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Case Report

Regenerative Endodontic Therapy for a Necrotic Immature Permanent Tooth Using a Tricalcium Silicate-Based Material - Biodentine: A Case Report

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Abstract

Aim: To present a clinical case of a permanent immature tooth with necrotic pulp, wherein pulp regeneration and further root development were induced with the use of a tricalcium silicate-based material.

Case Report: A healthy 8-year-old male was referred for endodontic treatment of a traumatized right maxillary central incisor. Clinical examination revealed a negative response to pulp vitality tests and radiographically an immature root with a wide open apex. After the canal was cleaned and disinfected, bleeding was induced in the root canal space. After a blood clot was obtained at approximately 2 mm short of the CE-junction, a plug of Biodentine was placed covering the blood clot. The access cavity was temporized with a glass ionomer cement. After 2 weeks the tooth was asymptomatic without a fistula and no swelling. After 30 months, clinical and radiographic examinations revealed an asymptomatic tooth that responded positive to vitality tests. Radiographically the root showed complete maturation with healthy surrounding tissues.

Conclusion: Based on the favorable outcome of this case, Biodentine may be considered as a suitable material for regenerative endodontic treatment of immature necrotic permanent teeth.

Keywords: *Biodentine; Dentin Substitute; Pulp Necrosis; Regenerative Endodontics; Tricalcium Silicate-Based Cement*

Abbreviations

RET: Regenerative Endodontic Therapy; MTA: Mineral Trioxide Aggregate; BDT: Biodentine; EDTA: Ethylenediamine Tetra-Acetic Acid

Introduction

Pulp necrosis in immature permanent teeth has a significant negative impact on long-term tooth retention. As a result, endodontic treatment of these necrotic teeth has always been a challenge in Endodontics [1]. In these cases a traditional long-term apexification procedure or the apical barrier technique have been used for many years [1-3]. In case of the apical barrier technique a material is placed at the apical third of the root canal to facilitate further obturation [4,5]. Although both techniques are predictable and successful, neither one allows for continued root development and for maturation of the canal walls, which results in a tooth that is highly susceptible to root fracture [2,3].

More recently, Regenerative Endodontic Therapy (RET) has gained much attention among clinicians. To date, cumulative evidence of successful RET showed that immature permanent teeth with pulp necrosis with or without apical pathosis can undergo a regenerative process of the pulp along with apparent normal root development [6-10]. The prognosis of RET is based on various important factors, such as accurate diagnosis and case selection, effective disinfection of the canal space, induction of bleeding inside

the canal with subsequent blood clot formation and a biomaterial that is placed in direct contact with the blood clot [6,7]. For many years mineral trioxide aggregate (MTA) has been used as the gold standard for RET [11-13]. MTA is biocompatible and possesses antibacterial properties with improved sealing ability [14,15]. However, MTA has some undesirable physical and chemical properties, such as a long setting time, difficult handling characteristics, high solubility and the potential to discolor hard dental tissues [14-16].

More recently a tricalcium silicate-based material, Biodentine (BDT; Septodont, Saint-Maur-des-Fossés, France) has been suggested to replace MTA in RET [17-19]. BDT is composed of a powder and liquid. The powder contains tricalcium silicate, dicalcium silicate, calcium carbonate, and zirconium dioxide to make it radiopaque. The liquid is composed of calcium chloride (a setting accelerator) and a water-soluble polymer to provide plasticity [20]. In contrast to MTA, BDT is easy to manipulate, has a short setting time (approximately 12 minutes) and has superior physical and chemical properties [20,21].

Aim of the Study

The aim of this article is to describe a clinical case of successful pulp regeneration of a necrotic immature tooth in which BDT was used as a wound dressing.

