EC DENTAL SCIENCE
Case Report

Use of Mineral Trioxide Aggregate in the Treatment of Horizontal Root Fractures of Permanent Teeth: Cases Report

Fatma Masmoudi Baccouche[1,2]*, Imene Gharbi, Anouar Sebai, Zied Baccouche and Fethi Maatouk

[1]*Biological and Clinical Dento-facial Approach Laboratory LR12ES10*

[2]*Department of Pediatric Dentistry, University of Monastir, Tunisia*

***Corresponding Author:** Fatma Masmoudi Baccouche, Biological and Clinical Dento-facial Approach Laboratory LR12ES10 and Department of Pediatric Dentistry, University of Monastir, Tunisia.

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Abstract

Radicular fractures in immature permanent teeth are uncommon injuries among dental trauma accounting for 0.5 - 7% of the cases. Fractures most frequently occur in the middle third of the root and they rarely occur in the apical third.

Mineral Trioxide Aggregate (MTA) was introduced in dentistry as a root end filling material. It has been advocated for filling root canals, repairing perforations, pulp capping and root end induction.

The present paper reports a clinical cases of a horizontal radicular fracture located between the middle and apical third of an upper central incisors treated with MTA.

The use of MTA in the treatment of horizontal root fractures is not a routine application. However, it has positively affected the healing of fractured teeth after 4 years. Thus, it may be concluded that MTA can be used clinically in the treatment of horizontal root fractures.

Keywords: *Apical Plug; Follow-Up; Mineral Trioxide Aggregate; Root Canal Therapy; Root Fracture*

Introduction

Traumatic injuries involving root fractures are uncommon in children. These fractures involve the dentin, cementum, and pulp. They are reported to account for 0.5% to 7% of all traumatic injuries to teeth.

Horizontal root fractures commonly occur in the anterior maxilla of children. Generally, teeth with complete root formation are the most affected.

It is common that these fractures lead to necrosis of the coronal fragment while the apical fragment remains vital (in 99% of cases) [1]. The two fragments are then considered as separate entities that do not require the same treatment. The pulp processing located in the apical fragment is then not recommended and endodontic treatment will be limited to the coronal one [1-3]. The key to endodontic treatment success is partly related to the determination of the working length and the correct endodontic filling. In the case of horizontal root fractures, these two principles are more difficult to reach compared to a conventional endodontic treatment.

Indeed, with regard to the determination of the working length, the practitioner can rely on the usual endodontic treatment protocol, searching for the apical constriction and detecting the radiographic apex. In the case of the treatment of coronal single fragment, the clinician must consider that the definition of the working length does not reach the tooth apex but only the fracture line. The location of this area is not always easy given the fracture's often oblique transverse axis [4]. A Poor determination of this length is detrimental since it prevents the removal of the contaminated tissues as a whole if it is underestimated. Likewise, its overestimation results in a possible injury of the apical fragment's pulp by advanced instrumentation and over filling [3].

The lack of an apical barrier is an additional challenge for endodontic treatment. In fact, it causes an overflow of the filling material between the fragments, mostly resulting in the therapy failure. Thus, the closure of the coronal fragment establishes the same difficulties as the treatment of an immature tooth. To overcome these difficulties, creation of an apical barrier at the end of the coronal fragment is required [3,4].

MTA was introduced to overcome the drawbacks of calcium hydroxide. Indeed, this material possesses the desired properties of calcium hydroxide, particularly its effectiveness in creating an apical barrier at the coronal fragment of a horizontally fractured root [2,5-8]. MTA is widely used in endodontics thanks to its various advantages:

- Biological activity: MTA promotes the formation of calcified tissue including cementogenesis [6,7-9].
- Sealing ability: It offers a strong seal of the dentinal tubules allowing to fight against reinfection [1,2,9].
- Moisture tolerance [3,10]
- Radio opacity: allowing radiographic control [10].
- Biocompatibility, tissue tolerance without mutagenic effects [2,8,11].

