

DENTAL TRAUMA LATEST GUIDELINES 2017

Examination of a patient with a dental trauma injury

A rational examination procedure is essential in order to establish a complete and correct diagnosis of all soft and hard tissue injuries (Andreasen and Andreasen 1985, Bakland and Andreasen 1996, Andreasen et al. 2007).

Clean the face and the oral cavity with water or saline. If there are soft tissue wounds, a mild detergent should be used. This cleaning will make the patient feel more comfortable and facilitate extraoral and oral examination.

Make a short medical and dental history. The medical history should reveal possible allergies, blood disorders and other information that may influence treatment. The dental history should indicate previous dental traumas, information which may explain radiographic findings such as pulp canal obliteration or apical pathology.

Questions relating to the injury

Where did the injury occur? This information may have legal implication for the patient and may on occasion indicate the possibility of contamination.

How did the injury occur? This may lead to identification of the impact zones, i.e. a chin injury is often combined with crown or crown-root fractures in premolar and molar regions.

When did the injury occur? This information may be essential in relation to many injury types. In relation to a tooth avulsion the extent of time and the extraoral storage condition becomes very decisive for later treatment.

Was there a period of unconsciousness? If so, for how long? Amnesia, nausea and vomiting are all signs of brain damage and require medical attention.

Is there any disturbance in the bite? An affirmative answer may indicate a luxation injury with displacement, an alveolar or jaw fracture or a fracture of the condylar region.

Is there any reaction in the teeth to cold and/or heat exposure? A positive finding indicates exposed dentin and/or pulp.

Clinical examination

Examine the face, lips and oral muscles for soft tissue lesions.

Palpate the facial skeleton for signs of fractures.

Inspect the dental trauma region for fractures, abnormal tooth position, tooth mobility and abnormal response to percussion. Furthermore, registration of direction of displacement in case of luxation injuries. In case of fractures their relation to the gingival sulcus area is noted as well as possible pulp involvement.

Pulp testing (usually electrometric) completes the clinical examination.

Radiographic examination

The completed clinical examination has now identified the trauma region and this site should now be examined with relevant radiographic techniques. Several clinical studies have shown that multiple radiographic procedures are needed to detect displacement of the tooth in its socket as well as presence of root fractures (Andreasen and Andreasen 1985, Andreasen and Andreasen 1988).

It is essential to consider the radiographic film format used in order to achieve a high quality image of the traumatized tooth. A steep occlusal exposure (using a size 2 film (DF 58, EP 21)) of the traumatized anterior region gives an excellent view of most lateral luxations, apical and mid-root fractures and alveolar fractures. The standard periapical bisecting angle exposure of each traumatized tooth (using a size 1 film (DF 56, EP 11)) provides information about cervical root fractures as well as other tooth displacements. Thus, a radiographic examination comprising one steep occlusal exposure and three periapical bisecting angle exposures of the traumatized region will provide sufficient information in determining the extent of trauma to an incisor region.

Radiographic examination of soft tissue lesions

In the presence of a penetrating lip lesion, a soft tissue radiograph is indicated in order to locate any foreign bodies. It should be noted that the orbicularis oris muscles close tightly around foreign bodies in the lip, making them impossible to palpate; they can only be identified radiographically. This is accomplished by placing a dental film between the lips and the dental arch and using 25% of the normal exposure time. If this exposure reveals foreign bodies (a radiographic examination will normally demonstrate foreign bodies such as tooth fragments, composite filling material, metal, gravel, whereas organic materials such as cloth and wood cannot be seen), a lateral radiograph can be added (at 50% normal exposure time) to visualize the foreign bodies in relation to the cutaneous and mucosal surfaces of the lips. With the combined information from the clinical and radiographic examinations, diagnosis, prognosis and treatment planning can be accomplished.

Photographic registration

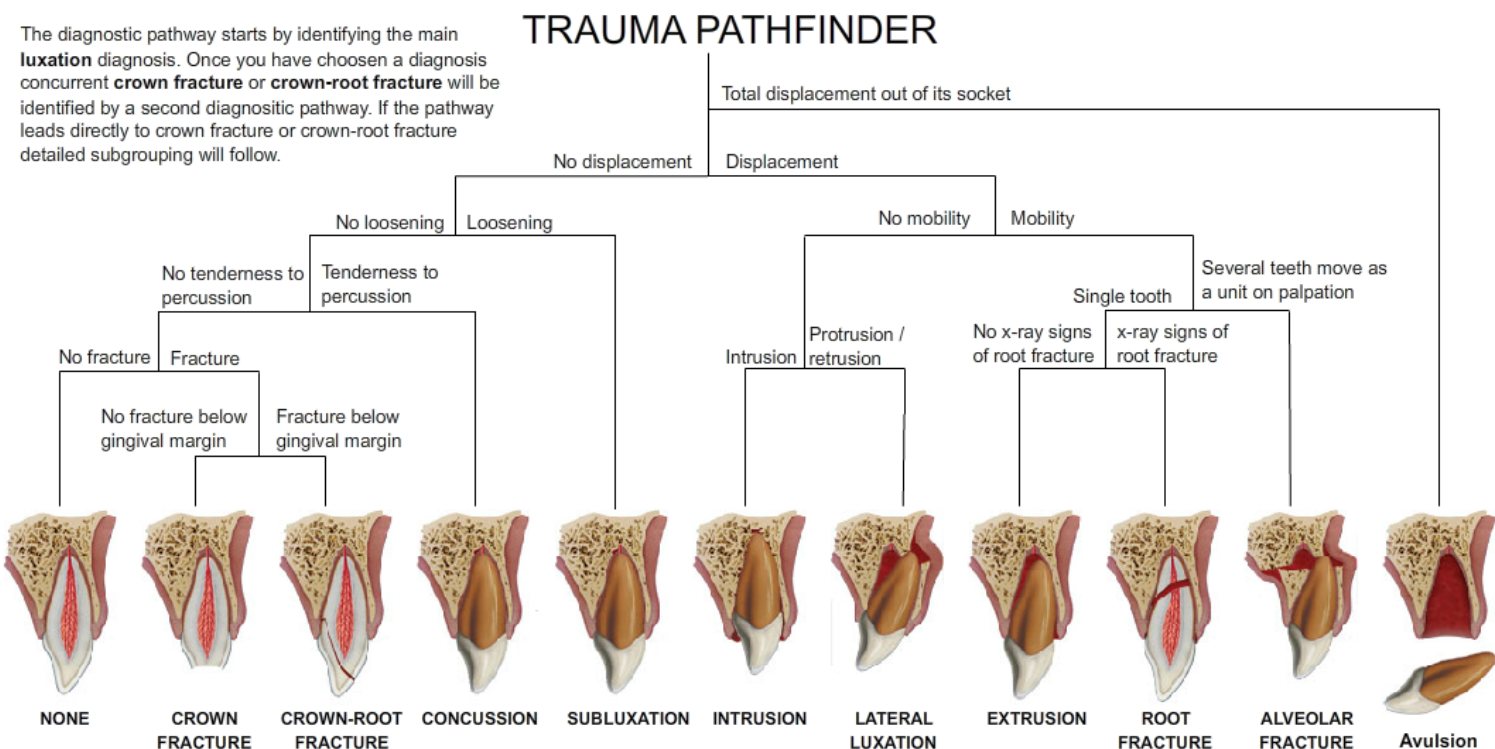
Finally, photographic registration of the trauma is recommended as it offers an exact documentation of the extent of injury and can be used later in treatment planning, legal claims or clinical research. Note that a patient consent is required.