Case Report

A healthy 8-year old white male with a non-contributory medical history was referred for evaluation and treatment of his right maxillary central incisor. The father of the patient reported that the tooth was traumatized causing slight displacement, which was caused by a fall that happened almost twenty days prior to the current visit. He also reported that the patient had been seen first by an emergency service in which the tooth was repositioned and splinted with a stainless steel wire (Figure 1A). At the time of the current visit the patient was asymptomatic. A cold test (Endofrost spray; Coltene Whaledent, Langenau, Germany) with a small saturated cotton pellet elicited no response, while the adjacent teeth responded normally without lingering. Radiographic examination showed an immature root with a wide open apex, thin dentinal walls and no evidence of periapical pathology (Figure 1B). From the combined patient history and clinical and radiographic examinations, a diagnosis of pulp necrosis was arrived at. Considering the incomplete root formation, RET was recommended. The treatment, risks and benefits were explained in detail to the parent with emphasis on the importance to render treatment that promotes complete root development, following which the father of the patient signed an informed consent. RET was subsequently performed in a next appointment.

Following administration of local anesthesia with 1.7 mL of Carticaine 4%/L-adrenaline 1:100.000 (Laboratorios Bernabó SA, Buenos Aires, Argentina) the stainless steel wire was removed and the tooth isolated with rubber dam. To improve visualization, a dental operating microscope (Newton; Buenos Aires, Argentina) was used during treatment. A cavity access was prepared with a sterile no. 4 round carbide bur (Dentsply, Maillefer, Ballaigues, Switzerland) operated at low speed under copious irrigation with saline. The necrotic pulp tissue was removed from the canal with hand operated sterile K-files (Dentsply, Maillefer). Care was taken so as to not to disturb the thin dentinal walls. The canal was then irrigated and disinfected for 5 minutes with 20 ml of 1.5% NaOCl, followed by copious rinsing with saline. After the canal was dried with sterile paper points, a creamy premixed calcium hydroxide paste (Encal; Densell Co., Buenos Aires, Argentina) was placed in the canal, approximately 2 mm short of the radiographically estimated root length, and the access cavity temporized with a 3 mm-thick layer of glass ionomer (Fuji Corp, Osaka, Japan). At the 2-week follow-up appointment the patient was asymptomatic. The tooth was anesthetized with 3% mepivacaine (Septodont, Cedex, France) without vasoconstrictor to facilitate bleeding. After the rubber dam was placed the temporary restoration and the calcium hydroxide paste were removed. The canal was irrigated with 1.5% NaOCl followed by 17% EDTA and a final copious rinsing with saline. After the canal was dried with paper points, bleeding was induced by irritating the apical tissues with a sterile #20 K-file. The intracanal hemorrhage was controlled by applying pressure for 4 minutes with a sterile cotton pellet soaked in saline until a blood clot had formed approximately 2 mm below the CE-junction. BDT was then prepared according to the manufacturer´s instructions and placed on the blood clot (Figure 1C). To assure intimate contact of BDT with the clot a cotton pellet moistened with saline was applied for a few seconds with slight pressure. The access cavity was then sealed with an adhesive restorative resin composite (3M/ESPE, St Paul, MN, USA). A cone beam computed tomography (CBCT) image was taken and confirmed the level of the BDT placement (Figure 1D). The patient returned after 30 months for a follow-up examina-

tion. At this time the tooth was still asymptomatic and functional. There were no signs of infection, sinus tract or swelling. The tooth responded positive to vitality tests and periodontal examination showed normal physiologic mobility without pocketing. Radiographic examination (Figure 1E) revealed that the thickness of the dentin walls had increased. The root development was complete and showed apical closure with normal periapical tissues.

