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Traumatic dental ınjuries: A review

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Abstract
Dental traumas are among the most frequently encountered cases in clinical practice. Dental traumas that occur in primary and permanent teeth not only cause functional and aesthetic problems but also affect the patient at the physical and psychological levels. Appropriate treatment options should be evaluated after performing clinical and radiological evaluations for a patient presenting to the clinic with a history of trauma. The aim of this review is to provide information about the endodontic treatment approaches to the teeth that have been exposed to dental trauma.

Keywords: crown fracture, dental trauma, endodontic treatment, luxation ınjury

1. Introduction

Dental traumas are injuries caused mostly as a result of sports activities, violence, traffic accidents and falls at school or at home, particularly seen in children and young adults aged 7–12 years [1, 2].

These injuries are more common in boys compared to girls [3, 4] and are most commonly seen in upper incisors [2]. It occurs more frequently in individuals with increased overjet and inadequate lip coverage. Increased overjet increases the risk of trauma; normal limits of overjet are between 0 and 3 mm and overjet of 3–6 mm and >6 mm causes a two-fold and three-fold increase in trauma risk, respectively [2]. The following injuries are seen in these patients: uncomplicated crown fractures with 26–76% prevalence, complicated crown fractures with 15.5% prevalence, root fractures with 7.7% prevalence, avulsion with 4–22% prevalence, alveolar bone fractures with 5.5% prevalence, and soft tissue injuries such as concussion, subluxation, extrusive, lateral and intrusive luxation injuries with 47–58% prevalence [5].

International Association for Dental Traumatology (IADT) guideline updated with the help of published articles helps physicians in the accurate diagnosis, treatment planning, treatment and follow-up of such injuries.(6) In these patients, it should be given priority to create a biological response to maintain the growth and development of the alveoli for aesthetic and functional rehabilitation of the area affected by trauma. This review includes endodontic treatment approaches to teeth that have been exposed to dental trauma.

First of all, protective and preventive treatment should be applied to reduce the risk of trauma. For this purpose, orthodontic treatment should be started immediately after upper incision eruption in Class II patients with increased overjet. In cases where long-term orthodontic treatment is not suitable, measures should be taken in the early period with the use of custom-made mouthguards [7-9].

Clinical and radiographic evaluations should be performed as the first step for a patient presenting to the clinic with a history of dental trauma. Different treatment approaches are applied based on color change, mobility in the vertical or horizontal direction, sensitivity to palpation at the root end, sensitivity to percussion, findings of sensitivity tests performed at different times, and data supported by periapical radiographs taken at different angles or cone-beam computed tomography. Viability tests are important in terms of revealing the physiological status of pulp in the teeth exposed to trauma. These tests should be repeated at the third week and at the third, sixth and 12th months following the trauma. Furthermore, radiography is recommended to support the clinical examination to determine the position of tooth and crown/root status in trauma cases and to detect foreign body in soft tissue injuries. IADT recommends that at least four radiographs should be taken: one taken at an angle of 90°C, two taken at different vertical angles, and one occlusal [10].

Crown Fractures

A. Enamel crack

Detailed follow-up processes are important for the damage of primary and permanent teeth without enamel loss. However, if there is a symptom in the primary and permanent teeth such as the presence of a negative response from pulp tests, the presence of apical periodontitis, or if the root development does not continue, an endodontic treatment suitable for the root development level should be applied [10]. If there is a malocclusion, orthodontic force may be applied after three-month follow-up following the endodontic treatment [11, 12].

B. Enamel fracture / Enamel-dentin fracture

It is the most common form of dental trauma in children with mixed dentition [3]. There is sometimes a complete fracture in the enamel which includes the dentin. In crown fracture cases involving dentin, dentin canals should be isolated from the external environment and the remaining amount of dentin thickness should be accurately evaluated. Pulp tissue should be aimed to be kept alive in the restoration of the fractures to cover the dentin canals and even the materials to be used during the restoration should be determined directly in relation to the fracture line [13]. In cases with enamel fracture only involving the enamel, the route to be followed for treatment is decided according to the width of the fracture line. Sharp edges of the fractured enamel are rounded or the missing tooth structure can be

restored through enamel restoration. Following the restoration, the patient is followed for symptoms for up to one year at intervals of six to eight weeks. Tooth extraction can be also added to the treatment options such as pulpotomy and pulpectomy in the treatment of primary teeth.

C. Crown root fracture with pulp involvement

If the patients with crown root fracture with pulp involvement are not treated, prognosis results in pulp necrosis [14]. Following the trauma, the relevant teeth can be treated in two ways: vital pulp treatment or root canal treatment. The treatment modality should be determined based on the development stage of the tooth, the time between trauma and treatment, the status of the surrounding tissues, and restoration type [15].

