The treatment of traumatic dental injuries

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 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 Guidelines for the Treatment of Traumatic Dental Injuries. These guidelines were based in part on the current recommendations of the International Association of Dental Traumatology (www.iadtdental-trauma.org for more information).

This article provides an overview of the AAD guidelines; the complete guidelines are available for free download at www.aae.org/clinical-resources/trama-resources.aspx.

The benefit of adhering to guidelines for treatment of dental trauma was recently shown in a study by Buehrer et al. The study found that, compared with cases treated without 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.

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. Where, when 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/sour.
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 that approximately 95% of intracranial hemorrhages follow a mild head injury is 8 percent, and the onset of symptoms can be delayed for minutes to hours. 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, atonic or contusion, blurred vision or unexplained pupil, and difficulty of speech and/or slurred speech may also indicate serious injury.

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 AAD 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 and alveolar fractures, as well as all luxation injuries.

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*Splint removal in apical third and root fractures. **Splint removal with a root fracture near the cervical area.

Fig. 2a: Clinical case of two uncompleted crown fractures in which the two broken pieces were located and treated. (Photos/Provided by American Association of Endodontists)

Fig. 2b: Clinical pictures of the revascularized.

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Dental Tribune Middle East & Africa Edition | 3/2017 11

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*Splint removal in apical third and root fractures. **Splint removal with a root fracture near the cervical area.

Fig. 2a: Clinical case of two uncompleted crown fractures in which the two broken pieces were located and treated. (Photos/Provided by American Association of Endodontists)

Fig. 2b: Clinical pictures of the revascularized.

Fig. 2c: After the two pieces had been attached, a chamfer cut along the fracture line and additional compo
Additionally, sensitivity tests should be conducted on all teeth involved as well as opposing teeth. Cold testing is recommended before every follow-up testing in young individuals.10 Both testing methods should be considered, however, especially when there is no response to either of the two. The pulp might be non-responsive for several weeks after a traumatic injury, so a pulp test should be done at every follow-up appointment until a normal response is obtained.10

Once the diagnosis is confirmed and more serious complications such as CNIS and jaw or other facial bone fractures have been ruled out, the emergent phase of the treatment needs to be initiated. The aim of treating dental trauma should be to either maintain or regain pulpal vitality in traumatized teeth. This is because dental trauma most frequently occurs in the anterior part of the mouth, in which the teeth have not yet fully developed, and root development will cease without a vital pulp.

**Clinical examples**

Dental trauma can be roughly divided into two groups: fractures and luxation injuries. The fractures are then divided into crown, root, crown-root, 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 fractures:** The fracture line 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 esthetically the best solution. Prior to reattaching the tooth fragment, the remaining dental pulp needs to be assessed radiographically and clinically. If there is at least 3 mm of the pulp coronal, indicating that there is no need to cover it, a protective liner can be placed. If it is estimated that the remaining dentin is less than 0.5 mm, it is advisable to cover the root canal. If the tooth is kept dry, it should be rehydrated in distilled water or saline for 10 minutes prior to reattachment. This process will increase its bonding strength. (Figs. 1a–c)

In a complicated fracture, the goal is to create a tight seal to protect the pulp, after ensuring that the pulpal wound is clean and all infected tissue is removed.12 The two best capping materials available today are calcium hydroxide and mineral trioxide aggregate (MTA),15 but newer bioceramic materials are showing promise for this application.6 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).

**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/ crown/root to reattaching the tooth. This can be accomplished by gingivectomy if the fracture line is in the sulcus, or more extreme cases, the tooth will have to be extruded with orthodontic forces or surgically repositioned. If the emergency session, if the pulp 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.16 Therefore, it is of utmost importance that a recall schedule is followed and that the teeth involved in the trauma are tested every time. Table 1 includes a clinical guideline for the response of vitality tests for up to three months, and a lack of response to vitality tests does not always be covered for the patient’s comfort.