Using the Dental Trauma Guide for treatment advice and prognosis estimation

The combined clinical and radiographic examination has now classified the injured tooth into the proper category (fractures or luxation). In case of a combined fracture-luxation injury, primarily enter the actual luxation injury where an alternative “route” will indicate the relevant luxation-fracture combination and its treatment and prognosis.

References

ANDREASEN FM, ANDREASEN JO. Diagnosis of luxation injuries: the importance of standardized clinical, radiographic and photographic techniques in clinical investigations. Endod Dent Traumatol 1985;5:160-169.
 BAKLAND LK, ANDREASEN JO. Examination of the dentally traumatized patient. Calif Dent Ass J 1996;24:35-44.
 ANDREASEN FM, ANDREASEN JO, TSUKIBOSHI M. Examination and Diagnosis of Dental Injuries. In: Andreasen JO, Andreasen FM, Andersson L, (eds.). Textbook and Color Atlas of Traumatic Injuries to the Teeth (4th ed.). Oxford, Blackwell 2007, pp. 255-279.



The diagnostic pathway starts by identifying the main luxation diagnosis. Once you have chosen a diagnosis concurrent crown-fracture or crown-root fracture will be identified by a second diagnositic pathway. If the pathway leads directly to crown fracture or crown-root fracture detailed subgrouping will follow.

PRIMARY TEETH

Concussion



Clinical findings

- The tooth is tender to touch. It has normal mobility and no sulcular bleeding.

Radiographic findings

- No radiographic abnormalities. Normal periodontal space.

Treatment

- No treatment is needed. Observation.

Follow-up

- 1 week – Clinical examination.
- 6-8 weeks – Clinical examination.

Subluxation



Clinical findings

- The tooth has increased mobility, but it has not been displaced.
- Bleeding from gingival crevice may be noted.

Radiographic findings

- Radiographic abnormalities are usually not found. Normal periodontal space. An occlusal exposure is recommended in order to screen for possible signs of displacement or the presence of a root fracture. Furthermore, the radiograph can be used as a reference point in case of future complications.

Treatment

- No treatment is needed. Observation. Brushing with a soft brush and use of chlorhexidine 0.12% alcohol-free topically to the affected area with cotton swabs twice a day for one week.

Follow-up

- 1 week – Clinical examination.
- 6-8 weeks -Clinical examination.

Crown discoloration might occur. No treatment is needed unless a fistula develops. Dark discolored teeth should be followed carefully to detect signs of infection as soon as possible.

Extrusion



Clinical findings

- Partial displacement of the tooth out of its socket.
- The tooth appears elongated and can be excessively mobile.

Radiographic findings

- Increased periodontal ligament space apically.

Treatment

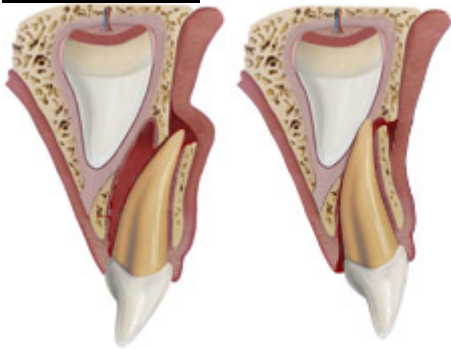
- Treatment decisions are based on the degree of displacement, mobility, root formation and the ability of the child to cope with the emergency situation.
- For minor extrusion (< 3mm) in an immature developing tooth, careful repositioning or leaving the tooth for spontaneous alignment can be treatment options.
- Extraction is the treatment of choice for severe extrusion in a fully formed primary tooth.

Follow-up

- 1 week – Clinical examination.
- 6-8 weeks – Clinical and radiographic examination.
- 6 months – Clinical and radiographic examination.
- 1 year – Clinical and radiographic examination.

Discoloration might occur. Dark discolored teeth should be followed carefully to detect signs of infection as soon as possible.

Lateral luxation



Clinical findings

- The tooth is displaced, usually in a palatal/lingual or labial direction.
- It will be immobile.

Radiographic findings

- Increased periodontal ligament space apically is best seen on the occlusal exposure. Sometimes an occlusal exposure can also show the position of the displaced tooth and its relation to the permanent successor.

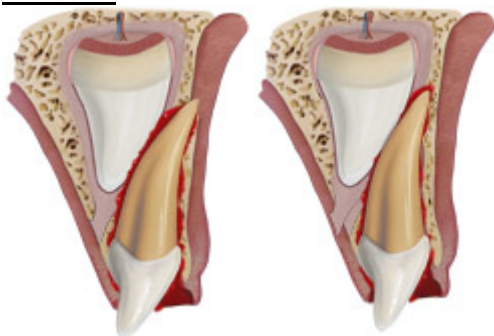
Treatment

- If there is no occlusal interference, as is often the case in anterior open bite, the tooth is allowed to reposition spontaneously.
- If minor occlusal interference, slight grinding is indicated.
- When there is more severe occlusal interference, the tooth can be gently repositioned by combined labial and palatal pressure after the use of local anesthesia.
- In severe displacement, when the crown is dislocated in a labial direction, extraction is the treatment of choice.

