



The Treatment of Avulsed Permanent Teeth

NAJIA USMAN, DDS

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COURSE AUTHOR

Najia Usman DDS, an endodontist, completed her dental training at the State University of New York at Buffalo in 1995. Her one-year General Practice Residency at the Cleveland Clinic Foundation was followed by four years of private practice. Recently, Dr. Usman completed a two-year postgraduate program in Endodontology at the Oregon Health & Sciences University in Portland, Oregon. She is currently in private practice in Beachwood, Ohio.

COURSE OBJECTIVES

Upon completion of this course, the participant will have reviewed the types and severities of the common types of dental injuries; the various transport media for an avulsed tooth; methods for splinting; a schedule for applying calcium hydroxide therapy; and indications for endodontic treatment. The course also includes a section on preparation and prognosis of the root based on the stage of apex development and time outside the mouth.

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Introduction

Dental trauma requires the dentist to make quick decisions in both diagnosis and treatment. Though treatment philosophies have not changed a great deal, what is interesting to note is that today, one in four girls versus one in three boys will have suffered a dental injury by the time they complete high school. The most common time is between ages eight and 12 when children are most active. As treatment is based on diagnosis, Andreasen's modification of the original World Health Organization classification of traumatic dental injuries has been included.

Dental avulsion is the complete displacement of a tooth from its socket. It is a rare and complex injury affecting multiple tissue compartments.¹ The periodontal ligament, alveolar bone, cementum, gingival and dental pulp are all damaged when a tooth is avulsed. Healing is not only dependant on the healing potential and rates of the various compartments, but also on the conditions of the avulsion accident, replantation management and patient-specific factors. The American Association of Endodontists (AAE) has guidelines that were most recently revised in 1995 for the treatment of the avulsed permanent tooth. These guidelines are based on a review of the pertinent literature and clinical experience in managing cases.

Managing an avulsion

Treatment is directed at avoiding the effects of two main complications: first, damage to the attachment apparatus (periodontal ligament and cementum) and second, pulpal infection. The aim is to replant the tooth with the maximum number of periodontal ligament cells that have the potential to regenerate and repair the damaged root surface. The single most important factor is time outside of the mouth. Therefore, the tooth must be handled minimally (washed gently in running water or saline) and re-implanted within the first 12 to 20 minutes.

If the tooth cannot be replanted adequately, a storage medium is required. Suggested storage media include the vestibule of the mouth, physiologic saline, milk and cell culture media such as Hanks Balanced Salt Solution (HBSS) in specialized transport containers. Water is least desirable because of its hypotonic properties. The vestibule of the mouth (maximum 2 hours) keeps the tooth moist but has bacteria, an incompatible pH and osmolality. Milk is preferred for an uncomplicated avulsion because it is usually readily available, has a pH and osmolality that is compatible and is bacteria free. HBSS can be purchased over the counter in dental first aid kits in most local drug stores (Save-A-Tooth®) and extends the storage period significantly compared to milk.

Initially, examination of the patient should include: chief complaint, history of present illness, pertinent medical history and clinical examination. The clinician should be observing the patient for neurological and other medical complications, as head and neck trauma may have occurred simultaneously. It is important to exclude any neurological complications before analgesics are prescribed or sedation by inhalation



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of nitrous oxide and oxygen are used. Any external injuries should be noted such as tissue lacerations, swelling and bruising. The TMJ and anterior border of the mandible should be palpated for tenderness. A similar intraoral soft tissue and hard tissue examination should be done noting fractured cusps, pulpal exposures and hemorrhage in the gingival sulcus. A radiographic examination consisting of periapical, occlusal, soft tissue and panoramic films should be performed.

The socket should be gently aspirated, not curetted and rinsed with saline. Remove clots and/or debris and assess the integrity of the walls of the socket. Preparation and prognosis of the root should be based on the stage of apex development and time outside the mouth.