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

<table>
<thead>
<tr>
<th>Time</th>
<th>Concussion/Subluxation</th>
<th>Extrusion</th>
<th>Lateral Luxation</th>
<th>Intrusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 Weeks</td>
<td>Splint removal (ifSplint removal (if</td>
<td>Clinical and radiographic examination</td>
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**Table 3. Splinting Time for Various Types of Luxated Permanent Teeth**

<table>
<thead>
<tr>
<th>Type of Injury</th>
<th>Splinting Time</th>
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<tr>
<td>Subluxation</td>
<td>2 weeks</td>
</tr>
<tr>
<td>Extrusion Luxation</td>
<td>2 weeks</td>
</tr>
<tr>
<td>Avulsion</td>
<td>2 weeks</td>
</tr>
<tr>
<td>Lateral Luxation</td>
<td>2 weeks</td>
</tr>
<tr>
<td>Intrusion</td>
<td>4 weeks</td>
</tr>
<tr>
<td>Root fracture (middle 1/3)</td>
<td>4 weeks</td>
</tr>
<tr>
<td>Alveolar fracture</td>
<td>4 weeks</td>
</tr>
<tr>
<td>Root fracture (cervical 1/3)</td>
<td>4 months</td>
</tr>
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</table>

Sclerally, it is well to advise the patient and the parents/guardians that the long-term prognosis of an intruded tooth is unpredictable, as it is likely to eventually be lost due to ankylosis.12,13,17

**Table 2. Follow-Up Procedures for Luxated Permanent Teeth**

Splinting of a luxated tooth is recommended only for teeth that are still mobile without any root movement. In all types of trauma cases, a splint must allow for physiological movement.12,17 (Figs. 3a–c & Table 3 regarding splinting time.)

When assessing luxation trauma, it is important to consider the maturity of the apex. If it is still open, there is a chance that pulp will survive the trauma or revascularize, allowing the growth of the tooth to continue (Figs. 4a–c).

If the apex is closed, endodontic treatment is likely needed. It is advisable to follow the patient closely (Table 4) or refer him or her to an endodontist for further evaluation.19-21

It is important to remember that dental injuries do not always fall into one group or category, but often a combination of several categories. Injuries in multiple categories will impact the outcome. For example, it was recently demonstrated that the existence of a concurrent luxation injury with an uncomplicated crown fracture and root displacement are significant risk factors of pulpal necrosis.24

**Avulsion**

The time outside of the socket for an avulsed tooth is critical to the PPD and efficiency of its survival. If the tooth is replanted within 30 minutes, or alternatively kept in a physiological solution of specialized media or milk for a few hours prior to transplantation, it is possible to save the tooth.24,25,26 If the tooth has been dry for more than one hour, the periodontal ligament with pulp vitality may survive and the tooth will likely become revascularized.27,28 However, the tooth needs to be stabilized with a physiological splint for two weeks.27,28 If the avulsed tooth has an open apex and was reimplanted within the hour, there is a possibility that the pulp will revascularize. In this case, delaying endodontic treatment at the emergency stage is recommended.25

Endodontic treatment should be performed later only if signs of pulpal necrosis are present.
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 principles to the dimension 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 coping, 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 implant implemented 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 angiosogenesis to provide the required vascularization 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 a periradicular cyst. With the patient’s consent, the decision was made to perform an extraction (crestal sinus lift). The patient was on standard premedication method (crestal sinus lift). The patient was on standard premedication method (crestal sinus lift). The patient was on standard premedication method (crestal sinus lift). The patient was on standard premedication method (crestal sinus lift). The patient was on standard premedication method (crestal sinus lift). The patient was on standard premedication method (crestal sinus lift).

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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

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Fig. 1. Original explanatory sketch of Summers’ technique.
Fig. 2. Bone expansion through the septum with the use of osteotomes (a, b). Choice of healing screw that enables primary closure of soft tissue (c, d).
Fig. 3. Preoperative clinical view of #16 fractured and infected.
Fig. 4. Use of Osteodotjet.
Fig. 5. Complete Osteodotjet kit.
Fig. 6. Bone expansion (a), positioning of the implant (b) and choice of the healing screw (c).
Fig. 7. Panoramic views (d) Pre-op, (e) Post-op, (f) at three months, (g) follow up at one year.
Fig. 8. Control at six months.
Fig. 9. Preoperative view of fistula on 24.
Fig. 10. Panoramic view with Gutta-Percha cone inserted in the fistula that reaches the apex.
Fig. 11. Laser decontamination.
to be well executed. The cone beam 3-D imaging in the first place showed a healthy sinus without inflammation or infection as well as bone re-modelling at the apex and around the implant (Fig. 7-8).

