

Dental Trauma: Case-Scenario Protocol for Dentists

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Abstract

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The prompt and appropriate management of traumatic dental injury is an important determinant of the prognosis of the involved tooth. The lack of knowledge of the appropriate handling sequence often has detrimental effect. Dental injuries can be classified by etiology, anatomy, pathology or therapeutic considerations with extrusion, intrusion and tooth avulsion being the most frequent types of dental trauma that we see in the dental office. The transport and care of the affected tooth, the prompt and adequate treatment in the dental office, as well as the proper follow up are imperative for a successful outcome of these incidents. The goal of present paper is to help develop a case-scenario protocol for dentists which can help deal with everyday teeth trauma in most appropriate way.

Introduction

The ultimate goal in treating teeth trauma is the long term prognosis of the involved teeth. In most cases, the long-term prognosis closely relates to the site and severity of the trauma, as well as the time outline involved, due to the ultimate importance of the vitality of the periodontal ligament cells. The prompt and appropriate management of traumatic dental injury is an important determinant of prognosis particularly in avulsed permanent tooth, where the well-being of tooth depends on how to

handle this situation. Time interval between avulsion and reclamation and extraoral storage medium are probably most crucial factors affecting prognosis.

Careful literature review reveals that the most important actuality that often imposes unproductive outcome in traumatized teeth is the lack of knowledge of the appropriate handling sequence [1]. Since most reports on dental trauma indicate that most dental injuries are sports-related, school or home accidents, the comprehension of school teachers, parents and sport

teachers is paramount in handling these types of injuries appropriately in the initial, crucial stage. There is data indicating that close to 60% of school teachers have no knowledge how to handle avulsed teeth [2-6] although incisor injury has been reported to range from 1.8% to 49% and many teeth could be lost in the esthetic area, resulting in other additional issues [7]. Almost all parents (95%) do not have any familiarity with first aid for dental injuries, and 30% of them don't even encompass the basic concepts of tooth avulsion [8]. Furthermore, 50% of physicians in hospital emergency rooms consider that avulsed permanent incisor should not be replanted under any circumstances, and some have written protocols with misleading instructions for treatment of avulsed teeth [9]. Therefore, it is of tremendous significance that the dentist in the dental office is equipped exceptionally well to handle the teeth trauma cases correctly and in apt way; in order to present best patient care and advance the prospects of these cases.

The goal of present paper is to help develop a case-scenario protocol for dentists which can help deal with everyday teeth trauma in most appropriate way.

Entities and Treatment

Extrusion, intrusion and tooth avulsion are the most frequent types of dental trauma that we see in the dental office. Still, the most challenging entity of those is the avulsion, with parents sometimes showing up in the dental office quite some time after the incident, with the avulsed tooth in dad's wallet, asking if the tooth can be repositioned in place. The opposite case scenario is the "almighty parent" who immediately repositions the tooth inside the socket, possibly damaging the permanent successor, or the surrounding tissues.

Of course, the visit to the Dentist office is of paramount importance, whenever a trauma occurs. The dentist should be equipped and prepared to perform methodical clinical and radiographic exam, percussion test, as well as test for tooth mobility and pulp sensitivity. Lacerations to the surrounding soft tissues can also accompany the dental trauma, so be prepared for soft tissue trauma management, as well.

It is imperative to obtain the pulp status through pulp testing. However, the sensitivity to cold, hot, as well as electric pulp testing may be diminished immediately after the traumatic accident. Therefore, follow-up appointments are essential in order to repeat pulp testing. Be prepared to schedule the patient from 2 to 6 weeks after

the trauma occurrence, in order to follow up on the pulp status. Initial radiographs are also indispensable, but be aware of the need of follow-up radiographs which are looked-for to detect any alteration of the root surface (i.e. internal and/or external resorption), as well as the condition of the surrounding bone.

