

Traumatic Injuries

One of the most disturbing cases that may present itself at your dental office is that of a traumatic injury. What does 'traumatic injury' mean? Is it an emergency? How do we diagnose it? How do we treat these cases? Traumatic injuries in the dental office are not unheard of they are usually associated with an accident or trauma. Examples of possible candidates for traumatic injuries are children, athletes that play contact sports and teenagers with motorcycles. Traumatic injuries are tough to handle because it is usually associated with an accident so the patient is worried, panicking, there may even be bleeding or other associated injuries. The average age group that experience traumatic injuries is from between 7-12 years old. Why? This is attributed to the mind set of that age group these children are active, discovering their potential, curious and most of all unaware of the dangers surrounding them.

Good news or Bad news?

The fact that the most common age group for traumatic injuries is from 7-12 years has an upside and a down side.

The good news: Younger patient's tissues are more vital and have better blood supply.

The bad news: Patients within this age group usually don't have mature root apices.

Classification of Dental Traumatic Injuries:

1. Ellis classification (Early 1970's)

- **Class I** Crown fracture (Root intact)
- **Class II** Crown fracture without pulp exposure
- **Class III** Crown fracture with pulp exposure
- **Class IV** Coronal fracture extending subgingivaly
- **Class V** Root fracture
- **Class VI** Tooth displacement
- **Class VII** Injuries to deciduous teeth

2. World Health Organization (WHO) Classification (Late 1970's)

- **873.60** Enamel fracture.
- **873.61** Coronal fracture without pulp exposure.
- **873.62** Coronal fracture with pulp exposure.
- **873.63** Root fracture.
- **873.64** Crown root fracture.
- **873.66** Tooth luxation.
- **873.67** Intrusion and extrusion.
- **873.68** Avulsion.
- **873.69** Other injuries (soft tissues).

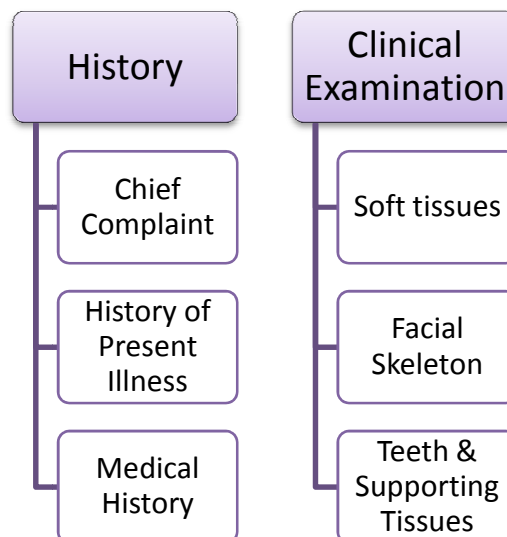
- **802.20** Fracture of alveolar process of mandible.
- **802.40** Fracture of alveolar process of maxilla.
- **802.21** Fracture of body of mandible.
- **802.41** Fracture of body of maxilla.

3. Modification of the WHO Classification by Andreason

- ***Enamel Fracture***
- ***Crown Fracture without Pulp Involvement***
- ***Crown Fracture with Pulp Involvement***
- ***Crown-Root Fracture***
- ***Root Fracture***
- ***Luxation***
- ***Avulsion***

The most common teeth involved in traumatic injuries are upper anterior teeth simply because they are in the fore front. So a patient presents to your dental office with a traumatic injury related to an upper central tooth ***what should be done first?***

Examination & Diagnosis



History

1. **Chief complaint:** It is a statement in the patients own words of what happened i.e. “I was playing with my brother and he pushed me down the stairs”. Sometimes it is so obvious, therefore be smart and ask the right questions.

