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Multidisciplinary approach to the rehabilitation of a tooth with two trauma episodes: systematic review and report of a case

CASE REPORT

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Abstract – Studies have shown that some children and adolescents are affected only once with dental trauma, while others seem to be accident-prone and suffer from multiple dental trauma episodes. Less is known about treatment consequences related to repeated traumatic dental injuries to the same tooth and treatment guidelines are not well established. Complicated crown fractures and crown-root fractures pose difficulties for dentists to establish adequate treatment plans because these fractures require multidisciplinary knowledge and approach for a correct case planning and prognosis. The objective of this paper was to present and discuss a case of a child who sustained a second trauma to the same tooth following treatment of an earlier sustained crown fracture. The research-based background for establishment of the treatment plan is discussed. Reattachment of tooth fragment is a minimal invasive and esthetic method. Essential advantage of the reattached teeth is the fact that all the alternative methods as direct adhesive resin reconstruction, veneers and crowns can be performed in case of failure or a refracture. As a consequence of initial trauma, the tooth suffered a complicated crown fracture which was resolved by endodontic therapy and fragment reattachment. During follow-up, the child suffered a second trauma resulting in dislodgement and fracture of the reattached fragment and a crown-root fracture extending subgingivally with involvement of the biologic width. A conservative restorative option is described. After 1 year of follow-up, the clinical and radiographic findings demonstrated that the adopted clinical protocol was successful and yielded healthy periodontal tissues with no signs of periradicular pathosis. The occurrence of repeated traumatic dental injuries to teeth involving conservative management of both crown-root fracture and complicated crown fracture on the same tooth is extremely rare and a challenge for dental professionals to treat.

Studies conducted on children and adolescents reported that 16–30% of these individuals sustain dental trauma more than once (1–4). Traumatic dental injuries that partially involve the root are many times associated with these cases and may be a very important complicating factor (5).

Multiple dental traumatic episodes to the same teeth have been reported to range from 8% to 45% (1, 3, 6, 7). It is likely, that repeated traumatic dental injuries to the teeth increase the possibility of sustaining a more serious injury resulting in an increased risk of developing complications and increasing the cost of treatment. It is conceivable, therefore, that the relationship between repeated traumatic dental injuries and type of injury, complications and treatment need further investigations.

The results of a study on multiple dental trauma episodes showed an increased risk of sustaining fractured restorations, root fractures and concussions in patients with repeated traumatized teeth as compared to single traumatized teeth (8). Another study reported that an increased number of trauma episodes per patient resulted in an increased number of follow-ups, filling therapy, information and prosthetic treatment (6).

Crown-root fractures account for only 5% of all traumatic injuries (9–11) and present difficulties for successful management. The treatment of crown-root fractures in children is compromised by a fracture below the gingival margin and/or bone. Various reports have been published in which cases of crown-root fracture have been treated by tooth fragment reattachment with or without surgical exposure or extrusion of the root depending on the site of fracture (10, 12–15). The occurrence of repeated traumatic dental injuries to teeth involving conservative management of both crown-root fracture and complicated crown fracture on the same tooth is rare.

The fracture of a tooth is itself a traumatic incident for a young patient, and it has been found that there is a positive emotional and social response from the patient to the preservation of natural tooth structure (16).

Essential advantage of the reattached teeth is the fact that all the alternative methods as direct adhesive resin reconstruction, veneers and crowns can be performed in case of failure or a refracture. Many articles have been published regarding a variety of preparations for tooth fracture secondary to traumatic injuries, but tooth fragment reattachment still offers a relatively simple and low-cost treatment protocol (17, 18).

The objective of this paper was to present and discuss the case of a child who sustained a second trauma to the same tooth resulting in a Crown-root fracture involving the biologic width following conservative treatment and fracture fragment reattachment of an earlier sustained complicated crown fracture. Another objective was to relate several challenges that dental professionals might have to deal with in repeated trauma cases.