Dental injuries can be classified by etiology, anatomy, pathology or therapeutic considerations. The most common crown injuries are: enamel infraction, enamel fracture, enamel-dentin fracture and complicated crown fracture (pulp tissue exposed). The traumas that often involve injuries to the periodontal tissues are: subluxation, lateral luxation, extrusive and intrusive luxation and avulsion [10]. The case-scenario protocols for all entities are summarized in Table 1.

Table 1: Case-scenario protocol for dental trauma of permanent teeth.

Entity	Treatment Protocol
Crown Fractures	<ul style="list-style-type: none"> • explore the fracture • no pulp involvement-place restoration • pulp involved-MTA
Subluxation	<ul style="list-style-type: none"> • soft diet and splinting for the first 2 weeks. • radiographs at 6 weeks/1 year
Extrusive Luxation	<ul style="list-style-type: none"> • reposition tooth and check occlusion • radiograph before and after • non-rigid splint • recall patient within the next 2 weeks • testing pulp vitality during follow-up visits • radiographs at 6 weeks/1 year
Lateral Luxation	<ul style="list-style-type: none"> • reposition tooth with anesthesia and check occlusion • radiograph before and after • non-rigid splint • testing pulp vitality during follow-up visits • NSRCT probably at first follow-up • radiographs at 6 weeks/1 year
Intrusive Luxation	<ul style="list-style-type: none"> • reposition tooth with anesthesia and check occlusion • radiograph before and after • orthodontic treatment if needed • testing pulp vitality during follow-up visits • radiographs at 6 weeks/1 year
Avulsion	<ul style="list-style-type: none"> • rinse the tooth and flush socket with saline • re-implant the tooth slowly • splint for 2 weeks. • RCT outside the socket or 7 to 10 days later • follow-up radiographs and pulp tests • antibiotic coverage • tetanus prophylaxis

Crown Fractures can involve the enamel, enamel-dentin and/or the pulp with pulp exposure. It presents with normal radiographic appearance and the prognosis is excellent if the crown fracture does not affect or involve the pulp tissue. It is a good idea to explore the fracture under higher magnification (loupes or microscope), with good illumination and additional use of a sharp endodontic explorer. Adequate composite restoration should be placed upon parent's consideration.

If pulp exposure is detected, the tooth needs to be

anesthetized and dental dam placed. Decontamination of the area should be done with NaOCl 6% solution [10]. When pulp capping or pulpotomy is warranted, using MTA (Mineral Trioxide Aggregate (ProRoot™ MTA; Dentsply/Tulsa Dental, Tulsa, OK) has been established to offer superb outcome [11], and survival rates are high, especially if the treatment is right away after the trauma occurred [12].

Subluxation is a tooth supporting structure injury. Even though the tooth involved can present with mobility, the radiographic appearance is typically normal. Nevertheless, total or partial rupture of blood supply in to the pulp tissue may occur as a result of the trauma [13]. Soft diet and splinting may be required for the first 2 weeks. Radiographic follow up at 6 weeks and 1 year post injury is crucial. Although the pulp prognosis typically depends on the stage of root development, root resorption is rarely seen in these cases [10].

Extrusive Luxation occurs when the tooth is partially axially displaced out of the socket and is very mobile. On a radiograph, the tooth appears dislocated and the apical part of the socket presents empty. This displacement results in almost total disruption of the apical neurovascular bundle and periodontal fibrous attachment. Regularly, pulpal revascularization of these cases depends on the apical foramen size. Teeth with closed foramen almost exclusively develop pulp necrosis [13]. Although post-traumatic inflammatory root resorption is rare, it can be seen in teeth that develop pulp necrosis as a result of the trauma [13]. Anesthesia and/or pulp vitality testing is typically not warranted. The tooth needs to be repositioned using axial finger pressure on the incisal edge, occlusion checked and non-rigid splint should be placed at the first visit. Radiograph should be taken both before and after the dental intervention. It is important to schedule the patient within the next 2 weeks for another clinical and radiographic exam, in order to follow up on potential root surface and bone changes. Radiographic and pulp testing follow up should be done at 6 weeks and 1 year post injury [10].

