

# Two-year follow-up of a direct pulp capping and dental fragment bonding with self-adhesive cement – Case report

Julio Cezar Chidoski-Filho, Fabrício Rutz da Silva, Abraham Lincoln Calixto, Bruna Fortes Bittencourt, Giovana Mongruel Gomes

Department of Dentistry, State University of Ponta Grossa. Ponta Grossa, Paraná, Brazil.

**Abstract**— Fractures in permanent teeth due to trauma have become an increasingly frequent problem, and these fractures often affect the dentin-pulp complex. Direct pulp capping with MTA and tooth fragment reattachment with a self-adhesive resin cement proved to be a minimally invasive and high success rate procedure over one year follow-up. The objective of this article is to discuss relevant aspects about tooth fragment reattachment and direct pulp capping, reporting a clinical case of anterior tooth fracture. MTA was selected as the direct pulp capping material and tooth fragment reattachment was bonded with a self-adhesive resin cement. Clinical examination after one year recall showed excellent function and esthetics, pulp vitality and periodontal health.

**Keywords**— Dental Bonding, Dental Esthetics, Dental Pulp Capping, Tooth Crown.

## I. INTRODUCTION

The largest number of coronary fractures occur in anterior teeth, mainly in children and adolescents (ANDREASEN; ANDREASEN, 2007; DIETSCHI et al., 2000). The most affected tooth by this type of injury is the maxillary central incisor, due to its most prior position (ZUHAL et al., 2005; BRUSCHI-ALONSO et al., 2010). One conservative and aesthetic way to rehabilitate traumatized teeth is bonding the original tooth fragment to the fracture substrate, the so-called tooth fracture reattachment (FARIK et al., 2002; CORRÊA-FARIA et al., 2010). With this approach, clinical time is decreased, there is less wear and more predictable long term results, compared with composite restorations (FARIK et al., 2002). Authors have reported a 10-year follow-up case report of a tooth fragment reattachment in a lower canine, showing the longevity that this technique may achieve (RESTON et al., 2014). In another study, Moura et al (2013), reported 18 years of success of bonding a homogeneous tooth fragment.

When dental trauma generates pulpal exposure, it is necessary to protect the exposed remnant tissue. Direct pulp capping is indicated when the pulp is accidentally exposed during cavity preparation or by trauma – at least 24 h after the accident (ANDREASEN; ANDREASEN,

1991). Several materials are available to be used in this technique, such as mineral trioxide aggregate (MTA) and calcium hydroxide (CH). The current biocompatibility technology allows the application of these materials in direct contact with the pulp, in cases of small exposures and absence of bleeding, in order to stimulate the dentin bridge formation (ANDREASEN et al., 1995; SAWICKI et al., 2008). The treatment longevity with direct pulp capping using MTA has proved to be more effective than calcium hydroxide (WITHERSPOON, 2008; MENTE et al., 2014).

According to Reis et al. (2009), several materials may be used for bonding dental fragments, such as resin modified glass ionomers, flowable composite and resin cements. In another study, the authors used conventional microhybrid composite resin to reattach the tooth fragment (Macedo et al., 2008). The use of just an adhesive system to adhere the tooth fragment was also reported in the literature (VADINI et al., 2011). In the last years, a new generation of materials were developed, which had the main purpose to decrease the clinical steps, consequently reducing the overall clinical time dispensed. This is the case of self-adhesive resin cements (RADOVIC et al., 2008). However, there are few studies in the literature with the use of these resin cements to reattach tooth fragment.

In this way, the objective of this case report is to describe the treatment and two-year follow-up of a crown fracture with pulp exposure, treated with MTA as the direct pulp-capping agent and restoration by fragment reattachment combined with a self-adhesive resin cement.

## II. METHOD

A 22-year-old male patient had an accident fall and fractured the crown of the upper right central incisor tooth (tooth 11 in the ISO system or tooth 8 in the universal numbering system) (Fig. 1). The tooth fragment was recovered by the patient and maintained in water until his appointment at the Clinic of State University of Ponta Grossa, PR, Brazil (Fig. 2).