- Closed apex < 20 minutes extra-oral: Revitalization is not possible, but periodontal healing is possible. Therefore, rinse with water or saline gently and replant.
- Open apex < 20 minutes extra-oral: Revascularization and continued root growth are possible. One study suggested soaking the root for five minutes in doxycycline to inhibit the bacteria in the pulpal lumen thus removing the obstacle to revascularization. This is followed by a gentle rinse and replant.
- Open/Closed apices, 20-60 minutes extra-oral time: A recent study suggested that PDL cells may be revived with Viaspan.
- Open/Closed apices, > 60 minutes extra-oral time: It is recommended to soak the tooth in citric acid to remove any remaining PDL cells followed by a five minute soak in an accepted fluoride solution before rinsing and replanting. With a blunderbuss or divergent apex, extra-oral/aseptic endodontics may be more advantageous in getting an apical seal before replantation.

Splinting

Splinting to stabilize the injured tooth is indicated to allow fibrous reattachment of the severed periodontal ligament. A flexible nylon monofilament is attached to the tooth and two teeth on either side with resin. This allows for physiologic movement which will allow normal function and occlusion and discourage ankylosis. Circumferential wire splints are contra-indicated. While the splint should be removed in seven to 10 days, alveolar fractures may result in mobility requiring longer splinting. These fractures should be rigidly splinted for six to eight weeks.

Diagnostic tests should be performed on adjacent teeth, as they serve as a baseline for later testing. With the aid of soft tissue radiographs, any tooth fragments and debris should be removed and soft tissue lacerations should be sutured. A consult with a plastic surgeon may be prudent. The need for systemic antibiotics and analgesics for seven to 10 days is recommended. Rinsing with chlorhexidine may be beneficial in the maintenance of oral hygiene. The patient's tetanus vaccination status must also be confirmed within 48 hours, as it needs to be renewed every 10 years.

In seven to 10 days, the patient should be seen in order to remove the splint and also remove the irritants in the root canal space that may provide stimulation for the progression of an inflammatory response leading to bone and root resorption. All medications and rinses may be suspended at this point. If a tooth has an open divergent apex and has had an extra-oral time < 60 minutes, the possibility of revitalization is high. This tooth should be observed and tested every four weeks for evidence of pathosis, i.e.: change in color, mobility or presence of pain and swelling. If pathosis develops, endodontic treatment is indicated. In an open apex case, and apexification procedure will be necessary. For the permanent tooth with a closed or partially open apex and extra-oral time < 60 minutes, the pulp should be removed seven to 14 days after initial implantation. A non-setting calcium hydroxide preparation (such as Pulpdent TempCanal™) should medicate the canals for six to 12 months with changes every three months. This step is critical in inhibiting destructive external inflammatory resorption as well as reducing the likelihood of external replacement resorption (ankylosis). After one year, the tooth may be obturated with gutta percha and sealer and the definitive restoration placed. For the permanent tooth with a closed or partially open apex and an extra-oral time > 60 minutes the root canal may be performed intra-orally or extra-orally before implantation. Long-term calcium hydroxide therapy is preferred when the injury occurred more than two weeks before initiation of treatment, and if radiographic evidence of resorption is present.

Follow-up care

Follow-up care should occur every six months for five years after completion of obturation. Replacement resorption (ankylosis), inflammatory resorption and delayed or lack of eruption are potential complications of the avulsed tooth. Ankylosis may take months

or even years to manifest and requires revision of a long-term treatment plan as it is irreversible and the tooth is ultimately lost. Radiographically, there is an absence of the lamina dura and the root assumes a moth eaten appearance as the dentin is replaced by bone. Clinically, the tooth will lack mobility and when percussed will have a metallic sound. Inflammatory resorption requires a further attempt at disinfection by standard re-treatment methods. Again, adjacent teeth may show pathologic changes long after the original accident and should be tested at recall.