Root Fracture

It is the fracture involving cement, dentin, and pulp. It most commonly occurs obliquely in the buccolingual direction. Radiography is recommended to be performed at least three different angles (45, 90, 110 degrees) to detect the fracture line [15]. Localization of the fracture line has an important role in the prognosis. In crown and root fractures caused by dental trauma in the primary tooth, the entire tooth, including the fractured part, should be removed from the alveoli so that fractured parts do not adversely affect the permanent tooth eruption [16].

In root fractures of permanent teeth, the apical segment is kept alive because it is mostly not displaced and its vascular-nerve support is not damaged [16, 17]. However, in cases where the coronal part is displaced, it should be positioned in the proper position and splinted with a flexible splint for four weeks. It is recommended to splint the tooth up to four months for fractures in the cervical region. Furthermore, the length of the root fragment remaining in the alveolar bone, its compliance with the fractured part remaining in the cervical part, and the proximity of the fracture line to the cervix level should be evaluated for treatment prognosis. The condition of the pulp is monitored for a year in moderate and apical root fractures. If necessary, partial pulpectomy is performed for the area up to the fracture level [16]. There are four types of root fracture healing patterns according to Andreasen and Hjorting-Hansen [18].

1. Healing with hard tissue
2. Healing with connective tissue
3. Healing with bone and connective tissue
4. Inflammatory connective tissue formation.

When partial pulpectomy is performed, the formation of the hard tissue barrier is observed radiographically starting from the third month. Prognosis in teeth with incomplete root development mostly results in short root length. Orthodontic treatments are recommended to be postponed until the root development is completed. The incomplete root development of the tooth is advantageous for the healing of the pulp and fracture line. Orthodontic treatment can be initiated after a year in root fractures if there are no signs of complications [19]. The fractured part must be extruded orthodontically to perform crown restoration of the teeth with cervical root fracture or crown-root fracture. Orthodontic extrusion can be performed by moving or fixed mechanics by applying low forces [12].

Fracture line area does not have to be separated when orthodontic treatment is applied in cases where the fracture is healed with calcified tissue where the fracture line is filled with dentin and cementum [20]. However, the orthodontic force causes the fractured pieces to move away from each other in cases where the fracture line is healed by being filled with connective tissue [21].

Teeth with horizontal root fracture that are healed by connective tissue should be considered as short rooted teeth. In deep root fractures, roots are recommended to be left in place until implantation to protect the alveolar bone if the patient's growth/development continues and implant treatment is planned to be performed in later periods.

Luxation Injuries

Luxation injuries are the cases resulting in damage to the periodontal ligament and cementum layer. The most severe damage is seen in the case of intrusion where the mildest damage is caused by a concussion. The viability of the dental pulp depends on the damage caused by the trauma on the neurovascular support in the apical area.

A. Concussion

It is the most common type of injury in primary teeth [22]. Temporary sensitivity to percussion occurs in concussion injuries that do not lead to tooth displacement and damage to the alveolar bone. Endodontic treatment is not performed unless there is an infection in primary teeth. Permanent teeth are checked at intervals of four to six weeks. It should be remembered that pulp tests may give false negative responses up to the first three months. Endodontic treatment should be preferred if the apex is damaged [11, 12].

B. Intrusion

It is the movement of the traumatized tooth in the apical direction within the alveolar socket. Spontaneous eruption is expected if the primary teeth intrusion is not in contact with the permanent tooth follicle. Some or all of the primary teeth can erupt spontaneously within the two to six months. Erupting primary teeth have been reported to remain in the mouth for more than three years. If the primary tooth comes in contact with the follicle, it may cause malformations or eruption failures. The traumatized primary tooth should be pulled out, space maintainer should be placed and permanent tooth development should be monitored [23]. Eruption potential is higher in permanent teeth with incomplete root development compared to teeth with completed root development. The tooth can be left to spontaneous eruption if the amount of intrusion is less than 7 mm in teeth, one-third or two-thirds of root development of which is completed. Teeth left for spontaneous eruption have a better prognosis than the repositioned teeth. If the tooth eruption does not start within two weeks, the tooth should be extruded by applying light orthodontic forces so that the aesthetic and function, as well as neurovascular continuity, would be maintained [24]. Retention should be performed for five to eight weeks to prevent relapse after orthodontic eruption. Fixed protectors are more suitable for providing vertical control. The tooth should be repositioned orthodontic ally within two or three weeks to apply the endodontic treatment for the teeth following the intrusion of permanent teeth with completed root development. In this way, it is intervened before the ankylosis development. Orthodontic force may be insufficient if the intrusion is very