2. History of present illness: (Questions to Ask)

- a. When & how did this injury occur?
 - Are there any missing teeth?
 - Contamination (Tetanus)
 - Time elapsed between the injury and presence in the dental office. Treatment options vary depending on the time elapsed
- b. Have you had any previous injuries to your mouth or teeth in the past?
 - If the patient has had similar injuries he maybe a battered wife or child, in the United States of America you maybe legally held accountable if you do not report this.
 - The patient maybe accident prone
 - The patient may take part in contact sports and that may explain the repetitive injuries

Knowing this information may shed some light on previously undiagnosed injuries

- c. What symptoms are you now having with the affected teeth or tooth?
 - Mobility
 - Pain
 - Bleeding

This will help with diagnosis

3. Medical History

- a. Allergies to antibiotics, medication or anaesthesia
- b. Medical conditions i.e. cardiac disease, liver disease
- c. Tetanus status (When was the last booster shot if not within 5 years then the patient may need to take another one)

4. Examination & Diagnosis

- a. Clinical Examination
 - i. Soft tissues: The soft tissues (Lips, cheeks, tongue etc...) need to be evaluated for the extent of damage which may require suturing and if any foreign body has been lodged in them. The examination of the soft tissues is done visually and radiographically Figure 1.

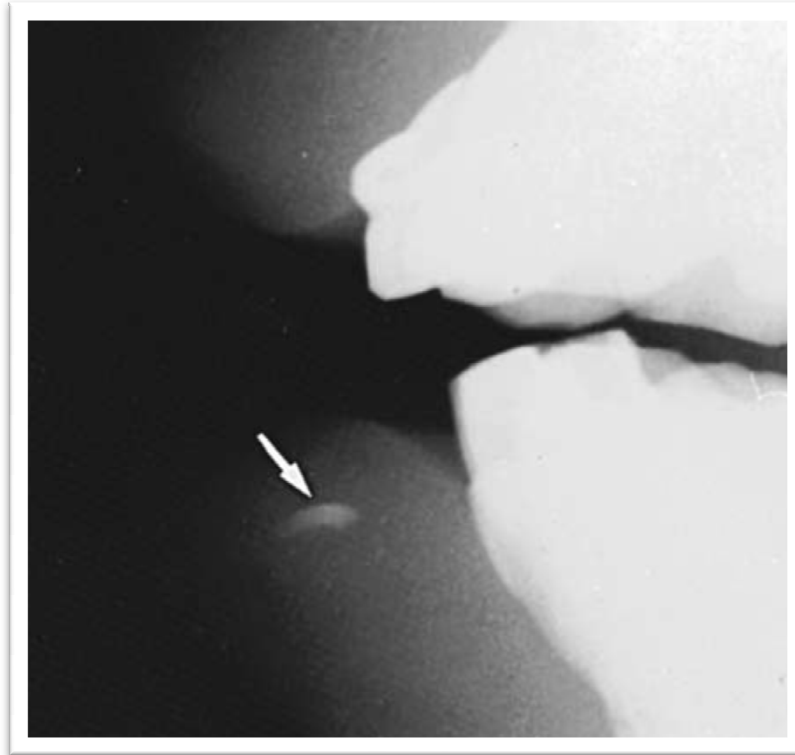


Figure 1: Lateral view radiograph showing a fractured tooth segment embedded in the lower lip

- ii. Facial Skeleton: Both the maxilla and mandible should be checked for fractures, in the case that there is a fracture then the case should be referred to an oral surgeon for fixation. When teeth are involved in the fracture line they may become necrotic and will require root canal treatment.

When should you worry?

- When several teeth are displaced
 - When tooth displacement is extensive
 - When there is occlusal malalignment
- iii. Teeth & Supporting tissue: When examining you should look for the following:
 - Mobility: Check the degree of horizontal mobility
 - 0 = No mobility (May be locked in bone)
 - 1 = < 1mm mobility
 - 2 = 1 to 3 mm mobility
 - 3 = > 3mm mobility
 - Displacement: If a tooth is displaced from its original position this maybe a luxation injury

- **Periradicular Damage:** Injury to the apical vessels may result in pulp necrosis. Use gentle Percussion if the tooth is affected it will be sensitive to even mild touch. When examining you should examine both the affected & adjacent. This is necessary to identify other teeth that maybe injured. Start with the adjacent teeth to set a base line for comparison. If you start with the affected tooth the patient may then give exaggerated responses when you try the other teeth.
- **Pulpal Injury:** Sometimes traumatic injuries may cause damage to the pulpal tissues resulting in internal resorption, external resorption or calcific metamorphosis. Pulp testing should be carried out to evaluate the state of the pulp using either thermal pulp testing using (ice) or an electric pulp tester. Using a hot thermal test is not recommended it may not give accurate results.
- **Radiographic Examination:** Radiographs should be taken to search for bone & tooth fractures. These may also be used for medico legal purposes when dealing with accidents or battered children etc... Multiple exposures with multiple angulations are required to view all possible fracture angles. Using a film holder is required for reproducibility and to minimize distortion

Dental Injuries:

1. Enamel Fractures

Description: They appear as cracks & chips of enamel; these injuries are usually mild and are not associated with pulpal damage.