Thus, MTA appears as an excellent alternative to the long-term use of calcium hydroxide [2,6].

Case Reports

Case 1

A 9-year-old boy, victim of a trauma at his maxillary anterior teeth, was referred to the Department of Pediatric Dentistry at the Faculty of Dentistry, Monastir. Tunisia.

The Intraoral examination showed a coronal fracture of both maxillary central incisors.

The Radiographic examination showed a horizontal root fracture in the apical third of the left one and the separation of the fractured segments. It was also observed that all the apices were completely formed (Figure 1).

He was referred with a standard root canal filling performed on the left incisor using gutta percha. The radiograph showed a non-adaptation of the filling to the root canal anatomy. Indeed, the treatment failure was due to the impossibility of obtaining an apical stop (Figure 2).

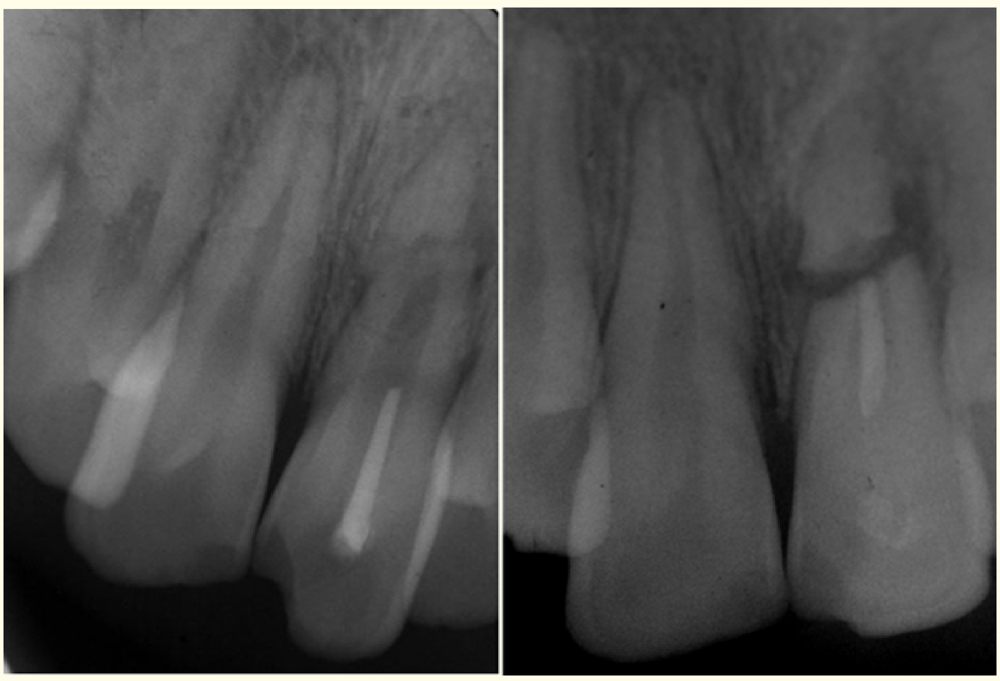

Figure 1 and Figure 2: *Root canal filling attempts.*

A root canal treatment of the coronal fragment was planned.

Following rubber dam isolation of the tooth, the access cavity was prepared. Then, gutta percha was removed, and the working length was determined (Figure 3). The root canal was prepared with K-files and irrigation was performed using 2.25% sodium hypochlorite.