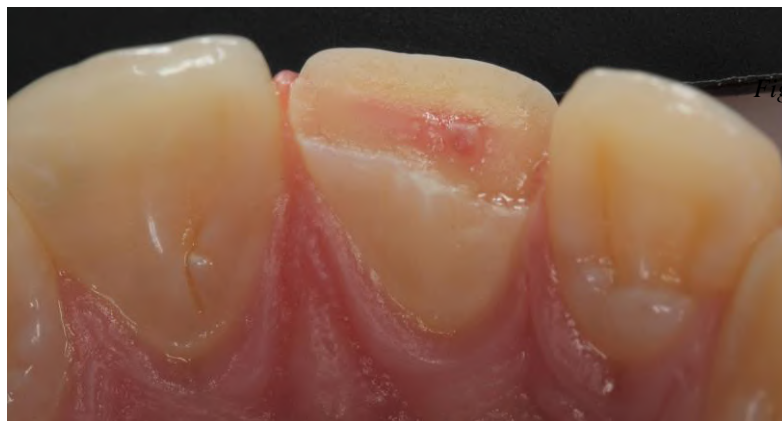


Fig. 1: Fractured tooth 11



Fig. 2: Tooth fragment

During clinical examination, the patient only reported a slight sensitivity in the dental element. Intraoral examination revealed an oblique fracture line and pulp exposure (Fig. 3), but no alveolar bone fracture. The initial radiograph indicated complete root formation and a closed apex with no periapical radiolucency (Fig. 4).



Fig. 3: Tooth tooth with oblique fracture and pulp exposure

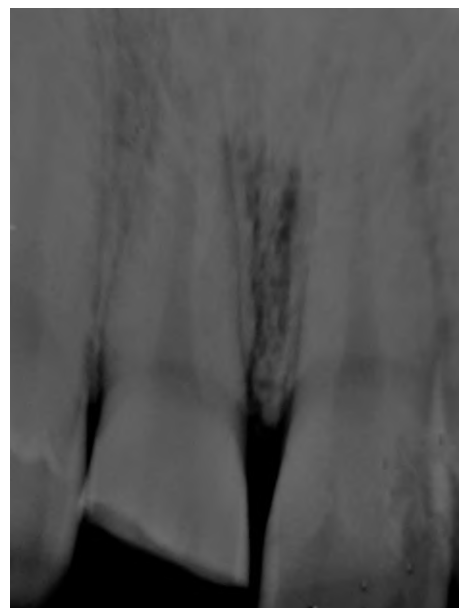


Fig. 4: Radiography showing normal periapical region

Vitality test was conducted (Endo Ice, Maquira, Maringá, PR, Brazil) and the tooth responded positively to the test. There was no pain with percussion test. The other teeth were not affect by the trauma. The treatment plan consisted of direct pulp capping, as the exposure was recent, and tooth fragment reattachment. The patient agreed with the treatment plan and signed the written consent term.

Prophylaxis and infiltrative anesthesia (3% Citanest, prilocaine hydrochloride and felypressin) were

performed. The operating field was isolated with a rubber dam and the dental fragment was placed in position to analyze the adaptation. After obtaining hemostasis, the exposed area was cleaned with copious irrigation of saline solution, and air-dried. The protection of the dentin-pulp complex (Fig. 5) was done with MTA-Angelus (Angelus, Londrina, PR, Brazil), which was manipulated according to the manufacturer's instructions: one sachet with one drop of distilled water were mixed for 30 s in a glass slab with a metallic spatula. A 2-mm thick of the material was slightly condensed over the pulpal exposure with an amalgam condenser (#1, Duflex, SS White, Rio de Janeiro, RJ, Brazil). After the setting time established for MTA (15 min), a small portion of self-adhesive resin cement (RelyX U200 3M ESPE, St. Paul, MN, USA) was manipulated, placed on dental substrate and on the fragment, and light-cured for 20 s (Fig. 6) with an LED light-curing device (Radii-Cal SDI, Bayswater, VIC, Australia) using a power intensity of 1200 mw/cm<sup>2</sup>.



Fig. 5: Protection of the dentin-pulp complex with MTA



Fig. 6: Polymerized of self-adhesive resin cement joining fragments

In order to mask the fracture line, the enamel/fragment interface was beveled with a spherical diamond bur (# 1014 KG Sorensen, São Paulo, SP, Brazil), acid-etched for 30 s (Fig. 7) (37% Phosphoric acid, Condac, FGM, Joinville, SC, Brazil) and cleaned with air/water spray. One single coat of adhesive system (Adper Single Bond 2, 3M ESPE, St. Paul, MN, USA) was applied and light-cured for 10 s. A composite resin (Shade A2, IPS Empress Direct, Ivoclar Vivadent, Schaan, Liechtenstein) was placed over the fracture line (Fig. 8), and light cured for 40 s (Radii-Cal). After that, the resin was finished with abrasive discs (Sof-Lex 3M ESPE, St. Paul, MN, USA), polished with abrasive silicon tips (Optimize-TDV, Pomerode, SC, Brazil) and diamond polishing paste (Diamond Gloss, TDV) (Fig. 9). The occlusion was carefully checked and adjusted in all excursive movements.