Treatment:

- a. Grinding & polishing of the fractured edge
- b. Restoration using bonded composite

Prognosis: It is good, unless it is compounded with a luxation injury

2. Crown Fracture without pulp involvement

Description: This type of injury is a little more 'aggressive' it usually consists of a fracture of enamel & dentin. It is not usually associated with severe pain and usually doesn't require urgent care.

Treatment:

- a. Restoration using bonded composite
- b. Bonding of fractured segment

- c. In severe cases an indirect veneer maybe required

Prognosis: It is good, unless compounded with a luxation injury

Primary teeth: It is not common but it may occur, obviously with children patient handling is more difficult, the sharp edges can be ground and the tooth maybe left alone till shedding.

3. Crown Fracture with pulp involvement

Description: It is a more complicated fracture involving enamel, dentin & pulp. Treatment option varies according to

- Level of root maturity (Pulpotomy or else)
- Extent of damage restorability (Vital pulp therapy or RCT)
- Time elapsed after fracture

Treatment:

1. *Shallow Pulpotomy (Cvek Technique)*

For many years the endodontic community used to do deep pulpotomies under the pretense that the further the pulp was cut the better the chance that the pulp would survive the procedure. On the other hand the teeth that had immature teeth were weak especially coronally, so with deep pulpotomies there was no chance of hard tissue deposition coronally which severely weakened the remaining tooth structure. When doing shallow pulpotomies only 2 mm of the pulp is removed coronally allowing for deposition of hard tissue coronally.

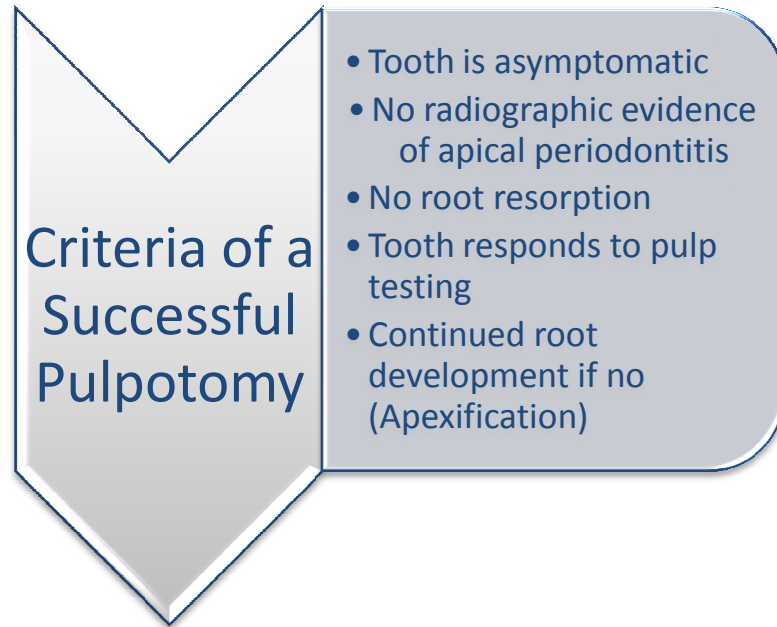
Indication: Immature teeth (Immature teeth are weak). It allows the pulp to deposit hard tissue reinforcing the tooth structure and allowing for root completion.