Conclusion

The type and severity of injury and the patient's immune response to injury are uncontrollable factors that play a role in the avulsion accident. By using the best transport media, splinting and calcium hydroxide intracanal medicament, we improve the chances for successful replantation. Minimization of the extra-oral time is of paramount importance in increasing the longevity of the tooth overall.

Self-Test

1. **What trend in dental trauma has changed over time?**
 - A. Philosophies in management
 - B. Increased dental injuries in females
 - C. The treatment modalities used
 - D. The classification system
2. **Avulsion is defined as:**
 - A. Tooth displacement (includes concussion, subluxation, extrusive luxation, lateral luxation and intrusive luxation)
 - B. Fracture of root only involving cementum, dentin and pulp
 - C. Complete displacement of a tooth out of its socket
 - D. None of the above
3. **An avulsion injury involves:**
 - A. Periodontal ligament
 - B. Alveolar bone
 - C. Dental pulp
 - D. Cementum
 - E. All of the above

CLASSIFICATION OF DENTAL INJURIES

ENAMEL FRACTURE: Involves the enamel only and includes enamel chipping and incomplete fractures or enamel cracks

CROWN FRACTURE WITHOUT PULP INVOLVEMENT: An uncomplicated fracture involving enamel and dentin without any pulpal exposure

CROWN FRACTURE WITH PULP INVOLVEMENT: A complicated fracture involving enamel and dentin and exposure of the pulp

CROWN-ROOT FRACTURE: Tooth fracture that includes enamel, dentin and root cementum and may or may not include the pulp

ROOT FRACTURE: Fracture of root only involving cementum, dentin and pulp; also referred to as horizontal root fracture

LUXATION: Tooth displacement, includes concussion, subluxation, extrusive luxation, lateral luxation, and intrusive luxation

AVULSION: Complete displacement of a tooth out of its socket

FRACTURE OF THE ALVEOLAR PROCESS (MANDIBLE OR MAXILLA): Fracture or comminution of the alveolar socket or of the alveolar process

References

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3. Walton R.E., Torabinejad M. Principles and Practice of Endodontics, 3rd Edition. WB Saunders, Philadelphia, PA, USA 2002
4. Diangelis A.J., Bakland L.K. Traumatic Dental Injuries: Current Treatment Concepts. JADA, Vol. 129, October 1998, 1401-1408
5. American Association of Endodontists website: www.aae.org – Treating the Avulsed Permanent Tooth.
6. Barrett E.J., Kenny D.J. Avulsed permanent teeth: a review of the literature and treatment guidelines. Endodon Dent Traumatol 1197: 13: 153-163