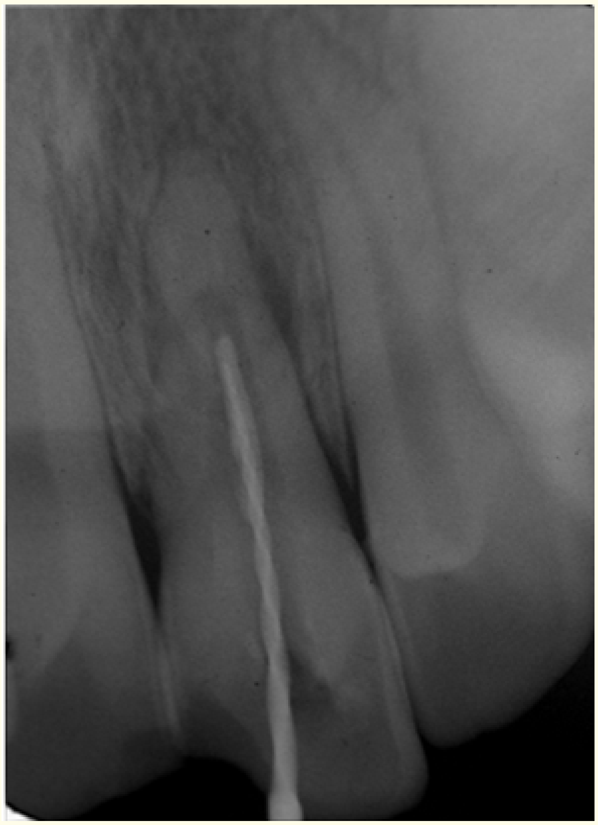

Figure 3: *Disobturation and Working Length determination radiograph.*

A Calcium hydroxide powder was mixed with normal saline. This mixture was placed into the canal and vertically condensed using endodontic pluggers (Machtou plugger Maillefer –Dentsply). The coronal cavity was temporarily filled with CavitTM (3M ESPE).

As the fracture line was anatomically similar to the apex of an immature permanent tooth, the creation of an apical plug with MTA was required.

At the next visit, MTA (ProRoot Dentsply –Tulsa Dental Specialty) apical plug was placed in the apical portion of the coronal fragment with a 4 mm thickness, as recommended by the manufacturer, using an MTA Endo Gun (Dentsply Maillefer, Ballaigues, Switzerland) which condensed with pluggers previously fitted to the working length. A radiograph was performed to control the proper placement of the apical plug with MTA (Figure 4). A damp cotton ball was inserted in the access cavity and a tight temporary coronal filling was put in place.

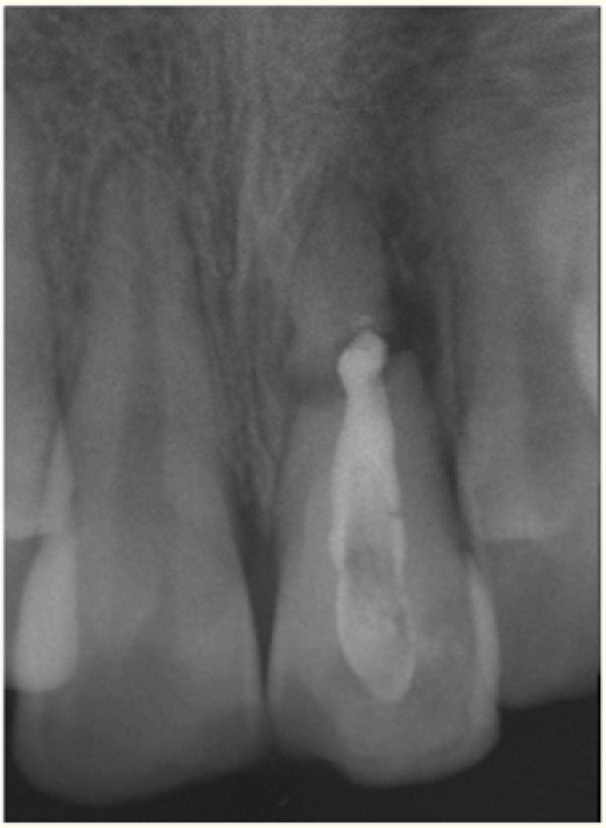

Figure 4: *Application of apical plug with MTA.*

At the next visit, MTA hardening was verified and the root canal was definitively obturated with gutta percha (Figure 5).