Lateral Luxation occurs when lateral eccentric displacement of the tooth in its socket and fracture of the alveolar bone is present. The tooth is typically displaced in a palatal direction and mobility may or may not be present. On a radiograph, the tooth appears dislocated and the apical part of the socket presents empty. Because the tooth repositioning is painful, anesthesia is required. The repositioning procedure can be done manually and/or with the use of instruments (typically forceps). The apex of the tooth needs to be disengaged slightly then

repositioned in an apical direction. Once the tooth is in place, verify the correct position with a radiograph. The tooth should be splinted for at least 3-4 weeks with a non-rigid splint and testing the pulp for vitality is warranted during all of the follow-up visits. Pulp necrosis is expected in teeth with well closed foramen but revascularization may be possible in teeth with open foramen. Inflammatory and replacement resorption may occur. Surface resorption is frequent and is usually located in the apical area [10]. Non-surgical root canal treatment (NSRCT) can be started after the first follow-up appointment. Radiographic and pulp testing follow up should be done at 6 weeks and 1 year post injury.

Intrusive luxation occurs when the tooth has been forced into the socket and locked into the bone. Clinically, the crown appears short, there is bleeding from the surrounding tissues, and the percussion test produces a high and metallic-like tone, which is the pathognomic feature for this particular diagnosis. Radiographically, the tooth appears dislocated in an apical direction. Because the tooth repositioning is painful, anesthesia is required. The repositioning procedure should be done with the use of instruments (typically forceps). The tooth should be slightly loosened and released from its locked position in the bone, in order to be placed back to its original position. Revascularization can be expected in teeth with immature apex, but in cases with close apices, necrosis is frequent [10]. Surgical repositioning increases the frequency of complications (external root resorption and loss of marginal bone support). The treatment of choice for teeth with closed apex should be the orthodontic repositioning (3-4 weeks) and should be carried out to monitor the rate of marginal bone repair and in 2-3 weeks to ensure access to the pulp chamber, where the endodontic treatment is necessary. This is important as the external root resorption begins around this time and the only way to stop this process is the endodontic therapy. This is the reason not to wait for spontaneous eruption, which takes 2-3 months [14]. Radiographic and pulp testing follow up should be done at 6 weeks and 1 year post injury.

Avulsion is a frequent dental trauma; when the tooth is totally displaced out of its socket. Clinically, the alveolar socket can be empty or with a coagulum present. On the radiographs, the socket appears empty with possible surrounding bone fracture lines. Probably the best possible treatment case scenario is the tooth can be re-implanted at the site of the avulsion. First, the tooth needs to be rinsed with tap-water for at least 10 seconds and then the tooth should be properly oriented and placed back in the socket. Immediately, the patient needs to be

directed to a dental office for further treatment. If the tooth can not be re-implanted, it should be kept in some storage media, until the immediate dental treatment. Solutions for this problem may be trying to keep the tooth in milk, saline solution, or even inside the patient's mouth, such as keep it under the tongue or in the oral vestibule. Once the patient is in the dental chair, the treatment considered will depend on the circumstances surrounding the traumatic incident. If the tooth has not been re-implanted, rinse the tooth with a saline solution in order to remove all the contaminants. The socket coagulum should be than flushed with saline. For teeth with open apex, rinse the root surface with Arestin (minocycline) [15]. Use small and constant digital pressure to re-implant the tooth slowly into the socket. Do not force the tooth into the socket. If any resistance is met, remove the tooth, place it in saline solution and examine the socket for any bony fractures. Following successful implantation, the tooth should be splinted for 2 weeks and follow-up exams are absolutely necessary.

