Diagnosis and Emergency Treatment of Dental Trauma

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Luxation Injuries

Emergency Treatment

Directed at Attachment Damage

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At The Site of The Accident

First aid for avulsed teeth at the place of accident:
"An avulsed permanent tooth is one of the few real emergency situations in dentistry"

"In addition to increasing the public awareness by, for example, mass media campaigns, healthcare professionals, guardians and teachers should receive information on how to proceed following these severe unexpected injuries. "

www.iadt-dentaltrauma.org

(JO Andreasen et al. 2012)

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Luxation Injuries

Emergency Treatment

"Prevention"

Minimize additional PDL damage

Limit initial inflammatory response

Stimulate cemental healing

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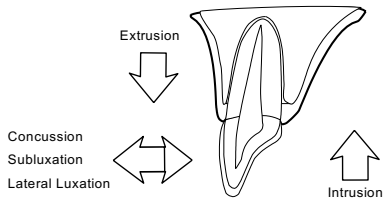
Forces on Teeth During Traumatic Injury



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Forces on Teeth During Traumatic Injury

Luxation injury

Concussion
Subluxation
Lateral Luxation
Intrusion
Extrusion

Always causes damage to the PDL. May cause a damage to the pulp.

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Luxation Injuries

Concussion

- No abnormal loosening
- Reaction to percussion

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Luxation Injuries

Subluxation

- Abnormal loosening but no displacement
- Reaction to percussion
- Often negative Sensibility

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Luxation Injuries

Concussion / Subluxation

Treatment inside the office:
- Rule out root fracture (Radiographs)

Adjust occlusion – splint only for patient comfort.
- Baseline Sensibility tests

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Luxation Injuries

Follow-up Concussion*

4 weeks
1 year

All appointments incl: Sensibility test and Radiographic evaluation

*Providing sensibility test normal

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Luxation Injuries

Follow-up Subluxation*

2 weeks
3 months
6 months
1 year

All appointments incl: Sensibility test and Radiographic evaluation
*Providing sensibility test normal

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Luxation Injuries

Lateral, Extrusive Luxation

- Displacement
- Reaction to percussion
- Negative Sensibility

? Fracture of root or alveolar process

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Luxation Injuries

Luxation

Treatment outside the office:
Reposition tooth if easy - otherwise refer to dental office ASAP

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Luxation Injuries

Luxation

Treatment inside the office :

1. Radiographs at 3 vertical angles.
2. Reposition
3. Functional splint 2 weeks

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Luxation Injuries

Lateral Luxation

Apical translocation?

Two possibilities:

- Apex in its original location
- Apex moved facially

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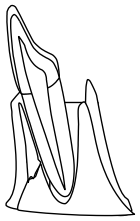

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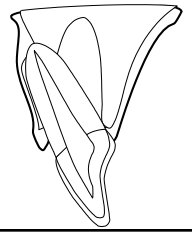
Luxation Injuries
Apical translocation:



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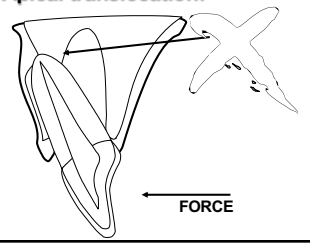
Luxation Injuries
Apical translocation:



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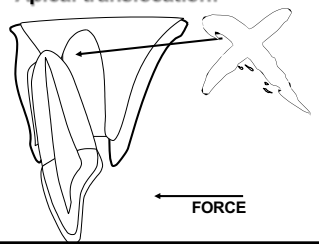
Luxation Injuries
Apical translocation:



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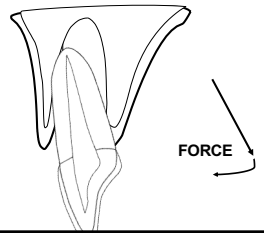
Luxation Injuries
Apical translocation:



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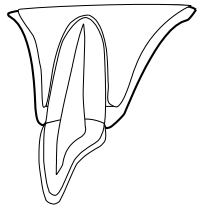
Luxation Injuries
Apical translocation:



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Second Visit

7-10 days
Treatment Objective

Prevent or treat

pulpal infection

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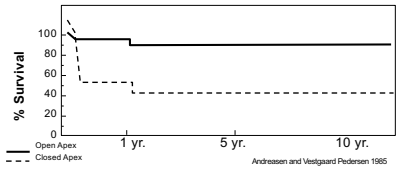
Traumatic Injuries
Extrusion Luxation
Pulpal Prognosis:



