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Endodontic Therapies of Traumatized Permanent Immature Incisors with Complicated Crown Fracture: A 3 Years Follow Up Case Report

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Abstract

Introduction: Crown fracture with pulp exposure is highly prevalent among children. This article presents, from a case report, the management of immature permanent tooth following a crown fracture with pulp exposure.

Case Report: An 8 year's old patient consulted for a crown fracture of 21 and 11 caused by a sport accident occurred 2 hours ago. Clinical examination revealed complicated crown fracture of 21 and 11. Radiological examination revealed the presence of open apices linked to the teeth immaturity. The treatment decision was to maintain pulp vitality aiming for apexogenesis. Endodontic management involved full pulpotomy in 11 and direct pulp capping in 21.

Discussion: The clinical and radiographic examinations of 11 on the 6-month, 9-month and 36-month follow-ups showed that the pulp remained alive, the apex was formed, and root development was completed. However, the 6-month clinical control of 21 showed a negative vitality test with an apical abscess. Apexification using Biodentine apical plug was the new therapeutic goal for the 21.

Conclusion: Therapeutic management of an immature permanent tooth with complicated crown fracture depends on several factors. Partial pulpotomy was recommended more than direct pulp capping for traumatized teeth with complicated crown fractures. Also, we can conclude that the success rate of VPT with the use of MTA or with comparable cements is better than that with the use of calcium hydroxide.

Keywords: Complicated crown fracture; Endodontic therapies; Direct pulp capping; Pulpotomy; Immature permanent teeth

Introduction

The most dental injuries are crown fractures (26% to 76%), and more accurately complicated crown fractures occur in 2 - 13% of all dental trauma [1]. In excess of 40% of all dental injuries of permanent teeth occur before the age of 14, moreover nearly 25% of these occur before the age of 9. Permanent teeth are still immature at this age. Roots of the maxillary anterior teeth are not yet fully developed and the dentinal walls are still fine, the root fracture risk is higher than it is in teeth with mature roots [2]. This clinical illustration is aimed at describing a 3-year follow-up of two traumatized immature permanent maxillary incisors with complicated crown fracture.

Case Report

An 8-year-old girl presented to the Department of Pedodontics and Preventive Dentistry at the Dental Clinic of Monastir (Tunisia) with a crown fracture in both maxillary central incisors. The patient consulted our department accompanied by her father who reported that his daughter was subjected to a traumatic dental injury two hours back during sport activity at school. The clinical examination revealed complicated crown fracture was diagnosed in both incisors, in addition to mild pain to percussion, mobility degree I, absence of pain to periapical palpation, and positive response to thermal test. The pulp exposure in the right central

incisor was registered nearly 2 mm, while it was less than 1 mm in 21 (Figure 1).

The intraoral periapical radiograph revealed that the fractured teeth had immature apices with fracture lines communicating with the pulp. The periapical region did not show any signs of pathology (Figure 2).

Figure 1: *Crown fracture with pulp exposure in both incisors.*

Figure 2*: Preoperative radiograph.*

Figure 3**:** *immediately postoperative radiographs after pulpotomy in right central incisor and direct pulp capping in left central incisor.*

Based on radiographic and clinical examinations, the final diagnosis of subluxation with complicated crown fracture was made for both central maxillary incisors. Considering the teeth immaturity, the first treatment option was vital pulp therapy (VPT): direct pulp capping for 21 and pulpotomy for 11. The advantages of vital pulp treatment were explained to the father. After administration of local anesthesia with 1.8 mL of 2% lidocaine with 1:100,000 epinephrine, an access cavity was prepared for the right central incisor. Coronal pulp tissues were removed by making use of a long shank round diamond bur, with high speed and copious water spray. The associated bleeding from the radicular pulp signified healthy status of the pulp. The area was rinsed with normal saline solution. Hemostasis was achieved by gentle placement of a sterile cotton pellet moistened with normal saline solution over the amputated pulp. Biodentine™ was immediately placed over the exposed pulp. At the same appointment, the exposed dentin and Biodentine were both sealed with composite restoration to build up the fractured tooth structure (Figure 3).

