CLINICAL-THERAPEUTICAL MANAGEMENT OF EXPOSED PULP USING BIOACTIVE MATERIALS: TWO CASE REPORTS.

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ABSTRACT

Aims: This article present alternatives of bioactive materials use for direct pulp capping in immature teeth and for apexogenesis.
Case report: Two case reports with the application of bioactive cements are presented here: one in a tooth with pulp exposure and another with deep carious lesion, pulp exposure and open apex.
Results: In both cases, the treatment was performed in one visit and a favorable clinical and radiographic follow-up was achieved.
Conclusion: The use of bioactive materials led to the formation of a dentin bridge and healing process in the pulp tissue exposure, without the need for conventional endodontic treatment.
KEYWORDS: Apexogenesis. Pulp capping. Mineral trioxide aggregate.

INTRODUCTION

Dental filling materials have been considered toxic for a long period of time as they can lead to reversible or irreversible pulp inflammatory reaction. In order to reduce the complications, bases and liners were widely used to separate the dental tissues from restoration. This theory was based on the relationship between the pulp and the low pH of the materials[1,2].

The bases and liners are indicated according to the final restorative material; however, they follow a method of use. The bases are applied in thicker layers (>1mm) and are recommended for pulp protection against thermal and electrical irritants and for internal preparation delimitation without wearing down dental tissues[3,4]. Liners are used in thinner layers (<0.5mm) and are indicated to protect directly the pulp - dentin complex from the toxic effects of restorative materials, dentin sealing and fluoride release[5].

In case of pulp injuries, the recovery will be also activated by the factors related to the body. In pulp exposure, a reparative dentinogenesis occurs where stem cells migrate to the damaged region and are differentiated into odontoblast-like cells, initiating the reparative dentin formation[5,6]. This process can be mediated by biologically compatible materials such as calcium hydroxide cements, aggregated mineral trioxide (MTA) and tricalcium silicate cements[2,7,8].

MTA cements are bioactive, biocompatible materials with remarkable biological properties and are indicated in cases of pulp exposure, root and/or furcation perforation and for apexification or apexogenesis[5,9]. MTA cements create a mechanical barrier and gradually replace it with hydroxyapatite and then dentin, totally sealing the pulp from bacterial or chemical invasions[10]. The objective of this article is to present the alternatives of bioactive materials use in two clinical situations, for direct pulp capping in immature teeth and for apexogenesis.