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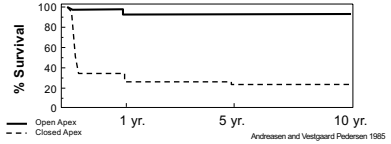
Traumatic Injuries

Lateral Luxation
Pulpal Prognosis:
Note no difference made between apical translocation or not



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Traumatic Injuries

Extrusion and Lateral Luxation

Treatment:

- Anesthesia (? Vasoconstrictor ?).
- Reposition the tooth into normal position.
- Confirm the position with radiograph.
- Splint for 2 weeks if needed.
- Follow-up 2 weeks, 4 weeks, 6-8 weeks, 3, 6 & 12 months and then yearly for at least 5 years.
- Initiate root canal therapy as soon as symptoms indicate.

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Traumatic Injuries

Luxation Injuries

Possible complications:

✓Pulpal obliteration

"Of 122 teeth showing partial or total pulpal obliteration, 16 (13%) teeth showed periapical signs of pulpal necrosis"

(Jacobsen & Kerekes 1977)

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Traumatic Injuries

✓Pulpal obliteration

82 teeth, follow up 7-22 years (mean 16y) with pulp canal obliteration:

- 51% normal electric pulp test response
- 40% no EPT response but normal PDL

Yellow discoloration frequent.

"Although the incidence of PN in teeth displaying pulp canal obliteration seems to increase over the course of time, prophylactic endodontic intervention on a routine basis does not seem justified."

(Robertson A et al. 1996)

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Luxation Injuries

Follow-up Extrusive luxation

2 weeks; splint removal
4 weeks
6-8 weeks
3 months
6 months
1 year and yearly for 5 years

All appointments incl: Sensibility test and Radiographic evaluation

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Luxation Injuries

Follow-up Lateral luxation

2 weeks
4 weeks; splint removal
6-8 weeks
3 months
6 months
1 year and yearly for 5 years

All appointments incl: Sensibility test and Radiographic evaluation

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Intrusion

Does always cause massive injury to the periodontal ligament.

Does almost always (>95%) cause pulpal necrosis in case of closed apex.

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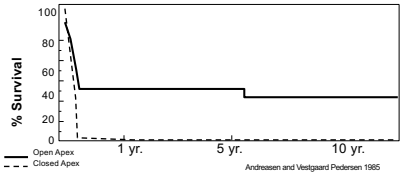
Traumatic Injuries

Intrusion

Pulpal Prognosis:



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Intrusion

Incisors intruded > 6 mm had significantly decreased survival compared with incisors intruded < 3 mm.

(Humphrey et al. 2003)

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Intrusion

Treatment options Permanent teeth:

- Spontaneous re-eruption.
- Orthodontic forced eruption.
- Surgical reposition.

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Intrusion

Treatment options Permanent teeth:

- Spontaneous re-eruption.

  Is relatively rare in permanent teeth unless the intrusion was minor and the apex was not completely formed.

(Andreasen et al 2002)

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Intrusion

Treatment options Permanent teeth:

- Spontaneous re-eruption.

  The dilemma is that if the tooth is left too long in its position (few weeks at most) ankylosis will start to develop and thereby precluding orthodontic forced eruption.

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Intrusion

Treatment options Permanent teeth:

- Orthodontic forced eruption.

  Has to be initiated with in few days to weeks.
  Not as invasive as surgical approach but much more expensive.

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Intrusion

Clinical and histological alterations in the surrounding periodontium of dog's teeth submitted for an intrusive luxation.

12 teeth, $Ca(OH)_2$ placed after 14 d. Ortho extrusion 40 d. observation:

The teeth that were moved immediately after the trauma had lesser degree of replacement resorption compared with those that were extruded 7 days after the trauma.

(Gomes JC. et al. 2008)

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Intrusion

Treatment options Permanent teeth:
- Surgical reposition.

Is quick and cost effective way.
Can cause additional damage to the tooth and alveolar bone.

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Intrusion

A dog model/histology:

A careful immediate surgical repositioning of severely intruded permanent tooth with complete root formation has many advantages with few disadvantages.

