

ENDODONTICS



Colleagues for Excellence

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Endodontic Considerations in the Management of Traumatic Dental Injuries

Welcome to *ENDODONTICS: Colleagues for Excellence*...the newsletter covering the latest in endodontic treatment, research and technology. We hope you enjoy our coverage on the full scope of options available for patients through endodontic treatment and that you find this information valuable in your practice. All issues of this *ENDODONTICS* newsletter are available on the AAE Web site at www.aae.org, and cover a range of topics on the art and science in endodontic treatment.

Management of dental trauma is often a team effort involving general dentists, along with one or more of the specialty disciplines. This issue of *ENDODONTICS: Colleagues for Excellence* will address the management of traumatic dental injuries from an endodontic perspective. Detailed clinical illustrations are provided to assist general practitioners in understanding how wound healing affects the pulp, so that accurate assessments of a trauma situation can be made.

Levels of Treatment for Traumatic Dental Injuries

Treatment of traumatic dental injuries can be categorized as primary, secondary and tertiary care. A **primary level of treatment** would involve urgent care provided soon after an accident in which dental injury has occurred. Such urgent care could include replanting an avulsed tooth, stabilizing luxated teeth or re-attaching a broken tooth fragment. Most often, these services are provided by general dentists, pediatric dentists, and oral and maxillofacial surgeons, either in hospital emergency rooms, dental offices or other clinics.

Three priority categories have been identified for dental trauma based on the effect time has on the outcome. *Acute priority* includes avulsion, alveolar fracture, extrusive and lateral luxation, and root fractures. These traumas respond most favorably if treated within a few hours. *Subacute priority* includes intrusion, tooth concussion, subluxation and crown fractures with pulp exposures. Delaying treatment several hours does not appear to affect the outcome of these injuries. Finally, *delayed priority* can be assigned to crown fractures with no pulp exposure, which appear to respond well even after more than a 24-hour delay in treatment. These guidelines were

developed to provide information to help in treatment planning; obviously, primary treatment should be provided as soon as possible in any trauma situation.

Recognizing that treatment priority can be assigned to various dental traumas can lead to a more effective use of dental resources. The goal of the urgent care—whether it is acute, subacute or delayed—is to promote wound healing in damaged tissues. In minor injuries, *e.g.*, tooth concussion, the primary treatment, such as adjusting any premature occlusal contact, is often all that is necessary. In most other cases of dental trauma, secondary, and possibly tertiary, treatment will be needed.

Secondary level of treatment for traumatic injuries includes:

1. Monitoring and evaluating the condition of the pulp and the supporting structures clinically and radiographically.
2. Endodontic therapy in situations where the pulp is not expected to survive (*e.g.*, avulsed and replanted mature teeth) and in situations in which pulpal disease develops subsequent to primary treatment procedures.
3. Soft tissue surgery to repair damaged gingival and periodontal tissues that heal unsatisfactorily.
4. Definitive restorations of teeth with crown fractures in which the primary treatment goal was to protect the pulp.
5. In rare cases, decoronation of a tooth in a young patient to maintain alveolar bone integrity until a dental implant or fixed partial denture can be placed. Decoronation is a procedure in which the crown of an ankylosed tooth is resected to just below the crest of the alveolar bone and the root is left in the

alveolus; the purpose of the procedure is to maintain ridge contour (See Malmgren et al., 1984).

A **tertiary level of treatment** may take place any time from a few years to many years after a patient has had primary and secondary levels of treatment. A wide variety of dental procedures would constitute tertiary treatment, including dental implants, fixed partial dentures, orthodontic treatment or autotransplantation.

The Role of Pulp in Dental Trauma

As can readily be seen from the preceding description of the management of traumatic dental injuries, general dentists and various specialists often need to work as a team to accomplish the necessary tasks. It is understood that not all patients with a dental injury will need to go through all three levels of care; some heal completely after primary or secondary care, but many go through years of procedures. The goal for all dentists involved in caring for patients with dental injuries is to help their patients get the best possible short- and long-term result.

Endodontists are by training and experience prepared to function as productive members of treatment teams managing trauma patients. Since the pulp invariably plays an important role in the outcome of dental trauma, understanding how wound healing affects the pulp is important in assessing a trauma situation and projecting the prognosis and possible outcome. Endodontists can provide expertise in making these assessments.

