



the
143RD
CHICAGO DENTAL SOCIETY
MIDWINTER MEETING

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SCIENTIFIC PROGRAM: FEBRUARY 21 - 24, 2008

EXHIBIT DATES: FEBRUARY 22 - 24, 2008

COURSE F02B
CONTEMPORARY MANAGEMENT OF TRAUMATIC DENTAL INJURIES
ANTHONY J. DIANGELIS, DMD, MPH
THURSDAY, FEBRUARY 21, 2008

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CHICAGO DENTAL SOCIETY MIDWINTER MEETING COURSE EVALUATION

SPEAKER: _____ DATE: _____

SUBJECT: _____ NUMBER OF ATTENDEES: _____

PLEASE RATE YOUR SPEAKER AS TO:					Fair	Poor	N/A
SUBJECT SELECTED	Excellent	Good			2	1	0
TIMELINESS OF SUBJECT	4	3			2	1	0
COMPREHENSIVENESS	4	3			2	1	0
MEETING YOUR EXPECTATIONS	4	3			2	1	0
CONTENT LEVEL	4	3			2	1	0
DELIVERY	4	3			2	1	0
VOICE QUALITY	4	3			2	1	0
HOLDING YOUR INTEREST	4	3			2	1	0
APPROPRIATE AUDIOVISUALS	4	3			2	1	0
EFFECTIVE AUDIOVISUALS	4	3			2	1	0
OVERALL EVALUATION OF SPEAKERS	4	3			2	1	0
OVERALL EVALUATION OF THE PROGRAM	4	3			2	1	0

SHOULD THIS SPEAKER BE INVITED FOR FUTURE MEETINGS? YES NO

WHAT TOPICS INTEREST YOU FOR THE FUTURE? _____

COMMENTS (use reverse if you need additional space): _____

NAME (REQUESTED BUT NOT REQUIRED—PLEASE PRINT): _____

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Contemporary Management of Traumatic Dental Injuries

***143rd
Chicago Dental Society
Midwinter Meeting***

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TRAUMA CHECKLIST

I. Medical History

II. Dental History

Previous dental injuries?

Injury History

How?

Where?

When?

Why?

III. Brief Neurological Exam

Cranial Nerve Assessment

History re:

headache

lethargy

nausea/vomiting

unconsciousness

amnesia

orientation x3

IV. Head Exam

A. Skin

abrasions

contusion

laceration

edema

ecchymosis

B. Bones

mobility

crepitus

tenderness

asymmetry

C. Nose

D. Ears

E. Eyes

V. TMJ

joint pain

muscle pain

intraoral opening

deviation on opening

open/closed lock

chewing difficulty

VI. Intraoral Exam

A. Oral mucosa, gingiva, tongue

abrasion

contusion

laceration

B. Periodontal Status

C. Occlusion

classification

open bite

overjet

disruption

Do your teeth come

together like they

did before the

accident?

D. Teeth

color changes

mobility

pain

biting

cold

percussion

unstimulated

vitalometer readings

infracture

crown fx

crown-root fx

root fx

concussion

subluxation

extrusion

intrusion

lateral luxation

avulsion

VII. Radiographs

VIII. Photographic Documentation

IX. Follow-up

EXAMINATION FORM FOR TRAUMA PATIENTS

Patient Name _____

Clinicians should use their standard office form to record medical history.

NEUROLOGIC ASSESSMENT

Does the patient have or has the patient had any of the following symptoms since the injury?

☐ nausea ☐ headache ☐ vomiting

Did the patient lose consciousness? ☐ Yes ☐ No If so, for how long? _____

Can the patient remember what happened ☐ before ☐ during ☐ after the accident?

Is there: ☐ double vision ☐ limited eye movement ☐ abnormal pupillary reflex

HISTORY OF THE INJURY

Date: _____ Time: _____ Place where injury happened: _____

How did the injury occur? _____

Was treatment provided elsewhere? ☐ Yes ☐ No If so describe: _____

Chief complaint: _____

Pain ☐ Yes ☐ No Location of pain (tooth/teeth): _____

Type of pain (percussion, biting, cold) _____

Characteristics of pain (constant, episodic) _____

Were the teeth avulsed? ☐ Yes ☐ No

If so:

Where were the teeth found? _____

When were the teeth found? _____

Were the teeth dirty? ☐ Yes ☐ No

How were the teeth stored? _____

Were the teeth rinsed prior to replantation? ☐ Yes ☐ No If so, with what _____

When were the teeth replanted? _____

Was tetanus antitoxoid given? ☐ Yes ☐ No

Were antibiotics given? ☐ Yes ☐ No If so, type and dosage _____

EXTRAORAL EXAMINATION

Is the patient's general condition affected? ☐ Yes ☐ No

Pulse and blood pressure _____

Objective findings within the head and neck? ☐ Yes ☐ No If yes, type and location: _____

Bleeding from the: ☐ nose ☐ ear

Palpable signs of fracture of facial skeleton? ☐ Yes ☐ No If yes, location of fracture _____

INTRAORAL EXAMINATION

Injury to the oral mucosa ☐ Yes ☐ No Location _____

Injury to the gingiva ☐ Yes ☐ No Location _____

Tooth fracture ☐ Yes ☐ No Location _____

Alveolar fracture ☐ Yes ☐ No Location _____

Tooth discoloration ☐ Yes ☐ No Location _____

DENTAL EXAMINATION

General condition of dentition ☐ Good ☐ Fair ☐ Poor

Caries ☐ Minimal ☐ Moderate ☐ Extensive

Periodontal status ☐ Good ☐ Fair ☐ Poor

Horizontal occlusal relationship ☐ Underbite ☐ Overbite ☐ Normal

Vertical occlusal relationship ☐ Deep ☐ Open ☐ Normal

EVALUATION OF THE INJURED TOOTH

Tooth #				
Date				
Heat (+/-)				
Cold (+/-)				
Percussion (+/-)				
Ankylosis tone				
Mobility				
Palpation				
Color				
EPT (#)				
Occlusal contact (+/-)				

Tooth #				
Date				
Heat (+/-)				
Cold (+/-)				
Percussion (+/-)				
Ankylosis tone				
Mobility				
Palpation				
Color				
EPT (#)				
Occlusal contact (+/-)				

RADIOGRAPHIC EXAMINATION

Types of films

- ☐ Periapical
- ☐ Angulated periapical
- ☐ Occlusal
- ☐ Soft tissue film
- ☐ Panoramic

Observation

- ☐ Root fracture
- ☐ Bone fracture
- ☐ Pulp canal obliteration
- ☐ Root resorption
- ☐ Immature root, open apex.
Size of apical foramen _____ mm.

INJURIES

Tooth # Fractures

- | | |
|--|---|
| | Crown fracture/no pulp exposure |
| | Crown fracture/pulp exposure |
| | Crown-root fracture/no pulp exposure |
| | Crown-root fracture/pulp exposure |
| | Root fracture (apical, middle, coronal 1/3) |
| | Alveolar fracture |
| | Mandibular fracture |
| | Maxillary fracture |

_____ Additional remarks: _____

Tooth # Luxations

- | | |
|--|------------------|
| | Concussion |
| | Subluxation |
| | Lateral luxation |
| | Extrusion |
| | Intrusion |
| | Avulsion |

_____ Additional remarks: _____

Location Abrasions/Contusions/Lacerations

- | | |
|--|---------------------|
| | Skin abrasion |
| | Skin laceration |
| | Skin contusion |
| | Mucosal abrasion |
| | Mucosal laceration |
| | Mucosal contusion |
| | Gingival abrasion |
| | Gingival laceration |
| | Gingival contusion |

_____ Additional remarks: _____

TREATMENT PLAN

At time of injury		Follow-up	
Repositioning		Restoration	
Fixation/splinting		Fixation/splinting	
Pulpal therapy		Pulpal therapy	
Dentinal coverage		Soft tissue suture removal	
Soft tissue suturing		Endodontic referral	
Prescription		Oral surgery referral	
Emergency room/ physician referral		Orthodontic referral	

PROGNOSISTooth # _____ ☐ Good ☐ Fair ☐ PoorTooth # _____ ☐ Good ☐ Fair ☐ PoorTooth # _____ ☐ Good ☐ Fair ☐ Poor**FOLLOW-UP****3 weeks** Date of visit _____

Remarks: _____

3 months Date of visit _____

Remarks: _____

6 months Date of visit _____

Remarks: _____

12 months Date of visit _____

Remarks: _____

2 years Date of visit _____

Remarks: _____

3 years Date of visit _____

Remarks: _____

4 years Date of visit _____

Remarks: _____

5 years Date of visit _____

Remarks: _____

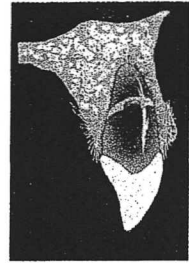
The most pale ink is better
than the clearest memory!