Follow-up

- 1 week – Clinical examination.
- 2-3 weeks – Clinical examination.
- 6-8 weeks – Clinical and radiographic examination.
- 1 year – Clinical and radiographic examination.

Intrusion



Clinical findings

- The tooth is usually displaced through the labial bone plate or can be impinging upon the succedaneous tooth bud.

Radiographic findings

- When the apex is displaced toward or through the labial bone plate, the apical tip can be visualized and appears shorter than its contra lateral. When the apex is displaced towards the permanent tooth germ, the apical tip cannot be visualized and the tooth appears elongated.

Treatment

- If the apex is displaced toward or through the labial bone plate, the tooth is left for spontaneous repositioning.
- If the apex is displaced into the developing tooth germ, extract.

Follow-up

- 1 week – Clinical examination.
- 3-4 weeks – Clinical and radiographic examination.
- 6-8 weeks – Clinical examination.
- 6 months – Clinical and radiographic examination.
- 1 year – Clinical and radiographic examination, clinical and radiographic monitoring until eruption of the permanent successor.

Avulsion



Clinical findings

- The tooth is completely out of the socket.

Radiographic findings

- A radiographic examination is essential to ensure that the missing tooth is not intruded.

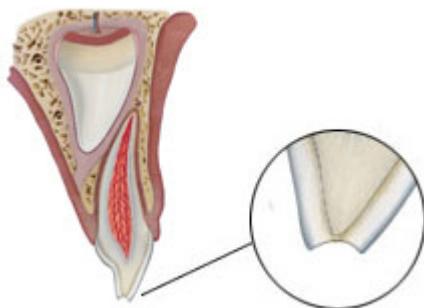
Treatment

- It is not recommended to replant avulsed primary teeth.

Follow-up

- 1 week – Clinical examination.
- 6 months – Clinical and radiographic examination.
- 1 year – Clinical and radiographic examination, clinical and radiographic monitoring until eruption of the permanent successor.

Enamel fracture



Clinical findings

- Fracture involves enamel.

Radiographic findings

- No radiographic abnormalities.

Treatment

- Smooth sharp edges.

Follow-up

- No follow-up procedures needed.

Enamel-dentin fracture



Clinical findings

- Fracture involves enamel and dentin; the pulp is not exposed.

Radiographic findings

- No radiographic abnormalities. The relation between the fracture and the pulp chamber will be disclosed.

Treatment

- If possible, seal the involved dentin completely with glass ionomer to prevent microleakage. In case of large lost tooth structure, the tooth can be restored with composite.

Follow-up

- 3-4 weeks – Clinical examination.

Enamel-dentin-pulp fracture



Clinical findings

- Fracture involves enamel and dentin and the pulp is exposed.

Radiographic findings

- The stage of root development can be determined from one exposure.

Treatment

- If possible, preserve pulp vitality by partial pulpotomy. Calcium hydroxide is a suitable material for such procedures. A well condensed layer of pure calcium hydroxide paste can be applied over the pulp, covered with a lining such as reinforced glass ionomer. Restore the tooth with composite.
- The treatment is depending on the child's maturity and ability to cope. Extraction is usually the alternative option.

Follow-up

- 1 week – Clinical examination.
- 6-8 weeks – Clinical and radiographic examination.
- 1 year – Clinical and radiographic examination.

Crown-root fracture without pulp involvement



Clinical findings

- Fracture involves enamel, dentin and root structure; the pulp may or may not be exposed.
- Additional findings may include loose, but still attached, fragments of the tooth.
- There is minimal to moderate tooth displacement.

Radiographic findings

- In laterally positioned fractures, the extent in relation to the gingival margin can be seen. One exposure is necessary to disclose multiple fragments.

Treatment

Depending on the clinical findings, two treatment scenarios may be considered:

- Fragment removal only. If the fracture involves only a small part of the root and the stable fragment is large enough to allow coronal restoration.
- Extraction in all other instances.

Follow-up

In cases of fragment removal only:

- 1 week – Clinical examination.
- 6-8 weeks – Clinical and radiographic examination.
- 1 year – Clinical and radiographic monitoring until eruption of the permanent successor.

Crown-root fracture with pulp involvement



Clinical findings

- Fracture involves enamel and dentin and the pulp is exposed.

Radiographic findings

- The stage of root development can be determined from one exposure.

Treatment

- If possible preserve pulp vitality by partial pulpotomy. Calcium hydroxide is a suitable material for such procedures. A well condensed layer of pure calcium hydroxide paste can be applied over the pulp, covered with a lining such as reinforced glass ionomer. Restore the tooth with composite.
- The treatment is depending on the child's maturity and ability to cope. Extraction is usually the alternative option.

Follow-up

- 1 week – Clinical examination.
- 6-8 weeks – Clinical and radiographic examination.
- 1 year – Clinical and radiographic examination.

Root fracture



Clinical findings

- The fracture involves the alveolar bone and may extend to adjacent bone.
- Segment mobility and dislocation are common findings.
- Occlusal interference is often noted.

Radiographic findings

- The horizontal fracture line to the apices of the primary teeth and their permanent successors will be disclosed.
- A lateral radiograph may also give information about the relation between the two dentitions and if the segment is displaced in labial direction

Treatment

- Reposition any displaced segment and then splint.
- General anesthesia is often indicated.
- Stabilize the segment for 4 weeks.
- Monitor teeth in fracture line

Follow-up

No displacement:

- 1 week – Clinical examination.
- 6-8 weeks – Clinical examination.
- 1 year – Clinical and radiographic examination, clinical and radiographic monitoring until eruption of the permanent successor each subsequent year until exfoliation.

