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CONGRESS PROCEEDING

Clinical And Radiographic Evaluation Of Biomaterials Used In Different Endodontic Procedures-Case Report

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Abstract

Introduction: Endodontic treatment may be required for the permanent teeth due to different reasons in childhood. Biological materials such as MTA and tricalcium silicate-based (Biodentine®, Septodont, France) bioceramic repair material have started to be used nowadays in different endodontic treatment. Studies have shown that these materials stimulated the formation of new vascularized tissue in the apical of mature teeth with necrotic pulp and with periapical lesions. In addition, MTA and tricalcium silicate-based (Biodentine®, Septodont, France) bioceramic repair material are preferred in direct and indirect pulp capping due to their properties such as biocompatibility and impermeability.
Purpose: The aim of this study is to examine the teeth clinically and radiologically after the use of tricalcium silicate-based (Biodentine®, Septodont, France) bioceramic repair material and MTA as a barrier on the pulp capping, Cvek pulpotomy and regenerative endodontic treatment. Case Description: Different endodontic procedures using MTA and Biodentine in pediatric patients with different endodontic treatment needs are shown with 4 cases.
Conclusion: Today, the success rate is high in vital pulp treatments with newly developed materials such as MTA and tricalcium silicate-based (Biodentine®, Septodont, France) bioceramic repair material In addition, root development continues after regenerative endodontic treatments with Mineral Trioxide Aggregate (MTA) or tricalcium silicate-based (Biodentine®, Septodont, France) bioceramic repair material in non-vital and open-apex teeth.

Key words: Biodentine; MTA; Pulp capping; Pulpotomy; Regenerative endodontics

Introduction

In the childhood, need for endodontic treatment arise due to dental caries or traumatic injuries to permanent teeth. Especially, as a result of the loss of pulp vitality in immature permanent teeth associated with a poor crown-to-root ratio, thin dentin walls, a fragile tooth structure, and cessation of root development, a wide apical opening may occur, which complicates the endodontic treatment applications.[1] In order to prevent such adverse situations, it is important to maintain the vitality or ensure revascularization of the pulp in the immature permanent teeth.[2] Vital pulp treatments that may be applied in the immature permanent teeth can be listed as; pulp capping, shallow pulpotomy or partial pulpotomy.[1,2] Immature permanent teeth have a very high healing potential through their high cellular activity.[2] Mineral Trioxide Aggregate (MTA) and tricalcium silicate-based (Biodentine®, Septodont, France) bioceramic repair material, increase the recovery rate in vital pulp treatments with their antibacterial effects, regenerative properties, biocompatibility, bioactivity, and excellent hermetic sealing properties. MTA's longer curing time, difficult clinical manipulation, high cost and tooth discoloration problem make tricalcium silicate-based (Biodentine®, Septodont, France) bioceramic repair material a new calcium silicate-based material with improved properties, more advantageous.[3] When pulpal necrosis occurs in immature permanent teeth, root development stops, tooth becomes prone to fracture as the roots remain short and weak, and treatment prognosis decreases due to the more difficult application of endodontic procedures.[1] Calcium hydroxide apexification had previously been applied in order to maintain root development, but due to the disadvantages of this treatment, apical barrier have started to be formed with MTA and endodontic treatments were completed in a single session, and thus MTA apexification has currently become clinically preferred.[1,4] Plugging the area where root development has stopped with MTA does not allow root development to continue, causing insufficient crown-to-root ratio and crown fractures. Therefore, regenerative applications in immature permanent teeth are focused on.[1] Regenerative endodontic applications are a new, biologically based approach that provides the replace-

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Figure 1

Figure 2

ment of damaged structures in the dentin and root structure together with pulp and dentin cells. In particular, open-apical teeth with ongoing root development can show successful results even in cases of pulp necrosis, apical periodontitis or abscess, due to their rich pulpal blood supply and apical stem cells with high regeneration ability.[5,6] The aim of this case report is to clinically and radiographically demonstrate the success of MTA and tricalcium silicate-based (Biodentine®, Septodont, France) bioceramic repair material in pulp capping, shallow pulpotomy and regenerative endodontic treatment in immature permanent teeth.