Document – Document - Document

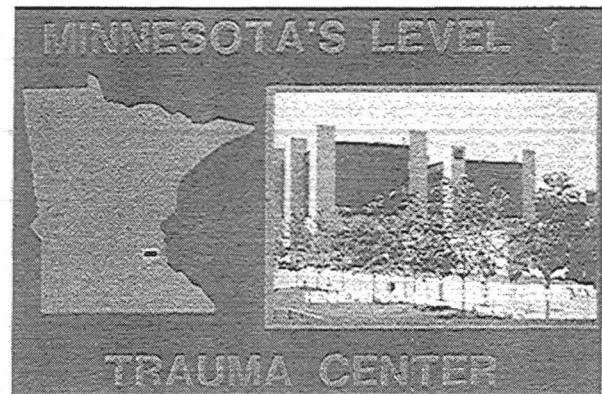
- liability
- advocacy
- collateral injuries - look beyond initial injury
- establish prognosis
- monitor progress
- specialist referral

Definitions of Injuries

- **Concussion**
– Injury to supporting structure with no loosening or displacement
- **Subluxation** *can splint if want*
– Loosening but no displacement
- **Intrusion**
– Displacement into alveolar bone
- **Extrusion**
– Partial vertical displacement out of socket
- **Lateral luxation**
– Displacement other than axial in direction with comminution or fracture of socket
- **Avulsion**
– Total displacement of tooth from socket



"The Unexpected
Doesn't Happen Very
Often, But When It Does,
It's detcepxenU"



Trauma Etiology

- Falls
- Accidents
- Abuse
- Alcohol and Testosterone
- Two Dudes Syndrome



Mouthguards



Traumatic Equation

Patient + Dentist x Time = Exam
 Injured Unprepared Inconvenient Incomplete
 Stressed

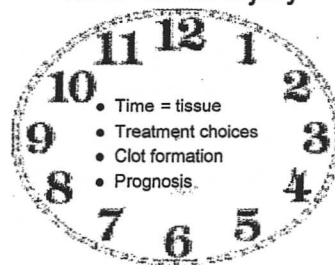
Diagnostic Protocol

- Medical and dental history
- Brief neurological evaluation
- Head and neck exam
- Oral exam
- Radiographic exam
- Photographic documentation

Trauma History

- | | |
|----------|-------------------|
| • When? | • Why? |
| • Where? | • Injured Before? |
| • How? | • Treated Before? |

Time Since Injury



The Diagnostic Trinity

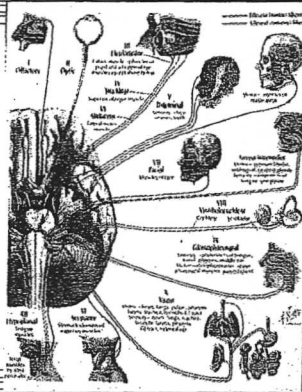
- What does patient say?
- What does clinical exam say?
- What do radiographs say?

make sure it all adds up

Neurologic Assessment

- Mental status
- Motor systems
- Sensory systems
- Cranial nerves

Cranial Nerves



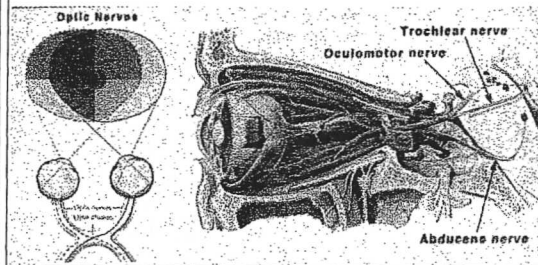
Cranial Nerves

- | | |
|-----------------|----------------------|
| i. Olfactory | vii. Facial |
| ii. Optic | viii. Acoustic |
| iii. Oculomotor | ix. Glossopharyngeal |
| iv. Trochlear | x. Vagus |
| v. Trigeminal | xi. Accessory |
| vi. Abducens | xii. Hypoglossal |

Cranial Nerves

- | | | |
|---|---|---|
| <ul style="list-style-type: none"> • ii. Optic • iii. Oculomotor • iv. Trochlear • vi. Abducens | > | <ul style="list-style-type: none"> • Visual field • Diplopia • Blurring • Range of motion • Nystagmus • Pupil size and reactivity |
|---|---|---|

Cranial Nerves involved with vision



Cranial Nerves

- v. Trigeminal
- Sensation above eyelids
 - Sensation infraorbital area
 - Sensation on chin



Cranial Nerves

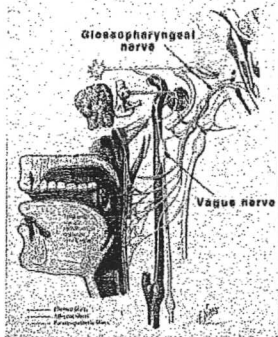
- vii. Facial
- Eye closure
 - Facial contractions



Cranial Nerves

ix. Glossopharyngeal and x. Vagus

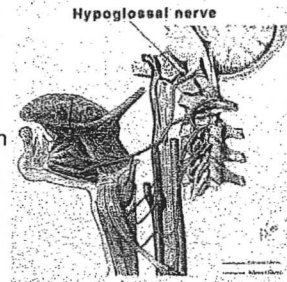
- Normal speech
- Normal swallowing
- Normal gag reflex



Cranial Nerves

xii. Hypoglossal

- Tongue Protrusion



Cranial Nerves

xi. Spinal Accessory

- Neck rotation



Nerves Most Likely Affected

III, IV, V, VI,
VII

Immediate Referral

to ER

- Lethargy
- Severe headache
- Vomiting
- Dilated / fixed pupils

Soft Tissue Exam

- Extraoral
- Intraoral

Check for abrasions / lacerations

though? through lacerations
close in layers.

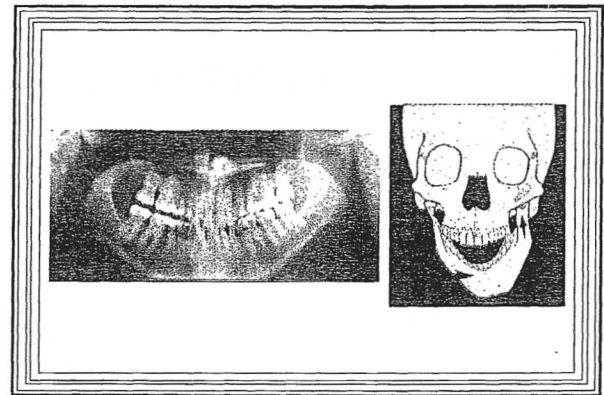
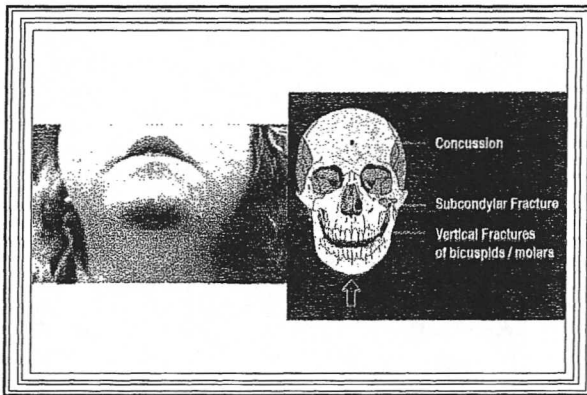
Orofacial Assessment

- Asymmetry
- Occlusal disharmony
- Pain
- Crepitation
- Impairment of function
- Mobility
- Trismus

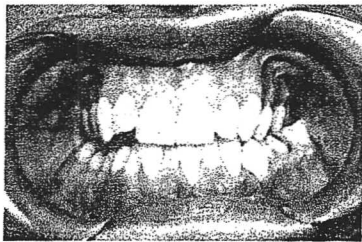
red sclera = Zygoma Fracture

Orofacial Assessment

- Ecchymoses
- Parasthesia
- Diplopia
- Subconjunctival hemorrhage
- CSF / blood in ears or nose
- Hemorrhage floor of mouth or palate



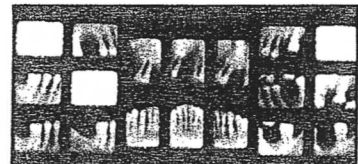
Do your teeth come together like they did before the injury?