Along with pulp biology, the cementum-PDL complex and the interaction between the status of the pulp and the affect pulp space infections have on root and bone resorptions are essential components of managing dental trauma. Based on their expertise in this area, endodontists can contribute valuable insight into successful treatment planning, in addition to providing essential care for traumatized teeth.

Publications in recent years have provided considerable evidence for selecting treatment, much of which has been used as a basis for the American Association of Endodontists' treatment guidelines. Following are clinical case illustrations describing current treatment recommendations based on the best available evidence.

Clinical Examples

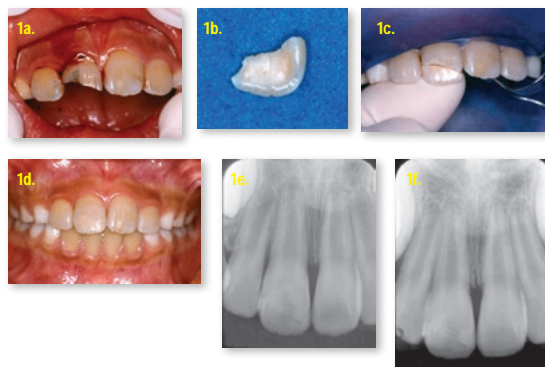
Crown Fractures

The endodontic consideration in crown fractures is to protect the pulp in young, developing teeth. In fully formed teeth, root canal treatment is often a practical choice.

A fractured tooth in a child can be restored by bonding the broken tooth fragment to the tooth; this is also a good way to protect the pulp to allow continued root formation (Fig. 1).

Fig. 1

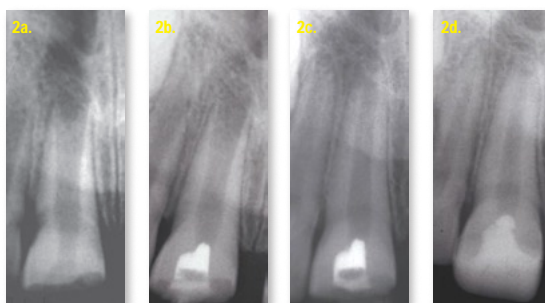
Courtesy of Dr. Mitsuhiro Tsukiboshi, Aichi, Japan



- 1a. Fractured central incisor in a nine-year-old child.
- 1b. Broken tooth fragment saved by parent. These fragments should be kept in water until rebonded to the tooth.
- 1c. Rubber dam isolation facilitates the bonding procedure.
- 1d. Successful rebonding of broken fragment.
- 1e. Radiograph taken after rebonding.
- 1f. One-year follow-up shows continued root development—the pulp has been well protected.

When a crown fracture exposes the tooth pulp in a child with an immature apex and a vital pulp, the goal of treatment should be to protect the exposed pulp with a material that is biocompatible with pulpal tissues. For years, calcium hydroxide has been the material of choice for vital pulp therapy, and it continues to be used with good success. Recently, a new material, mineral trioxide aggregate (MTA), has been developed for various endodontic situations including pulp protection. MTA provides a very good seal against microleakage and is well tolerated by pulpal tissues (Fig. 2).

Fig. 2



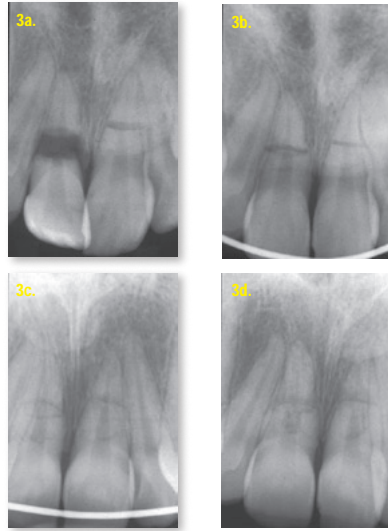
- 2a. Fractured crown with pulp exposure in an eight-year-old girl.
- 2b. Pulpotomy using MTA for pulpal protection.
- 2c. One-year follow-up; note continued root formation.
- 2d. Two-year recall showing further root development. (The initial grey MTA was replaced.)

Root Fractures

Because they are an infrequent occurrence (approximately five percent of all traumatic dental injuries), horizontal root fractures are frequently mismanaged, resulting in either unnecessary extractions or root canal treatment. Most teeth with root fractures will recover successfully following repositioning of the coronal segment (if displaced) and stabilization for

four to six weeks. Stabilization of a root-fractured tooth can be done using a functional, nonrigid splint (Fig. 3; also see Dental Splints inset below).

