The treatment of traumatic dental injuries

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By Dr Asgeir Sigurdsson, USA

When treating dental trauma, the timeliness of care is key to saving the tooth in many cases. It is, therefore, important for all dentists to have an understanding of how to diagnose and treat the most common dental injuries. This is especially critical in the emergency phase of treatment. Proper management of dental trauma is most often a team effort with general dentists, pediatric dentists or oral surgeons on the front line of the emergency service, and endodontic specialists joining the effort to preserve the tooth with respect to the pulp, pulpal space and root. An informed and coordinated effort from all team members ensures that the patient receives the most efficient and effective care. Recently, a panel of expert members of the American Association of Endodontists prepared an updated version of the American Association of Endodontists’ Traumatic Dental Injuries guidelines.1,2 These guidelines were based, in part, on the current recommendations of the International Association of Dental Traumatology (see www.iadtrauma.org for more information). This article provides an overview of the AAE guidelines; the complete guidelines are available for free download at www.aae.org/clinical-resources/trauma-resources.aspx.

The benefit of adhering to guidelines for treatment of dental trauma was recently shown in a study by Bucher et al.3 The study found that, compared with cases treated with- out compliance to guidelines, cases that adhered to guidelines produced more favorable outcomes, including significantly lower complication rates. The study also found that early follow-up visits were essential to ensure prompt treatment of complications when they arose.4

Emergency care

Prior to any treatment, one must evaluate the injury thoroughly by careful clinical and radiographic investigation.

It is recommended to follow a check-list to ensure that all necessary information regarding the patient and the injury is gathered, including:

1. Patient’s name, age, sex, address and contact numbers (including weight for young patients).
2. Central nervous system symptoms exhibited after the injury.
3. Patient’s general health.
4. When, where and how the injury occurred.
5. Treatment the patient received elsewhere.
6. History of previous dental injuries.
7. Disturbances in the bite.
8. Tooth reactions to thermal changes or sensitivity to sweet/acid.
9. If the teeth are sore to touch or during eating.
10. If the patient is experiencing spontaneous pain in the teeth.

Once all of this information is gathered, a diagnosis can be made and appropriate treatment rendered. If the injured individual is not a patient of record, all necessary demographic information should be gathered as soon as the patient arrives and prior to any assessment.

In the case of avulsion and the tooth being out of its socket, one should immediately place the tooth in a physiological solution of specialized media (such as Hank’s Balanced Salt Solution) or milk, or saline if those are not available. Only after the tooth is secured in solution should one obtain the patient’s information. Once the patient is seated in the dental chair, it is necessary to do a quick central nervous system (CNS) evaluation before proceeding with further assessments.

Often, the dentist is the first health care provider to see the patient after a head injury (any dental trauma is, by definition, a head injury) and must assess the risk of concussion or hemorrhage. It has been estimated by a meta-analysis that the prevalence of intracranial hemorrhage after a mild head injury is 8 percent, and the onset of symptoms can be delayed for minutes to hours.4

The most common signs of serious cerebral concussion or hemorrhage are loss of consciousness or post-traumatic amnesia. Nausea/vomiting, fluids from the ear/nose, ataxia, confusion, blurred vision or uneven pupils, and difficulty of speech and/or slurred speech may also indicate serious injury.5

Once the patient has been cleared of any CNS issues, the dental trauma should be assessed. The key is to obtain comprehensive information about the injury and, to do so, one must conduct thorough extra-oral and intraoral clinical exams as well as appropriate radiographic evaluations. The new AAE guidelines recommend taking one occlusal and two periapical radiographs with different lateral angulations for all dental injuries, including crown fractures. If cone-beam computed tomography is available, it should be considered for more serious injuries, such as crown/root, root and alveolar fractures, as well as all luxation injuries.