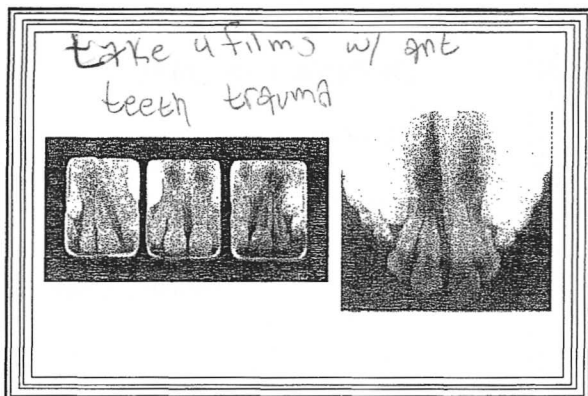


Contralateral open bite with condylar fracture.

Radiographs

- Periapical
- Occlusal
- Soft tissue
- Panorex
- Lateral



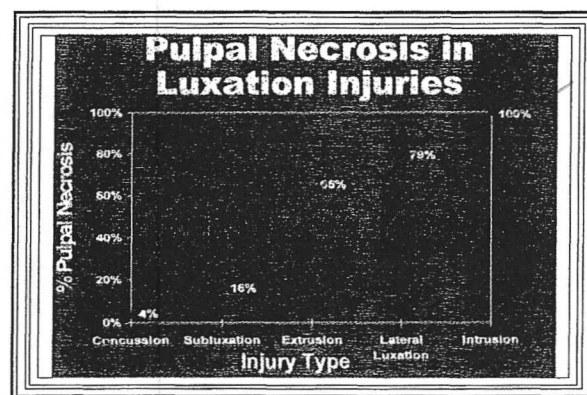


Dentition Assessment

- Color
- Displacement
- Mobility
- Fracture
- Percussion
- Occlusal interference
- Pulp test

Immediate Treatment

- Preservation of the pulp
- Regeneration of the PDL



Closed apex

Immature vs Mature Permanent Tooth

- revascularization
- continuous root formation
- pulpal treatment



Determinants of Revascularization

- Type of luxation
- Root canal length (shorter = better)
- Root canal width (shorter = better)

Width	Success Rate
0.1-0.5 mm	34%
0.6-1.0 mm	44%
1.1-2.0 mm	71%
2.1-5.0 mm	97%

- Exclude bacteria

Concussion > sublux > ext > laterext > intrusion

Semi rigid
fishing line
light wire
can go one tooth either side

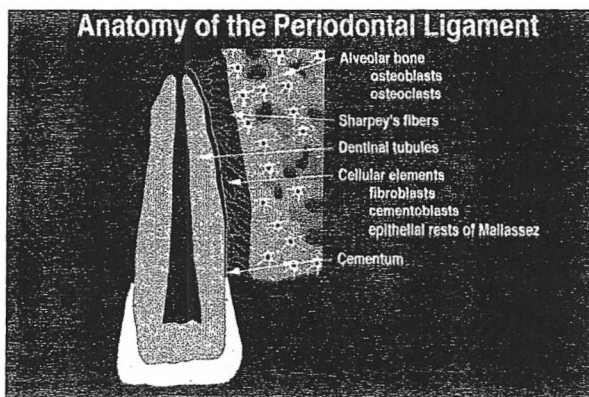
Displacement injuries
1015 - 1030 mm wire
root: alveolar fractures
105 mm wire.

Repair vs. Regeneration

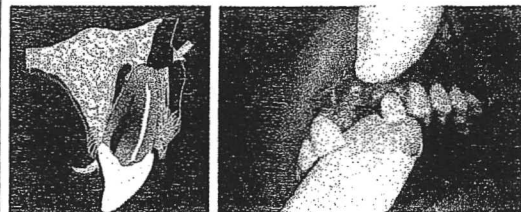
- Repair
 - Continuity is restored but new tissue differs in structure and function
- Regeneration
 - Original structure and function is restored

Requirements for Regeneration

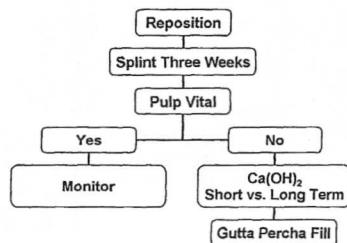
- Tissue-specific cells
- Conditions for migration of tissue-specific cells into the wound
- Absence of contaminants



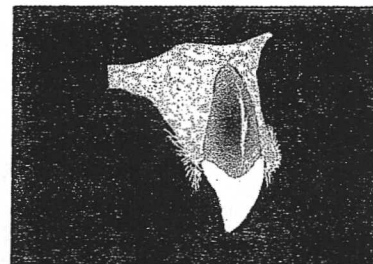
Repositioning Luxated Tooth



Extrusion 3 Weeks



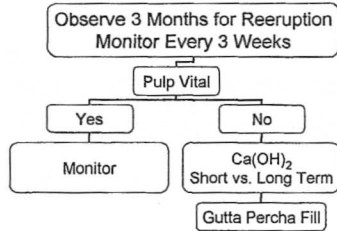
Intrusion



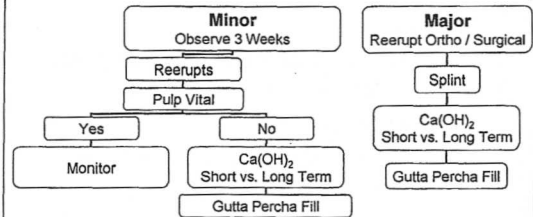
Splints

- easily applied, removed, cleaned
- passive
- no occlusal interference
- allows endo therapy

Open Apex



Closed Apex



Treatment advice should be based on root development age and extent of intrusion

- Teeth with immature root development monitor for spontaneous eruption.
- Teeth with mature root development age 12-17 years: monitor for spontaneous eruption.
- Above 17 years of age re-erupt orthodontically or surgically.

Andressen JO et al. Dent Traumatol
22(2):99-111, 2006. Traumatic
Intrusion of permanent teeth. Part 3

INTRUDED DECIDUOUS TEETH

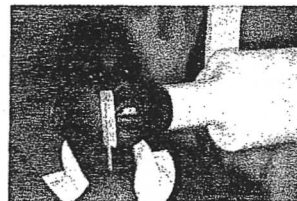
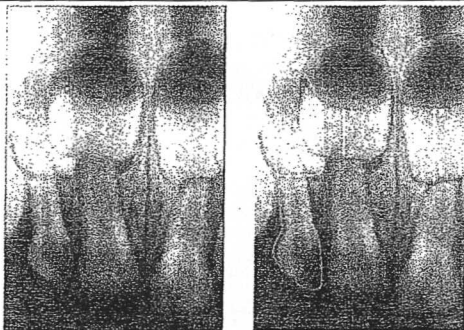
Intruded Towards
Tooth Bud

Intruded Away
from Tooth Bud



Elongated

Foreshortened



Potential Sequelae to Trauma of Deciduous Incisors

- Disturbances in permanent teeth
 - Delayed eruption
 - Malposition
 - Defects
 - Discoloration
 - Enamel hypoplasia
 - Dilaceration
- Infection

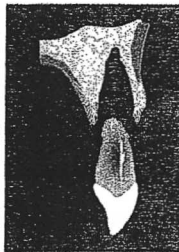
Damage to Developing Permanent Teeth after Primary Tooth Trauma

- 60% if trauma occurred in child under age 4
- Prevalence of injuries is 12-69%
- Order of seriousness of injury;

Intrusive luxation	69%
Avulsion	52%
Extrusive and subluxation	34%

– Andreasen, JO and Ravn, JJ. Jour Dent Res, 1971

Avulsion



Treatment Goal

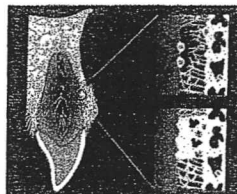
Minimize Complications

Maintain PDL vitality
Timely pulpal management

Ankylosis

"The status of the periodontal membrane is critical to the initiation of ankylosis"

– Hammarstrom et al.



Ankylosis / Replacement Resorption Clinical Signs

- Metallic sound to percussion
- Lack of mobility
- Loss of lamina dura
- Moth eaten appearance of root
- Tooth submergence



doesn't come down

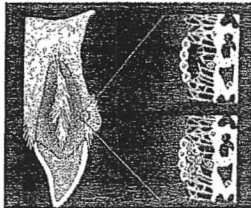
Competitive healing occurs, osteoblasts have less distance to travel than fibroblasts

hard to treat ankylosis - monitor for 1st year tightly

Inflammatory Resorption

"...inflammatory root resorption occurs when bacteria present in the pulp tissue and when the cementum has been damaged."

- Hammarstrom et al.



"Inflammatory and replacement resorption in reimplanted incisor teeth..."