Figure 5: *Final root canal filling.*

At the six-month follow-up visit, the intraoral examination showed the absence of mobility, pain, and all other signs of possible complications. The radiographic examination revealed a satisfying healing (Figure 6).

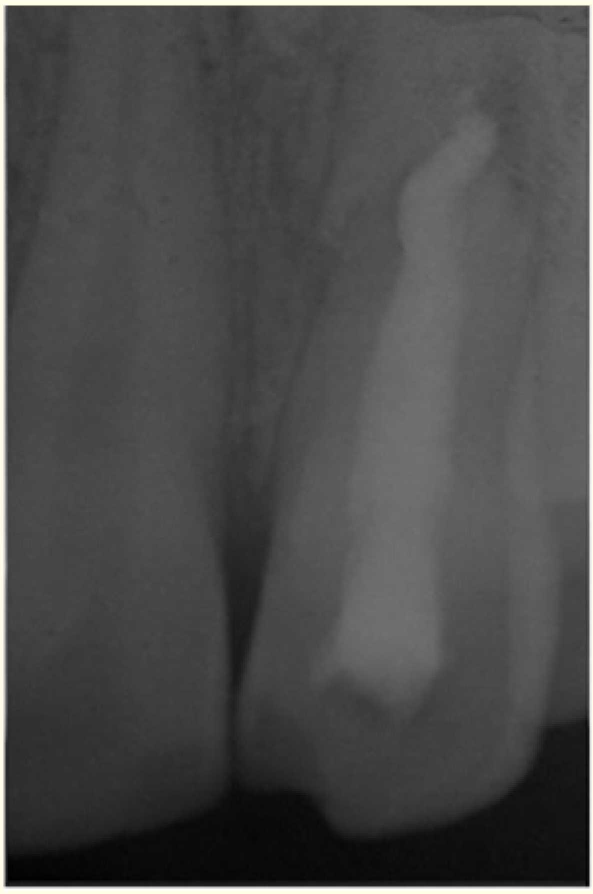

Figure 6: *Six-month follow-up radiograph.*

At the two-year follow up visit, the clinical examination revealed asymptomatic teeth and the radiographic examination showed the formation of new hard tissues around MTA which is a sign of our therapy success (Figure 7).

Figure 7: *Two-year follow-up radiograph.*

Case 2

An 8-year-old boy consulted at the Department of Pediatric Dentistry after a bicycle accident that resulted in a. coronal fracture of both central incisors. The intraoral examination showed a fistula related to the right one.

The radiographic examination revealed the immaturity of the central incisors and an apical third horizontal root fracture on the right one. A dense radiolucent area at the fracture line of the coronal segment was noted (Figure 8).

Figure 8: *Radiographic appearance of root fracture in the central incisor.*

The right central incisor responded negatively to the vitality pulp test. Root canal treatments of the coronal fragments were planned.

The teeth were isolated with a rubber dam. Then, the access cavity on the right maxillary central incisor was prepared. The root canal anatomy of the coronal part of the fractured root was similar to the apical area of an immature permanent tooth. Therefore, an apical stop could not be obtained. The canal was instrumented, irrigation was applied with 2.5% sodium hypochlorite and the working length was determined (Figure 9). The root canal was filled with calcium hydroxide and the access cavity was filled with a temporary material Cavit™ (3M ESPE) (Figure 10).