Technique of Pulpotomy:

1. Administration of anesthesia
2. Application of rubber dam
3. Wash exposed dentin with saline
4. Excavation to remove granulation tissue and pulp tissue to a level 2mm below exposure site
5. Complete the pulpotomy using a round bur in high speed with coolant
6. Create a dentin shelf to support the capping material
7. Wash with saline and apply pressure to achieve Hemostasis
8. Remove clot and apply either CaOH or MTA
 - a. CaOH: Apply the liner material followed by a base material (IRM or Resin Reinforced Glass Ionomer) followed by a final restoration using bonded composite. Re-entry after 6-12 months to reapply CaOH because it is soluble.

- b. MTA: Apply the material in increments apply a temporary dressing and wait for 6 to 12 hrs for complete setting. Then place a final restoration using bonded composite, unlike CaOH re-entry is not needed.

In all cases evaluation is done after 6 months & yearly after that



2. **Root Canal Treatment:** This is indicated for mature teeth or for teeth that can't be restored with a bonded composite restoration.

Prognosis: This depends on the time elapsed from the actual injury, reflecting the state of the pulp. Figure 2

Less than 1 week good prognosis
More than 1 week prognosis gets worse

Primary Teeth: It occurs less often and the treatment options vary depending on the extent of the injury and the degree of root resorption (pulpotomy, RCT or extraction).

If More than ½ the deciduous root is resorbed then extract it



Figure 2 An upper central incisor showing root completion after a pulpotomy

4. Crown-Root Fracture

Description: This type of injury involves both the crown and root. It has many names oblique fracture, chisel fracture (Anterior teeth) or shattered tooth (when the tooth presents with multiple fractures) it usually occurs with a pulp exposure. On the other hand, it rarely affects posterior teeth but if it does happen it usually doesn't involve a pulp exposure.

Examination: Check for loose fragments, the old school of thought involves removing all the fractured segments while the new school suggests bonding the fragments, especially when the tooth is immature (Temporarily) to allow for root completion.

Treatment: If the root is immature and the pulp is exposed then pulpotomy or vital pulp therapy may be needed.

Treatment Planning: 'You need to ask yourself certain questions'

- Which is better for the tooth pulpotomy or pulpectomy? Depending on root maturity.
- Is the remaining tooth structure enough to support a restoration?
- How subgingival is the fracture? Crown-root ration.
- Should it be extracted and restored with bridge or implant?
- Or should the space be closed orthodontically?

Primary Teeth: This usually means an extraction. Occasionally, there may be enough remaining tooth structure for a restoration.

5. Root Fracture

Description: As the name implies, this type of injury involves only the root of the tooth. There are many names to describe it intra-alveolar root fracture, horizontal root fracture and transverse root fracture. Generally root fractures are difficult to detect and are easily missed, that is why radiographs are essential for diagnosis of root fractures. Be sure to take multiple radiographs

with severe angulations this is done to be sure of ones diagnosis. The central beam must pass through the space for it to appear on the radiograph Figure 3. Teeth that have root fractures usually have mild symptoms and sometimes no symptoms at all these symptoms maybe:

- Mobility
- Displacement
- Pain on biting

The RULE: The more coronal the fracture the more symptoms

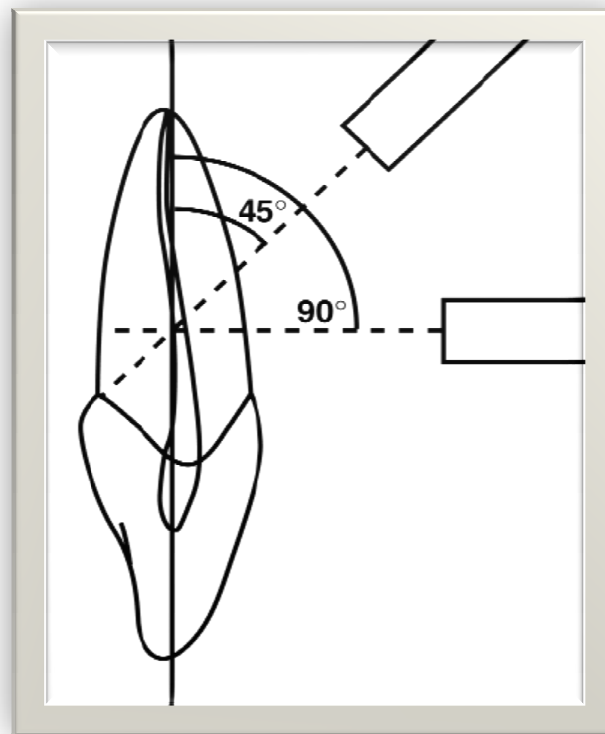


Figure 3 Different angulations when taking radiographs of suspected root fractures