- If pulp extirpation time exceeded **20 d**, increase in inflammatory resorption.
- If splinting time exceeded **10 d**, increase replacement resorption.

- Kinirons, MJ et al., Endod Dent Traumatol, 1999



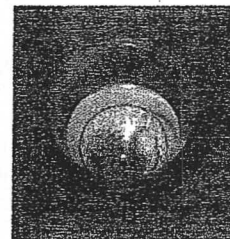
get pulp out in 2-3 weeks will ↓ 85% of ectb. resorp.

Transport Media

- HBSS
- Milk
- Saline
- Saliva
- ~~Water~~
- Other

First Appointment

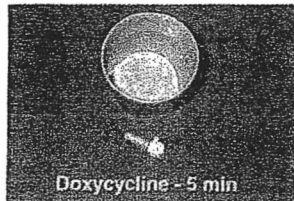
- Soak tooth in HBSS
- Radiographs
- Medical, dental, injury history
- Socket management
- Replant and stabilize
- Adjunctive care
- Patient instructions



Doxycycline Solution

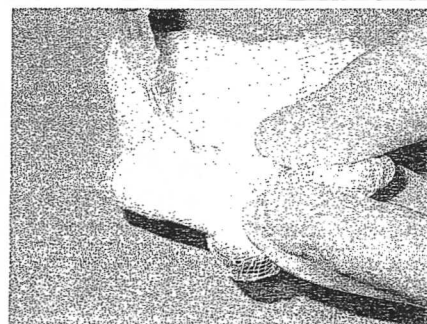
¼ capsule 100 mg doxycycline in 6 oz. sterile saline

Soak open apex teeth in this for 5 mins before



Doxycycline - 5 min

implantation.



Can put on root surface

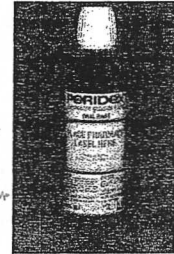
Socket Management

- Remove obstructions
- Irrigate with saline



Adjunctive Care *& home*

- Soft diet
- Hygiene
- Peridex *- or Argem in socket*
- Antibiotics *- doxycycline 50mg 1-2x daily*
- Tetanus status *- USAIDS*
- Analgesics



1 week for gingival reattachment

Second Appointment

- Extirpate pulp
- Clean and shape
- Fill with $\text{Ca}(\text{OH})_2$ *within 2-3 weeks*
- Remove splint
- Reschedule
 - 2 weeks
 - 3 months

"...short and long-term $\text{Ca}(\text{OH})_2$ treatment resulted in similar healing patterns when endodontic treatment is initiated 14 days after replantation."

- Trope, M. et al, J of Endod. 1992

$\text{Ca}(\text{OH})_2$ - *(-) osteoblasts*
 - induces mineralized tissue formation

Systemic & Topical Medications

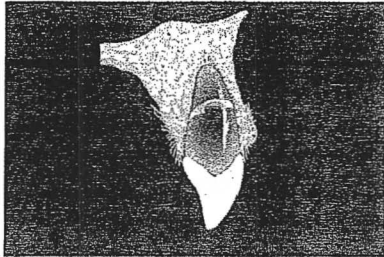
- $\text{Ca}(\text{OH})_2$ *- long term may weaken dentin bonds*
- doxycycline
- minocycline
- peridex
- triamcinolone

Avulsed Tooth Follow-Up Schedule

Time	Closed Apex	Open Apex
1 - 2 wks	S+ initiate RCT	S+ revascularization or RCT
4 wks	Complete RCT	C
8 wks	C	C
6 mos	C	C
1 year	C	C
Yearly for 5 yrs	C	C

(s = splint removal)
 (c = clinical exam & radiograph)

Root Fracture



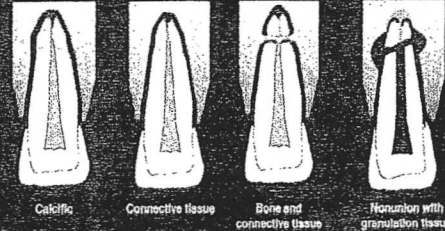
Treatment

- Reposition segments
- Splint for 3 weeks
- No RCT unless evidence of pulpal necrosis

Healing Determinants

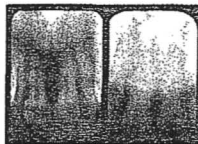
- Horizontal vs. vertical
- Time since injury
- Degree of displacement
- Communication with oral cavity
- Stage of root development
- Position of fracture

ROOT FRACTURE HEALING

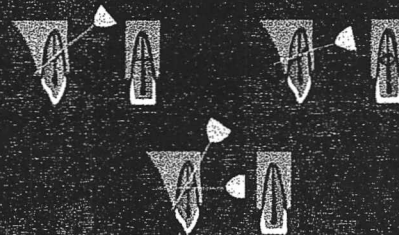


Pulp Canal Obliteration After Root Fracture

- Frequency 73-86% of cases
- Location
 - Apical only = Calcific repair
 - Coronal only = Connective tissue repair
 - Both segments = Connective tissue repair



RADIOGRAPHIC DIAGNOSIS OF ROOT FRACTURES



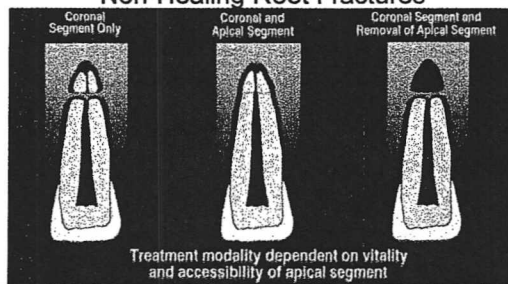
Treatment of Coronal Segment When Pulp Necrosis

- Gutta Percha
 - Absence of apical radiolucency
 - Minimal space between segments
 - Apical end of coronal segment sufficiently restricted for mechanical stop
 - Apical pulp bleeds when touched with paperpoint

Treatment of Coronal Segment When Pulp Necrosis

- $\text{Ca}(\text{OH})_2$
 - Absence of apical radiolucency
 - Apical segment vital
 - Radiolucency between segments
 - Widening between segments
 - Internal or external resorption of coronal segment
 - Wide root canal space
 - Cohen and Burns, 1991 Mosby

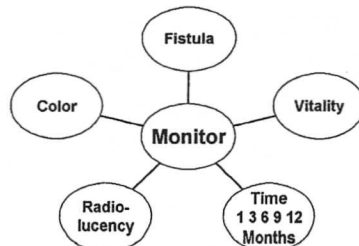
Endodontic Treatment Choices for Non-Healing Root Fractures



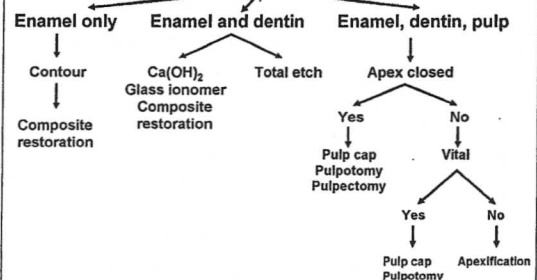
Orthodontic Treatment Post Root Fractures

- Type of healing
- Fracture location

Best Treatment is Minimal Treatment

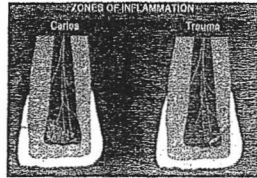


Crown Fractures



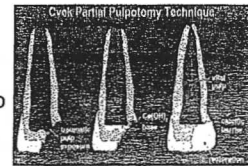
Partial Pulpotomy After Trauma

- Cvek, M., J. Endod., 1978
- Klein et al., J. Pedod., 1985
- Fuks et al., Endod. Dent. Traumatol., 1987
- Fuks et al., Ped. Dent., 1993



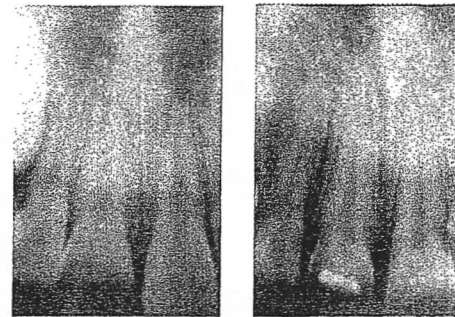
Technique

- Remove pulp and surrounding dentin to a depth of 2 mm with high-speed diamond.
- Irrigate with sterile saline to stop bleeding.
- Dry with cotton pellets.
- Apply $\text{Ca}(\text{OH})_2$ paste (not base).
- Seal.