Figure 9: *Working length determination radiograph.*

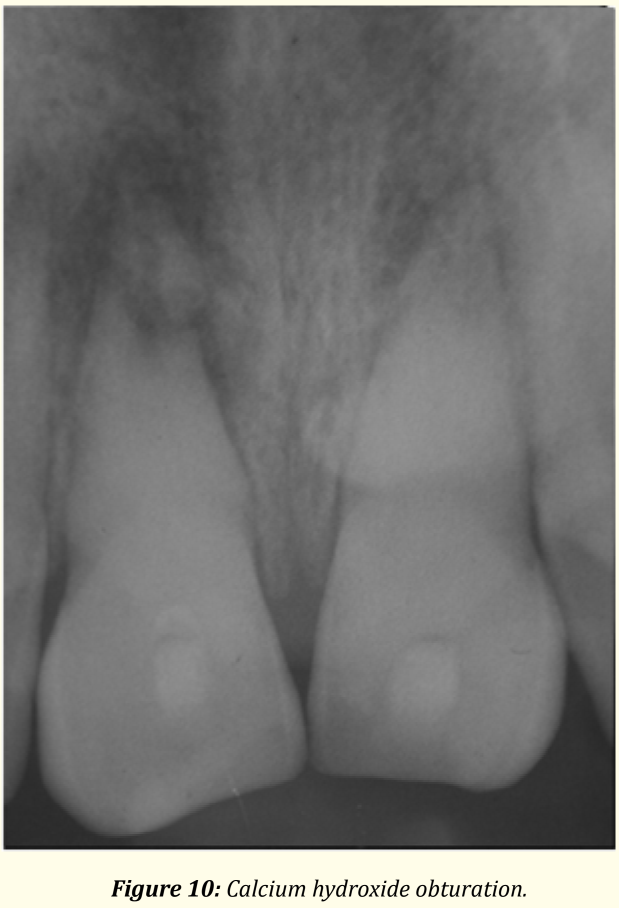

Figure 10: *Calcium hydroxide obturation.*

MTA was prepared according to the manufacturer's instructions. An endodontic plugger adequate for the length of the canal was used and the stopper was fixed 4 mm before the fracture line. MTA was inserted into the canal with a MTA Endo Gun (Dentsply Maillefer, Ballaigues, Switzerland) and it was compacted with the plugger. A radiograph was carried out to control the proper placement of the apical plug with MTA. It showed the extrusion of MTA in the fistula pathway. A damp cotton ball was inserted in the access cavity and a tight temporary coronal filling was placed (Figure 11).

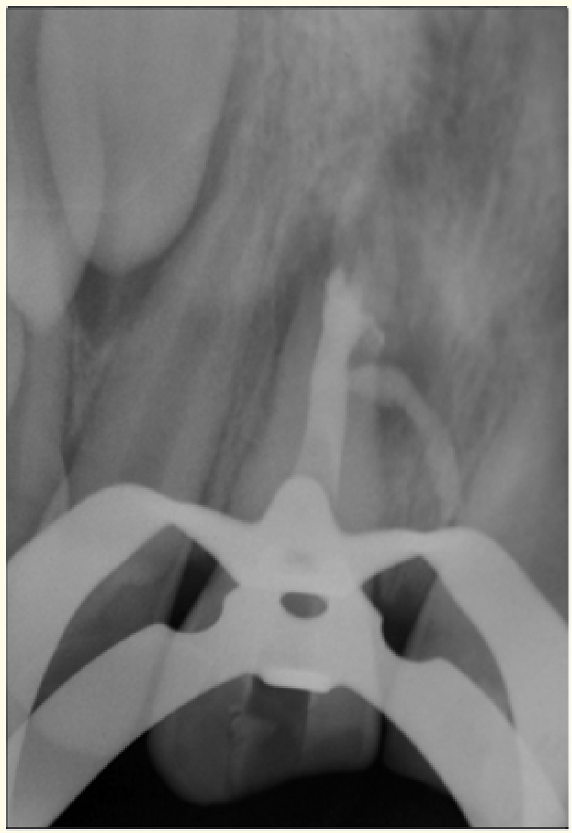

Figure 11: *Application of apical plug with MTA.*

At the next visit, a preoperative radiograph was performed to control MTA extrusion. It was noticed that the extruded MTA was no more visible (Figure 12). The patient reported white debris discharge from the fistula.