Concerning the left central incisor, the pulp-dentine wound was first carefully cleaned with a cotton pellet moistened with normal saline solution. Then, calcium hydroxide cement was set against the pulp exposure, and the fractured tooth was restaured by composite resine (Figure 4).

Figure 4*: 1week follow-up radiograph***.**

A follow-up period of 1 week and 3 months, showed no evidence of inflammation. Then, 6 months later, the patient consulted in an emergency for a periapical abscess in relation to the left central incisor. So, a conventional endodontic access cavity was established. As the apex locator produced inconstant canal length readings, the working length was determined radiographically with a #15 K-file (Figure 5-7).

Figure 5: *3 month follow-up radiograph*

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

***Figure 7**: Working length (WL) determination.*

The canal was quietly instrumented to #40 K-files using a circumferential filing movement. Root canal debridement was done using alternative irrigation with a solution of 3% sodium hypochlorite. Then, intracanal calcium hydroxide medication was placed. After 2 weeks, the calcium hydroxide dressing was removed by rinsing with alternating solutions of 3% sodium hypochlorite and 17% ethylenediaminetetraacetic acid. A final irrigation with normal saline solution was done. Then, Biodentine was carried into canal by using amalgam carrier and condensed with prefitted plugger until the formation an apical plug of 4 mm length, which was confirmed radiographically (Figure 8,9).

***Figure 8**: Radiograph plugger at WL-4mm.*

***Figure 9**: Post-op radiograph after Biodentine plug placement.*

After then, the root canal was backfilled with Gutta Percha using obturaII and access was sealed with composite. After apexification, 11 and 21 were followed radiographically and clinically one month, three months, six months and yearly for three years. During follow up periods, there were no clinical signs of inflammation and mobility. Radiographs showed an increased root length in the right central incisor with no evidence of radiolucent lesions in both teeth. A total root edification with apical closure in 11 was evident after 3 years (Figure 10).

***Figure 10**: 36 month follow-up radiograph.*

Discussion

Vital pulp therapy (VPT) is intended to preserve the vitality of the coronal or remaining radicular pulp in reversible pulp injury. It is a reasonable treatment for immature permanent teeth after a traumatic pulp exposure because they have great repair potential. In fact, in accordance with the International Association of Dental Traumatology (IADT) and the American Academy of Pediatric Dentistry (AAPD), every effort must be made to preserve pulp vitality in the immature permanent tooth to guarantee continuous root development, apical closure and increased strength of root walls [3]. In the context of an immature permanent tooth with complicated crown fracture, VPT includes procedures such as direct pulp capping, partial or cervical pulpotomy. Direct pulp capping (DPC) is defined as the use of dental materials as a pulp dressing to preserve the tooth vitality after a pulp exposure [4]. In the case of complicated crown fracture, direct pulp capping is indicated only when there is minimal pulp exposure and treatment can be performed in a short amount of time after the injury. Partial pulpotomy was defined by Cvek as the partial removal of the potentially inflamed and irreversibly damaged coronal pulp adjacent to the exposure [5]. This form of treatment is particularly indicated if a wide area of the pulp is exposed and primary care cannot be administered within the first 2h after the injury [2]. The indication for a partial pulpotomy is judged by the clinical evaluation of bleeding from the pulp chamber, which should be controlled within 3 to 5 minutes under the slight pressure of a cotton pellet soaked in physiologic saline. If bleeding is excessive, a more invasive treatment such a cervical pulpotomy may be needed [2]. Some authors still recommend pulpotomy as more reliable than direct pulp capping. In accordance with the study, carried out on 375 immature permanent teeth with complicated crown fracture, the success rates of pulp treatments oscillate between 54.5 and 81.5% for direct pulp capping, 94 and 96% for partial pulpotomy, and between 86 and 92% for coronal pulpotomy [6]. Furthermore, he reported that there was no difference between partial and coronal pulpotomy. The pulp necrosis risk was not significantly different between pulpotomy