Mineral Trioxide Aggregate (MTA)

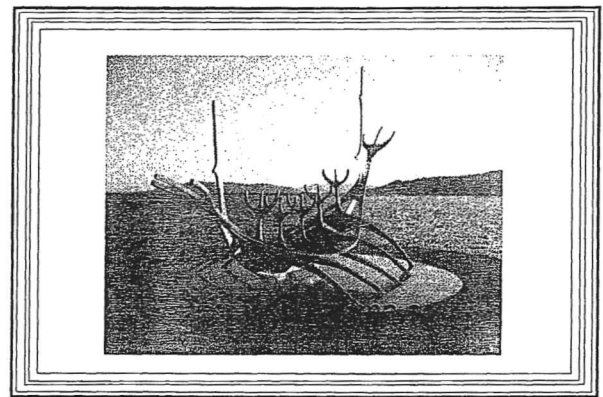
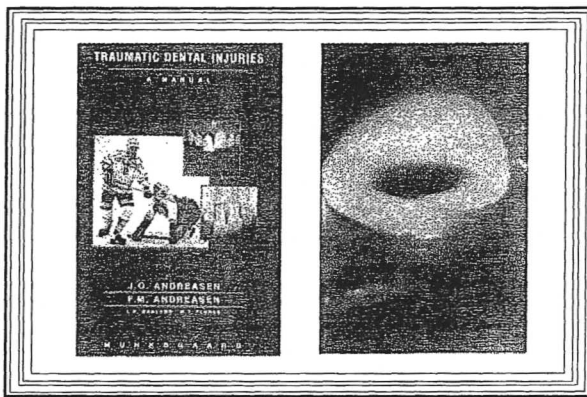
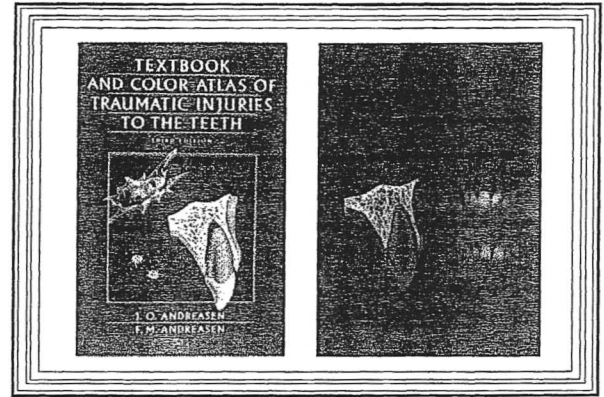
- High pH
- Excellent biocompatibility
- Reduced leakage
- Good compressive strength
- Sets in presence of moisture
- Good adaptation to dentin



Orthodontic Treatment Post Trauma

	6 Wks	3 Mos	3-6 Mos	6 Mos
Concussion/Subluxation	X			
Lateral luxation				X
Extrusion		X		
Intrusion				X
Avulsion				X
Crown Fx	X			
Root Fx			X	

"The Unexpected Doesn't Happen Very Often, But When It Does, It's detcepxenU"



INTERNATIONAL ASSOCIATION OF DENTAL TRAUMATOLOGY**Guidelines for the management of traumatic injuries in the primary dentition
2007**

Prepared by a committee of the IADT:

Dr. Marie Therese Flores, Chile; Dr. Lars Andersson, Kuwait; Dr. Jens Ove Andreasen, Denmark; Dr. Leif K. Bakland, USA; Dr. Barbro Malmgren, Sweden; Dr. Fred Barnett, USA; Dr. Cecilia Bourguignon, France; Dr. Anthony DiAngelis, USA; Dr. Lamar Hicks, USA; Dr. Asgeir Sigurdsson, Iceland; Dr. Martin Trope, USA; Dr. Mitsuhiro Tsukiboshi, Japan; Dr. Thomas von Arx, Switzerland

The guidelines represent the current best evidence based on literature research and professional opinion. As is true for all guidelines, the health care provider must apply clinical judgment dictated by the conditions present in the given traumatic situation. The IADT does not guarantee favorable outcomes from following the Guidelines, but using the recommended procedures can maximize the chances of success.

Introduction

The management of traumatic injuries to primary teeth differs from that used for permanent teeth. It is important to keep in mind that there is close relationship between the apex of the root of the injured primary tooth and the underlying permanent tooth germ. Tooth malformation, impacted teeth and eruption disturbances in the developing permanent dentition are some of the consequences that can occur following severe injuries to primary teeth and/or alveolar bone. Because of this potential sequelae treatment selection should such as to avoid any additional risks of further damaging the permanent successors.

The child's maturity and ability to cope with the emergency situation, the time for shedding of the injured tooth and the occlusion, are important factors that influence treatment selection.

The Guidelines contain recommendations for diagnosis and treatment of traumatic injuries in the primary dentition for caries-free or sound primary teeth using proper examination procedures:

A. Clinical Examination.

Information about examination of traumatic injuries in the primary dentition can be found in a number of current textbooks (links).

B. Radiographic examination

Depending on the child's ability to cope with the procedure and the type of injury suspected, several angles are recommended:

1. 90° horizontal angle, with central beam through the tooth in question (size 2 film, horizontal view)
2. Occlusal view (size 2 film, horizontal view)
3. Extra-oral lateral view of the tooth in question, which is useful to reveal the relationship between the apex of the displaced tooth and the permanent tooth germ as well as the direction of dislocation (size 2 film, vertical view).

C. Patient instructions

Good healing following an injury to the teeth and oral tissues depends, in part, on good oral hygiene. Parents should be advised on how best to care for their children's primary teeth after an injury. Brushing with a soft brush after each meal and applying chlorhexidine (0.1%) topically to the affected area(s) with cotton swabs twice a day for one week, is beneficial to prevent accumulation of plaque and debris. Along with recommending a soft diet for 10 to 14 days, restrict the use of pacifier.

If there are associated lip injuries, use of lip balm during the healing period will avoid dryness.

Parents should be further advised about possible complications that may occur, like swelling, increased mobility or fistula. Children may not complain about pain; however, infection may be present and parents should watch for signs such as swelling of the gums and bring the children in for treatment.

Document in the chart that the parent has been informed about possible complications in the development of the permanent teeth, especially following intrusion, avulsion and alveolar fracture injuries sustained in children under 3 years of age.

1. Treatment guidelines for fractures of teeth and alveolar bone.

Uncomplicated crown fracture
Complicated crown fracture
Crown-root fracture
Root fracture
Alveolar fracture

2. Treatment guidelines for luxation injuries

Concussion
Subluxation
Extrusive luxation
Lateral luxation
Intrusive luxation
Avulsion

PRIMARY TEETH

1. Treatment guidelines for fractures of teeth and alveolar bone

Uncomplicated Crown Fracture

Clinical findings	Radiographic findings	Treatment
Fracture involves enamel or dentin and enamel; the pulp is not exposed.	The relation between the fracture and the pulp chamber will be disclosed.	Smooth sharp edges. If possible the tooth can be restored with glass ionomer filling material or composite.

Complicated Crown Fracture

Clinical findings	Radiographic findings	Treatment
Fracture involves enamel and dentin and the pulp is exposed.	One exposure is useful to rule out the extent of fracture and stage of root development.	In very young children with immature, still developing roots, it is advantageous to preserve pulp vitality by pulp capping or partial pulpotomy. This treatment is also the choice in young patients with completely formed roots. Calcium hydroxide is a suitable material for such procedures. Both treatments should be considered whenever possible, otherwise extraction is indicated.

Crown-Root Fracture

Clinical findings	Radiographic findings	Treatment
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	In laterally positioned fractures, the extent in relation to the gingival margin can be seen.	Treatment recommendation is tooth extraction. Care must be taken to prevent trauma to the subjacent tooth bud.

Root Fracture

Clinical findings	Radiographic findings	Treatment
The coronal fragment is mobile and may be displaced.	The fracture is usually located mid-root or in the apical third.	If the coronal fragment is displaced, extract only that fragment. The apical fragment should be left to be resorbed.

Alveolar Fracture

Clinical findings	Radiographic findings	Treatment
The fracture involves the alveolar bone. The tooth-containing segment is mobile and usually displaced. Occlusal interference is often noted.	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.	Reposition any displaced segment and then splint. General anesthesia is often indicated. Monitor teeth in fracture line.

2. Treatment Guidelines for Luxation Injuries

Concussion

Clinical findings	Radiographic findings	Treatment
The tooth is tender to touch; it has no increased mobility or sulcular bleeding.	No radiographic abnormalities. Normal periodontal space.	No treatment is needed. Observation.

Subluxation

Clinical findings	Radiographic findings	Treatment
The tooth has increased mobility but has not been displaced. Bleeding from gingival crevice may be noted.	Radiographic abnormalities are usually not found. Normal periodontal space.	No treatment is needed. Observation.