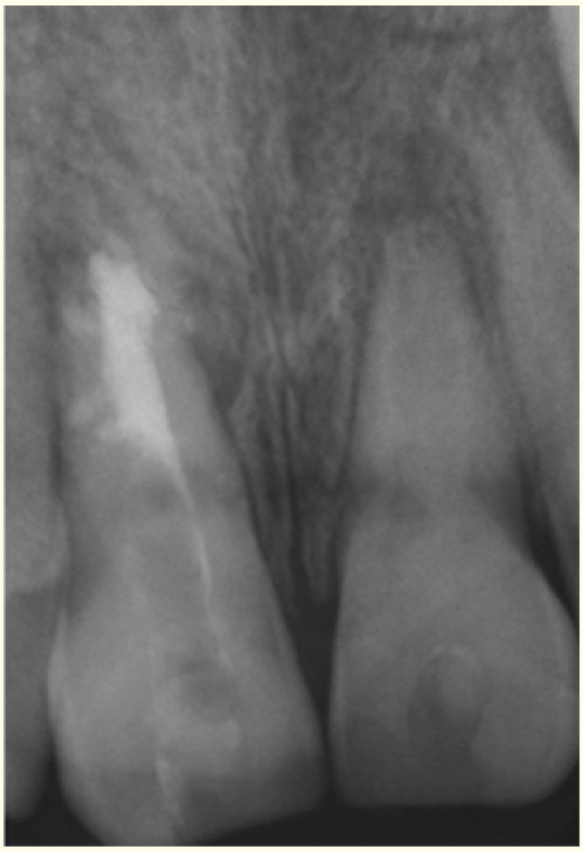

Figure 12: *Two-week follow-up radiograph: extrusion of MTA.*

A definitive root canal filling was carried out with gutta percha (Figure 13). At the same visit, an apical plug with MTA was placed in the left central incisor following the same procedure (Figure 14). The root canal and the coronal definitive fillings were placed at the later visits.

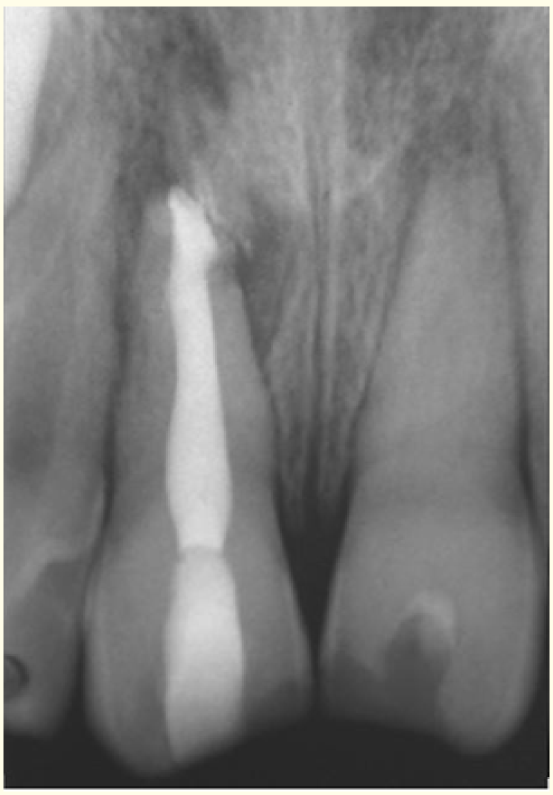

Figure 13: *Final root canal obturation.*

Figure 14: *Application of apical plug with MTA in the left central incisor.*

At the four- year follow- up visit, the clinical examination showed asymptomatic teeth and the radiographic examination (Figure 15,16) revealed the formation of new hard tissues around MTA. This proves the contribution of MTA in the treatment of such cases.

Figure 15: *Six-month follow-up radiograph.*

Figure 16: *Four-year follow-up radiograph. Note the new hard tissue around the MTA.*

Discussion

Horizontal root fractures originate mainly from trauma [12]. They can be diagnosed radiographically.

These teeth have great healing potentials (80%) compared with luxations [12-14].