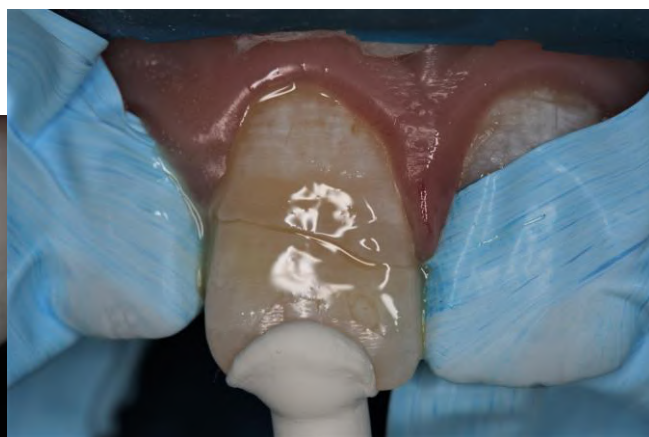


Fig. 7: Groove in the fracture line

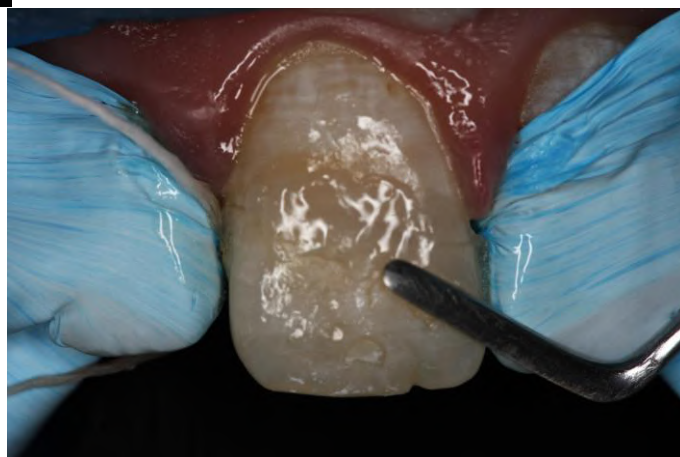


Fig. 8: Fracture line masking





*Fig. 9: Polishing with diamond paste*

### III. RESULTS

The patient was recalled in 1 week, 1 month, and 6 months. At the recall appointments, new radiographs were taken, and the pulp-capped tooth was tested with a cold stimulus, responding positively in every section. The two-year recall view also showed the adequate results in terms of aesthetics and functionality (Fig. 10), and another radiograph was taken (Fig. 11).



*Fig. 10: Bonding after 2 years*



*Fig. 11: Periapical radiography showing periapical health*

### IV. DISCUSSION

Dental trauma is considered a public health problem, causing psychological, aesthetic and physical damages (DIAZ et al., 2010). Reattachment of a fragment to the fractured tooth may result in a positive psychological response by the patient (MAIA et al., 2003).

Dental fragment reattachment is one of the suitable techniques to reestablish aesthetics and function to a fractured dental element (REIS et al., 2004). In contrast to the conventional composite resin restoration, which may result in a not-so-similar coloring and natural contours, the fragment bonding preserve the color, texture, incisal translucency, original tooth anatomy and the clinical time dispensed to a fragment reattachment is less than a composite resin reconstruction, also this is a low-cost technique to the patient (GOENKA et al., 2010).

However, in more severe coronary fractures, where there is pulp exposure, it is necessary to establish the pulp involvement degree. In this way, collection of subjective and objective data is required to perform a well-conducted diagnosis (DIANGELIS et al., 2012). In the present case report, to achieve the correct diagnosis and consequently a correct treatment plan, periapical radiographs and pulp sensitivity test were conducted. It is important to perform control radiographs in the recall appointments to observe the success of the treatment, as was as done in this present study. Radiographs are very important when dental trauma occurs in order to analyze if there is the presence of periapical lesions, root fractures, invasion of the biological space or involvement of other teeth.