Root canal treatment will be necessary in case revascularization fails. For teeth with closed apex, start root canal treatment (RCT) outside the socket immediately. You can elect to perform the RCT 7 to 10 days later, at the follow-up visit. If infraocclusion occurs in younger patients, tooth ankylosis is expected in these cases. Splint the tooth with semi-rigid splint for 2 weeks. Take follow-up radiographs for the next 2, 4, and 6 weeks; later 3, 6 and 12 months; annually thereafter.

Antibiotic coverage should be given. Administer systemic antibiotics. Although the choice of antibiotics is a matter of personal preference of the treating doctor, often tetracycline is the first choice because of its ability to bind to osseous structures (Doxycycline 2x per day for 7 days at appropriate dose for patient age and weight). The risk of discoloration of permanent teeth must be considered before systematic administration of tetracycline in young patients. In young patient, antibiotic of choice may be Phenoxymethyl penicillin (PenV) in an appropriate dose for age and weight, as an alternative to tetracycline [16].

Tetanus prophylaxis is assessed according to the immunization status of the patient. If avulsed tooth has contacted soil, and if previous tetanus immunization history is uncertain, refer to physician for evaluation [16].

Do not replace the tooth in the socket in cases of extensive carious destruction, extensive loss of marginal periodontal support, and in medically compromised patients (e.g. infectious endocarditis, immunosuppressive treatment, etc) [17].

When the tooth stayed a long period of time out

its socket, the root surface can be treated with a sodium fluoride solution (2.4% solution for 20 minutes) trying to provide resistance to future osteoclast activity and ankylosis [18].

Because the viability of periodontal ligament cells is of outmost importance, it is very important to use proper media for storage and transport of the avulsed tooth. To have the perfect media at hand is of course not always feasible, since the trauma can occur anywhere and anytime. There has been somewhat widespread debate about the use of different solutions as transport media for the avulsed tooth, especially the use of milk, since its physiological properties includes pH of 6.5 to 7.2 and similar osmolality to extracellular fluid [18]. Most probably, the best action is to reposition the avulsed tooth right away at the site of the accident. However, it is of extreme importance to maintain the hygiene during this process, and of course to orient the tooth appropriately, which may be somewhat perplexing to a lay person. If this action is not achievable, the tooth should be placed inside the patient mouth, preferably bellow the tongue. Although a risk exists that the patient will swallow the tooth, the saliva is probably the best and most accessible transport solution. The second most preferred solution after saliva is milk, which has been found by some authors to be an excellent media to keep the avulsed tooth in, but for no more than 30 minutes after the trauma [19-21]. Water is not recommended as storage media due the hypotonic environment will cause cell lysis [18].

Special considerations: dislocated teeth

Special attention should be kept for the risk teeth dislocation to other regions. Trauma can dislocate teeth into the nasal cavity [22], frontal sinus [23] and maxillary sinus [24]. Posterior–anterior and lateral chest radiographs should be performed in some cases to verify whether the missing teeth had been aspirated or swallowed [22].

Special considerations: primary dentition

Special consideration should be taken in cases when the tooth trauma involves primary dentition. The proposed treatment guidelines for traumatized primary dentition teeth are reliant on the type and scope of the trauma (Table 2).

In cases of crown fracture, smooth the sharp edges of the tooth involved. If there is a pulp tissue exposure, proceed with pulp capping or pulpotomy. If there

Table 2: Case-scenario protocol for dental trauma of primary dentition.

Entity	Treatment Protocol
Crown Fractures	<ul style="list-style-type: none"> • smoothen edges • In pulp exposure-pulp capping or pulpotomy
Subluxation	<ul style="list-style-type: none"> • observation
Extrusive Luxation	<ul style="list-style-type: none"> • careful repositioning • extraction
Lateral Luxation	<ul style="list-style-type: none"> • observation
Intrusive Luxation	<ul style="list-style-type: none"> • observation • examine permanent successor
Avulsion	<ul style="list-style-type: none"> • do NOT replant • observation

is a crown-root fracture, extract the tooth. Subluxation cases should be scheduled regularly for careful observation.

