Direct pulp capping in an immature incisor using a new bioactive material

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Abstract

Preservation of the pulp in a traumatized immature fractured incisor tooth is of prime importance in order to achieve apexogenesis, a natural apical closure. The main factor influencing this is pulpal protection by a bioactive material proving optimum marginal seal in preventing any microleakage. This case report presents an 8-year-old female diagnosed with Ellis Class 3 fracture of immature tooth 11 involving the mesial pulp horn. Under rubber dam isolation, a partial pulpotomy was performed and the pulp was sealed using a new bioactive material BIODENTINE to stimulate apexogenesis, dentine replacement and pulp protection. The fractured segment was reattached for optimum esthetics, which was a concern for the patient. The patient was followed-up for 1, 3, 6 and 12 months, which revealed continued apical closure and maintenance of pulp vitality. The patient remained asymptomatic. This case report provides evidence for the potential use of Biodentine as an effective pulp capping material in the future.

Keywords: Biodentine, immature tooth, pulp capping

Introduction

Biodentine is a new bioactive cement with dentin-like mechanical properties that can be used as a dentin substitute on crowns and roots.[1] It has a positive effect on vital pulp cells and stimulates tertiary dentin formation. In direct contact with vital pulp tissue, it also promotes the formation of reparative dentin.[2]

Biodentine is an interesting alternative to conventional calcium hydroxide-based materials due to its improved material properties.[3] It offers advantages for direct pulp capping and, in properly selected cases, may contribute to the long-term maintenance of tooth vitality.

For many decades, calcium hydroxide has been the standard material for maintaining pulp vitality. Both clinically and histologically, it has been found to produce satisfactory results in indirect and direct pulp capping because it is capable of stimulating the formation of tertiary dentin by the pulp.[4] In contact with vital pulp tissue, it contributes to the formation of reparative dentin, a special variant of tertiary dentin, which seals exposures by newly formed hard tissue.[5,6] Currently, calcium hydroxide products are the best documented and most reliable materials for direct pulp capping and serve as the "gold standard" against which new materials have to be tested.[7]

Calcium hydroxide has some drawbacks like poor bonding to dentin, material resorption and mechanical instability. As a result, calcium hydroxide does not prevent microleakage in the long run. The porosities (tunnel defects) of the newly formed hard tissue may act as a portal of entry for microorganisms. These may cause secondary inflammation of the pulp tissue and are thought to be responsible for failed maintenance of tooth vitality. In addition, the high pH (12.5) of calcium hydroxide suspensions causes liquefaction necrosis at the surface of the pulp tissue.[8-10]

Case Report

A 8-year-old female patient reported to the Department of Paedodontics, Yenepoya Dental College, with the chief complaint of fracture of the upper front teeth due to a fall while playing 24 h back [Figure 1a and b].

On clinical examination, the tooth 11 displayed an Ellis Class 3 fracture. The fracture line extended mesio-distally with pulpal exposure of about 1 mm. The patient gave a history of sensitivity to cold after fracture, indicating that the pulp was vital. The tooth was nontender and showed no mobility. The exposed pulp did not show evidence of hemorrhage. The patient also reported with the fractured tooth fragment [Figure 2a].

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On radiographic examination, the crown portion in the intraoral periapical radiograph displayed the fractured line involving the mesial pulp horn. The root was immature, with the apical third of the root formation remaining. The periapical region did not show any signs of pathology.

On the basis of history, clinical and radiographic examination, the diagnosis was Ellis Class 3 fracture with vital pulp and incomplete root formation. Treatment decision was made to perform partial pulpotomy and use Biodentine as the agent for pulpal protection and apexogenesis.

The fractured tooth fragment was checked for its integrity and was cleaned with sodium hypochlorite and then kept in normal saline [Figure 2a].

The tooth was anesthetized by local infiltration and was isolated using rubber dam (Optra Dam, Ivoclar Vivadent). The tooth was disinfected by wiping it with cotton roll moistened with 2.5% sodium hypochlorite. The area of pulpal exposure was widened and about 2 mm of the coronal pulpal tissue was removed using a round diamond bur on a high-speed handpiece under water spray.

The pulp tissue was evaluated. The bleeding was controlled by placing a cotton pellet moistened with saline. After hemostasis, the cavity and pulp tissue were irrigated with 2.5% sodium hypochlorite.

Biodentine was mixed according to the manufacturer's instructions (Septodont, France) and was gently placed in the cavity. Care was taken not to place any pressure on the vital pulpal tissue. The material was adapted to the cavity walls and was filled with Biodentine up to the level of the fracture [Figure 3].

The fractured fragment was secured on a piece on sticky wax prior to its preparation. A groove was made on the fractured surface of the tooth using a small round diamond bur and checked for its adaptation to the tooth surface [Figure 2b].

A bevel was made on the facial and lingual surfaces of the tooth and the fractured fragment to prepare them for reattachment. The surfaces were etched using 35% phosphoric acid (3M ESPE, St Paul, MN, USA) and bonding agent (Adper, 3M ESPE, St Paul, MN, USA) was applied using microbrushes and light cured for 20 s. A layer of flowable composite (Tetric Flow, IvoclarVivadent, USA) was applied on both the surfaces and was approximated to the original tooth contour and light cured for 40 s. Any deficiency along the fractured line was filled using flowable composite. The tooth was finished and polished (Soflex, 3M ESPE, St Paul, MN, USA) [Figure 4].