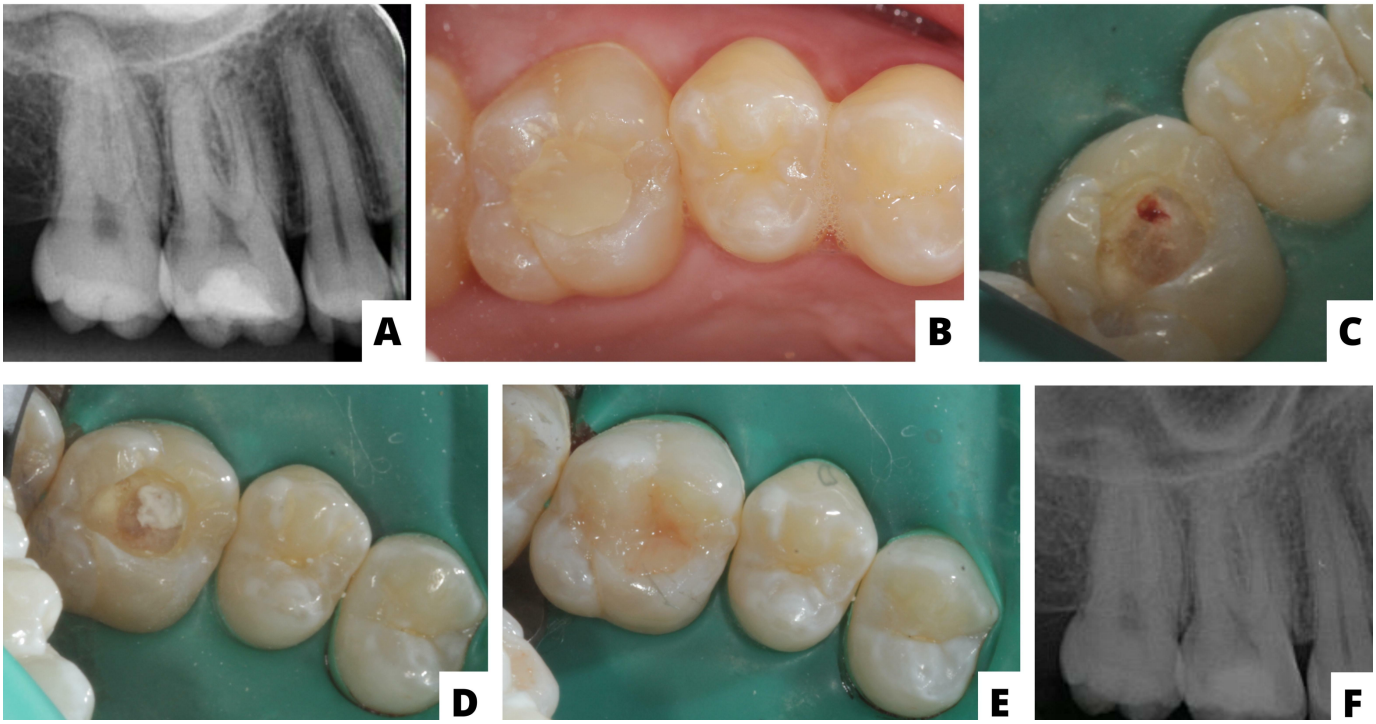

Figure 1. A. Initial periapical radiography. **B.** Clinical aspect. **C.** Pulp exposure. **D.** Application of MTA on pulp exposure. **E.** Resin composite final restoration. **F**. Periapical radiography after fourteen months.

CASE REPORT 1

On July 29, 2021, a 24-year-old male patient attended the FAEPO Dental Service with the complains of sensitivity to cold and chewing discomfort in tooth 1.6. An initial periapical radiography was performed (**Figure 1A**) and a radiolucent halo was observed under the composite resin restoration. Clinically (**Figure 1B**) the restoration had irregular and protruding edges, poor polishing, unsatisfactory anatomy, and slight marginal staining. The established plan of treatment was the replacement of the existing restoration. Operative field isolation was performed, and filling removal was associated with the presence of infiltration and no adhesion to the pulp wall. The calcium hydroxide used as pulp protection material was soluble, with underlying caries. Material removal was performed with carbide burs at low speed. Due to the proximity of the pulp chamber (already perceived on the initial radiography), its exposure occurred (**Figure 1C**). 0.9% saline solution was used for hemostasis and cavity cleaning. After that, a portion of White MTA (Angelus, Londrina, PR, Brazil) was prepared and placed only on the exposed pulp region. Then a portion of Vitrebond (3M ESPE Dental Products Division, St. Paul, MN, USA) was applied over the MTA and the entire pulp wall (**Figure 1D**). Selective acid etching was performed on enamel and the Clearfil SE Bond 2 (Kuraray, Tokyo, Japan) adhesive system was applied to enamel and dentin. A layer of 2 mm flowable resin GrandioSo Heavy Flow (Voco GmbH, Cuxhaven, Germany) was applied and then a conventional resin Z350XT (3M ESPE) was used to fill the entire cavity, by layering technique (**Figure 1E**). On September 05, 2022, during the patient recall, it was underlined the remission of initial patient´s symptoms. Also, on a control radiography (**Figure 1F**), a periapical health and a tertiary dentin formation was observed.

CASE REPORT 2

On May 5, 2021, a 12-year-old female patient presented intermittent spontaneous pain in lower left first premolar. In previous clinical examination was observed an unsatisfactory temporary restoration (Coltosol; Vigodent, Rio de Janeiro, RJ, BR). The thermal test showed the vitality of dental pulp. An initial radiography underlined an incomplete radicular formation, but without periapical radiolucency and signs of pulp necrosis (**Figure 2A**). Absolute isolation was carried out and temporary restorative material was removed. After carious tissue removal, clinically was observed a superficial dental pulp exposure, approximately 2 mm in diameter, with healthy appearance as reddish-pink color and controlled bleeding. In sequence, a copious local irrigation was performed by using saline solution which was aspirated with specific endodontic tips (Cappilary Tips; Ultradent, South

Jordan, UT, USA). The cavity was dried with sterile absorbent paper points.

Due to the favorable clinical aspect, dental pulp preservation was chosen by performing a conservative treatment. Immediately afterwards, bioceramic repairing cement (Biodentine; Septodont, Saint-Maurdes-fossés Cedex, France), prepared in a 5:1 ratio (powder and liquid) according to the manufacturer's instructions, was inserted at the level of pulp exposure (**Figure 2B**). The protection of this area was done by using a glassionomer cement and the restoration of the coronal part was achieved with a self-etching adhesive system (Scotchbond Universal, 3M, Campinas, SP, Brazil) and composite resin (Filtek Z350, 3M, Campinas, SP, Brazil).

A clinical and radiographic follow-up was performed after 5 and 11 months, showing the absence of symptoms and dentin bridge formation between the dental pulp and bioceramic cement. Crucially, the apexogenesis was achieved and the reduction of root canal diameter was observed. The success of the procedure avoided the need for endodontic treatment (**Figure 2C**).

DISCUSSION

The biologically based treatment strategies are a modern approach in restorative dentistry by inducing the remineralization and by protecting and preserving the pulp vitality. For minimally invasive biologically based therapies a variety of bioactive dental materials are used. The direct pulp capping is the application of such biomaterials when there is pulp exposure in vital and asymptomatic teeth or reversible pulpitis, during dental trauma or removal of necrotic dentin.