Emergency Care:

1. Repositioning: The fractured segment should be repositioned using mild finger pressure if that is not possible then it maybe positioned orthodontically.
2. Stabilization: This is accomplished using composite & orthodontic wire for 12 weeks for to allow for healing between the two segments.
3. Follow up: To check on vitality and take radiographs to estimate the degree of healing between the segments. Most cases heal by calcific metamorphosis in the coronal segment but it may occur in either or both segments.

Sequelae of root fracture: Figure 4 shows the four possible sequelae of root fracture.

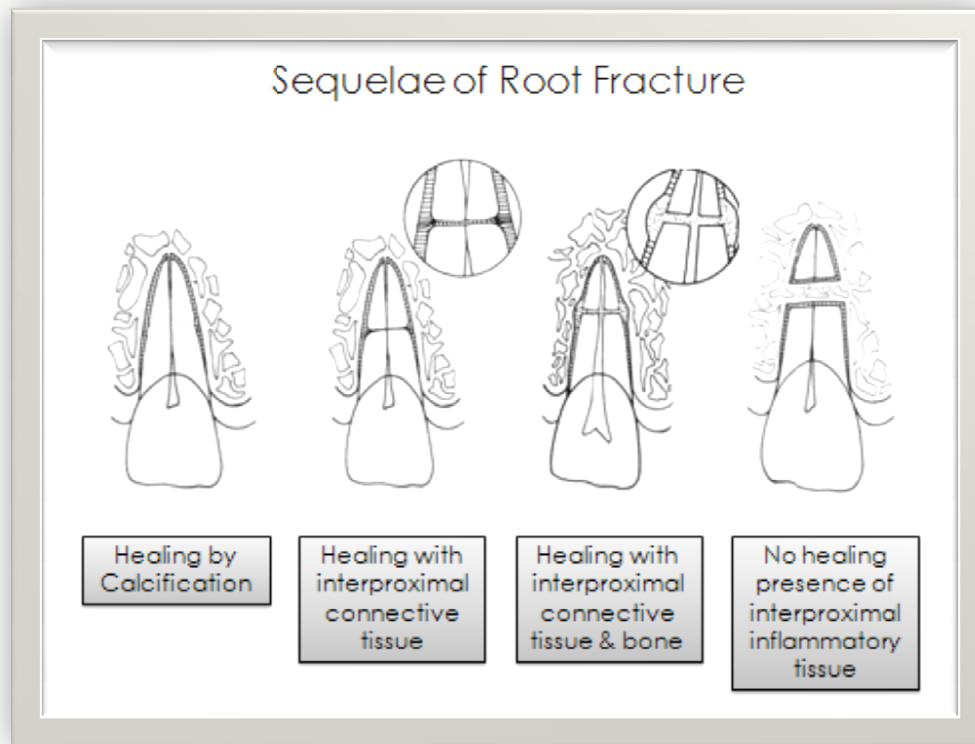


Figure 4 The sequelae of root fracture

Treatment: If the root segments heal and the tooth maintains its vitality there is no need for anymore intervention. In the case that the tooth becomes necrotic there are seven different treatment options.

1. Root canal treatment for both segments
2. Root canal treatment for the coronal segment
3. Surgical removal of the apical segment and root canal treatment of the coronal segment
4. **The Recommended Method:** Hard tissue induction at the fracture site and root canal treatment
5. Intraradicular splint: Using a post to stabilize both segments
6. Endodontic implant: A special implant is through the segment all the way into the periapical bone to stabilize the two fractured segments
7. Removal of the coronal segment followed by root canal treatment and orthodontic extrusion of the root portion.

Primary Teeth: Fortunately it is not common. In case it is not mobile and there are no symptoms therefore no treatment is necessary. If it is mobile just remove the coronal portion and leave the apical portion do not try to remove because there maybe damage done to the successor.

