative endodontic procedure have responded positively to cold and/or electric pulp tests at follow-up appointments (6, 23). In the present cases, all teeth responded negatively to cold and electric pulp tests in follow-up evaluations. Although a positive response to a pulp test is not conclusive of regeneration of pulp tissue in the canal space, it is 1 of the requirements for regeneration. It is important to note that the absence of a pulp response does not necessarily indicate the absence of vitality (25). Both the coronal level of regenerated tissue and the thickness of filling materials placed over this tissue could affect the presence or absence of responses to cold and electric pulp tests (6).

In conclusion, a single-visit regenerative endodontic procedure may be a favorable treatment option for an asymptomatic immature tooth with a necrotic pulp and no periapical lesion. Further clinical studies are needed to investigate the outcome of single-visit regenerative endodontic treatment of immature necrotic teeth.

Acknowledgments

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References