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Table 1. Follow-Up Procedures for Fractured Permanent Teeth and Alveolar Fractures

<table>
<thead>
<tr>
<th>TIME</th>
<th>Crowned Fracture</th>
<th>Crowned-Root Fracture</th>
<th>Root Fracture</th>
<th>Alveolar Fracture</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 Weeks</td>
<td>Uncomplicated</td>
<td>Complicated</td>
<td>Uncomplicated</td>
<td>Complicated</td>
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<tr>
<td></td>
<td>Splint removal**</td>
<td>Clinical and radiographic control</td>
<td>Splint removal**</td>
<td>Clinical and radiographic control</td>
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<tr>
<td>0-8 Weeks</td>
<td>Clinical and radiographic control</td>
<td>Clinical and radiographic control</td>
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<tr>
<td>0-4 Months</td>
<td>Clinical and radiographic control</td>
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<tr>
<td>6 Months</td>
<td>Clinical and radiographic control</td>
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<tr>
<td>6-8 Months</td>
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<tr>
<td>1 Year</td>
<td>Clinical and radiographic control</td>
<td>Clinical and radiographic control</td>
<td>Clinical and radiographic control</td>
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<tr>
<td>1-2 Years</td>
<td>Clinical and radiographic control</td>
<td>Clinical and radiographic control</td>
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</tbody>
</table>

*Temporary removal in apical third and root fractures. **Temporary removal with a root fracture near the crestal area.
Additionally, sensitivity tests should be conducted on all teeth involved as well as opposing teeth. Cold testing is recommended to confirm crown intrusion, crown-root, crown-root fracture, and root fractures. If the pulp is exposed to the oral environment, it is called a complicated fracture; if not exposed, it is called an uncomplicated fracture.

Crown-root fractures:

The first thing to do in any crown or crown-root fracture is to look for the broken-off tooth fragment. With modern bonding technology, it is possible to rebond the fragment to the tooth, which is euthetically the best solution. Prior to rebonding the tooth fragment, the remaining dental crown needs to be immediately covering the pulp needs to be assessed radiographically and clinically. If there is at least 0.5 mm of bone between the crown and the bone apices, there is no need to cover it with a protective liner. If it is estimated that the remaining dentin is less than 0.5 mm, it is advisable to cover the crown with a temporary crown that may be used as a cavity liner, and then displace the crown fragment accordingly. If the tooth fragment is kept dry, it should be rehydrated in distilled water or saline for 5 minutes prior to matching/repairment. This process will increase its bonding strength (Fig. 4a–c).

In a complicated fracture, the goal is to create a tight seal to protect the pulp, after ensuring that the pulp wound is clean and all inflamed tissue removed.11,12 The two best capping materials available today are calcium hydroxide and mineral trioxide aggregate (MTA), but newer bioceramic materials are showing promise for this application. It is advisable to create a 2-mm reservoir into the pulp with a high-speed diamond bur and copious water cooling, place the capping material, and then either reattach the tooth fragment or restore the crown with a composite resin material (Figs. 2a–c).

Crown-root fractures

One of the most challenging types of fracture to treat is the crown-root fracture because the fracture margin has to be exposed around the tooth/implant to properly restore the tooth. This can be accomplished by gingival resection if the fracture line is in the sulcus. In more extreme cases, the tooth will have to be extruded with orthodontic forces or surgically repositioned. In the emergency session, if the tooth is exposed, it needs to be protected in the same fashion as complicated crown fractures.

If the pulp is not exposed, all accessible exposed dentin areas should be covered for the patient’s comfort. Pulpal survival for all these fracture types is generally good, however, endodontic treatment may be indicated later. Therefore, it is of utmost importance that a recall schedule is followed and that the teeth involved in the trauma are tested every time. Tables 1 and 2 outline the recommended recall rates for most common dental injuries. It is not uncommon for there to be no response to vitality tests for up to three months, and a lack of response to vitality tests does not always mean that the pulp is necrotic. Therefore, it is advisable to look for at least one other sign of pulp necrosis, such as vestibule swelling, periapical lesions, and/or dark color change of the crown. If no signs exist, continue to monitor the patient at regular appointments every three months, for up to one year.

Root fractures

The pulp is affected in all root fractures. However, if the fragments are approximated soon after the fracture, there is a good chance that no endodontic treatment is necessary, just observation. With good approximation, it is likely that the pulp will revascularize across the fracture regardless of the age of the patient.13,14 If the fragments are not approximated, splinting is recommended. If no signs exist, continue to monitor the patient at regular appointments every three months, for up to one year.