The patient was recalled the next day for follow-up. On clinical examination, the tooth was sound and the patient was asymptomatic. Periodic recall after 1, 3, 6 and 12 months was made. The patient remained asymptomatic and radiographs displayed continued root formation [Figures 5a and b and 6].

Discussion

Bioactive cement, Biodentine (Septodont, France), was recently launched in the dental market as a dentin substitute.[1] Having similarity in its indications and mode of action with calcium hydroxide, it eliminates its drawbacks.

Biodentine consists of a powder in a capsule and liquid in a pipette. The powder mainly contains tricalcium and dicalcium silicate as well as calcium carbonate. Zirconium dioxide is the contrast medium. The liquid consists of calcium chloride in aqueous solution with an admixture of polycarboxylate. The powder is mixed with the liquid in a capsule in the triturator for 30 s. Once mixed, Biodentine sets in about 12 min. During the setting of the cement, calcium hydroxide is formed. The consistency of Biodentine is similar to that of phosphate cement.[1,11]

Biodentine can be used on crowns and roots. Its uses include pulp protection, temporary closure, deep caries management, cervical filling, direct and indirect pulp capping and pulpotomy.[12,13] It can also be used in managing perforations of root canals or the pulp floor, internal and external resorption, apexification and retrograde root canal obturation.[14]

Biodentine has been proven to be biocompatible (it does not damage pulpal cells *in vitro* or *in vivo*). It has a capability of stimulating tertiary dentin formation. Hard tissue formation is seen after indirect and direct capping with Biodentine.[1,2,15] In pulp capping, its benefits versus calcium hydroxide are: It is stronger mechanically, less soluble and produces tighter seals. This qualifies it for avoiding three major drawbacks of calcium hydroxide, mechanical instability and the resultant failure of preventing microleakage.[9,16,17]

Compared with other materials, Biodentine displays ease of handling and decreased setting time.[11] Unlike other Portland cement-based products, it is sufficiently stable so that it can be used both for pulp protection and temporary fillings.[13,18]

Apart from the choice of the agent used for pulp capping, the other factors that need to be considered are the clinical status of the pulp and the microbial contamination of the pulp at the site of injury.[4]

In clinical terms, this means the tooth should be asymptomatic and that pulp bleeding after exposure should be easily and rapidly controllable.[4] Hemostasis is a prime factor. Blood clots left at the material/pulp interface act as factors for treatment failure. Sodium hypochlorite is an ideal agent

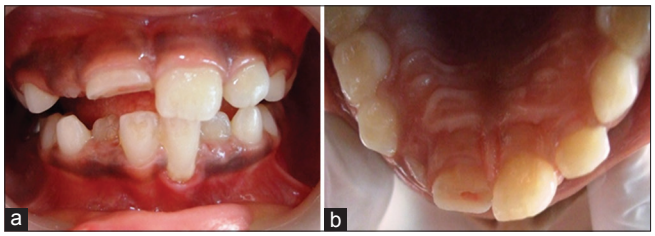

Figure 1: (a) Pre operative labial view and (b) Preoperative incisal view

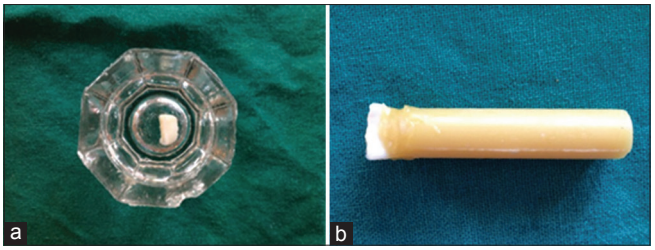

Figure 2: (a) Fractured tooth fragment and (b) Fragment attached to sticky wax

Figure 3: Biodentine application

Figure 4: Fractured segment reattached

Figure 5: (a) Preoperative (b) Postoperative radiograph

Figure 6: Twelve-month follow-up radiograph

for removal of surface clots and clearing the debris, while at the same time disinfecting the cavity.[19,20] Microbial contamination of the pulp tissue during treatment should be avoided. This is best achieved with a rubber dam when treating on the dentin third close to the pulp, which reliably prevents the invasion of microorganisms from the oral cavity or saliva.[21,22] Preventing microorganisms from entering the pulp is a key factor for successful direct capping.[23]

Esthetic replacement of the fractured tooth is one of the most important factors to be taken into consideration in treating a case of fractured anterior teeth in a young patient.

A trauma accompanying with fracture of anterior teeth is a tragic experience for the young patient who requires immediate attention, not only because of damage to the dentition but also because of psychological effect of the trauma to the child and his parents.[24] Reattached fragment to a great extent restores esthetics as it uses the original tooth's shape, color, translucence and surface structure.[25] Reattachment of the tooth fragment of the anterior teeth is easy to practice and is an economic method that has the potential to assume the incisal strength during tooth functioning. The method ensures increased wearing steadiness and thus creates better function.[26]

Conclusion

Biodentine is an interesting and promising product that has the potential to make major contributions to maintaining pulp vitality in patient judiciously selected for direct pulp capping. The reattachment of the fractured tooth segment appears to be the most conservative, simple and esthetically acceptable method of restoring the form and function of the teeth.

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