Extraction:

- 1 year – Clinical and radiographic examination, clinical and radiographic monitoring until eruption of the permanent successor each subsequent year until exfoliation.

Alveolar fracture



Clinical findings

- The fracture involves the alveolar bone and may extend to the adjacent bone.
- Segment mobility and dislocation are common findings.
- Occlusal interference is often noted.

Radiographic findings

- The horizontal fracture line to the apices of the primary teeth and their permanent successors will be disclosed.
- A lateral radiograph may also give information about the relation between the two dentitions and if the segment is displaced in labial direction

Treatment

- Reposition any displaced segment and then splint.
- General anesthesia is often indicated.
- Stabilize the segment for 4 weeks.
- Monitor teeth in fracture line

Follow-up

- 1 week – Clinical examination.
- 3-4 weeks – Splint removal, clinical and radiographic examination.
- 6-8 weeks – Clinical and radiographic examination.

- 1 year – Clinical and radiographic examination, clinical and radiographic monitoring until eruption of the permanent successor each subsequent year until exfoliation.

PERMANENT TEETH

Concussion



Clinical findings

- The tooth is tender to touch or tapping; it has not been displaced and does not have increased mobility.

Radiographic findings

- No radiographic abnormalities.

Treatment

- No treatment is needed.
- Monitor pulpal condition for at least one year.

Follow-up

- 4 weeks – Clinical and radiographic examination.
- 6-8 weeks – Clinical and radiographic examination.
- 1 year – Clinical and radiographic examination.

Subluxation



Clinical findings

- The tooth is tender to touch or tapping and has increased mobility; it has not been displaced.
- Bleeding from gingival crevice may be noted.
- Sensibility testing may be negative initially indicating transient pulpal damage.
- Monitor pulpal response until a definitive pulpal diagnosis can be made.

Radiographic findings

- Radiographic abnormalities are usually not found.

Treatment

- Normally no treatment is needed, however, a flexible splint to stabilize the tooth for patient comfort can be used for up to 2 weeks.

Follow-up

- 2 weeks – Splint removal, clinical and radiographic examination.
- 4 weeks – Clinical and radiographic examination.
- 6-8 weeks – Clinical and radiographic examination.
- 6 months – Clinical and radiographic examination.
- 1 year – Clinical and radiographic examination.

Extrusion



Clinical findings

- The tooth appears elongated and is excessively mobile.
- Sensibility tests will likely give negative results.

Radiographic findings

- Increased periodontal ligament space apically.

Treatment

- Reposition the tooth by gently reinserting it into the tooth socket.
- Stabilize the tooth for 2 weeks using a flexible splint.
- In mature teeth where pulp necrosis is anticipated, or if several signs and symptoms indicate that the pulp of mature or immature teeth is becoming necrotic, root canal treatment is indicated.

Follow-up

- 2 weeks – Splint removal, clinical and radiographic examination.
- 4 weeks – Clinical and radiographic examination.
- 6-8 weeks – Clinical and radiographic examination.
- 6 months – Clinical and radiographic examination.
- 1 year – Clinical and radiographic examination yearly.
- 5 years – Clinical and radiographic examination.

Lateral luxation



Clinical findings

- The tooth is displaced, usually in a palatal/lingual or labial direction.
- It will be immobile and percussion usually gives a high, metallic (ankylosed) sound.
- Fracture of the alveolar process present.
- Sensibility tests will likely give negative results.

Radiographic findings

- The widened periodontal ligament space is best seen on eccentric or occlusal exposures.

Treatment

- Reposition the tooth digitally or with forceps to disengage it from its bony lock and gently reposition it into its original location.
- Stabilize the tooth for 4 weeks using a flexible splint.
- Monitor the pulpal condition.
- If the pulp becomes necrotic, root canal treatment is indicated to prevent root resorption.

Follow-up

- 2 weeks – Clinical and radiographic examination.

- 4 weeks – Splint removal, clinical and radiographic examination.
- 6-8 weeks – Clinical and radiographic examination.
- 6 months – Clinical and radiographic examination.
- 1 year – Clinical and radiographic examination.
- Yearly for 5 years – Clinical and radiographic examination.

Intrusion



Clinical findings

- The tooth is displaced axially into the alveolar bone.
- It is immobile and percussion may give a high, metallic (ankylosed) sound.
- Sensibility tests will likely give negative results.

Radiographic findings

- The periodontal ligament space may be absent from all or part of the root.
- The cemento-enamel junction is located more apically in the intruded tooth than in adjacent non-injured teeth, at times even apical to the marginal bone level.

Treatment

Teeth with incomplete root formation:

- Allow eruption without intervention.
- If no movement within few weeks, initiate orthodontic repositioning.
- If the tooth is intruded more than 7 mm, reposition surgically or orthodontically.

Teeth with complete root formation:

- Allow eruption without intervention if the tooth is intruded less than 3 mm. If no movement after 2-4 weeks, reposition surgically or orthodontically before ankylosis can develop.
- If the tooth is intruded 3-7 mm, reposition surgically or orthodontically.
- If the tooth is intruded beyond 7 mm, reposition surgically.
- The pulp will likely become necrotic in teeth with complete root formation. Root canal therapy using a temporary filling with calcium hydroxide is recommended and treatment should begin 2-3 weeks after repositioning.
- Once an intruded tooth has been repositioned surgically or orthodontically, stabilize with a flexible splint for 4 weeks.

Follow-up

- 2 weeks – Clinical and radiographic examination.
- 4 weeks – Splint removal, clinical and radiographic examination.
- 6-8 weeks – Clinical and radiographic examination.
- 6 months – Clinical and radiographic examination.
- 1 year – Clinical and radiographic examination.
- Yearly for 5 years – Clinical and radiographic examination.

Avulsion



Avulsion – First aid for avulsed teeth

Dentists should always be prepared to give appropriate advice to the public about first aid for avulsed teeth. An avulsed permanent tooth is one of the few real emergency situations in dentistry. In addition to increasing the public awareness by mass media campaigns, healthcare professional, parents and teachers should receive information on

how to proceed following these severe unexpected injuries. Also, instructions may be given by telephone to parents at the emergency site.