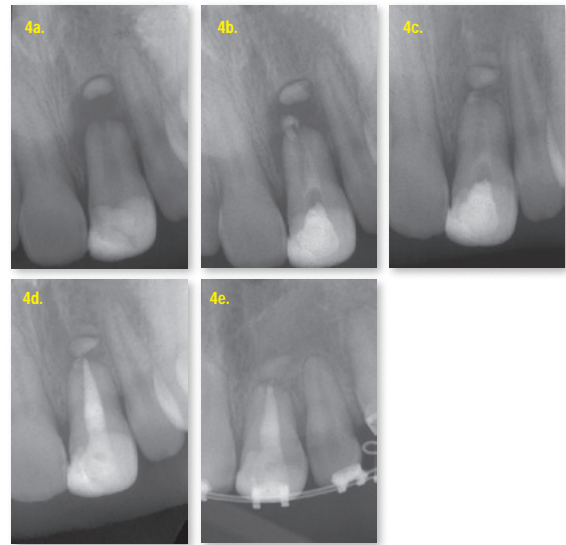
Fig. 3



- 3a. Both maxillary central incisors in this 10-year-old boy suffered root fractures. Note extensive displacement of the coronal segment of the right incisor. Repositioning the coronal segment is considered an acute priority for best outcome.
- 3b. Radiograph taken after repositioning and splinting. The wire used in this case is thicker than it needs to be; a thinner wire will permit functional mobility, which favors healing of the PDL.
- 3c. Radiograph taken at the time of splint removal three months later (the current recommendation is to remove the splint after four to six weeks, unless the root fracture is very close to the alveolar crest). There is no indication of pulp necrosis and pulp testing was within normal limits.
- 3d. One-year follow-up. Note extensive calcification of the pulp spaces. Pulp testing was within normal limits. Typically, the pulp spaces continue to calcify both in coronal and apical directions.

In some cases, the pulp in a root-fractured tooth becomes necrotic and infected. When that happens, root canal treatment can save the tooth. The necrotic pulp tissue is usually confined to the coronal part of the tooth and root canal treatment can be confined to the coronal segment only; the apical segment can be left untreated (Fig. 4).

Fig. 4



- 4a. The left central incisor in a 10-year-old boy suffered both a root fracture and a crown fracture as a result of a traumatic injury. The crown fracture was restored with composite resin, but microleakage led to pulp necrosis and an endodontic lesion confined to the space between the coronal and apical segments.
- 4b. The initial treatment was cleaning and shaping the root canal to the fracture site and disinfecting with calcium hydroxide.
- 4c. Three months later, the endodontic lesion has responded well to the cleaning and disinfection of the root canal.
- 4d. The root canal was filled to the fracture line. No treatment was indicated for the apical segment of the tooth.
- 4e. One-year follow-up shows good healing in the area between the two segments of this root-fractured tooth.

Luxation Injuries

The most common dental injuries are the various types of tooth luxations. From least to most severe, they are:

- **Concussion**—the tooth is sensitive to percussion but it is not excessively mobile.
- **Subluxation**—the injury has left the tooth with increased mobility.
- **Extrusive luxations**—the tooth is partially extruded in the socket and as a result, is also very mobile.

Dental Splints

The current concept of stabilizing traumatized teeth (luxation injuries, root fractures and avulsions) is to use dental splints that permit some mobility of the injured teeth. The terms “functional and nonrigid” describe splints that allow some mobility, which encourages healing of damaged periodontal ligament fibers and results in less resorption than when rigid splints are used. Nonrigid splints can be made by using thin orthodontic wires bonded to the crowns of teeth or by bonding flexible, unfilled resin to the teeth.



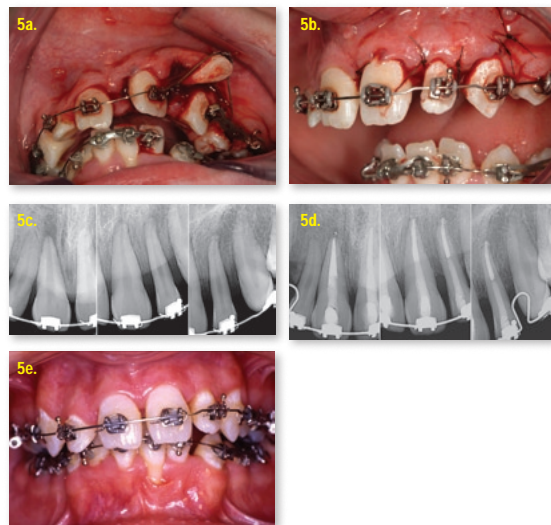
- a. Radiograph shows root fracture involving tooth #9. The mobility was slightly increased compared to the adjacent teeth.
- b. Small areas on the labial surfaces of teeth #8 and #9 were etched for bonding.
- c. An unfilled resin (such as that used for temporary crowns) has been used to make a nonrigid splint.
- d. Radiograph taken six weeks later when the splint was removed.