(Cunha et al. 2002)

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Intrusion

79 teeth; 58 patients (9.19 ± 2.34 y) follow-up 7 to 87 months (median 18 m):

Teeth intruded <3 mm = 57.1% complete re-eruption rate
(0.5 to 18 m, mean 5.3/median 3.5)
Teeth intruded 3–7 mm = 18.2% complete re-eruption rate

	Complete re-eruption	Partial re-eruption	No re-eruption	n
Immature	**44.8%**	**31%**	**24.1%**	**29**
Mature	**33.3%**	**38.1%**	**28.6%**	**21**

* Not clear in the paper the ratio between 3mm and 7mm intrusion

(Wang N et al 2019)

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Intrusion

Follow-up

2 weeks
4 weeks; splint removal
6-8 weeks
3 months
6 months
1 year and then yearly for min 5 years.

All appointments incl: Sensibility test and Radiographic evaluation

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Clinical Management of the Avulsed Tooth

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Avulsion

Known Factors Affecting Prognosis:

- ✓Time out of the socket
- ✓Storage condition
- ✓Splinting technique and time
- ✓Condition of the alveolus
- ✓Stage of root development

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Avulsion

Known Factors Affecting Prognosis:

- ✓Time out of the Socket
  - 90% of teeth replanted within 30 minutes were without root resorption
  - 43% of teeth replanted 31 - 90 minutes were without root resorption
  - 7% of teeth replanted after 90 minutes were without root resorption

(Andreasen and Hjörting-Hansen, 1966)

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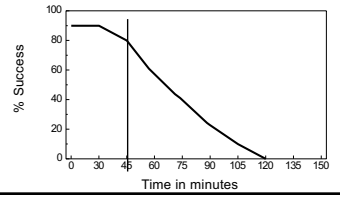
Avulsed tooth Success rate
vs.
Extraoral Dry Time



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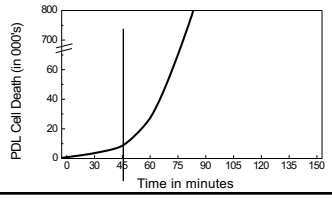
PDL cell Death
vs.
Extraoral Dry Time



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Avulsion

Consequences:

- ✓Attachment damage
- ✓Pulpal necrosis
- ✓Bacteria contamination

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Treatment Objectives

Minimize or Treat

- *Attachment Damage* ***Inflammation***
- *Pulp Space* ***Infection***

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Treatment of Avulsion

Place the tooth in physiologic storage medium immediately once in the office, while examining the patient!

- ✓ Clean the root with a stream of saline.
- ✓ Administer local anesthesia (vasoconstriction??)
- ✓ Irrigate the socket with saline.
- ✓ Examine the alveolar socket, if fractured gently reposition the fragments.
- ✓ Replant the tooth, slowly with slight digital pressure. NO force!

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Treatment of Avulsion

Place the tooth in physiologic storage medium immediately once in the office!

- ✓ Suture gingival lacerations
- ✓ Verify normal (correct) position of the tooth, clinically AND radiographically.
- ✓ Apply a flexible splint for up to two weeks, away from the gingiva.
- ✓ Administer systemic antibiotics.
- ✓ Check tetanus protection
- ✓ Give patient instruction (incl. hygiene, diet, pain med)
- ✓ Initiate root canal therapy in 7 to 10 days, before removing the splint if apex is closed.

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Treatment of Avulsion

If the tooth was replanted at the site of the injury:

- ✓ Leave the tooth in place.
- ✓ Clean the area with water spray, saline or chlorhexidine.
- ✓ Suture gingival lacerations.
- ✓ Verify normal (correct) position of the tooth, clinically AND radiographically.
- ✓ Apply a flexible splint for up to two weeks, away from the gingiva.
- ✓ Etc.

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Management of the ***Emergency Patient***

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Management of the ***Emergency Patient***

Treatment focus:

Minimize inflammation due to attachment damage

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Emergency Management ***Outside the dental office***

Minimize dry time !!!!!