In the case of an intruded tooth with an uncomplicated crown, the apex is closed, endodontic treatment is necessary, and root development is complete.15,16 In the case of an intruded tooth with an uncomplicated crown, the apex is closed, endodontic treatment is necessary, and root development is complete.15,16 In the case of an intruded tooth with an uncomplicated crown, the apex is closed, endodontic treatment is necessary, and root development is complete.15,16 In the case of an intruded tooth with an uncomplicated crown, the apex is closed, endodontic treatment is necessary, and root development is complete.15,16 In the case of an intruded tooth with an uncomplicated crown, the apex is closed, endodontic treatment is necessary, and root development is complete.15,16

It is important to remember that dental injuries do not fall into one group or category, but often a combination of several categories. Injuries in multiple categories may impact the outcome. For example, it was recently demonstrated that the existence of a complicated luxation injury with an uncomplicated crown fracture and root development is one of the most significant risk factors for pulpal necrosis.17,18

Avulsion

The time outside of the socket for an avulsed tooth injury to the PDL, the periodontal ligament, is critical to the survival of the tooth. If the tooth is replanted within 30 minutes, or alternatively if kept in a physiological solution of specialized media or milk for a few days, the survival of the tooth is high. The longer the period of time, the poorer the prognosis. If the tooth has been dry for more than one hour, the periodontal ligament and the root will likely become necrotic. If the root is not moving after two to three weeks, however, orthodontic extrusion or extraction and reimplantation is recommended. If a tooth is avulsed and alveolus is extruded when it might not be possible to replant the tooth, it is advisable to look for at least one other sign of pulp necrosis, such as vestibule swelling, periapical lesions, and/or dark color change of the crown. If no signs exist, continue to monitor the patient at regular appointments every three months, for up to one year. If the apex has been repositioned, the patient lives into a softened tooth with a closed apex is intruded for two weeks prior to obturating is recommended, however, one should allow the PDL and the periodontal ligament to heal for two weeks before placement of an orthodontic appliance. If the apex is open, apical and crown. The long-term prognosis of an intruded tooth with a closed apex is intruded for two weeks prior to obturating is recommended, however, one should allow the PDL and the periodontal ligament to heal for two weeks before placement of an orthodontic appliance. If the apex is open, apical and crown. The long-term prognosis of an intruded tooth with a closed apex is intruded for two weeks prior to obturating is recommended, however, one should allow the PDL and the periodontal ligament to heal for two weeks before placement of an orthodontic appliance. If the apex is open, apical and crown. The long-term prognosis of an intruded tooth with a closed apex is intruded for two weeks prior to obturating is recommended, however, one should allow the PDL and the periodontal ligament to heal for two weeks before placement of an orthodontic appliance. If the apex is open, apical and crown. The long-term prognosis of an intruded tooth with a closed apex is intruded for two weeks prior to obturating is recommended, however, one should allow the PDL and the periodontal ligament to heal for two weeks before placement of an orthodontic appliance. If the apex is open, apical and crown.
Minimally invasive implant placement without the use of biomaterials using the bone expansion technique

By Dr Gilles Chaumanet, France

The success rate in implantology is close to 96 percent. Thanks to well-established implant placement protocols, with a few differences according to the implant system used, the predictability of the result under optimum tissue conditions is quite significant. It is very different when these conditions do not meet the recognized standards in terms of volume and quality for reproducibility in implantology. For example, thin ridges, which are frequent occurrences, will require a long and costly process for patients because they entail bone augmentation or possibly support tissue grafts.

Is there a minimally invasive alternative for these patients that allows them to be treated without these problems? One line of thinking is to stop the systematic practice of implantology as subtractive at the tissue level, but rather to transfer these volumes and thereby ensure a minimally invasive procedure. This implies reviewing all the biomechanical principles of implantology, not only in terms of the implant structure and design but also in relation to peri-implant tissue.

The general surgical principle of modern implantology, called osteotomy, as close as possible to the dimensions of the implant that will be placed. This principle is still widely prevalent.

However, soft-tissue management has evolved, and the trend the past few years has been to manage soft tissue from the first surgical step. With the arrival of self-tapping conical implants, a new technique was developed that enables lateral as well as vertical bone compressing, condensing or expanding. In addition, in 1994, Summers, practicing his crestal sinus lift technique with careful choice of conical taps, was the first to demonstrate the capacity of cancellous bone to be modeled (Fig. 1).