- **Lateral luxation**—the tooth has been displaced horizontally; often it is “locked” in position and has no mobility.
- **Intrusive luxation**—perhaps the worst of all dental injuries, the tooth is forced into the alveolus and as a result, appears ankylosed with no mobility.

With the exception of concussion injuries, luxation injuries frequently result in pulp necrosis requiring root canal treatment (Fig. 5).

Fig. 5

Courtesy of Dr. James Tinnin, Fayetteville, Ark.

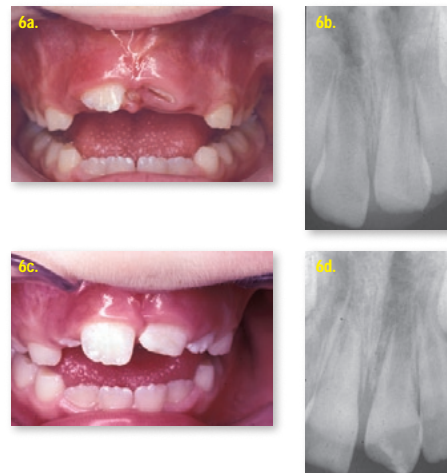


- 5a. A 12-year-old boy fell while ice skating and luxated four of his maxillary anterior teeth: tooth #8 - extrusive luxation; #9 - intrusive luxation; #10 - lateral luxation; and #11 - subluxation.
- 5b. Primary care included repositioning the displaced teeth (#8, #9 and #10), replacing the orthodontic wire, which provided a convenient splint, and suturing the lacerated gingival tissues.
- 5c. Radiographs taken after repositioning the teeth.
- 5d. Root canal treatment completed on teeth #8, #9 and #10. Tooth #11 (subluxation) did not require root canal treatment.
- 5e. Clinical photograph showing good healing of the soft tissues.

In young children, intruded teeth may re-erupt spontaneously, which is the ideal outcome. If re-eruption occurs, root canal treatment is not usually indicated, but close monitoring of the outcome is necessary (Fig. 6). If re-eruption does not occur, orthodontic repositioning should be attempted, possibly combined with partial surgical repositioning.

Fig. 6

Courtesy of Dr. Steve Morrow, Loma Linda, Calif.



- 6a. Intruded left central incisor in a six-year-old boy.
- 6b. Radiograph shows very immature root development.
- 6c. Re-eruption progress after six weeks.
- 6d. Radiograph confirms re-eruption.

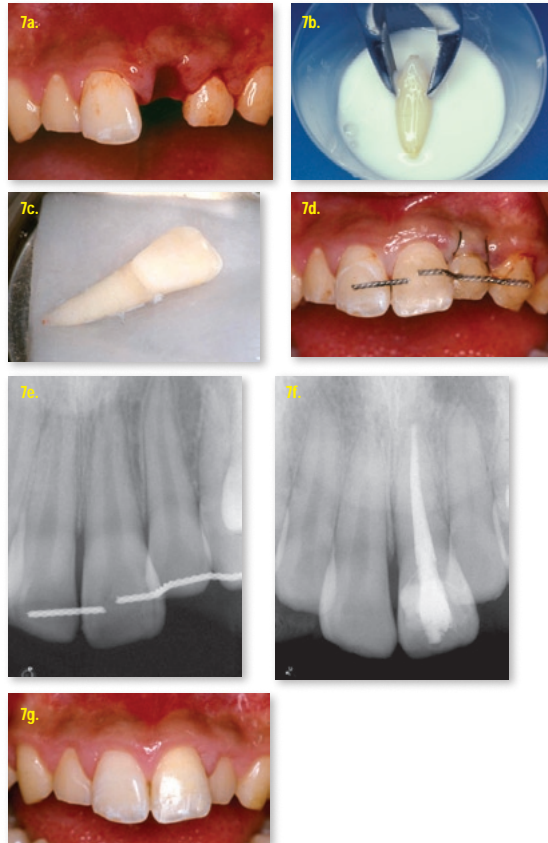
Avulsions

The best outcome for a tooth avulsion is when the tooth can be replanted within a few minutes after the accident. A very high percentage of teeth replanted within 15 minutes will have the PDL restored within a few weeks. The pulp, however, cannot be expected to survive, so root canal treatment becomes a very important component of successful treatment. The only exception to routine root canal treatment of replanted teeth is the case of a very immature tooth in which revascularization of the pulp is possible and desirable.