4. **Treatment is directed in minimizing the effects of:**
 - A. Poor esthetics
 - B. Damage to the attachment apparatus
 - C. Pulpal infection
 - D. All of the above
 - E. B & C only
5. **TRUE OR FALSE: Only a trained professional should re-implant a tooth.**
 - A. True
 - B. False
6. **What is the single most important factor that determines prognosis of an avulsion case?**
 - A. Minimizing extra-oral time
 - B. Transport media
 - C. Calcium hydroxide treatment
 - D. The patient's immune status
7. **What is the best transport medium available?**
 - A. Milk
 - B. Hanks Balanced Salt Solution
 - C. Tap water
 - D. Viaspan
 - E. Vestibule of the mouth
8. **TRUE OR FALSE: Scraping the cementum before re-implantation will allow for maximum fibrous attachment.**
 - A. True
 - B. False
9. **Why is the mouth not a preferred site for storage of the avulsed tooth?**
 - A. Presence of bacteria
 - B. Incompatible pH
 - C. Incompatible osmolality
 - D. Possibility for inadvertent swallowing or aspiration
 - E. All of the above
10. **Examination of the patient should involve:**
 - A. Pertinent medical history
 - B. Chief complaints
 - C. History of present illness
 - D. Family history
 - E. A, B and C
11. **What is important to exclude before prescribing analgesics and/or using nitrous oxide?**
 - A. History of nausea
 - B. Allergies
 - C. Neurological complications
 - D. None of the above
12. **In preparation the socket should be:**
 - A. Assessed for broken walls
 - B. Cured
 - C. Clot removed
 - D. Gently rinsed
 - E. A, C & D
13. **The best changes for revitalization are in a tooth that has:**
 - A. Closed apex, <20 minutes extra-oral time
 - B. Open apex, < 20 minutes extra-oral time
 - C. Open apex, > 60 minutes extra-oral time
 - D. Tooth stored in HBSS
 - E. None of the above
14. **In what situation is extra-oral endodontics indicated (before re-implantation)?**
 - A. Closed apex, <20 minutes extra-oral time
 - B. Open apex, < 20 minutes extra-oral time
 - C. Open apex, > 60 minutes extra-oral time
 - D. Tooth stored in HBSS
 - E. None of the above
15. **Physiologic movement is desired because:**
 - A. Prevention of ankylosis
 - B. Patient comfort
 - C. Allows normal function
 - D. A & C
 - E. All of the above
16. **Splinting may be indicated for 6-8 weeks:**
 - A. When the patient needs to go on vacation
 - B. If a physiologic splint cannot be made
 - C. When using circumferential wire splints
 - D. If alveolar fractures are present
 - E. None of the above
17. **Adjacent teeth should be tested at the emergency visit because:**
 - A. They serve as a baseline for future testing
 - B. These teeth may also develop pathosis months later
 - C. Patients usually are poor historians during trauma cases
 - D. None of the above
 - E. A & B only
18. **Systemic antibiotics should be prescribed:**
 - A. For heart murmur patients only
 - B. For 7-10 days
 - C. If the patient presents more than two weeks after the injury
 - D. All of the above
 - E. None of the above
19. **Tetanus vaccinations must be renewed:**
 - A. Annually
 - B. Every five years
 - C. Every ten years
 - D. They do not need to be renewed
 - E. Only after titers are checked
20. **The main cause of bone and root resorption is:**
 - A. Irritants left in the root canal
 - B. Irritants that are in the bone
 - C. Irritants left on the surface of the root
 - D. None of the above
 - E. All of the above
21. **A tooth that is being monitored for revitalization should be checked for:**
 - A. Color changes
 - B. Mobility changes
 - C. Presence of pain
 - D. Presence of swelling
 - E. All of the above
22. **Apexification is necessary:**
 - A. To lengthen the root
 - B. To create a stop in a divergent immature root
 - C. When the tooth has had an extra-oral time > 60 minutes
 - D. None of the above
 - E. All of the above
23. **Calcium hydroxide is used to medicate the canal for:**
 - A. Three months
 - B. Six to 12 months
 - C. 12 to 15 months
 - D. Until the patient has their complete adult dentition
 - E. None of the above
24. **Long-term calcium hydroxide therapy:**
 - A. Disinfects the pulp space
 - B. Reduces inflammatory resorption
 - C. Reduces external replacement resorption
 - D. None of the above
 - E. All of the above
25. **TRUE OR FALSE: Ankylosis and External Replacement Resorption are the same thing.**
 - A. True
 - B. False
26. **Follow-up care should be for:**
 - A. 1 year
 - B. 2 year
 - C. 3 years
 - D. 4 years
 - E. 5 years
27. **Ankylosis tends to appear:**
 - A. Within 3 months
 - B. May take months or years
 - C. Within 1 year
 - D. None of the above
28. **Radiographically, ankylosis:**
 - A. Is undetectable
 - B. Has a moth eaten appearance
 - C. Shows loss of the lamina dura
 - D. All of the above
 - E. B & C
29. **TRUE OR FALSE: There is no cure for external replacement resorption.**
 - A. True
 - B. False
30. **TRUE OR FALSE: There is no cure for external inflammatory resorption.**
 - A. True
 - B. False

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The Treatment of Avulsed Permanent Teeth

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