If a tooth is avulsed, make sure it is a permanent tooth (primary teeth should not be replanted).

- Keep the patient calm.
- Find the tooth and pick it up by the crown (the white part). Avoid touching the root.
- If the tooth is dirty, wash it briefly (10 seconds) under cold running water and reposition it. Try to encourage the patient / parent to replant the tooth. Bite on a handkerchief to hold it in position.
- If this is not possible, place the tooth in a suitable storage medium, e.g. a glass of milk or a special storage media for avulsed teeth if available (e.g. Hanks balanced storage medium or saline). The tooth can also be transported in the mouth, keeping it between the molars and the inside of the cheek. If the patient is very young, he/she could swallow the tooth- therefore it is advisable to get the patient to spit in a container and place the tooth in it. Avoid storage in water!
- Seek emergency dental treatment immediately.

The poster "Save a Tooth" is written for the public and is available in several languages: Spanish, English, Portuguese, French, Icelandic, Italian, and can be obtained at the IADT website: <https://www.iadt-dentaltrauma.org>.

Closed Apex:

Tooth replanted prior to the patient's arrival at the dental office or clinic

Treatment

- Leave the tooth in place.
- Clean the area with water spray, saline, or chlorhexidine.
- Suture gingival lacerations if present.
- Verify normal position of the replanted tooth both clinically and radiographically.
- Apply a flexible splint for up to 2 weeks.
- Administer systemic antibiotics. Tetracycline is the first choice (Doxycycline 2x per day for 7 days at appropriate dose for patient age and weight). The risk of discoloration of permanent teeth must be considered before systemic administration of tetracycline in young patients (In many countries tetracycline is not recommended for patients under 12 years of age). In young patients Phenoxymethyl Penicillin (Pen V) or amoxycillin, at an appropriate dose for age and weight, is an alternative to tetracycline.
- If the avulsed tooth has been in contact with soil, and if tetanus coverage is uncertain, refer to physician for a tetanus booster.
- Initiate root canal treatment 7-10 days after replantation and before splint removal.

Patient instructions

- Avoid participation in contact sports.
- Soft food for up to 2 weeks.
- Brush teeth with a soft toothbrush after each meal.
- Use a chlorhexidine (0.1 %) mouth rinse twice a day for 1 week.

Follow-up

- Root canal treatment 7-10 days after replantation. Place calcium hydroxide as an intra-canal medicament for up to 1 month followed by root canal filling with an acceptable material. Alternatively an antibiotic-corticosteroid paste may be placed immediately or shortly following replantation and left for at least 2 weeks.
 - Splint removal and clinical and radiographic control after 2 weeks.
 - Clinical and radiographic control after 4 weeks, 3 months, 6 months, 1 year and then yearly thereafter.
-

Closed apex:

Extraoral dry time less than 60 min. The tooth has been kept in physiologic storage media or osmolality balanced media (Milk, saline, saliva or Hank's Balanced Salt Solution) and/or stored dry less than 60 minutes

Treatment

- Clean the root surface and apical foramen with a stream of saline and soak the tooth in saline thereby removing contamination and dead cells from the root surface.
- Administer local anesthesia
- Irrigate the socket with saline.
- Examine the alveolar socket. If there is a fracture of the socket wall, reposition it with a suitable instrument.
- Replant the tooth slowly with slight digital pressure. Do not use force.
- Suture gingival lacerations if present.
- Verify normal position of the replanted tooth both, clinically and radiographically.
- Apply a flexible splint for up to 2 weeks, keep away from the gingiva.
- Administer systemic antibiotics. Tetracycline is the first choice (Doxycycline 2x per day for 7 days at appropriate dose for patient age and weight). The risk of discoloration of permanent teeth must be considered before systemic administration of tetracycline in young patients (In many countries tetracycline is not recommended for patients under 12 years of age). In young patients Phenoxymethyl Penicillin (Pen V) or amoxycillin, at appropriate dose for age and weight, is an alternative to tetracycline.
- If the avulsed tooth has been in contact with soil, and if tetanus coverage is uncertain, refer to physician for a tetanus booster.

- Initiate root canal treatment 7-10 days after replantation and before splint removal.

Patient instructions

- Soft food for up to 2 weeks.
- Brush teeth with a soft toothbrush after each meal.
- Use a chlorhexidine (0.1 %) mouth rinse twice a day for 1 week.

Follow-up

- Root canal treatment 7-10 days after replantation. Place calcium hydroxide as an intra-canal medicament for up to 1 month followed by root canal filling with an acceptable material. Alternatively an antibiotic-corticosteroid paste may be placed immediately or shortly following replantation and left for at least 2 weeks.
- Splint removal and clinical and radiographic control after 2 weeks.
- Clinical and radiographic control after 4 weeks, 3 months, 6 months, 1 year and then yearly thereafter.

Closed apex:

Extraoral dry time exceeding 60 min or other reasons suggesting non-viable cells

Treatment

Delayed replantation has a poor long-term prognosis. The periodontal ligament will be necrotic and can not be expected to heal. The goal in delayed replantation is, in addition to restoring the tooth for esthetic, functional and psychological reasons, to maintain alveolar bone contour. However, the expected eventual outcome is ankylosis and resorption of the root and the tooth will be lost eventually.

- Remove attached non-viable soft tissue carefully, with gauze.
- Root canal treatment can be performed prior to replantation, or it can be done 7-10 days later.
- Administer local anesthesia
- Irrigate the socket with saline.
- Examine the alveolar socket. If there is a fracture of the socket wall, reposition it with a suitable instrument.
- Replant the tooth slowly with slight digital pressure. Do not use force.
- Suture gingival lacerations if present.
- Verify normal position of the replanted tooth clinically and radiographically.
- Stabilize the tooth for 4 weeks using a flexible splint.
- Administer systemic antibiotics. Tetracycline is the first choice (Doxycycline 2x per day for 7 days at appropriate dose for patient age and weight). The risk of discoloration of permanent teeth must be considered before systemic administration of tetracycline in young patients (In many countries tetracycline is not recommended for patients under 12 years of age). In young patients Phenoxymethyl Penicillin (Pen V) or amoxycillin, at an appropriate dose for age and weight, is an alternative to tetracycline.
- If the avulsed tooth has been in contact with soil, and if tetanus coverage is uncertain, refer to physician for a tetanus booster.

