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Case Report

Vital pulp therapy with mineral trioxide aggregate

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Abstract – The present case report describes the treatment of complicated crown fractures using mineral trioxide aggregate (MTA). MTA was used as pulp-capping material after partial pulpotomy to preserve the vitality of the pulpal tissues in two cases. Follow-up examinations revealed that the treatment was successful in preserving pulpal vitality and continued development of the tooth.

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Complicated crown fractures are fractures involving enamel, dentin and exposed pulp (1). Treatment and prognosis of injured pulp and fractured crown depends on the degree of pulp exposure, root development, time spent between the accident and examination as well as the restorability of the tooth. Correct diagnosis and complete documentation with follow-up visits are essential for the prognosis of injured teeth. However, special effort must be made to maintain pulp vitality, especially in young teeth, to continue physiologic development.

Partial pulpotomy (Cvek pulpotomy) with calcium hydroxide-based materials has been a recommended choice of treatment for complicated crown fractures to conserve healthy pulp (2). Histologic examination on traumatized pulp showed that the depth of inflammatory reaction did not exceed 2 mm from the exposed surface within 48 h (3). Therefore, injured pulp can be successfully removed leaving the non-inflamed pulp to reorganize (2, 4). Data from pulp-capping experiments suggest that initiation of reparative dentin formation occurs not because of specific dentinogenic effect of calcium hydroxide but because of its controlling infection and stimulating the wound healing process. In addition, it is well known that when further bacterial contamination is prevented with a biocompatible material, the exposed dental pulp has the capacity to maintain vitality and build a new dentinal bridge (5, 6).

The present case report describes treatments of complicated crown fracture with a new dental material, mineral trioxide aggregate (MTA).

Case report

Case 1

A 9-year-old male was referred for endodontic evaluation and treatment of traumatic injury to upper anterior teeth to the Endodontic Clinic at the University of Pennsylvania School of Dental Medicine. His medical history was non-contributory. The dental history revealed that he broke tooth no. 9 two days prior when he fell and hit his front teeth on the floor. He complained of mild pain to cold without any spontaneous pain.

The dental examination revealed normal soft tissue appearance. Tooth no. 9 had horizontal mid-crown fracture with small pulp exposures (Fig. 1). Diagnostic tests were performed on all upper and lower anterior teeth. Tooth no. 9 responded with moderate pain to percussion and severe but not lingering pain to cold thermal test. It was asymptomatic to palpation and responded within normal limits to electric pulp test (EPT). Radiographic examination showed a large canal space with an immature apex without additional root fracture (Fig. 2). The adjacent and opposing teeth were

Fig. 1. Tooth no. 9: horizontal mid-crown fracture with small pulp exposures observed.

Fig. 2. Preoperative radiograph.

asymptomatic and responded normally to all diagnostic tests.

The tooth was anesthetized with local infiltration of 1.8 cm^3 of 2% xylocaine with 1:100 000 epinephrine (Dentsply, York, PA, USA). After placing a rubber dam, the exposed pulp tissue was removed with a sterile no. 2 round diamond bur in a high-speed handpiece with water spray, creating a 2-mm deep cavity into the pulp chamber. Hemorrhage was controlled with sterile cotton pellets and anesthetic solution irrigation. When pulpal bleeding stopped, MTA was placed without any pressure to cover the exposed pulp and surrounding dentin. MTA powder was mixed with 2% xylocaine with 1:100 000 epinephrine to the recommended consistency. The cavity was sealed with moist cotton pellet and ZOE temporary cement. The patient was reexamined 3 days later; tooth no. 9 was asymptomatic with a mild cold and percussion sensitivity. Electric pulp test was within normal limits. Therefore, the temporary filling was removed and the tooth was restored permanently with a composite restoration (Fig. 3).

Fig. 3. Postoperative radiograph.

The patient was followed for one and a half years with 3, 6 and 18 month examinations. During this period the patient was asymptomatic and sensitivity tests were within normal limits. Follow-up radiographs also showed evidence of continuing apical root development (Fig. 4).

Fig. 4. Eighteen-month follow-up radiograph showing apical root development and coronal dentinal bridge formation.

Case 2

A 9-year-old girl was referred to the Endodontic Clinic for dental evaluation the same day following a trauma to the maxillary incisors. Her medical history was non-contributory. Upon clinical examination, it was evident that the trauma caused a mid-crown fracture of tooth no. 8 with pulp exposure (Fig. 5). Diagnostic tests were performed on all upper and lower anterior teeth. Teeth no. 8 and 9 did not respond to cold test nor EPT while other teeth gave positive results. Only tooth no. 8 was sensitive to palpation and percussion with +2 mobility. A radiographic examination was then performed with varying degrees of vertical angulations to determine the possible cause of fracture of the root surface. No fracture lines were seen; however, the apex of the tooth was not yet fully formed (Fig. 6). It was determined that the ideal course of treatment was vital pulp therapy with partial pulpotomy. The patient was anesthetized with local infiltration of 1.8 cm^3 of 2% xylocaine with 1:100 000 epinephrine. The tooth was then isolated with rubber dam and the exposed coronal pulp was removed with a no. 4 round diamond bur in a high-speed hand piece with water spray. The area was then irrigated with NaOCl and pulpal hemorrhage was controlled and dried with sterile cotton pellets. Gray MTA mixed with 2% xylocaine was placed covering the pulp tissue completely. The cavity was sealed with a wet cotton pellet and ZOE. The patient was scheduled for reevaluation; however, he did not return at the instructed recall intervals. He was later seen in the clinic approximately 1 year later due to RCT treatment of no. 30. The patient was asymptomatic in the anterior region and the temporary filling was still intact. Clinical and radiographic examination indicated that the treatment resulted in not only the complete formation of the root apex but also formation of a dentinal bridge (Fig. 7). Diagnostic tests indicated that teeth no. 8 and 9 were vital with physiologic mobility. A new ZOE temporary was placed and postoperative instructions were given to the parent in terms of a final restoration. A direct phone call was also placed with the patient's pediatric dentist to inform that a composite resin restoration was the ideal choice of treatment at this time.

Fig. 5. Tooth no. 8: mid-crown fracture with pulp exposure.

Fig. 6. Preoperative radiograph: immature apex observed.

Discussion

In recent years, MTA has became the widely preferred material to use in contact with vital tissue to promote healing. Many *in vivo* and *in vitro* studies

Fig. 7. One-year follow-up X-ray: complete formation of the root apex and dentinal bridge formation observed.

Fig. 8. Cervical discoloration due to gray color of MTA.

have reported the superior physical and biological properties of MTA. In animal studies, MTA has been able to stimulate reparative dentin formation after mechanical pulp exposure (7, 8). These studies demonstrated new matrix deposition with cellular inclusions in a 2-week period and tubular type dentin-like barrier at 3 weeks (7, 9). It has been speculated that hard tissue stimulation may occur because of the biocompatibility, sealing properties and the alkalinity of MTA.

In this article two cases of incompletely developed fractured teeth were presented where MTA was used as pulp-capping material. Recall examinations revealed that treatment was successful in preserving pulpal vitality and continued development of the tooth. However, case 1 showed cervical discoloration due to gray color of MTA (Fig. 8). For similar cases, use of a new generation white MTA to prevent unwanted discoloration of the crown is suggested.

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