In extrusion cases, evaluate for either careful repositioning, or extraction, depending on the severity.

Lateral luxation cases should be left alone because the tooth will typically reposition spontaneously if there are no occlusal interferences present.

Intrusions can also be left alone and the tooth will spontaneously reposition. However, the trauma should be examined carefully to determine if the tooth has been intruded straight into the developing tooth germ. If so, the intruded primary tooth should be removed.

If avulsion of primary teeth occurs, radiographs must be taken and examined in order to make sure that the tooth has not been totally intruded and is not visible on a clinical exam. Primary teeth should not be replanted [25].

Splinting teeth

The ideal splint should not invade or injure the pulp of the traumatized or adjacent teeth, should be placed in such manner not to interfere with intra-oral radiographic techniques, should allow placement of a rubber dam, should not interfere with proper oral hygiene or promote root resorption, and should be economical and easy to use [26]. For better and optimal healing outcome, it is recommended that the splinting be semi-rigid [27,28]. The following protocol is recommended when considering splinting of traumatized teeth.

- Reposition the tooth in its socket, check occlusion, and verify radiographically the proper position.
- Acid-etch the enamel (incisal third of the labial aspect of the tooth) for 30 seconds with phosphoric acid gel.
- Rinse 20 seconds with water spray to remove the acid-etching gel. Isolate the buccal vestibule with

cotton rolls and dry the tooth surface.

- Although semi-rigid splinting alternatives include the use of different materials, such as glass fiber (Kevlar), or fiber/ribbon, the material of choice for lots of dentists for semi-rigid splints may be the thin orthodontic wire, due to its price and availability.

- The splint bonding material (resin of your choice) is applied in a thin layer, over the previously applied splint. It is important to keep the composite away from the gingival tissue to prevent irritation and to allow proper oral hygiene.

- When removing the splint, the composite material should be removed carefully with a scaler or high speed bur (diamond), and the enamel should be polished.

Management of soft tissue trauma

As mentioned before, trauma of the surrounding soft tissues is also common with dental trauma. The radiographic evaluation of the trauma is very important; in order to locate possible fragments (tooth, bone or foreign material) within the soft tissue wound before closure. Additionally, it increases the possibility of making a correct diagnosis by over 10%, from 80% to 91% [29]. Facial lacerations in an otherwise healthy individual heal well, even after 19 hours from the injury [30], in contrast to the 'golden period' of 4–6 hours from time of injury which is needed to close lacerations in other parts of the body and to attain a low infection rate [31]. Instruments and supply for suturing (needle holder, suture material of your choice, preferably absorbable) should be readily available for use in any dental office. Suturing should be performed carefully under anesthesia, using a technique that provides best outcome. Although oral wounds heal well and with minimum scar formation compared to skin [32], an attempt to provide excellent wound closure is mandatory, to prevent secondary infection and future scarring. Finally, meticulous oral hygiene instructions should be provided, accompanied with 0.12% chlorhexidine mouthwash (rinse for 30 seconds twice a day, then expectorate), as upholding of proper oral hygiene has an imperative task in good healing of oral traumas [16].

As mentioned before, the adequate knowledge and proper sequencing is a key to proper treatment of teeth trauma. The dentist should be adequately trained and equipped to handle the teeth trauma cases in his/her office in timely and adequate manner, in order to assure the most successful clinical outcome for the dental patient.

Summary/Conclusion

Dental injuries are common incidents and timely and suitable management of these occurrences is crucial for the prospects of the involved tooth. Although different entities require different treatment approaches, it is paramount to determine the time frame of the incident, the vitality of the affected tooth, as well as set up a proper follow up scenario. Dentist should have readily available a case-scenario protocol which can help deal with teeth trauma in most fitting way.

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