To slow down osseous replacement of the tooth, treatment of the root surface with fluoride prior to replantation has been suggested (2 % sodium fluoride solution for 20 min).

Patient instructions

- Avoid participation in contact sports.
- Soft food for up to 2 weeks.
- Brush teeth with a soft toothbrush after each meal.
- Use a chlorhexidine (0.1%) mouth rinse twice a day for 1 week.

Follow-up

- Root canal treatment 7-10 days after replantation. Place calcium hydroxide as an intra-canal medicament for up to 1 month followed by root canal filling with an acceptable material. Alternatively an antibiotic-corticosteroid paste may be placed immediately or shortly following replantation and left for at least 2 weeks.
- Splint removal and clinical and radiographic control after 4 weeks.
- Clinical and radiographic control after 4 weeks, 3 months, 6 months, 1 year and then yearly thereafter.

Ankylosis is unavoidable after delayed replantation and must be taken into consideration. In children and adolescents ankylosis is frequently associated with infraposition. Careful follow-up is required and good communication is necessary to ensure the patient and guardian of this likely outcome. Decoronation may be necessary when infraposition (> 1 mm) is seen. For more detailed information of this procedure the reader is referred to textbooks.

Open apex:

Tooth replanted prior to the patient's arrival at the dental office or clinic

Treatment

- Leave the tooth in place.
- Clean the area with water spray, saline, or chlorhexidine.
- Suture gingival laceration if present.
- Verify normal position of the replanted tooth both clinically and radiographically.
- Apply a flexible splint for up to 1-2 weeks.
- Administer systemic antibiotics. Tetracycline is the first choice (Doxycycline 2x per day for 7 days at appropriate dose for patient age and weight). The risk of discoloration of permanent teeth must be considered before systemic administration of tetracycline in young patients (In many countries tetracycline is not

recommended for patients under 12 years of age). In young patients Phenoxymethyl Penicillin (Pen V) or amoxycillin, at an appropriate dose for age and weight, is an alternative to tetracycline.

- If the avulsed tooth has been in contact with soil and if tetanus coverage is uncertain, refer to physician for a tetanus booster.
- The goal for replanting still-developing (immature) teeth in children is to allow for possible revascularization of the tooth pulp. If that does not occur, root canal treatment is recommended.

Patient instructions

- Avoid participation in contact sports.
- Soft food for up to 2 weeks.
- Brush teeth with a soft toothbrush after each meal.
- Use a chlorhexidine (0.1%) mouth rinse twice a day for 1 week.

Follow-up

- For immature teeth, root canal treatment should be avoided unless there is clinical or radiographic evidence of pulp necrosis.
- Splint removal and clinical and radiographic control after 2 weeks.
- Clinical and radiographic control after 4 weeks, 3 months, 6 months, 1 year and then yearly thereafter.

Open apex:

Extraoral dry time less than 60 min. The tooth has been kept in physiologic storage media or osmolality balanced media (Milk, saline, saliva or Hank's Balanced Salt Solution) and/or stored dry less than 60 minutes

Treatment

- Clean the root surface and apical foramen with a stream of saline.
- Topical application of antibiotics has been shown to enhance chances for revascularization of the pulp and can be considered if available (minocycline or doxycycline 1 mg per 20 ml saline for 5 minutes soak).
- Administer local anesthesia.
- Examine the alveolar socket. If there is a fracture of the socket wall, reposition it with a suitable instrument.
- Irrigate the socket with saline.
- Replant the tooth slowly with slight digital pressure.
- Suture gingival lacerations, especially in the cervical area.
- Verify normal position of the replanted tooth clinically and radiographically.
- Apply a flexible splint for up to 2 weeks.
- Administer systemic antibiotics. Tetracycline is the first choice (Doxycycline 2x per day for 7 days at appropriate dose for patient age and weight). The risk of discoloration of permanent teeth must be considered before systemic administration of tetracycline in young patients (In many countries tetracycline is not recommended for patients under 12 years of age). In young patients Phenoxymethyl Penicillin (Pen V) or amoxycillin, at an appropriate dose for age and weight, is an alternative to tetracycline.
- If the avulsed tooth has been in contact with soil and if tetanus coverage is uncertain, refer to physician for a tetanus booster.

The goal for replanting still-developing (immature) teeth in children is to allow for possible revascularization of the pulp space. The risk of infection-related root resorption should be weighed up against the chances of revascularization. Such resorption is very rapid in children. If revascularization does not occur, root canal treatment may be recommended.

Patient instructions

- Avoid participation in contact sports.
- Soft food for up to 2 weeks.
- Brush teeth with a soft toothbrush after each meal.
- Use a chlorhexidine (0.1%) mouth rinse twice a day for 1 week.

Follow-up

- For immature teeth, root canal treatment should be avoided unless there is clinical or radiographic evidence of pulp necrosis.
- Splint removal and clinical and radiographic control after 2 weeks.
- Clinical and radiographic control after 4 weeks, 3 months, 6 months, 1 year and then yearly thereafter.

Open apex:

Dry time longer than 60 min or other reasons suggesting non-viable cells

Treatment

Delayed replantation has a poor long-term prognosis. The periodontal ligament will be necrotic and not expected to heal. The goal in delayed replantation is to restore the tooth to the dentition for esthetic, functional, and psychological reasons and to maintain alveolar contour. The eventual outcome will be ankylosis and resorption of the root.

- Remove attached non-viable soft tissue with gauze.
- Root canal treatment can be carried out prior to replantation or later.
- Administer local anesthesia.
- Irrigate the socket with saline.
- Examine the alveolar socket. If there is a fracture of the socket wall, reposition it with a suitable instrument.