Through two clinical cases, we will see it is possible to be minimally invasive, precise and also avoid the use of biomaterials simply by exploiting the biomechanical properties of bone tissue and its capacity to regenerate. Respecting guided regeneration principles, which means the implementation of physical barriers to isolate the epithelial and connective tissue cells from the operating site, enables regeneration of the different tissues.

These principles are (Fig. 2):

• Primary closure of the surgical site to enable undisturbed and uninterrupted healing
• Completion of the best possible angiogenesis to provide the required revascularisation and undifferentiated mesenchymal cells
• Creation and maintenance of a space to facilitate bone formation inside this space
• Stabilization of the surgical site to induce blood clot formation and facilitate healing

Thanks to the careful choice of the healing screw or the implant abutment/temporary crown pair, these two entities with different regeneration potentials can be hermetically sealed, thereby avoiding cell competition, which we know contributes to the growth of epithelial cells which develop more rapidly.

Case 1
The patient presented with a fracture of #16 (Fig. 3) and periapical cysts. With the patient’s consent, the decision was made to perform an extracortical debridement (vaporisation) of the entire “lamina dura” with an Erbium laser (2,940 nm) followed by decontamination with a diode laser (940 nm).

This was a flapless surgery. The expansion osteotomy was performed through the inter-radicular septum. It was initiated with a very thin manual bone tap (pointed) and then an automatic mechanical osteotome (Fig. 4) (Osteo Safe®-Anthogyr) was used. The use of convex inserts in the beginning enables lateral expansion of the native or healed bone and then concave inserts during the breaking of the last sub-sinus millimeter, enables lateral bone recovery of this bone socket while projecting it apically.

During sinus progression PRF membranes (or native collagen membranes) are placed in the osteotomy opening to fill the intra-sinus space that is thereby gained (they also provide protection of the sinus membrane).

The Erbium laser is again passed through the osteotomy socket to vaporize the bone debris and sludge along the walls of this osteotomy. The implant is placed according to the manufacturer’s recommendations but with an even slightly higher torque if the titanium grade so allows. A healing screw that fits the diameter and height of the residual gap to be closed is carefully chosen (Fig. 6).

If the healing screw does not enable primary closure of soft tissue, PRF membranes are used to fill the gap. If this gap is too big, a mucoperiosteal detachment of 6-10 mm and then a horizontal incision of the peristium of 6-8 mm are made. This technique serves to pull the gum around the healing screw by maintaining it with two sutures. The control X-rays clearly showed good osseointegration of the implant, significant filling and regeneration in only three months, and then perfect filling and regeneration four months after surgery.

The bone remodeling around and above the implant neck also seemed...
to be well executed. The cone beam 3D imaging in the first place showed a healthy sinus without inflammation or infection as well as bone re-modeling at the apex and around the implant (Fig. 7-8).

In the case of a trans-alveolar sinus lift combined with the placement of an implant by bone expansion, convex-tipped inserts should be used first to enable lateral expansion, and then cone convex inserts enable scraping of the bones of the lateral walls of the osteotomy to enable apical projection after breaking the last millimeter under the sinus floor. If the sinus floor while protecting the sinus membrane. The consequence is the notable increase in peri-implant bone density with a high elevation of BIC (Bone Implant Contact) and, therefore, bone stability.

The objective of this technique is to maintain, if possible, the entire maxillary bone by laterally pushing back the bone with minimal trauma while creating a precise osteotomy that breaks the last millimeter of the sinus floor while protecting the sinus membrane. The consequence is the notable increase in peri-implant bone density with a high elevation of BIC (Bone Implant Contact) and, therefore, bone stability.

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Vital importance is attributed to the closure of soft tissue during implant placement, either by carefully choosing the healing screw (the height and diameter) or the implant abutment, enabling slight compression of soft tissue and providing a barrier that enables the regeneration of the two families of tissues.

These minimal invasive techniques still require many improvements and more widespread validation. However, for ethical and safety reasons, the practitioner should always suggest the least invasive technique that contributes to guides and induces this tissue regeneration for which, most of the time, we have the matrix around these traumatized zones.

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Editorial note: The full list of references is available from the publisher.

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