Root canal treatment should ideally be done on a replanted tooth during the second week after replantation. Using calcium hydroxide for a short period of time (up to one month) before filling the root canal will help disinfect the root canal system. Stabilizing the tooth with a functional, nonrigid splint for two to three weeks will assist in re-establishing the PDL support of the tooth (Fig. 7).

Fig. 7

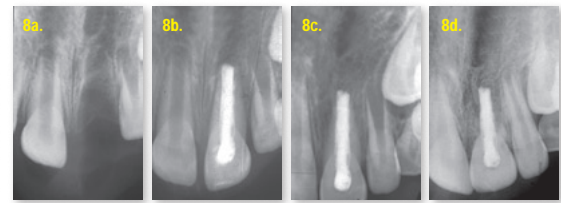
Courtesy of Dr. Mitsuhiro Tsukiboshi, Aichi, Japan



- 7a. A 15-year-old girl lost her tooth in a bicycle accident. The tooth was not replanted on site, but brought to the dentist.
- 7b. If a tooth cannot be replanted at the site of the accident, a convenient method for transporting the tooth is to place it in a cup of milk.
- 7c. In the dental office, the tooth was gently rinsed of any debris and placed in saline during the examination and preparation of the replantation socket.
- 7d. The tooth was replanted and splinted; the gingival tissues were sutured to allow good approximation to the tooth.
- 7e. Radiograph taken after replantation. The following week the tooth was opened for pulp extirpation and placement of calcium hydroxide. The splint was left in place.
- 7f. Two weeks later, the root canal was filled with gutta-percha and sealer, and the access cavity was restored with a bonded composite restoration; the splint was removed.
- 7g. Good healing of the soft tissue surrounding the replanted tooth.

If an avulsed tooth has been left dry for more than one hour, the odds of restoring the PDL are very poor. It may, however, still be worthwhile to replant such a tooth, because in spite of the likely ankylosis and resorption, the patient could get several years' use of the tooth. The procedure is relatively simple (Fig. 8).

Fig. 8

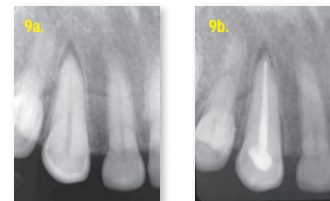


- 8a. A nine-year-old girl lost her left maxillary central incisor in an accident; it was not found until several hours later. In the dental clinic, the tooth was cleaned and any soft tissue adhering to the root surface was carefully removed. Root canal treatment was performed on the tooth from the apical opening, and the tooth was replanted and splinted.
- 8b. Radiograph taken six weeks later, after the splint was removed.
- 8c. Eighteen months post-replantation; some resorptive activity can be seen on the root surface.
- 8d. Three-year follow-up shows extensive resorption and the next level of treatment must be planned; extraction, or the possibility of maintaining the shape of the ridge by doing a procedure referred to as decoronation. Regardless of the next treatment choice, the patient has been able to use her tooth for over three years.

Alveolar Fractures

Fractures involving the alveolar ridges can have adverse effects on the teeth located in the fracture lines. It is important to examine and monitor the condition of the pulp in such teeth; if pulp necrosis is diagnosed, root canal treatment is indicated (Fig. 9).

Fig. 9



- 9a. The radiograph shows an alveolar fracture line that crosses the alveolar socket of tooth #6. Pulp necrosis was diagnosed from lack of response to electrical stimulation. Root canal treatment was indicated.
- 9b. Radiograph taken after root canal treatment was completed. Failure to treat a tooth associated with alveolar fracture can adversely affect bony healing.

Conclusion

Traumatic dental injuries present difficult problems for both patients and their dentists. Current evidence allows the dental health care provider to manage situations that, in the past, often resulted in crippled dentition and unsightly appearance. Appropriate treatment can turn what at first glance looks like a hopeless situation into a very satisfactory outcome for patients. The endodontic specialist can play an important role in the team approach to treating patients with traumatic dental injuries.

Reading List

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