Replant immediately if possible

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Emergency Management

Outside the dental office

Best TX - Replant if possible

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Emergency Management

Outside the dental office

Place in appropriate storage medium

- specialized media
- milk
- saline
- vestibule of mouth
- (((water)))

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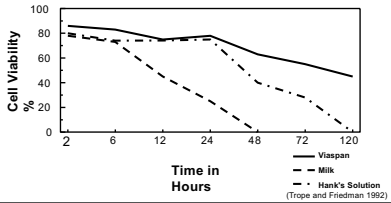
Cell Viability Maintenance:
Viaspan vs. Milk vs. Hank's Solution
(No refrigeration)



(Trope and Friedman 1992)

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Milk Is Good!

Has physiological osmolarity (230-270 mOsm/kg).
pH is in physiological range (6.5-6.9).
Can provide some nutrients to cells.
Pasteurized milk has very low bacterial count.

(Blomlöf et al. 1981)

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Evaluation of periodontal ligament cell viability in different storage media based on human PDL cell culture experiments —A systematic review

Conclusions:

"Milk remains the most convenient, cheapest, and readily available solution in most situations while also being capable of keeping PDL cells alive. "

(Osmanovic A et al. 2018)

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Alternatives to Milk or Saline

The risks of ankylosis of 89 avulsed human teeth stored in saliva prior to replantation
—A re-evaluation of a long-term clinical study

N=89 human
All teeth were stored in saliva before replantation.
Follow-up from 7 months to 20 years (mean 5.3 years).

(Albertsson J et al. 2021)

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Alternatives to Milk or Saline

The risks of ankylosis of 89 avulsed human teeth stored in saliva prior to replantation
—A re-evaluation of a long-term clinical study

N=89 human
Dry storage for 5 min or less before saliva = 47.4% ankylosis rate.
Dry storage >5 min and <20 min, = 76.8%
Dry storage > 20 min prior to saliva storage = 89.3%

Ankylosis also increased with increasing saliva storage time.

(Albertsson J et al. 2021)

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Emergency Visit

Root Preparation

Mature Tooth

Immature Tooth

Dry time
< 60 min
> 60 min

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Risk of Ankylosis of 400 Avulsed and Replanted Human Teeth in Relation to Length of Dry Storage

A re-evaluation of a long-term clinical study

Conclusions:
The risk of ankylosis rose with increasing length of dry time.

However, some teeth may heal without ankylosis even after 60 minutes of dry time.

Immature teeth have a lower risk of developing ankylosis.

Replantation should therefore always be considered for avulsed teeth.

(Lauridsen E, Andreason JO et al. 2019)

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Emergency Visit

Inside the dental office

Splint

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Guidelines of IADT

What is new? Any physiological and hygienic splint acceptable; monofilament fishing line 16 to 35 lbs!
Splinting Time:

Type of Injury	Splinting Time
Subluxation	2 weeks
Extrusive luxation	2 weeks
Lateral luxation	4 weeks
Intrusion	4 weeks
Avulsion	2 weeks
Root fracture (middle 1/3)	4 weeks
Alveolar fracture	4 weeks
Root fracture (cervical 1/3)	4 months

(Levin L et al. 2020)

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Emergency Treatment Adjunctive Therapy

Systemic Antibiotics?

Current recommendations of the American Association of Endodontists is Penicillin,

however the International Association for Dental Trauma has suggested to use Doxycycline (tetracycline) for anyone above 8 to 12 years of age.

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Emergency Treatment

Adjunctive Therapy

* Systemic Antibiotics
  (Doxycycline > 8 to 10 y. old)
* Systemic NSAIDS
* Chlorhexidine rinses
* Tetanus booster ?

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Emergency Visit

Patient instructions

Patient compliance with follow-up visits and home care contributes to satisfactory healing following an injury.

Parent and/or guardians of young patients should be advised regarding care of the replanted tooth for optimal healing and prevention of further injury.

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

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Second Visit

7-10 days

Treatment Objective

Prevent or treat

pulpal infection

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Treatment Objective

If tooth accessed symptomatic and no signs of infection:

Short term Calcium Hydroxide (few weeks)

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Second Visit

Treatment Objective

7-10 days

It was concluded that short- and long-term calcium hydroxide treatment resulted in similar healing patterns when endodontic treatment is initiated 14 days after replantation of teeth.