Case report

The patient was a 9½-year-old girl who reported to the Department of Pedodontics, M.M. College of Dental Sciences and Research, Mullana (Ambala) Haryana, India with a chief complaint of a broken upper front tooth due to fall during playtime at school. She gave a history of trauma to upper front tooth region 7 days ago. Neither the child nor the parent sought immediate dental treatment after the trauma. Her medical and dental history was unremarkable. Clinical and radiographic examinations were conducted. Clinical examination revealed a fracture in the middle third of the crown of the maxillary right central incisor, exposing the pulp (Fig. 1). The tooth showed negative response to cold and electric pulp sensibility tests. The remaining maxillary and mandibular anterior teeth were intact. Periapical radiograph revealed an intact periodontal ligament space (Fig. 2), incomplete root formation (Nolla stage 9) with absence of root fracture. The patient had brought the displaced tooth segment wrapped in a piece of paper. The fractured segment was evaluated intact and with adequate margins which could be closely adapted to the remaining crown structure.

Following local anesthesia and rubber dam application, a conservative approach by means of partial pulpotomy was attempted. For reasons of failure to achieve hemostasis by removal of infected pulp tissue, a cervical pulpotomy was then carried out. As the amputated radicular pulp continued to bleed profusely due to irreversible pulpitis, the remaining pulp tissue was then extirpated and root canal treatment was performed (Fig. 3). The fractured segment was rehydrated by immersing in normal physiologic saline solution and cleaned to remove foreign debris. The remaining tooth structure, chamber and the fractured segment were etched with 37% phosphoric acid for 15 s. Following washing the etchant for 10 s, the cavity was dried with a gentle blast of air with care taken not to desiccate the surface. Two coats of dentine bonding agent (single bond 3a ESPE) were applied at an interval of 10 s and cured for 10 s. The fragment was adapted and reattached with dual cure composite resin cement (3M™ Rely X™ Adhesive Resin Cement, 3M ESPE, St Paul, MN, USA). All margins were light cured for 40 s and then polished using diamond stones and a composite polishing kit (Shofu Co., Kyoto, Japan). The technique proved to be simple achieving good aesthetic and functional results (Figs 4 and 5).

Fig. 1. Pulp exposure.

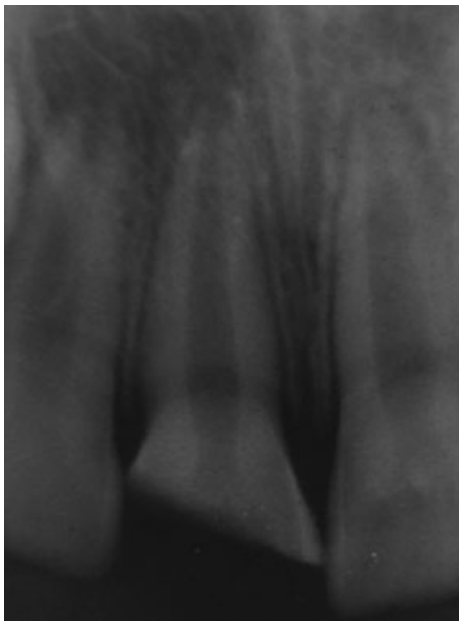

Fig. 2. Preoperative radiograph.

Four months after the initial injury, the patient presented with a second trauma to the same tooth sustained when she accidentally collided with her elder sister. She gave a history of trauma to upper front tooth region 7 days ago. This time too, neither the child nor the parent sought immediate dental treatment after the second trauma. Clinical and radiographic examinations were conducted. Intra-oral clinical examination revealed dislodgement and fracture of the reattached tooth fragment (Fig. 6). The examinations further revealed a crown-root fracture in the maxillary right central incisor (Fig. 7). The fracture line extended mesio-distally and seemed to involve the biologic width by running obliquely just palatal to the obturated pulp chamber. Although radiographs could not detect the fracture line due to presence of an intact labial surface (Fig. 8), clinical observation showed that the remaining crown

Fig. 3. Post obturation radiograph.

Fig. 4. Clinical view (facial), after segment reattachment.

Fig. 5. Clinical view (palatal), after segment reattachment.

fragment was mobile and still in place. There was absence of soft tissue damage and no evidence of alveolar bone fracture.

Fig. 6. Clinical view, after second trauma.

Fig. 7. Crown-root fracture.