In the case of a trans-alar sinus lift combined with the placement of an implant by bone expansion, con-vex-tipped inserts should be used first to enable lateral expansion, and then concave inserts enable scrape-ning of the bones of the lateral walls of the osteotomy to enable apical projection after breaking the last millimeter under the sinus floor. If a mandibular implant is to be placed completely in native bone, convex inserts suffice. The last insert that is placed is smaller in diameter than the implant that is chosen. The advantage of this technique was noted starting in 1996 by Summers himself with the use of conical osteotomes as opposed to cylindrical os-teotomes, which were all that were available up-un-till then. The idea was actually to enable lateral peri-implant bone condensation in order to increase notori-ably, primary stability and compensate for the lack of vertical dimension of the sub-sinus native bone.

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 si-nus membrane. The consequence is the notable increase in peri-implant bone density with a high elevation of CIE (Bone Implant Contact) and, therefore, bone stability.

Case 2

The patient presented with a fracture of 214 with significant perifac-ial dislocation (Figs. 9-10). It was decided that an extraction would be performed with immedi-ate placement and loading of an implant after complete decontami-nation of the extraction socket using lasers (Figs. 11, 12). Next, Osseosafe® was used (Fig. 13) to enable gentle trabecular expansion and placement of a self-tapping conical implant (Axicom, A*P*H* Anthogyr).

In this case, where bone re-covery along the osteotomy walls was not necessary, only convex inserts were used. The palatal and submental portion of the implant is respected (Fig. 14). The gap between the implant and the vestib-ular cortical bone is not filled. Care-ful choice of the implant abutment design is also an emergence both in terms of hard tissue and soft tissue. The temporary crown is thereby shaped inside the gap by slightly compressing the marginal gum (Fig. 15).

It is mounted out of functional oc-cision. Of course, the patient was ad-vised to avoid voluntary chewing on this implant and only use local cleaning with cotton soaked in Chlo-rexidine.

Following verification of the osseointegration (Fig. 46), the impression was made eight to ten weeks after sur-gery, followed by placement of the permanent prosthesis (Fig. 17).

Conclusion

The implant placement technique with the use of osteotomes is not a new concept. On the other hand, using an automatic osteotome pro-vides a better view of the site and makes it possible to practice flawless surgery, to position more precisely and obtain more homogeneous progression, in comparison to us-ing bone tapers with a surgical mill. From the patient’s perspective, sur-gical comfort is significant and very noticeable.

Vital importance is attributed to the closure of soft tissue during implant placement, either by carefully choos-ing the healing screw (the height and diameter) or the implant abutment, enabling slight compression of soft tissue and providing the implant/ prosthetic connection system with a ‘hanger’ that enables the regenera-tion of the two families of tissues. These minimal invasive tech-niques still require many improve-ments and more wide-spread valida-tion. However, for ethical and safety rea-sons, the practitioner should al-ways suggest the least invasive tech-nique that contributes to guided bone regeneration and induces this tissue regeneration for which, most of the time, we have the matrix around these traumatized zones.

References


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

Dr Gilles Chauvannet

Dr. Gilles Chauvannet graduated from the University of Nanterre in 1993. He has worked in more than 15 dif-ferent countries on four continents. Since 2000, the practice of his field has revolutionized his procedures. His prac-tice is limited to oral surgery and implantology in Paris and Versailles, France.

He holds different editions and post-grad-uate in lasers, periodontology, implant therapy, oral surgery, anatomy and endod-on-tology. He is president of SOFA (Societé Francaise pour Oral La réalité de la chirurgie); ambassador of Global Implant Therapy. He is also an active member of CENALS, member of French Society of Medical Laser (SFUGM), member of International Academy of Periodontology (IAP), member of Italian Society of Oral Surgery (SIC) and member of AGLZ Academy. He lectures widely in Europe, Asia and the Middle East. He is in private practice in Villepinte-Louveciennes (France) and Verona (Italy).


References


A complete list of references is avail-able from the publisher.

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He was a full-time faculty member at UNC School of Dentistry from 1992 until 2004, first as an assistant professor and then as associate professor with tenure beginning in 2000. He was appointed at the gradu-ate program director of endodontics (speci-alty training) in 1997 and served in that position until 2004. From 2004 to 2010 he was in a private endodontic practice in Reykjavik, Iceland, and London, England.

He is active in many professional organi-sations and is past president of the Inter-national Association for Dental Trauma-tology (IADT). He received the Edward M. Osetek Educator Award from the Amer-i-can Association of Endodontists in 1999.