(Trope et al. 1992)

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Second Visit

7-10 days

Treatment Objective

If tooth accessed symptomatic or with signs of infection:

Long term Calcium Hydroxide
(Several Months)

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Treatment of the Avulsed Tooth
Mature Tooth

Follow-up schedule

2 weeks; splint removal
4 weeks
3 months
6 months
12 months

Yearly for 5 years

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Treatment of the Avulsed Tooth
Immature Tooth

Follow-up schedule

2 weeks; splint removal
4 weeks
6-8 weeks
3 months
6 months
12 months

Yearly for 5 years

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Favorable Outcome

Closed apex:

- ✓ Asymptomatic.
- ✓ Normal mobility.
- ✓ Normal percussion sound.
- ✓ No radiographic evidence of resorption or periradicular osteitis.
- ✓ Lamina dura normal.

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Favorable Outcome

Open apex:

- ✓ Asymptomatic.
- ✓ Normal mobility.
- ✓ Normal percussion sound.
- ✓ Radiographic evidence of arrested or continued root formation and eruption.
- ✓ Pulp canal obliteration is to be expected.

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Unfavorable Outcome

Closed apex:

- ✓ Symptomatic.
- ✓ Excessive mobility or no mobility.
- ✓ High-pitched percussion sound.
- ✓ Radiographic evidence of resorption (inflammatory, infection-related resorption, or ankylosis-related replacement resorption).

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Unfavorable Outcome

Open apex:

- ✓ Symptomatic.
- ✓ Excessive mobility or no mobility.
- ✓ High-pitched percussion sound.
- ✓ In the case of ankylosis, the crown of the tooth will appear to be in an infra-position.
- ✓ Radiographic evidence of resorption.

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Most Common Late Complications after Dental Trauma

Pulpal necrosis
- immediately
- delayed by weeks or months
- delayed by years (at least only discovered)

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Most Common Late Complications after Dental Trauma

Pulpal necrosis
- immediately
- delayed by weeks or months
- delayed by years (at least only discovered)

Pulpal obliteration
- occurs over weeks or months post trauma
- pulp is vital while ongoing
- pulpal necrosis in 7 to 13% of all cases

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Most Common Late Complications after Dental Trauma

Root resorption:
- can take weeks to years to form

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Most Common Late Complications after Dental Trauma

Root resorption:
- Can take weeks to years to form

Four basic types possible:
- Internal

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Most Common Late Complications after Dental Trauma

Root resorption:
- Can take weeks to years to form

Four basic types possible:
- Internal
- Cervical:
  usually only appears months if not years later

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Most Common Late Complications after Dental Trauma

Root resorption:
- Can take weeks to years to form

Four basic types possible:
- Internal
- Cervical:
  usually only appears months if not years later
- Inflammatory
- Replacement/ankylosis

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Root Resorption

Diagnosis of root resorption:

- Multiple radiographs with different angulations.

Difficult, if not impossible, to assess true extent of the lesion,

AND more importantly confirm location, facial or lingual!

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Soft tissue management

Soft tissue injuries need to be attended as soon as possible.

Tooth, especially avulsed, takes thought usually priority over tissue injury.

Rule out any contamination in the injury.

Assess if muscle is cut or damaged – special suturing of muscles are essential for a good healing.

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Future areas of research

- Optimal splint types with regard to periodontal and pulpal healing.
- Effect on adrenaline content of local anesthesia on healing.
- Reducing the inflammation with corticosteroids.
- Extra-oral root filling of teeth with less than a 60 min drying period.
- Use of titanium posts for root elongation and as alternatives to conventional root canal treatment.
- Long-term development of alveolar crest following replantation and decoronation.

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Each dental trauma has a potential of a range of mental stress factors:

1. Circumstances related to the accident (expected versus unexpected).
2. Pain elicited by the trauma.
3. Emergency room settings.
4. Pain elicited by initial treatment.
5. Fear elicited by poor prognosis.
6. Fear of economic consequences of trauma.

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Potential of minimizing various stress factors:

1. Psychological help (debriefing).
2. First aid personnel giving pain relief.
3. Special waiting room for children and short waiting time.
4. Proper pain control during treatment.
5. Weighted information about prognosis.

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At The Site of The Accident

First aid for avulsed teeth at the place of accident:
"An avulsed permanent tooth is one of the few real emergency situations in dentistry."

"In addition to increasing the public awareness by, for example, mass media campaigns, healthcare professionals, guardians and teachers should receive information on how to proceed following these severe unexpected injuries. "

www.iadt-dentaltrauma.org

(JO Andreasen et al. 2012)

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