In most cases, the root fractures in the apical and middle third heal spontaneously [15]. However, in some cases, the coronal pulp may necrotize and thus it requires endodontic treatment. When the pulp necrosis arises, the apical part of the fractured tooth generally remains vital [13]. Therefore, root canal therapy is applied only to the coronal fragment, but it is difficult to seal the coronal part because an apical stop is often impossible to achieve. It is important to make the right treatment choice for such teeth. We believed that MTA could be used in fractured teeth with open apices because it is very difficult to achieve an apical stop. Therefore, MTA was selected in the treatment of this horizontal root fracture. An appropriate diagnosis and treatment plan have a significant role in the treatment success of traumatic injuries.

Therefore, being aware of the advances in this field and knowing the treatment choices are crucial. The use of MTA in the treatment of horizontal root fractures is not a routine application. However, it has positively affected the healing of fractured teeth after 4 years. So, it may be concluded that MTA can be used clinically in the treatment of horizontal root fractures [16].

Bibliography

1. Prithviraj DR., *et al*. "An Overview of Management of Root Fractures". *Kathmandu University Medical Journal* 12.47 (2015): 222-230.
2. Andreasen Jens O., *et al*. "Textbook and color atlas of traumatic injuries to the teeth". John Wiley & Sons (2013).
3. Roig Miguel., *et al*. "Horizontal root fracture treated with MTA, a case report with a 10-year follow-up". *Dental Traumatology* 27.6 (2011): 460-463.
4. Berman Louis H., *et al*. "A clinical guide to dental traumatology". Elsevier Health Sciences (2006).
5. Andreasen Jens O., *et al*. "Traumatic dental injuries: a manual". John Wiley & Sons (2011).
6. Andreasen Jens Ove., *et al*. "Comparison of fracture resistance in root canals of immature sheep teeth after filling with calcium hydroxide or MTA". *Dental Traumatology* 22.3 (2006): 154-156.
7. Bakland Leif K and Jens O Andreasen. "Will mineral trioxide aggregate replace calcium hydroxide in treating pulpal and periodontal healing complications subsequent to dental trauma? A review". *Dental Traumatology* 28.1 (2012): 25-32.
8. Yildirim Tahsin and Nimet Gençoğlu. "Use of mineral trioxide aggregate in the treatment of horizontal root fractures with a 5-year follow-up: report of a case". *Journal of Endodontics* 35.2 (2009): 292-295.
9. Hatibović-Kofman Šahza., *et al*. "Fracture resistance and histological findings of immature teeth treated with mineral trioxide aggregate". *Dental Traumatology* 24.3 (2008): 272-276.
10. Bogen George and Sergio Kuttler. "Mineral trioxide aggregate obturation: a review and case series". *Journal of Endodontics* 35.6 (2009): 777-790.
11. Shabahang Shahrokh., *et al*. "A comparative study of root-end induction using osteogenic protein-1, calcium hydroxide, and mineral trioxide aggregate in dogs". *Journal of Endodontics* 25.1 (1999): 1-5.
12. Artvinli Leyla Berna and Sema Dural. "Spontaneously healed root fracture: report of a case". *Dental Traumatology* 19.1 (2003): 64-66.
13. Andreasen JO and E Hjorting-Hansen. "Intraalveolar root fractures: radiographic and histologic study of 50 cases". *Journal of Oral Surgery* 25.5 (1967): 414-426.
14. Calişkan MK and Y Pehlivan. "Prognosis of root-fractured permanent incisors". *Dental Traumatology* 12.3 (1996): 129-136.
15. Duggan Derek, *et al*. "A long-term follow up of spontaneously healed root fractures later subjected to orthodontic forces–two case reports". *Dental Traumatology* 24.2 (2008): 231-234.
16. Holland Roberto., *et al*. "Influence of the type of vehicle and limit of obturation on apical and periapical tissue response in dogs' teeth after root canal filling with mineral trioxide aggregate". *Journal of Endodontics* 33.6 (2007): 693-697.

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