(partial and coronal) and retreatment by pulpotomy (partial or coronal) after direct pulp capping. However, the frequency of pulp necrosis and infection after pulpotomy was significantly less than that with direct pulp capping using Dycal [6]. In one hand, these results can be due to the capping material which may occupy some parts of dentine and perhaps even enamel, thus reducing the restoration abilityto prevent bacteria entering the tooth. Or in pulpotomy treatments, the pulp capping material can submerged reducing thus the risk of bacterial penetration and pulp contamination. In the other hand, the high rate of pulp necrosis is explained by the potentially contaminated pulp tissues not removed in case of direct pulp capping [7]. Furthermore, the long-term success of direct pulp capping and pulpotomy is intimately linked to the type of capping materials which are available in various kinds. In fact, according to a study released in vitro by Youssef et al., Mineral trioxide aggregate (MTA), Biodentine, CEM (calcium-enriched mixture) and EMD (Enamel Matrix Derivative) exhibit similar attributes and may better results than calcium hydroxide. Emdogain can be an interesting alternative to MTA and Biodentine in improving pulp repair capacity following dental pulp injury [8]. Although success rates of both partial and cervical pulpotomy are evident, partial pulpotomy remains more reliable in traumatic exposure of the pulp. An update review of literature carried out revealed that the cell-rich coronal pulp preserved during partial pulpotomy aids the pulp defence reaction to resist to bacterial contamination and provides a better healing potential. Also, partial pulpotomy maintains dentin physiologic apposition in the cervical region, natural color and translucency of the tooth. This procedure preserves the possibility to perform vitality testing [9,10]. The International Association of Dental Traumatology (IADT) guidelines 2020 have recommended pulp capping, partial or cervical pulpotomy for the treatment of teeth with complicated crown fracture without indication of the type of treatment [3]. The amount of time elapsed between dental injury and treatment is not a very interesting factor to choose the treatment procedure for the traumatic exposed pulp. In fact, the contamination risk and the infection depth through the exposed area is increased by the elapsed time. During the first 24 hours after traumatic exposure of the pulp, the inflammation is limited to the superficial layers of the pulp. After this period, inflammation spreads apically [11]. However, Cvek and Lundberg demonstrated that inflammatory pulpal changes are confined to the uppermost 2mm even after a period up to168 hours [12]. The results were confirmed by the study of Heide who reported that partial pulpotomy with the extirpation of 2mm of pulp tissue in the coronal region can be successful even after many days [13]. Although animal studies reveal that direct pulp capping can offer excellent prospects for success as much as 24h after exposure of the pulp to the oral environment, it seems recommended to restrict the time limit for direct capping to 2 h [14-16]. The level of root development at time of injury affect the outcome of conservative pulp treatments in the case of complicated crown fractures with concomitant luxation injuries [17]. In accordance with the study, the pulp necrosis incidence in mature teeth was considerably higher than with immature teeth. In fact, young teeth with open apices have a great repair potential and better pulp prognosis than those with mature roots, because the pulp of older patients is more fibrotic and has reduced ability to restor. In some studies, authors state that the traumatic pulp exposure size has relatively less influence on the prognosis [18,19]. Instead, some other authors reported that the extent of the exposure can be a determining factor when deciding between performing pulp capping and pulpotomy [20]. In fact, direct pulp capping is recommended only for cases with pin point exposures in fractured permanent teeth treated within a few hours after the dental trauma. When the trauma involves extensive complicated fracture, pulpotomy seems rather indicated. However, the outcome does not appear to be affected by the size of exposure as long it is less than 4 mm. In other studies, the presence of additional luxation injuries is judged as an important factor in the treatment decision process for complicated crown fractures. In fact, it has been indicated that subluxation or luxation injures may cause harm to the blood and nerve supply entering the apical foramen, thus compromising pulp healing and facilitating the pulp necrosis [21].

Conclusion

Complicated crown fractures are a frequent dental injury that should be appropriately treated by the practitioner. Thus, complete radiological and clinical examinations are necessary for diagnosis and treatment decision. Partial pulpotomy was recommended more than direct pulp capping for traumatized teeth with complicated crown fractures. Also, it appears that the VPT success rate using MTA or comparable cements is more interesting than that with the use of calcium hydroxide. Moreover, immature permanent teeth with complicated crown fracture and additional injury, should be followed-up radiographically and clinically yearly up to 5 years to ensure successful outcomes of the treatment measures used during management.

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