Case Description

Case 1

A 12-year-old girl, who applied to our clinic with the complaints of the intermittent pain and hot-cold sensitivity in her tooth 26, was diagnosed with reversible pulpitis after clinical and radiographic examination and we decided to perform pulp capping. After the local anesthesia, a rubber dam (Royal Shield Dental Dams, MALAYSIA) was inserted to provide isolation and the caries was removed. The caries was excavated carefully so that the pulp would not be exposed, but due to the depth of the caries, the pulpal tissue was opened about 1.5-2 mm, and direct pulp capping treatment option was chosen. After the cavity was wiped with a sterile cotton pellet saturated with 2,5% NaOCl, MTA (Dentsply Sirona Pro Root MTA White, America) was placed in. Then, a moist cotton pellet was placed on it and it was closed temporarily, and an appointment was scheduled for the patient 2 days later for permanent filling. In her second visit, a rubber dam (Royal Shield Dental Dams, MALAYSIA) was placed again to ensure isolation and the temporary filling was removed. Then the tooth was etched with 37% ortho-phosphoric acid (3M ESPE, USA). After the dentin bonding system (Clearfil SE Primer and Bond Kuraray, Tokyo, Japan) was applied, direct composite (3M ESPE Filtek Ultimate, USA) restoration was performed. The patient was followed up at 6-month intervals. In the radiograph taken 1 year later, it was observed that the tooth was clinically asymptomatic, there was no radiographical pathology, and we also noted that a dentinal bridge was formed in the form of a thin line in the area where the pulp was opened.
(Figure 1, Figure 2)

Case 2

A 7-year-old boy, with a complicated crown fracture in his tooth 11 due to a bike accident, was admitted to our clinic 18 hours after the first emergency room intervention. Clinical examination showed no sensitivity to percussion and palpation, and the tooth responded positively to a cold test. Periapical and occlusal radiographs were taken for the evaluation of tooth and bone tissue. No pathology was found on radiographs. We decided to apply shallow pulpotomy (Cvek pulpotomy) to the open-apex tooth. After applying local anesthesia, a rubber dam (Royal Shield Dental Dams, MALAYSIA) was inserted to provide isolation. Afterwards, approximately 2 mm of the coronal part of the exposed pulp was removed and bleeding stopped within 2-5 minutes with the help of 2.5% NaOCl. After bleeding control was achieved, Biodentine® (Septodont, France) was placed on the exposed area since it did not cause discoloration and did not require a two-stage procedure, and it was covered with glass ionomer cement (Ketac Molar Easymix, 3M ESPE, Germany). After the application of the adhesive system (Clearfil SE Primer and Bond Kuraray, Tokyo, Japan), the previously selected composite resin (3M ESPE Filtek Ultimate, USA) was polymerized in layers and necessary corrections were made. The patient was followed up at 6-month intervals. In the follow-up after 1.5 years, we observed that the tooth was clinically asymptomatic and in the radiographs we noted that root development had continued. In addition, no discoloration was observed in the anterior tooth.
(Figure 3, Figure 4)

Case 3

An 8-year-old girl with an enamel-dentin fracture in her tooth 11 caused by a fall in school was admitted to our clinic 2 months after the accident. We learned that the broken tooth was restored in another clinic immediately after the trauma. In the clinical examination, pain and swelling were observed. Necessary periapical and occlusal radiographs were taken. Since the tooth was predicted to have necrosis, the access cavity was opened without anesthesia after the application of a rubber dam (Royal Shield Dental Dams, MALAYSIA) in order to provide drainage. Subsequently, the working length was determined with an apex locator (Dentsply Propex Pixi Apex Locator, Israel) and the root was first washed with 20 ml of 2.5% NaOCl with an injector needle adjusted to approximately 1-2 mm shorter than the apical root, and then with 20 ml of saline solution. After the root was dried, it was filled with calcium hydroxide and the patient was given an appointment 2 weeks later. In the second visit, the needle length was adjusted in the same length and the root was washed using 20 ml of 5% EDTA followed by 20 ml of saline solution. After the application of local anesthesia