Clinical outcomes underlined the success of mineral trioxide aggregate (MTA), which is biocompatible, antibacterial and has good stability and sealing ability[2], despite the fact that calcium hydroxide (CaOH2) was considered the gold standard for a long period of time[11]. A clinical study conducted by Hilton et al. compared the failure rates of MTA and CaOH2 used as materials for pulp exposure treatment. MTA had a failure rate in 22% of patients while CaOH2 in 40%, at a follow-up interval of 12.8 months[8]. MTA has revealed higher success rates with less inflammatory responses, less pulp necrosis and more predictable histomorphologically favorable calcific barriers. It determines earlier formation of hard tissue bridges, larger daily dentin increase and few tunnel defects[12], as formation of calcified tissues is regarded as a reparative process more than a genuine regeneration response. When compared with Biodentine, MTA presented comparable clinical success rates for direct pulp capping. But on the micro-CT imaging, MTA showed a more regular, homogenous reparative dentin layer with uniform thickness[13]. By evaluating MTA in comparison with adhesive systems used as direct pulp capping materials, it showed a more favorable response in terms of pulpal inflammation and hard-tissue formation, as bonding agents exert a potential damage on dental pulp cells[14].

Despite these advantages, MTA has some disadvantages, which include discoloration potential, presence of toxic elements[15], poor handling properties, extended setting time[7]. The bismuth oxide (Bi2O3), used as a radiopacifier of MTA cement, can be oxidized by such agents, as residual sodium hypochlorite impregnated in the dentin, creating a dark colored precipitate and, over time, changing the color of the tooth[16]. In addition, it is described that collagen presented in dentin also causes oxidation of Bi2O3 and darkening of the tooth[17]. Biodentine cement, which has zirconium oxide as a radiopacifier, seems to have different results when used in direct pulp capping, and a lower rate of tooth discoloration is observed[18].

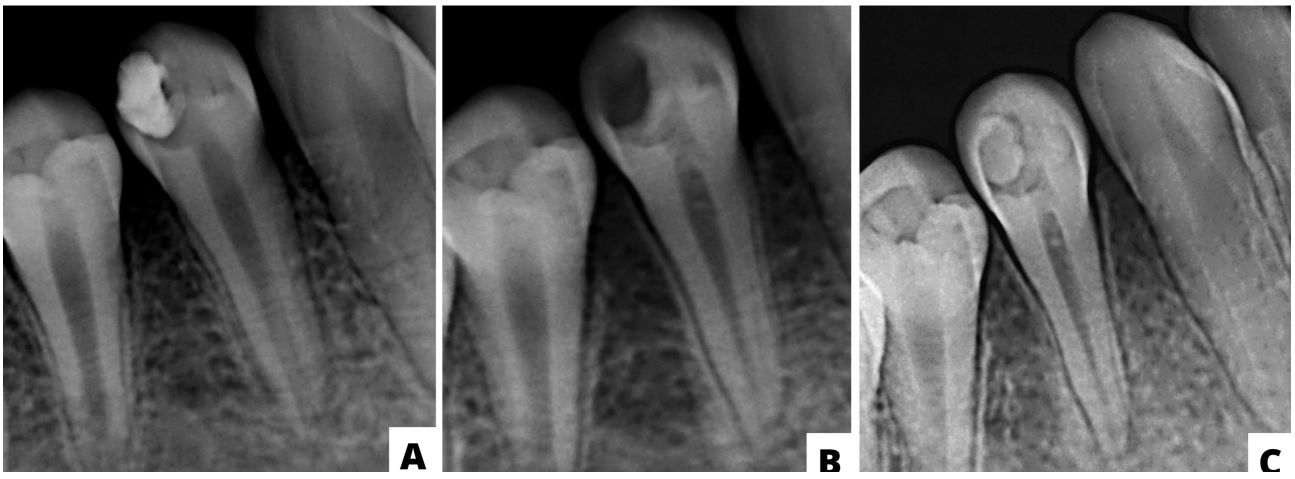

Figure 2. A. Periapical region without radiological changes. **B.** Location of pulp exposure. **C.** Periapical radiography after eleven months without the need of endodontic treatment.

Studies reported that MTA creates a physical barrier capable of sealing when it is used in teeth with open apex, even in the presence of moisture and blood[19]. In this case conservative treatment can be described as apexification and apexogenesis. The first term is the treatment of immature permanent tooth with pulp pathology and the second one is pulp capping in a vital tooth[9]. In teeth with reversible pulpitis, it is important to stimulate root maturation by inducing the formation of a dentin bridge[20]. A retrospective 5-year follow-up study shows the success rate of apexogenesis at 82.5% in anterior teeth and 96.4% in posterior teeth. A factor that must be taken into account is that 62.5% of anterior teeth presented crown discoloration[5]. The use of bioactive cements in cases of patients with pulpal exposure or incomplete apex formation is safe and described in the literature, however long-term studies, easy-to-use methods and cost still make its use limited. More clinical studies and long-term follow-up must be performed.

CONCLUSION

Based on the results achieved by two reported cases, the use of bioactive materials leads to the formation of a dentin bridge and healing process in the pulp tissue exposure, without the need for conventional endodontic treatment.

DECLARATION OF PATIENT CONSENT

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published, and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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