The sensitivity test was done to evaluate the pulp involvement degree. It may be selected a thermal test (cold or hot) or electric test (DIANGELIS et al., 2012). In this study, the cold test was chosen as it present higher sensitivity and specificity compared to other tests (DIANGELIS et al., 2012). Once the teeth responded positively, the most recognized procedure to protect the dentin-pulp complex is the direct pulp capping. The main purpose of this conservative approach is place a biocompatible material, directly on the exposed pulp, to provide the formation of a dentin bridge (ASGARY; AHMADYAR, 2013; ROTSTEIN; INGLE, 2019). This procedure aims to maintain and preserve dental pulp vitality, function and health, besides being a minimally invasive therapy as compared with conventional endodontic treatment, as pulpotomy and biopulpectomy (BERMAN, HARGREAVES; 2015). The most employed materials used in this technique are MTA and calcium hydroxide. Although calcium hydroxide is the most frequently used material for direct pulp capping, being considered gold standard for this type of technique for many years, MTA may also be used for this procedure and satisfactory results were found in the last years (WITHERSPOON, 2008; TORABINEJAD, PARIROKH, 2010; MENTE et al., 2014; LI et al., 2015; ROTSTEIN; INGLE, 2019). MTA is a calcium silicate based cement composed of tricalcium silicate, tricalcium aluminate, tricalcium oxide, silicate oxide and other mineral oxides. As well as calcium hydroxide, MTA induces the formation of dentinal bridges (TORABINEJAD, PARIROKH, 2010; ROTSTEIN; INGLE, 2019).

Several studies compared the efficacy of MTA and calcium hydroxide in direct pulp capping (WITHERSPOON, 2008; GOENKA et al., 2010; MENTE et al., 2014; LI et al., 2015). Mente et al. (2014), in a cohort study, observed that MTA is the best option for direct pulp capping compared to calcium hydroxide, when a definitive restoration is made immediately after the conservative pulp therapy. Witherspoon (2008), concluded that MTA is an excellent material indicated for vital pulp therapy and better than calcium hidroxide, in terms of clinical outcome results, as high success rate and long-term sealing capacity.

The materials based on calcium hydroxide tend to dissolve over time and leave a gap between tooth and restoration (HILTON, 2009). Other studies show that both materials induce the formation of hard tissue; however, the hard tissue formed in teeth treated with MTA is more homogeneous and thicker than that produced in teeth treated with calcium hydroxide, so the MTA was the

material of choice for this case report (SAWICKI et al., 2008; LI et al., 2015).

The pH of both materials is similar (10 and 12, respectively for calcium hydroxide and MTA) (PARIROKH; TORABINEJAD, 2010). The antimicrobial potential of MTA is greater than calcium hydroxide, because the pH of calcium hydroxide falls rapidly, while the pH of MTA remains alkaline for longer periods.

Yadav et al. (2013), using the self-adhesive resin cement to bond the tooth fragment, concluded that it is a conservative treatment and less time consumer option. The application mode of the self-adhesive resin cements is significantly simplified, eliminating the etching and adhesive application procedures. These materials combine the characteristics of composite resins, self-etching adhesives and in some cases, luting agents. Positive results of this category of resin cements, found in the literature, are the less susceptibility to humidity, when compared with zinc phosphate cement and conventional resin cements (RADOVIC et al., 2008; GUARDA et al., 2010). Regarding microleakage between dental substrate and resin cements, the results are controversial. Ibarra et al., 2007 showed decreased microleakage between dentin and conventional total-etching cements, compared to self-adhesive cements. On the other hand, Behr et al., 2004 obtained similar marginal adaptation results to dentin and enamel with both conventional and self-adhesive resin cements. In terms of clinical outcomes, the post-operative sensitivity reduction and color stability over time were also found for the self-etch resin cements (BEHR et al., 2004; COSTA et al., 2006).

The dental fragment bond is an extremely conservative procedure, fast and with low cost for the patient, with a very satisfactory aesthetic, being almost imperceptible and an excellent choice of treatment.

## V. CONCLUSION

It is possible to conclude that with a correct diagnosis, appropriate materials and monitoring over time, high success rate may be achieved in cases of dental trauma with pulp exposure. Direct pulp capping with MTA and tooth fragment reattachment with self-adhesive resin cement is a simple and fast procedure, which preserved the tooth integrity and promoted excellent aesthetics after two year follow-up.

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