Figure 3

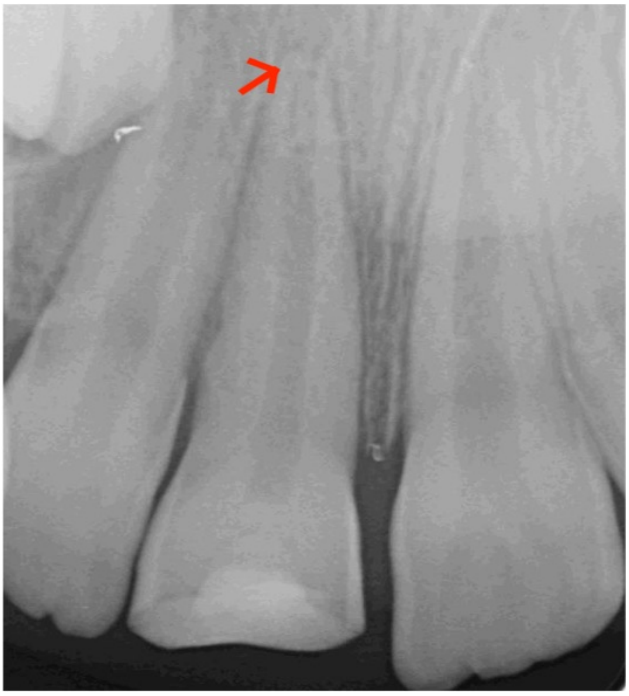

Figure 4

without vasoconstrictor, bleeding was managed with an H file sized 20 (Mani Inc. Utsomia, Japan) by rotating 2-3 mm beyond the root tip. After making sure that the canal space was filled with blood up to cementoenamel junction and a blood clot occurred and approximately 3-4 mm of the coronal part of the canal was filled with Biodentine® and then covered with glass ionomer cement (Ketac Molar Easymix, 3M Espe, Germany. 37% phosphoric acid (Actino Gel, Prevest DenPro, India) was applied to the enamel surfaces for 15 seconds and then washed and dried. Universal adhesive resin (Uni SE Bond, Cavex, Germany) was applied to the enamel surfaces and cured with a 20 sec LED light device (3M ESPE Elipar S10, The

Figure 5

Figure 6

Netherlands). Then, the tooth was restored with resin composite (Valux Plus, 3M ESPE Dental Products, St. Paul, USA) and necessary corrections were made. In the radiograph taken 1.5 years later, a remarkable thickening was observed in the root dentin. Additionally, we observed radiographically that root development had continued and the root was almost closed.
(Figure 5 , Figure 6)

Figure 7

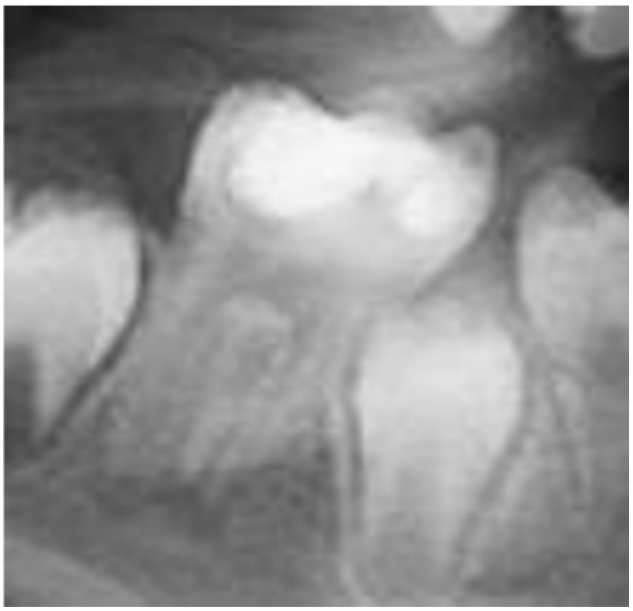

Figure 8

Case 4

A 7-year-old boy, admitted to our clinic with the complaints of the intermittent pain and hot-cold sensitivity in his tooth 46. After clinical and radiographic evaluation, we determined that the tooth was vital and with open apex, and pulp capping was decided. After applying local anesthesia, a rubber dam (Royal Shield Dental Dams, MALAYSIA) was inserted for isolation and the caries was carefully removed. A thin layer of dentin was observed at the cavity floor, the cavity was wiped with 2.5% NaOCl and covered with MTA (Dentsply Sirona Pro Root MTA White, America). MTA (Dentsply Sirona Pro Root MTA White, America) was temporarily closed by placing a moist cotton on it. Next day, the patient was called and the temporary filling material was removed after the rubber dam (Royal Shield Dental Dams, MALAYSIA) was placed for providing isolation. Subsequently, the tooth was etched with 37% ortho-phosphoric acid (3M ESPE, USA), an adhesive system (Clearfil SE Primer and Bond Kuraray, Tokyo, Japan) was applied to the cavity surfaces. The previously selected composite resin (3M ESPE Filtek Ultimate, USA) was applied in layers and each layer was light cured for 20 seconds. Necessary shape and form arrangements were made and its permanent restoration was completed. In the examination performed 1 year later, no clinical or radiological pathology was observed. Root development was also within the normal limits.
(Figure 7, Figure 8)