severe. In such cases, the intruded tooth can be surgically repositioned. The tooth is replaced under anesthesia, or orthodontic extrusion is applied after the adjacent teeth are braced if the root length has reached normal level but the apical foramen has not closed yet [25]. If the apex is closed, spontaneous eruption is not possible for the tooth. Orthodontic eruption is necessary. Prophylactically, the pulp of the respective tooth is recommended to be extirpated. If the patient is older than 12 years of age, repositioning the tooth with the help of surgery is recommended for healing. However, it is recommended to make an enhancement by suturing in the cervix area since the good adaptation of the surrounding soft tissue and lateral gingiva is important for healing. A flexible splint should be performed for four to eight weeks after the tooth is repositioned via surgery [26]. To correct the existing malocclusion, orthodontic treatment can be started with low forces by monitoring the prognosis of the tooth six months after the treatment [27].

C. Extrusion

It is the movement of the traumatized tooth in the coronal direction within the alveolar socket. If the amount of extrusion in the primary teeth is less than 3 mm, it can be expected that the tooth will align itself spontaneously or it will be positioned in the socket by the dentist. The primary tooth is pulled out in more severe cases. For permanent teeth, the tooth is placed in the socket and splinted for two weeks. If marginal bone destruction occurs, splinting is continued for an additional three or four weeks. External inflammatory root resorption may occur and endodontic treatment can be applied [28].

D. Subluxation

The traumatized tooth is not displaced but there is sensitivity in percussion and increased mobility. The observation period is at least three months for minor injuries such as compression and subluxation. If the tooth is in occlusion, the antagonist can be slightly ground out of occlusion, and the patient is recommended to go on a soft diet for two weeks. In severe luxation, the patient is monitored at intervals of two to three weeks and the follow-up period should be at least a year. The removed tooth and the displaced bone must be replaced under local anesthesia The position of the tooth should be checked through radiography. Duration of splinting should not be more than two weeks. Root canal treatment may be required in the teeth with completed root development [29].

E. Lateral Luxation

The tooth is generally displaced in the palatal/lingual or lateral directions. There is a fracture in the alveolar socket. Lateral luxation of primary teeth is tried to be treated by gently replacing the tooth and reducing its occlusal contact or through the extraction of the primary tooth if the eruption time of the permanent tooth is close [29].

Teeth repositioning spontaneously have a better prognosis. In permanent teeth, the repositioned tooth is fixed with a flexible splint for four weeks. The tooth can be extruded orthodontically to relieve vascular and nerve compression in the apical. If marginal bone destruction occurs, splinting is left in the mouth for an additional three or four weeks. Pulp necrosis is a common complication. External root resorption may occur [29].

F. Avulsion

The reposition is not recommended for avulsion of the primary tooth to avoid damaging the permanent tooth germ. Considering the eruption time of the permanent tooth, a space maintainer can be placed if necessary. For the avulsion of permanent teeth, the avulsed tooth should be washed with cold water for 10 seconds, antibiotic and tetanus prophylaxis should be applied for the patient, and the tooth should be replaced as soon as possible. If it is not possible to place the tooth immediately, it should be delivered to the physician by keeping it in the milk or in the vestibule area in the mouth. If the patient has come to the clinic in a short time, the tooth is replanted and splinted for 10 days to four weeks. Neurovascular continuity can be ensured by 18% in teeth with apices of more than 1 mm wide, root development of which has not completed yet. Therefore, if the apex is replanted within one hour, it should be monitored for revascularization and apexification should be preferred only if there is any finding compatible with the infection. However, if the permanent tooth with completed root development is replanted within or after an hour following the trauma, root canal treatment should be started after seven to 10 days [30]. Ankylosis may occur if the tooth is replanted after more than an hour following the trauma. If the central tooth is not replanted after permanent tooth avulsion in growing individuals, premolar autotransplantation can be applied to the cavity of the missing tooth to ensure the development of the alveolar bone. Successful results are obtained via autotransplantation in cases where the root length of the tooth is 1/3–3/4 or in teeth with open apices, which have long root length. Orthodontic force can be applied to the teeth undergoing transplantation [31]. The gap of the missing tooth can be closed if the tooth is not replanted after trauma. Orthodontic treatment should be started as early as possible if it is planned to close the gaps caused by the missing tooth. A space maintainer should be used if the tooth is not replanted and the closure is contraindicated. The gap should be preserved until the period of prosthetic rehabilitation. Implant treatment must be postponed until the growth is finished [32].

Conclusion

Teeth exposed to dental trauma should be examined both clinically and radiologically. Treatments to be applied should be determined based on the type of the tooth (primary or permanent), root development level, the amount of damage to teeth and surrounding tissues, The extent to which the pulp has been affected by trauma, and severity of trauma. Treatments that prolong the survival of the tooth in the mouth and provide a functional and good aesthetic result should be preferred.

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