- Replant the tooth slowly with slight digital pressure.
- Suture gingival lacerations if present.
- Verify normal position of the replanted tooth clinically and radiographically.
- Stabilize the tooth for 4 weeks using a flexible splint.
- Administer systemic antibiotics. Tetracycline is the first choice (Doxycycline 2x per day for 7 days at appropriate dose for patient age and weight). The risk of discoloration of permanent teeth must be considered before systemic administration of tetracycline in young patients (In many countries tetracycline is not recommended for patients under 12 years of age). In young patients Phenoxymethyl Penicillin (Pen V) or amoxycillin, at an appropriate dose for age and weight, is an alternative to tetracycline.
- If the avulsed tooth has been in contact with soil or if tetanus coverage is uncertain, refer to physician for evaluation of the need for a tetanus booster.

To slow down osseous replacement of the tooth, treatment of the root surface with fluoride prior to replantation has been suggested (2 % sodium fluoride solution for 20 min).

Patient instructions

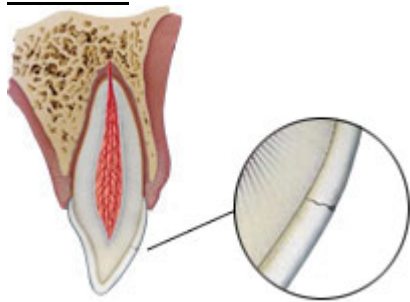
- Avoid participation in contact sports.
- Soft food for up to 2 weeks.
- Brush teeth with a soft toothbrush after each meal.
- Use a chlorhexidine (0.1%) mouth rinse twice a day for 1 week.

Follow-up

- For immature teeth, root canal treatment should be avoided unless there is clinical or radiographic evidence of pulp necrosis.
- Splint removal and clinical and radiographic control after 4 weeks.
- Clinical and radiographic control after 4 weeks, 3 months, 6 months, 1 year and then yearly thereafter.

Ankylosis is unavoidable after delayed replantation and must be taken into consideration. In children and adolescents ankylosis is frequently associated with infraposition. Careful follow-up is required and good communication is necessary to ensure the patient and guardian of this likely outcome. Decoronation may be necessary when infraposition (> 1 mm) is seen. For more detailed information of this procedure the reader is referred to textbooks.

Infracture



Clinical findings

- An incomplete fracture (crack) of the enamel without loss of tooth structure.
- Not tender. If tenderness is observed, evaluate the tooth for a possible luxation injury or a root fracture.

Radiographic findings

- No radiographic abnormalities.
- Radiographs recommended: a periapical view. Additional radiographs are indicated if other signs or symptoms are present.

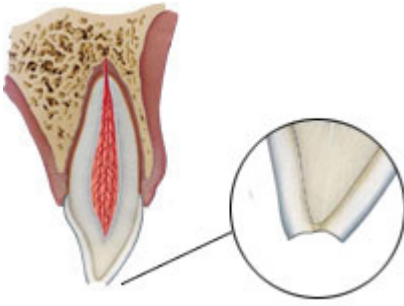
Treatment

- In case of marked infractures, etching and sealing with resin to prevent discoloration of the infracture lines. Otherwise, no treatment is necessary.

Follow-up

- No follow-up is generally needed for infracture injuries unless they are associated with a luxation injury or other types of fracture.

Enamel fracture



Clinical findings

- A complete fracture of the enamel.
- Loss of enamel. No visible sign of exposed dentin.
- Not tender. If tenderness is observed, evaluate the tooth for a possible luxation or root fracture injury.
- Normal mobility.
- Sensibility pulp test usually positive.

Radiographic findings

- Enamel loss is visible.
- Radiographs recommended: periapical, occlusal and eccentric exposures. They are recommended in order to rule out the possible presence of a root fracture or a luxation injury.
- Radiograph of lip or cheek to search for tooth fragments or foreign materials.

Treatment

- If the tooth fragment is available, it can be bonded to the tooth.
- Contouring or restoration with composite resin depending on the extent and location of the fracture.

Follow-up

- 6-8 weeks – Clinical and radiographic examination.
- 1 year – Clinical and radiographic examination.

Enamel-dentin fracture



Clinical findings

- A fracture confined to enamel and dentin with loss of tooth structure, but not exposing the pulp.
- Percussion test: not tender. If tenderness is observed, evaluate the tooth for possible luxation or root fracture injury.
- Normal mobility.
- Sensibility pulp test usually positive.

Radiographic findings

- Enamel-dentin loss is visible.
- Radiographs recommended: periapical, occlusal and eccentric exposure to rule out tooth displacement or possible presence of root fracture.
- Radiograph of lip or cheek lacerations to search for tooth fragments or foreign materials.

Treatment

- If a tooth fragment is available, it can be bonded to the tooth. Otherwise, perform a provisional treatment by covering the exposed dentin with glass ionomer or a more permanent restoration using a bonding agent and composite resin or other accepted dental restorative materials.
- If the exposed dentin is within 0.5 mm of the pulp (pink, no bleeding), place calcium hydroxide base and cover with a material such as a glass ionomer.

Follow-up

- 6-8 weeks – Clinical and radiographic examination.
- 1 year – Clinical and radiographic examination.

Enamel-dentin-pulp fracture



Clinical findings

- A fracture involving enamel and dentin with loss of tooth structure and exposure of the pulp.
- Normal mobility.
- Percussion test: not tender. If tenderness is observed, evaluate for possible luxation or root fracture injury.
- Exposed pulp sensitive to stimuli.

Radiographic findings

- Enamel-dentin loss visible.
- Radiographs recommended: periapical, occlusal and eccentric exposures, to rule out tooth displacement or possible presence of root fracture.
- Radiograph of lip or cheek lacerations to search for tooth fragments or foreign materials.

Treatment

- In young patients with immature, still developing teeth, it is advantageous to preserve pulp vitality by pulp capping or partial pulpotomy. Also, this treatment is the choice in young patients with completely formed teeth.
- Calcium hydroxide is a suitable material to be placed on the pulp wound in such procedures.
- In patients with mature apical development, root canal treatment is usually the treatment of choice, although pulp capping or partial pulpotomy also may be selected.
- If tooth fragment is available, it can be bonded to the tooth.
- Future treatment for the fractured crown may be restoration with other accepted dental restorative materials.

Follow-up

- 6-8 weeks – Clinical and radiographic examination.
- 1 year – Clinical and radiographic examination.