Extrusive luxation

Clinical findings	Radiographic findings	Treatment
The tooth appears elongated and is excessively mobile.	Increased periodontal ligament space apically.	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 are acceptable treatment options. Extraction is the treatment of choice for severe extrusion in a fully formed primary tooth.

Lateral luxation

Clinical findings	Radiographic findings	Treatment
The tooth is displaced, usually in a palatal/lingual direction. It will be often immobile.	Increased periodontal ligament space apically is best seen on the occlusal exposure.	If there is no occlusal interference, as is often the case in anterior open bite, the tooth is allowed to reposition spontaneously. When there is occlusal interference, with the use of local anesthesia, the tooth can be gently repositioned by combined labial and palatal pressure. In severe displacement, when the crown is dislocated in a labial direction, extraction is the treatment of choice. If minor occlusal interference, slight grinding is indicated.

Intrusive luxation

Clinical findings	Radiographic findings	Treatment
The tooth is usually displaced through the labial bone plate, or can be impinging upon the succedaneous tooth bud.	When the apex is displaced toward or through the labial bone plate, the apical tip can be visualized and appears shorter than the contra lateral tooth. When the apex is displaced towards the permanent tooth germ, the apical tip cannot be visualized and the tooth appears elongated.	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.

Avulsion

Clinical findings	Radiographic findings	Treatment
The tooth is completely out of the socket.	A radiographic examination is essential to ensure that the missing tooth is not intruded	It is not recommended to replant avulsed primary teeth.

Follow up procedures for traumatized primary teeth

Time		1 week	2-3 weeks	3-4 weeks	6-8 weeks	6 months	1 Year	Each subsequent year until exfoliation
Uncomplicated crown fracture				C				
Complicated Crown fracture		C			C+R		C+R	
Alveolar fracture		C		S+C+R	C+R		C+R	(*)
Root fracture	No Displacement	C	C+R		C+R		C(*)	
	Extraction						C(*)	
Concussion/ Subluxation		C			C			
Lateral Luxation Extrusion	Spontaneous Repositioning		C		C+R		C+R	
Intrusion		C		C+R	C	C+R	C+R	C(*)
Avulsion		C				C+R	C+R	C(*)

S=Splint removal

C=Clinical exam R=Radiographic exam

(*)=Radiographic monitoring until eruption of the permanent successor

INTERNATIONAL ASSOCIATION OF DENTAL TRAUMATOLOGY

Guidelines for the management of traumatic dental injuries 2007

Prepared by a committee of the IADT:

Dr. Marie-Therese Flores, Chili (Chair); Dr. Lars Andersson, Kuwait; Dr. Jens Ove Andreasen, Denmark; Dr. Leif K. Bakland, USA; Dr. Fred Barnett, USA; Dr. Cecilia Bourguignon, France; Dr. Anthony DiAngelis, USA; Dr. Lamar Hicks, USA; Dr. Barbro Malmgren, Sweden; Dr. Asgeir Sigurdsson, Iceland; Dr. Martin Trope, USA; Dr. Mitsuhiro Tsukiboshi, Japan; Dr. Thomas von Arx, Switzerland

The guidelines represent the current best evidence based on literature research and professional opinion. As is true for all guidelines, the health care provider must apply clinical judgment dictated by the conditions present in the given traumatic situation. The IADT does not guarantee favorable outcomes from following the Guidelines, but using the recommended procedures can maximize the chances of success.

Introduction

The Guidelines contain recommendations for diagnosis and treatment of specific traumatic dental injuries using proper examination procedures:

A. **Clinical Examination.**

Information about examination of traumatic injuries can be found in a number of current textbooks (links).

B. **Radiographic examination**

As a routine, several angles are recommended:

1. 90° horizontal angle, with central beam through the tooth in question
2. Occlusal view
3. Lateral view from the mesial or distal aspect of the tooth in question

C. **Sensibility tests**

Sensibility testing refers to tests (electric pulp test or cold test) to determine the condition of the tooth pulp. Initial tests following an injury frequently give negative results, but such results may only indicate a transient lack of pulpal response. Follow-up controls are needed to make a definitive pulpal diagnosis.

D. **Patient instructions**

Good healing following an injury to the teeth and oral tissues depends, in part, on good oral hygiene. Patients should be advised on how best to care for teeth that have received treatment after an injury. Brushing with a soft brush and rinsing with chlorhexidine 0.1% is beneficial to prevent accumulation of plaque and debris.

1. Treatment guidelines for fractures of teeth and alveolar bone

Uncomplicated crown fracture
Complicated crown fracture
Crown-root fracture
Root fracture
Alveolar fracture

2. Treatment guidelines for luxation injuries

Concussion
Subluxation
Extrusive luxation
Lateral luxation
Intrusive luxation

3. Treatment for avulsed permanent teeth

Avulsed tooth with a closed apex
Avulsed tooth with an open apex

PERMANENT TEETH

1. Treatment guidelines for fractures of teeth and alveolar bone

Uncomplicated Crown Fracture

Clinical findings	Radiographic findings	Treatment
Fracture involves enamel or dentin and enamel; the pulp is not exposed. Sensibility testing may be negative initially indicating transient pulpal damage; monitor pulpal response until a definitive pulpal diagnosis can be made.	The 3 angulations described in the <i>Introduction</i> to rule out displacement or fracture of the root. Radiograph of lip or cheek lacerations is recommended to search for tooth fragments or foreign material.	If tooth fragment is available, it can be bonded to the tooth. Urgent care option is to cover the exposed dentin with a material such as glass ionomer or a permanent restoration using a bonding agent and composite resin. Definitive treatment for the fractured crown may be restoration with accepted dental restorative materials.

Complicated Crown Fracture

Clinical findings	Radiographic findings	Treatment
Fracture involves enamel and dentin and the pulp is exposed. Sensibility testing is usually not indicated initially since vitality of the pulp can be visualized. Follow-up control visits after initial treatment includes sensibility testing to monitor pulpal status.	The 3 angulations described in the <i>Introduction</i> to rule out displacement or fracture of the root. Radiograph of lip or cheek lacerations is recommended to search for tooth fragments or foreign material. The stage of root development can be determined from the radiographs.	In young patients with immature, still developing teeth, it is advantageous to preserve pulp vitality by pulp capping or partial pulpotomy. This treatment is also the choice in young patients with completely formed teeth. Calcium hydroxide and MTA (white) are suitable materials for such procedures. In older patients, root canal treatment can be the treatment of choice, although pulp capping or partial pulpotomy may also be selected. If too much time elapses between accident and treatment and the pulp becomes necrotic, root canal treatment is indicated to preserve the tooth. In extensive crown fractures a decision must be made whether treatment other than extraction is feasible.

Crown-Root Fracture

Clinical findings	Radiographic findings	Treatment
Fracture involves enamel, dentin and root structure; the pulp may or may not be exposed. Additional findings may include loose, but still attached, segments of the tooth. Sensibility testing is usually positive.	As in root fractures, more than one radiographic angle may be necessary to detect fracture lines in the root. (see <i>Introduction for radiographic recommendations</i>).	Treatment recommendations are the same as for complicated crown fractures (See above). In addition, attempts at stabilizing loose segments of the tooth by bonding may be advantageous, at least as a temporary measure, until a definitive treatment plan can be formulated.

Root Fracture

Clinical findings	Radiographic findings	Treatment
The coronal segment may be mobile and may be displaced. The tooth may be tender to percussion. Sensibility testing may give negative results initially, indicating transient or permanent pulpal damage; monitoring the status of the pulp is recommended. Transient crown discoloration (red or grey) may occur.	The fracture involves the root of the tooth and is in a horizontal or diagonal plane. Fractures that are in the horizontal plane can usually be detected in the regular 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 diagonal, which is common with apical third fractures, an occlusal view is more likely to demonstrate the fracture including those located in the middle third.	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 one 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.

Alveolar Fracture

Clinical findings	Radiographic findings	Treatment
The fracture involves the alveolar bone and may extend to adjacent bone. Segment mobility and dislocation 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.	Fracture lines may be located at any level, from the marginal bone to the root apex. The panoramic technique is of great help in determining the course and position of fracture lines.	Reposition any displaced segment and then splint. Stabilize the segment for 4 weeks.