6. Luxation Injuries

These types of injuries usually involve a sudden impact and results in damage to the supporting structures and the neurovascular supply.

The severity of the injury is proportional to the degree of displacement

Types of Luxation injuries

- a. Concussion
- b. Subluxation
- c. *Extrusive Luxation*
- d. *Lateral Luxation*
- e. *Intrusive Luxation*

Description of the different luxation injuries: This is a table showing the different injuries and the specific descriptions for each one.

Description of the Different Luxation Injuries

Clinical Findings	Concussion	Subluxation	Extrusive Luxation	Intrusive Luxation	Lateral Luxation
Abnormal Mobility	-	+	+	- (+)	- (+)
Tenderness to Percussion	+	+ (-)	±	- (+)	- (+)
Percussion Sound	Normal	Dull	Dull	Metallic	Metallic
Response to pulp testing	±	±	- (+)	- (+)	- (+)
Clinical Dislocation	-	-	+	+	+
Radiographic Dislocation	-	-	+	+	+

- Subluxation injuries may exhibit bleeding
- Intrusive injuries may result in complete burial
- Lateral luxation may also be accompanied with alveolar fracture

Examination and Diagnosis:

Concussion: The pulp is most likely to recover

Subluxation: The pulp is also likely to recover but it is less predictable than concussion injuries

Extrusive, Intrusive & Lateral Luxation: These injuries are more aggressive; the pulp responds less and usually doesn't recover. In general, concerning luxation injuries, immature teeth have a better chance of recovery than mature teeth.

In case of luxation injuries, pulp status monitoring is required for weeks, months or years using the following methods:

- Pulp testing
- Radiographic evaluation
- Color changes

Pulp testing: Pulp testing is done using carbon ice or an electric pulp tester. An initial lack of response is not uncommon. Testing should be done in 4 to 6 weeks and again in 3 to 4 months. There are 3 possibilities to testing:

1st possibility: Immediate response, response after 4 to 6 weeks and response after 3 to 4 months. Good prognosis.

2nd possibility: No immediate response, response after 4 to 6 weeks and response after 3 to 4 months. Good prognosis.

3rd possibility: No immediate response, No response after 4 to 6 weeks and no response after 3 to 4 months. Bad prognosis.

Radiographic Evaluation: This is done at the same time as pulp testing; you should look for periapical lesions, internal or external resorption and calcific metamorphosis. Calcific metamorphosis doesn't require any intervention.

Crown color changes: During the visits the color of the affected teeth should be noted.

- Initial pink discoloration may occur due to hemorrhage in the pulp chamber if it persists it may denote internal resorption
- Grey discoloration and loss of translucency may denote necrosis
- Yellow or brown discoloration may denote calcific metamorphosis

Rarely there maybe a reversal of discoloration

Treatment:

Concussion: No immediate action is necessary 'rest' the tooth and follow up on the pulp status.

Subluxation: The treatment is the same as concussion in case of mobility splinting is required.

Extrusive & Lateral Luxation: These injuries require repositioning & splinting for 3 weeks on average and for 8 weeks if it is compounded with a bony fracture. If the tooth becomes necrotic, then it will require root canal treatment.

Intrusive Luxation:

Immature teeth: The tooth should be left alone and monitored, immature teeth still have eruptive power so the open apex may result in a re-eruption.

Mature teeth:

- Active orthodontic extrusion or surgical extrusion
- Root canal treatment

Primary Teeth:

Concussion & Subluxation: It requires no treatment if the tooth is necrotic root canal treatment or extraction is indicated.

Lateral & Extrusive Luxation: The treatment here depends on the severity and location; it is either left alone or extracted.

Intrusive Injury: If it the deciduous tooth is impinging on the successor then extraction is indicated if not then leave it alone. Radiographs should be taken to evaluate the position of the deciduous tooth in relation to the successor and to evaluate the shape and degree of impingement on the successor if any.

7. Avulsion Injuries:

Description: When a tooth has been totally displaced out of the socket. When this occurs the main concern for the endodontist is to preserve the periodontal ligaments, this is done by keeping the tooth moist, minimizing the time of the tooth is out of the socket and to minimize handling.