Crown-root fracture without pulp involvement



Clinical findings

- A fracture involving enamel, dentin and cementum with loss of tooth structure, but not exposing the pulp.
- Crown fracture extending below gingival margin.
- Percussion test: Tender.
- Coronal fragment mobile.
- Sensibility pulp test usually positive for apical fragment.

Radiographic findings

- Apical extension of fracture usually not visible.
- Radiographs recommended: periapical, occlusal and eccentric exposures. They are recommended in order to detect fracture lines in the root.

Treatment

Emergency treatment

- As an emergency treatment a temporary stabilization of the loose segment to adjacent teeth can be performed until a definitive treatment plan is made.

Non-emergency treatment alternatives

- Fragment removal only.
- Removal of the coronal crown-root fragment and subsequent restoration of the apical fragment exposed above the gingival level.

Fragment removal and gingivectomy (sometimes ostectomy)

- Removal of the coronal crown-root segment with subsequent endodontic treatment and restoration with a post-retained crown. This procedure should be preceded by a gingivectomy, and sometimes ostectomy with osteoplasty.

Orthodontic extrusion of apical fragment

- Removal of the coronal segment with subsequent endodontic treatment and orthodontic extrusion of the remaining root with sufficient length after extrusion to support a post-retained crown.

Surgical extrusion

- Removal of the mobile fractured fragment with subsequent surgical repositioning of the root in a more coronal position.

Root submergence

- Implant solution is planned.

Extraction

- Extraction with immediate or delayed implant-retained crown restoration or a conventional bridge. Extraction is inevitable in crown-root fractures with a severe apical extension, the extreme being a vertical fracture.

Follow-up

- 6-8 weeks – Clinical and radiographic examination.
- 1 year – Clinical and radiographic examination.

Crown-root fracture with pulp involvement



Clinical findings

- A fracture involving enamel, dentin and cementum and exposing the pulp.
- Percussion test: tender.
- Coronal fragment mobile.

Radiographic findings

- Apical extension of fracture usually not visible.
- Radiographs recommended: periapical and occlusal exposure.

Treatment

Emergency treatment

- As an emergency treatment a temporary stabilization of the loose segment to adjacent teeth.
- In patients with open apices, it is advantageous to preserve pulp vitality by a partial pulpotomy. This treatment is also the choice in young patients with completely formed teeth. Calcium hydroxide compounds are suitable pulp capping materials. In patients with mature apical development, root canal treatment can be the choice of treatment.

Non-emergency treatment alternatives

- Fragment removal and gingivectomy (sometimes ostectomy) Removal of the coronal fragment with subsequent endodontic treatment and restoration with a post-retained crown. This procedure should be preceded by a gingivectomy and sometimes ostectomy with osteoplasty. This treatment option is only indicated in crown-root fractures with palatal subgingival extension.

Orthodontic extrusion of apical fragment

- Removal of the coronal segment with subsequent endodontic treatment and orthodontic extrusion of the remaining root with sufficient length after extrusion to support a post-retained crown.

Surgical extrusion

- Removal of the mobile fractured fragment with subsequent surgical repositioning of the root in a more coronal position.

Root submergence

- An implant solution is planned, the root fragment may be left in situ.

Extraction

- Extraction with immediate or delayed implant-retained crown restoration or a conventional bridge. Extraction is inevitable in very deep crown-root fractures, the extreme being a vertical fracture

Follow-up

- 6-8 weeks – Clinical and radiographic examination.
- 1 year – Clinical and radiographic examination.

Root fracture



Clinical findings

- The coronal segment may be mobile and may be displaced.
- The tooth may be tender to percussion.
- Bleeding from the gingival sulcus may be noted.
- Sensibility testing may give negative results initially, indicating transient or permanent neural damage.
- Monitoring the status of the pulp is recommended.
- Transient crown discoloration (red or grey) may occur.

Radiographic findings

- The fracture involves the root of the tooth and is in a horizontal or oblique plane.
- Fractures that are in the horizontal plane can usually be detected in the regular periapical 90° angle film with the central beam through the tooth. This is usually the case with fractures in the cervical third of the root.
- If the plane of fracture is more oblique which is common with apical third fractures, an occlusal view or radiographs with varying horizontal angles are more likely to demonstrate the fracture including those located in the middle third.

Treatment

- Reposition, if displaced, the coronal segment of the tooth as soon as possible.
- Check position radiographically.
- Stabilize the tooth with a flexible splint for 4 weeks. If the root fracture is near the cervical area of the tooth, stabilization is beneficial for a longer period of time (up to 4 months).
- It is advisable to monitor healing for at least 1 year to determine pulpal status.
- If pulp necrosis develops, root canal treatment of the coronal tooth segment to the fracture line is indicated to preserve the tooth.

Follow-up

- 4 weeks – Splint removal, clinical and radiographic examination.
- 6-8 weeks – Clinical and radiographic examination.
- 4 months – Splint removal in cervical third fractures, clinical and radiographic examination.
- 6 months – Clinical and radiographic examination.
- 1 year – Clinical and radiographic examination.
- 5 years – Clinical and radiographic examination.

Alveolar fracture



Clinical findings

- The fracture involves the alveolar bone and may extend to the adjacent bone.
- Segment mobility and dislocation with several teeth moving together are common findings.
- An occlusal change due to misalignment of the fractured alveolar segment is often noted.
- Sensibility testing may or may not be positive.

Radiographic findings

- Fracture lines may be located at any level, from the marginal bone to the root apex and above the apex.
- In addition to the 3 angulations and occlusal film, additional views such as a panoramic radiograph can be helpful in determining the course and position of the fracture lines.

Treatment

- Reposition any displaced segment and then splint.
- Suture gingival laceration, if present.
- Stabilize the segment for 4 weeks.

Follow-up

- 4 weeks – Splint removal, clinical and radiographic examination.
- 6-8 weeks – Clinical and radiographic examination.
- 4 months – Clinical and radiographic examination.
- 6 months – Clinical and radiographic examination.
- 1 year – Clinical and radiographic examination.
- 5 years – Clinical and radiographic examination.