Follow-up procedures for fractured permanent teeth and alveolar fractures

Time	4 weeks	6-8 weeks	4 months	6 months	1 year	5 years
Uncomplicated crown fracture		C(1)			C(1)	
Complicated crown fracture		C(1)			C(1)	
Crown-root fracture		C(1)			C(1)	
Root fracture	S+C(2)	C(2)	S(*)+C(2)	C(2)	C(2)	C(2)
Alveolar fracture	S+C(3)	C(3)	C(3)	C(3)	C(3)	C(3)

S = Splint removal

S(*) = Splint removal in cervical third fractures

C = Clinical and radiographic examination

Favorable and Unfavorable outcomes include some, but not necessarily all of the following:

	Favorable Outcome	Unfavorable Outcome
(1)	Asymptomatic; positive response to pulp testing; continuing root development in immature teeth. Continue to next evaluation.	Symptomatic; negative response to pulp testing; signs of apical periodontitis; no continuing root development in immature teeth. Root canal treatment is indicated.
(2)	Positive response to pulp testing (false negative possible up to 3 months). Signs of repair between fractured segments. Continue to next evaluation.	Negative response to pulp testing (false negative possible up to 3 months). Clinical signs of periodontitis. Radiolucency adjacent to fracture line. Root canal treatment is indicated only to the line of fracture.
(3)	Positive response to pulp testing (false negative possible up to 3 months). No signs of apical periodontitis. Continue to next evaluation.	Negative response to pulp testing (false negative possible up to 3 months). Signs of apical periodontitis or external inflammatory resorption. Root canal treatment is indicated.

2. Treatment Guidelines for Luxation Injuries

Concussion

Clinical findings	Radiographic findings	Treatment
The tooth is tender to touch or tapping; it has not been displaced and does not have increased mobility. Sensibility tests are likely to give positive results	No radiographic abnormalities.	No treatment is needed. Monitor pulpal condition for at least one year.

Subluxation

Clinical findings	Radiographic findings	Treatment
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 abnormalities are usually not found.	A flexible splint to stabilize the tooth for patient comfort can be used for up to 2 weeks.

Extrusive luxation

Clinical findings	Radiographic findings	Treatment
The tooth appears elongated and is excessively mobile. Sensibility tests will likely give negative results. In mature teeth, pulp revascularization some times occurs. In immature, not fully developed teeth, pulpal revascularization usually occurs.	Increased periodontal ligament space apically.	Reposition the tooth by gently re-inserting it into the tooth socket. Stabilize the tooth for 2 weeks using a flexible splint. Monitoring the pulpal condition is essential to diagnose root resorption. In immature developing teeth, revascularization can be confirmed radiographically by evidence of continued root formation and pulp canal obliteration and usually return to positive response to sensibility testing. In fully formed teeth, a continued lack of response to sensibility testing should be taken as evidence of pulp necrosis together with periapical rarification and sometimes crown discoloration.

Lateral luxation

Clinical findings	Radiographic findings	Treatment
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. Sensibility tests will likely give negative results. In immature, not fully developed teeth, pulpal revascularization usually occurs.	The widened periodontal ligament space is best seen on eccentric or occlusal exposures.	Reposition the tooth 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. In immature, developing teeth, revascularization can be confirmed radiographically by evidence of continued root formation and possibly by positive sensibility testing. In fully formed teeth, a continued lack of response to sensibility testing indicates pulp necrosis, along with periapical rarification and sometimes crown discoloration.

Intrusive luxation

Clinical findings	Radiographic findings	Treatment
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. In immature, not fully developed teeth, pulpal revascularization may occur.	The periodontal ligament space may be absent from all or part of the root.	<p>1. <i>Teeth with incomplete root formation:</i> Allow spontaneous repositioning to take place. If no movement is noted within 3 weeks, recommend rapid orthodontic repositioning.</p> <p>2. <i>Teeth with complete root formation:</i> The tooth should be repositioned either orthodontically or surgically as soon as possible. The pulp will likely be necrotic and root canal treatment using a temporary filling with calcium hydroxide is recommended to retain the tooth.</p>

Follow-up procedures for luxated permanent teeth

Time	Up to 2 weeks	4 weeks	6-8 weeks	6 months	1 year	Yearly for 5 years
Concussion/Subluxation		C(1)	C(1)		C(1)	NA
Extrusive luxation	S+C(2)	C(3)	C(3)	C(3)	C(3)	C(3)
Lateral luxation	C(3)	S	C(3)	C(3)	C(3)	C(3)
Intrusive luxation	C(4)		C(4)	C(4)	C(4)	C(4)

S = Splint removal

C = Clinical and radiographic examination

NA = Not applicable

Favorable and Unfavorable outcomes include some, but not necessarily all of the following:

	Favorable Outcome	Unfavorable Outcome
(1)	Asymptomatic; positive response to pulp testing (false negative possible up to 3 months); continuing root development in immature teeth; intact lamina dura.	Symptomatic; negative response to pulp testing (false negative possible up to 3 months); no continuing root development in immature teeth, periradicular radiolucencies.
(2)	Minimal symptoms; slight mobility; no excessive radiolucency periradicularly.	Severe symptoms; excessive mobility; clinical and radiographic signs of periodontitis. Root canal treatment is indicated in a closed apex tooth. In immature teeth, apexification procedures are indicated.
(3)	Asymptomatic; clinical and radiographic signs of normal or healed periodontium; positive response to pulp testing (false negative possible up to 3 months). Marginal bone height corresponds to that seen radiographically after repositioning.	Symptoms and radiographic sign consistent with periodontitis; negative response to pulp testing (false negative possible up to 3 months); breakdown of marginal bone. Splint for additional 3-4 week period; root canal treatment is indicated if not previously initiated; chlorhexidine mouth rinse.
(4)	Tooth in place or erupting; intact lamina dura; no signs of resorption. In mature teeth start the root canal treatment within the first three weeks.	Tooth locked in place / ankylosed tone; radiographic signs of apical periodontitis; external inflammatory resorption or replacement resorption.

3. Treatment guidelines for avulsed permanent teeth

3.1 Tooth with a closed apex

- The tooth has already been replanted
- The tooth has been kept in special storage media (Hank's Balanced Salt Solution), milk, saline, or saliva. The extra-oral dry time is less than 60 minutes.
- Extra-oral dry time longer than 60 minutes.

3.2 Tooth with open apex

- The tooth has already been replanted
- The tooth has been kept in special storage media (Hank's Balanced Salt Solution), milk, saline, or saliva. The extra-oral dry time is less than 60 minutes
- Extra-oral dry time longer than 60 minutes

3.1 Treatment guidelines for avulsed permanent teeth with closed apex

Clinical situation (3.1a)	Treatment
Closed apex The tooth has been replanted, prior to the patient arriving in the dental office or clinic.	<p>Clean the area with water spray, saline or chlorhexidine. Do not extract the tooth. 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.</p> <p>Administer systemic antibiotics. Tetracycline is the first choice (Doxycycline 2x per day for 7 days at appropriate dose for patient age and weight). <u>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).</u> In young patients Phenoxymethyl Penicillin (Pen V), in an appropriate dose for age and weight, can be given as alternative to tetracycline.</p> <p>If the avulsed tooth has contacted soil, and if tetanus coverage is uncertain, refer to physician for evaluation and need for a tetanus booster.</p> <p>Initiate root canal treatment 7 to 10 days after replantation and before splint removal. Place calcium hydroxide as an intra-canal medicament until filling of the root canal.</p> <p>Patient instructions Soft diet for up to two weeks. Brush teeth with a soft toothbrush after each meal. Use a chlorhexidine (0.1%) mouth rinse twice a day for 1 week.</p> <p>Follow-up See 'Follow-up procedures for avulsed permanent teeth' below.</p>

Clinical situation (3.1b)	Treatment
Closed apex The tooth has been kept in special storage media (Hank's Balanced Salt Solution), milk, saline, or saliva. The extra-oral dry time is less than 60 minutes.	<p>If contaminated, clean the root surface and apical foramen with a stream of saline and place the tooth in saline. Remove the coagulum from the socket with a stream of 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. Verify normal position of the replanted tooth both clinically and radiographically. Apply a flexible splint for up to 2 weeks.</p> <p>Administer systemic antibiotics. Tetracycline is the first choice (Doxycycline 2x per day for 7 days at appropriate dose for patient age and weight). <u>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).</u> In young patients Phenoxymethyl Penicillin (Pen V), at appropriate dose for age and weight, can be given as alternative to tetracycline.</p> <p>If the avulsed tooth has contacted soil, and if tetanus coverage is uncertain, refer the patient to a physician for evaluation and need for a tetanus booster.</p> <p>Initiate root canal treatment 7 to 10 days after replantation and before splint removal. Place calcium hydroxide as an intra-canal medicament until filling of the root canal.</p> <p>Patient instructions Soft diet for up to two weeks. Brush teeth with a soft toothbrush after each meal. Use a chlorhexidine (0.1%) mouth rinse twice a day for 1 week.</p> <p>Follow-up See 'Follow-up procedures for avulsed permanent teeth' below.</p>