Discussion

Correct assessment of the inflammation level of the pulp and the selection of the appropriate materials are the primary success criteria in vital pulp treatment. The presence of pain that is not spontaneous but triggered by a stimulus, mild cold sensitivity, no percussion and palpation sensitivity, normal response to cold pulp tests, and absence of any radiographic pathology in the tooth indicate reversible pulpitis. On the contrary, the presence of spontaneous and nocturnal pain, hypersensitivity to cold and heat, pain on percussion and palpation, excessive response to pulpal tests, and gaping of the periodontal ligament on radiographs indicate irreversible pulpitis. In reversible pulpitis, when the irritant is removed, the pulp can return to its healthy structure, whereas in irreversible pulpitis, the inflamed pulp tissue should be removed partially or completely.[7] Unlike mature tooth, immature permanent tooth has a highly cellular pulp and a rich vascular nutrition system, and shows a high healing potential. However, the prognosis of pulp necrosis in an immature permanent tooth is risky and may potentially result in premature tooth loss.[1] Therefore, vital treatment applications such as pulp coatings, partial or coronal pulpotomy are gaining importance in immature teeth.[2] It has been claimed that pulp coatings can be the most effective treatments for maintaining pulpal health, and revealed that application of MTA and tricalcium silicate-based (Biodentine®, Septodont, France) bioceramic repair material in the treatment supported the sustainability of the pulpal defense ability by stimulating tertiary dentin formation and achieved high clinical success rates.[8]

In our study, the radiographs taken 1 year after the cases in which pulp coatings were performed with MTA and tricalcium silicate-based (Biodentine®, Septodont, France) bioceramic repair material showed that a thin tertiary dentin bridge was formed and root development continued in the case where we performed direct pulp coating. Pulpotomy is another vital pulp treatment approach that aims to maintain root development by removing the infected part of the pulp due to a number of factors such as caries or trauma.[1] Cvek et al. reported that the exposed pulp as a result of trauma in immature permanent teeth could maintain its vitality for 7 days and that the remaining pulp tissue could preserve its vitality by removal of the infected part about 2 mm from the coronal pulp.[9] The success of bioceramic materials in pulpotomy applications in asymptomatic immature permanent teeth is quite high, studies in symptomatic teeth are promising and more studies are reported to be needed.[1] Because the roots of necrotic immature permanent teeth are weaker, shorter and prone to fracture, performing chemomechanical debridement and creating an effective apical plug are difficult, lowering the success rate of endodontic applications.[1] Multi-session calcium hydroxide apexification has been successfully applied for many years in order to maintain root development and facilitate endodontic applications. However, due to the disadvantages such as long-term treatment, recurrent infections, and increased risk of root fracture caused by the long-term presence of calcium hydroxide in the root canal cavity, studies have focused on the creation of a single-session apical barrier and the application of regenerative methods.[1,4] In single-visit apexifications, MTA; has become the preferred material because of its low solubility, biocompatibility, hardening in the presence of moisture and inducing hard tissue formation.[3] Although apexification in a single session is a successful method, its disadvantages such as

cessation in root development, insufficient crown-to-root ratio and the tooth's propensity to fracture have brought regenerative treatment to the fore in necrotic immature teeth.[5] The aim of regenerative endodontic treatment is to ensure the proliferation of progenitor stem cells, which are resistant to infection and necrosis occurred in the apical papilla, in the root canal space, regeneration of pulp tissue and continuation of root development.[6] In the studies, MTA or tricalcium silicate-based (Biodentine®, Septodont, France) bioceramic repair material was recommended to be placed on the bleeding area that was controlled after the regenerative endodontic treatment and the success rate of both materials was found to be equal.[10] After the regenerative endodontic treatment applied to a patient presented at our clinic with an acute apical abscess in the tooth 21 with incomplete root development, we determined that the tooth was asymptomatic and also noted a remarkable root development and dentin thickening after 1.5 years. These results will contribute to supporting the new studies in the literature.

Conclusion

Using the proper materials for the cases encountered in vital pulp treatments, which are simple and effective applications is one of the most important factors for the success of the treatment. Thanks to their superior physicochemical and biological properties, the application and popularity of bioceramic materials in the pediatric dentistry is increasing day by day. Regenerative approaches used together with biomaterials in both mature and immature teeth should be preferred to more radical approaches, giving the tooth a chance to renew itself. Further research and clinical trials are needed in order to develop strong scientific evidence regarding the regenerative endodontic therapies in which biomaterials are used.

None

Author Contributions

A.B, P.C. conceived the ideas, collected and analyzed the data of cases, scanned literature, and wrote the manuscript: S.S.D. conceived the ideas, made the necessary corrections, scanned literature, and final edits.

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