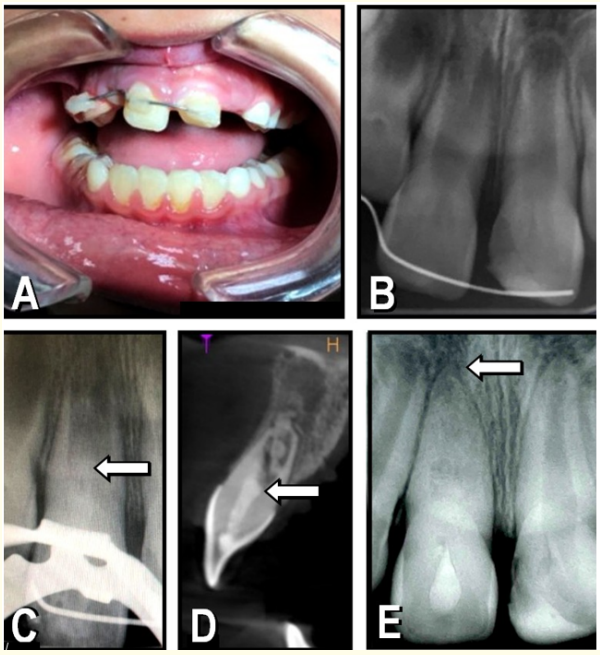

Figure 1: A: Clinical photograph showing the splinted maxillary right central incisor. B: Preoperative radiograph of the right central incisor showing a wide root canal and an open apex. C: Postoperative radiograph showing the placement of the BDT (arrow) after induction of bleeding and blood clot formation. D: Lateral view by cone beam computed tomography demonstrating the level of BDT application (arrow) and wide open apex. E: Follow-up radiograph after 30 months showing closure of the apex (arrow) and thickening of the dentinal walls.

Results and Discussion

This report describes a clinical case of a necrotic permanent immature central incisor that was successfully treated with RET. Our findings are in agreement with previous observations [6,8-12], indicating that RET procedures are effective in treating immature permanent teeth with necrotic pulps and lead to continuation of root development and thickening of canal walls. In order to preserve the epithelial cells of the Hertwig´s root sheath, the necrotic tissues have to be removed with minimum instrumentation and without disturbance of the dentin walls. Epithelial cells must be preserved because they are capable of inducing differentiation of mesenchymal stem cells into odontoblast-like cells that are important in the completion of the development of the root [9]. In the present case, a 1,5% NaOCl solution followed by a calcium hydroxide dressing were used to provide improved cleaning and asepsis of the canal space leading to a better scenario for healing and new hard tissue formation [22]. Although 1.5% NaOCl is less effective than 2.5% NaOCl for canal disinfection [22] evidence has demonstrated that higher concentrations than 1.5% may be deleterious to the apical papilla stem cells survival [22,23]. On the other hand, Ruparel., *et al.* [24] showed that calcium hydroxide did not exert cytotoxic effects on the mesenchymal stem cells while acting as an effective adjunct to NaOCl irrigation for canal disinfection [9,25,26].

The creation of a blood clot in the canal after disinfection is another factor that helped to mature the tooth thus achieving complete root development. The blood clot is a source for growth and differentiation factors and acts as a scaffold for the in-growth of new vital tissues into the canal space [7]. The choice of BDT for protection and stimulation of the underlying blood clot was based on its superior physiochemical and biological properties compared to other materials [16,21]. BDT increases secretion of TGF-B1 growth factor and has excellent sealing properties and provides a lower risks of postoperative bacterial penetration from the oral environment [16].

With respect to the type of the new vital tissue that is produced in the root canal after RET, this is still a controversial issue among researchers [6,27-29]. There is no information available concerning the type of vital tissue that develops inside the canal of human teeth after RE. However, recent experimental studies on immature rat [30] and dog teeth [27,29] with necrotic pulps showed that after RET the new generated vital tissues include cementum-like tissues, bone-like and periodontal-like tissues. These studies tend to support the theory that the newly formed tissues are not similar to healthy pulp cells but rather resemble a wound repair process [17,27,28]. In the present clinical case, confirmation of these histological features was not possible. However, the continued devel-

opment of the root and the positive response to vitality tests in the presence of normal periapical anatomy as evidenced by radiographs, can all be considered as indicators of a successful outcome that were observed 30 months postoperatively.

Conclusion

Based on the clinical outcome of the present case on one patient, BDT offered an interesting alternative in RET of a necrotic immature permanent tooth. However, further long-term clinical studies with a larger sample size will still be required before BDT can be recommended for routine use in RET.

Conflict of Interest

The authors declare that they have no conflicts of interest.

Disclosure

The paper, or any part of it, has not been submitted or published and will not be submitted elsewhere for publication while being considered by the *Scientific Archives of Dental Sciences*.

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