Clinical situation (3.1c)	Treatment
Closed apex Extra-oral dry time longer than 60 minutes	<p>Delayed replantation has a poor long term prognosis. The periodontal ligament will be necrotic and not expected to heal. The goal in doing delayed replantation is to promote alveolar bone growth to encapsulate the replanted tooth. The expected eventual outcome is ankylosis and resorption of the root. In children below the age of 15, if ankylosis occurs, and when the infraposition of the tooth crown is more than 1mm, it is recommended to perform decoronation to preserve the contour of the alveolar ridge.</p> <p>The technique for delayed replantation is:</p> <ol style="list-style-type: none"> 1. Remove attached necrotic soft tissue with gauze. 2. Root canal treatment can be done on the tooth prior to replantation, or it can be done 7-10 days later as for other replantations. 3. Remove the coagulum from the socket with a stream of saline. Examine the alveolar socket. If there is a fracture of the socket wall, reposition it with a suitable instrument. 4. Immerse the tooth in a 2% sodium fluoride solution for 20 minutes. 5. Replant the tooth slowly with slight digital pressure. Suture gingival laceration. Verify normal position of the replanted tooth clinically and radiographically. 6. Stabilize the tooth for 4 weeks using a flexible splint. <p>Administration of systemic antibiotics, see 3.1b.</p> <p>Refer to physician for evaluation of need for a tetanus booster if the avulsed tooth has contacted soil or tetanus coverage is uncertain.</p> <p>Patient instruction Soft diet for up to two weeks. Brush teeth with a soft toothbrush after each meal. Use a chlorhexidine (0.1%) mouth rinse twice a day for 1 week.</p> <p>Follow-up See <i>Follow-up procedures for avulsed permanent teeth</i> below.</p>

3.2 Treatment guidelines for avulsed permanent teeth with open apex.

Clinical situation (3.2a)	Treatment
Open Apex The tooth has already been replanted prior to the patient arriving in the dental office or clinic.	<p>Clean the area with water spray, saline or chlorhexidine. Do not extract the tooth. 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.</p> <p>Administer systemic antibiotics. For children 12 years and younger: Penicillin V at an appropriate dose for patient age and weight. For children older than 12 years of age, where there is little risk for tetracycline discoloration; Tetracycline (Doxycycline 2x per day for 7 days at appropriate dose for patient age and weight).</p> <p>Refer the patient to a physician for evaluation of need for a tetanus booster if avulsed tooth has contacted soil or tetanus coverage is uncertain.</p> <p>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 may be recommended – see <i>Follow-up procedures for avulsed permanent teeth</i> below.</p> <p>Patient instructions Soft diet for up to two weeks. Brush teeth with a soft toothbrush after each meal. Use a chlorhexidine (0.1%) mouth rinse twice a day for 1 week.</p> <p>Follow-up See <i>Follow-up procedures for avulsed permanent teeth</i> below.</p>

Clinical situation (3.2b)	Treatment
<p>Open Apex The tooth has been kept in special storage media (Hank's balanced Salt Solution), milk, saline, or saliva. The extra-oral dry time is less than 60 minutes</p>	<p>If contaminated, clean the root surface and apical foramen with a stream of saline. Remove the coagulum from the socket with a stream of saline and then replant the tooth. If available, cover the root surface with minocycline hydrochloride microspheres (Arestin™, OraPharma Inc.) before replanting the tooth.</p> <p>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, especially in the cervical area. Verify normal position of the replanted tooth clinically and radiographically. Apply a flexible splint for up to 2 weeks.</p> <p>Administer systemic antibiotics. For children 12 years and younger: penicillin V at appropriate dose for patient age and weight. For children older than 12 years of age, where there is little risk for tetracycline discoloration: Tetracycline (Doxycycline 2x per day for 7 days at appropriate dose for patient age and weight).</p> <p>Refer to physician for evaluation of need for a tetanus booster if avulsed tooth has contacted soil or tetanus coverage is uncertain.</p> <p>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 may be recommended – see 'Follow-up procedures for avulsed permanent teeth' below.</p> <p>Patient instructions Soft diet for up to two weeks. Brush teeth with a soft toothbrush after each meal. Use a chlorhexidine (0.1%) mouth rinse twice a day for 1 week.</p> <p>Follow-up See 'Follow-up procedures for avulsed permanent teeth' below.</p>

Clinical situation (3.2c)	Treatment
<p>Open Apex Extra-oral dry time longer than 60 minutes</p>	<p>Delayed replantation has a poor long-term prognosis. The periodontal ligament will be necrotic and not expected to heal. The goal in doing delayed replantation of immature teeth in children is to maintain alveolar ridge contour. The eventual outcome is expected to be ankylosis and resorption of the root. It is important to recognize that if delayed replantation is done in a child, future treatment planning must be done to take into account the occurrence of tooth ankylosis and the effect of ankylosis on the alveolar ridge development. If ankylosis occurs, and when the infraposition of the tooth crown is more than 1mm, it is recommended to perform decoronation to preserve the contour of the alveolar ridge.</p> <p>The technique for delayed replantation is:</p> <ol style="list-style-type: none"> 1. Remove attached necrotic soft tissue with gauze. 2. Root canal treatment can be done on the tooth prior to replantation through the open apex. 3. Remove the coagulum from the socket with a stream of saline. Examine the alveolar socket. If there is a fracture of the socket wall, reposition it with a suitable instrument. 4. Immerse the tooth in a 2% sodium fluoride solution for 20 minutes. 5. Replant the tooth slowly with slight digital pressure. Suture gingival laceration. Verify normal position of the replanted tooth clinically and radiographically. 6. Stabilize the tooth for 4 weeks using a flexible splint. <p>Administration of systemic antibiotics, see 3.1b.</p> <p>Refer the patient to physician for evaluation of need for a tetanus booster if the avulsed tooth has contacted soil or tetanus coverage is uncertain.</p> <p>Patient instructions Soft diet for up to two weeks. Brush teeth with a soft toothbrush after each meal. Use a chlorhexidine (0.1%) mouth rinse twice a day for 1 week.</p> <p>Follow-up See 'Follow-up procedures for avulsed permanent teeth' below.</p>

Follow-up procedures for avulsed permanent teeth

Root canal treatment

If root canal treatment is indicated (teeth with closed apex), the ideal time to begin treatment is 7-10 days post-replantation. Calcium hydroxide is recommended for intra canal medication for up to one month followed by root canal filling with an acceptable material. An exception is a tooth that has been dry for more than 60 minutes before replantation – in such cases the root canal treatment may be done prior to replantation.

In teeth with open apices, that have been replanted immediately or kept in appropriate storage media, pulp revascularization is possible. Root canal treatment should be avoided unless there is clinical and radiographic evidence of pulp necrosis.

Clinical control

Replanted teeth should be monitored by frequent controls during the first year (once a week during the first month, 3, 6, and 12 months) and then yearly thereafter. Clinical and radiographic examination will provide information to determine outcome. Evaluation may include the findings described below.

Favorable outcome

- (1) **Closed apex:** Asymptomatic, normal mobility, normal percussion sound. No radiographic evidence of resorption or periradicular osteitis; the lamina dura should appear normal.
- (2) **Open apex:** Symptomatic, normal mobility, normal percussion sound. Radiographic evidence of arrested or continued root formation and eruption. Pulp canal obliteration is the rule.

Unfavorable outcome

- (1) **Closed apex:** Symptomatic, excessive mobility or no mobility (ankylosis) with high pitched percussion sound. Radiographic evidence of resorption (inflammatory, infection-related resorption, or ankylosis-related replacement resorption).
- (2) **Open apex:** Symptomatic, excessive mobility or no mobility (ankylosis) with high pitched percussion sound. IN the case of ankylosis, the crown of the tooth will appear to be in an infra-occlusal position. Radiographic evidence of resorption (inflammatory, infection-related resorption, or ankylosis-related replacement resorption).

Splinting guidelines for tooth/bone fractures and luxated/avulsed teeth

A. Splinting times

	Type of injury	Splinting time	
	Subluxation	2 weeks	
	Extrusive Luxation	2 weeks	
	Avulsion	2 weeks	
	Lateral Luxation	4 weeks	
	Root fracture (middle third)	4 weeks	
	Alveolar fracture	4 weeks	
	Root fracture (cervical third)	4 months	

B. Type of splints

1. Wire-composite splint
2. TTS (Titanium trauma splint)
3. Unfilled resin (Protemp®, Luxatemp®, Isotemp®, Provipond®)