Treatment:

Three situations can occur:

Situation 1: The tooth has been immediately avulsed

Situation 2: The tooth has been out of the socket for less than an hour
(kept in storage media)

Situation 3: The tooth has been out of the socket for more than an hour
(not kept in storage media)

1. Immediate Replantation: As mentioned previously the aim of treating an avulsed tooth is to maintain the vitality of the periodontal ligaments. Usually the dentist will get a phone call with a patient saying that his tooth has been avulsed. In this case the dentist should give him the steps for first aid of that avulsed tooth as follows:
 - Rinse tooth with cold running tap water (10 sec)
 - Do not scrub tooth
 - Replace tooth in socket using gentle finger pressure
 - Hold tooth in place
 - Seek dental care immediately

When the patient presents to the dental office the dentist should do a complete clinical & radiographic examination keeping in mind the presence of other injuries. Then check the position and stability of the replanted tooth if everything is as should be then check the position & stability of the tooth and follow the steps that will be mentioned, after step 8, with teeth that are replanted within one hour.

2. Replantation within 1 hour: If the patient is unable to replant the tooth immediately then the tooth should be placed in transport media till the patient comes into the dental office. There are many transport media used but the most common and most readily available are saline, milk and saliva. The best transport media is milk. Some clinicians suggest the placement of the tooth in the patient's mouth until he makes it to the dental office. Although, it maybe difficult for a child to keep it in his mouth depending on his/her age. **Water** is not an acceptable transport media because it doesn't have a neutral ph.

Steps when the patient comes to the dental office:

1. Place tooth in a cup of saline
2. Check for alveolar fracture
3. Remove loose fragments and open the collapsed socket
4. Irrigate the socket with saline
5. Hold tooth from crown with forceps
6. Remove debris with a moist gauze
7. Replace the tooth in the socket with mild finger pressure
8. Adjust alignment

AT THIS POINT IMMEDIATE REPLANTATION CASES SHOULD BE TREATED
THE SAME AS CASES THAT COME IN WITHIN 1 HOUR

9. Suture soft tissue lacerations around the tooth
10. Stabilization with composite splint for 1 to 2 weeks
11. Tetanus shot & prophylactic antibiotics
12. Supportive care (Diet & Analgesic)

13. *Mature teeth:* After one week these teeth have to undergo root canal treatment because the neurovascular bundle will have been damaged.

Immature teeth: Due to the open apex and vitality of immature teeth these teeth do not undergo immediate root canal treatment because there is a possibility that the tooth may recover so it is evaluated at 2,6 and 12 months. If root completion occurs then the tooth has retained its vitality if not then root canal treatment or apexification is indicated.

3. Replantation after 1 hour: Patients that come into the office after 1 hour and have not placed the tooth in a transport media will be treated differently. With these cases the periodontal fibers will not survive this will result in replacement resorption. The treatment procedure involves root surface treatment to slow the resorptive process.
1. Similar steps as previously mentioned
 2. The root surface is cleaned
 3. The tooth is soaked in 2.4% NaF (Acidulated to pH 5.5) for 5 to 20 minutes
 4. Root canal treatment is performed *outside* the patients mouth while holding the tooth in a gauze soaked with NaF
 5. Remove the blood clot from the socket & irrigate with saline
 6. Gently replace tooth and adjust position & alignment
 7. Splint the tooth for 3 to 6 weeks

Sequelae to Replantation: It is common that after replantation resorption may occur. Three types of resorption occur:

1. Surface resorption: This is mild; it appears as lacunae of resorption on the cementum surface which become healed by deposition of cementum.
2. Inflammatory resorption: Occurs with infected necrotic pulp and injury to periodontal ligaments. It is characterized by loss of tooth structure & adjacent alveolar bone. This type of resorption subsides after root canal treatment.
3. Replacement resorption: This is the most aggressive type of resorption and is characterized by tooth structure being resorbed and replaced by bone, Ankylosis usually occurs. Clinically these teeth lack mobility, don't continue eruption and elicit a metallic sound when percussed.

Primary Teeth: If a primary tooth is avulsed *don't* replace it for fear of damaging the successor, replantation is not necessary.

Case Presentation: Avulsion



Case Presentation: Avulsion