Various options for treatment were presented to the patient and her guardian. These options included extraction of the tooth and restoration of the site with an implant-retained crown, crown lengthening, orthodontic extrusion of the root and restoration with a post-and-core and crown, and reattachment of the coronal fragment with resin-modified glass–ionomer cement (RMGIC). The patient and guardian were informed that the location of the fracture could determine whether or not the tooth could be saved, and that could only be determined after the patient was anesthetized and a conservative palatal mucoperiosteal envelope flap was raised. After all aspects of these options were presented and discussed, the patient and guardian opted for reattachment of the coronal fragment with RMGIC. The main reasons were the conservative aspect of this treatment option, the fact that the patient would still retain her natural tooth, and that the other treatment options could still be pursued in case of reattachment failure or refracture. An informed consent was obtained.

Under local anesthesia, a sulcular incision was made on the palatal gingival tissue of tooth 11 with a no. 12 scalpel blade and a full thickness palatal muco-periosteal envelope flap was raised for exposure of the fracture line. In this case, the vertical difference between the alveolar bone crest and the fracture line was 1 mm, i.e. violation of the biological width. Because of involvement of the biologic width, a RMGIC (Vitrebond; 3M ESPE) was the material of choice for the reattachment technique. The gutta percha was removed from the pulp chamber

Fig. 8. Radiograph after second trauma.

with the help of peeso reamer in a slow speed handpiece. The intervening portion of the tooth structure between the pulp chamber and the fracture line was removed with the help of tapered diamond bur under copious irrigation. The pulp chamber now in continuation with the palatally running fracture line was thoroughly irrigated with sterile water to remove debris. The internal surfaces of the fragment and the coronal portion of the traumatized tooth were etched with 10% polyacrylic acid, rinsed and blotted with absorbent paper points. After mixing, the RMGIC was applied to the tooth remnant and the fragment. The fragment was then reattached in the correct position and the luting material was light cured for 40 s (Fig. 9). After removal of excess cement, the remaining tooth structure was beveled on both buccal and palatal sides with a high speed diamond bur. The beveled surfaces were etched with 37% phosphoric acid for 30 s, rinsed and blotted with absorbent paper points. Scotchbond Multi-Purpose Plus adhesive system (3M/ESPE) was applied to the etched surface and light cured according to manufacturer's instructions. The coronal portion was built up with an all composite crown (3M ESPE Filtek™ Z350) and then polished using diamond stones and a composite polishing kit (Shofu Co., Kyoto, Japan). Occlusion was checked and adjusted accordingly (Fig. 10). After one year of follow-up, the radiograph revealed a healthy periodontium with no signs of periradicular pathosis (Fig. 11).

Fig. 9. Clinical view, after segment reattachment.

Discussion

The presence of the tooth in the socket is of primordial importance due to its functional, esthetic and social roles. Studies have proposed treatment alternatives to maintain a traumatized tooth for as long as possible even

Fig. 10. Clinical view – all composite crown.

Fig. 11. Twelve months postoperative radiograph.

when faced with an unfavorable prognosis. It is important to consider that patients go through several episodes of dental trauma, following a first occurrence of trauma (19). These repeated traumatic dental injuries highlight the need for replanning a patient's treatment as these injuries are mostly irreversible and treatment is likely to continue for the rest of the patient's life (9, 20).

Injury to anterior teeth is a relatively common event. Studies on incidence of dental trauma especially children have suggested that one-third of the patients suffer from some type of dental trauma (9). The prevalence of a second dental trauma is 24% as reported by Andreasen et al. (19) whereas it was found to be 25–30% among traumatized patients undergoing repeated trauma by Ravn (2). If the fracture extends up to the biologic width, which is described as the gap between crestal bone and gingival sulcus, flap surgery in combination with osteoplasty/osteotomy is required (16, 21, 22).

Various treatment approaches have been indicated for fractured teeth including: (i) laminate veneer restorations (23), (ii) fragment reattachment (24, 25), (iii) gingivectomy and osteotomy (i.e. crown lengthening) (24), (iv) vital root submergence (24), (v) orthodontic extrusion with/without gingivoplasty (11, 24), (vi) forced surgical extrusion (11, 24), (vii) extraction followed by surgical implants (24) and (viii) fixed partial denture (26). The treatment modality chosen depends mainly upon the location and extent of the fracture. If the fracture line is in the middle or incisal third of the crown and the patient is unable to retrieve the fractured segment, a resin composite restoration is used for aesthetics and function (27). If the patient is able to retrieve a closely adapting fractured segment, reattachment of the segment is a possibility. The segment reattachment technique has been widely accepted with the development of composites and resin adhesives (24, 25, 28). This technique requires only a thin layer of resin and restores the original form and contour of the tooth that often provides the best aesthetic result.

The technique of tooth fragment reattachment has advantages over direct composite resin restorations, namely, procedural simplification, less clinical chairtime, immediate reestablishment of aesthetics and function and similar wear rate. However, in this case, a second trauma on the same tooth resulted in dislodgement and fracture of the reattached fragment and a crown-root fracture which determined the need for an all composite restoration. In the first trauma experience, important factor taken into account was the excellent adaptation of the fragment to the fractured tooth and in the subsequent trauma the involvement of the biologic width.

The biocompatibility of the RMGICs is attributed to their excellent biological response when applied to cavities with invasion of the biologic width and sealing capacity which decreases bacterial penetration. Gultz and Scherer described the subgingival placement of a resin-ionomer for several restorative procedures, including root caries, resorption, endodontic perforation and root fracture (29). The cases presented by authors indicate that a resin-ionomer may be used as a subgingival restorative material and may be placed in lesions originally thought to be unrestorable. Therefore, we can conclude that resin-ionomer cements demonstrate a biocompatibility to both soft and hard tissues which encourage their use for treatment of crown-root fractures involving biologic width.

Several case reports show that even subgingival tooth fractures can be restored successfully (21, 28, 30, 31). Subgingival crown fractures are challenging in terms of coronal rehabilitation (32). In such cases the treatment should be aimed at exposing the fractured margins, so that all clinical procedures can be achieved with strict moisture and haemorrhage control. Intra-alveolar transplantation of teeth with crown-root fractures using a simple extraction technique with extrusion of the root has been advocated to allow coronal preparation (33). Furthermore, the prognosis may be improved further through better plaque control by the patient (11). Gingival and osseous recontouring for adequate margination to save such teeth has been suggested (11, 34). Adhesive fragment reattachment in periodontally healthy teeth affected by crown-root fracture has no detrimental impact on periodontal health (35).

In the present case, after 1 year of follow up, the clinical and radiographic findings demonstrated that the adopted clinical protocol was successful as the tooth was asymptomatic; there was absence of gingival inflammation and mobility as well as maintenance of normal probing depth. Radiographically, the periodontal tissues were healthy with no signs of periradicular pathosis. This report attempts to further highlight a case of a crown-root fracture treated by scientific evidences for the use of RMGIC.

Dental trauma is a relatively prevalent condition that may present restorative challenges. According to Hayashi et al. (36) the best restorative methods are needed to be identified for teeth with extensive loss of structure, and reinforcing pulpless teeth. In the present case, restoration of choice after the second trauma episode was an all composite crown. Long-term prognosis is uncertain as a result of a lack of longitudinal studies comparing the same pattern of fracture as well as the same restorative technique in cases of repeated traumatic dental injuries. This report provides a highly conservative approach that combines esthetics, function and health of periodontal tissues, postponing the use of a more aggressive prosthetic solution. In any case, if the young patient could benefit from the restoration for some years before receiving a more complex and expensive prosthetic solution, our objective will have been achieved.

Suggestions from the authors

Multiple dental trauma episodes cause psychological distress especially in children. It is important to retain the natural tooth to maintain space and also to maintain the alveolar bone height, so that later long-term prosthetic replacement or implants, if required, are feasible. There are various treatment guidelines and options available for fracture fragment reattachment and management of crown-root fractures but they may not be applicable in

cases of repeated traumatic dental injuries to the same tooth. Thorough knowledge of techniques, their indications, risks/benefits, research based evidence as well as expectation of the patients and their parents should be kept in mind whilst choosing a treatment plan. Such cases require regular and long-term follow-up so that complications, if any, can be treated early.

With an increase in the number of case reports becoming available regarding the rehabilitation of a tooth with multiple trauma episodes and if clinicians are engaged enough to report follow-ups, a more detailed analysis could be performed in the future to lay down treatment guidelines for repeated traumatic dental injuries.

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