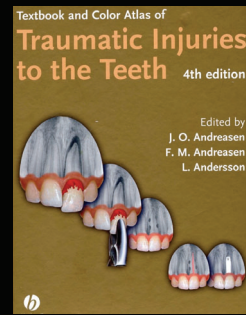


Biology, Technology, and Healing:
Managing Dental Trauma
And
Root Resorption

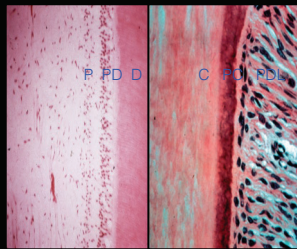
Sacramento District Dental Society MidWinter Convention
3/26/2026



<https://www.iadt-dentaltrauma.org/for-professionals.html>.

<http://www.aae.org/>

The Magic of Teeth



Traumatic injuries vs routine operative

- Goals may be different
- Mature vs immature root and apex
- Growth of patient
- Interpretation of tests/diagnosis
- Healing potential
- Requirements of materials
- Bacteria not involved initially

Incidence

Most dental trauma occurs in the 7-12 year-old age group.

1 in 3 males and 1 in 4 females will have dental trauma by age 20.





Prevention

- 4mm of overjet doubles likelihood of TDI
- Incompetent lips
- Short lip
- Mouth breathing
- Mouthguards can protect teeth and alveolus

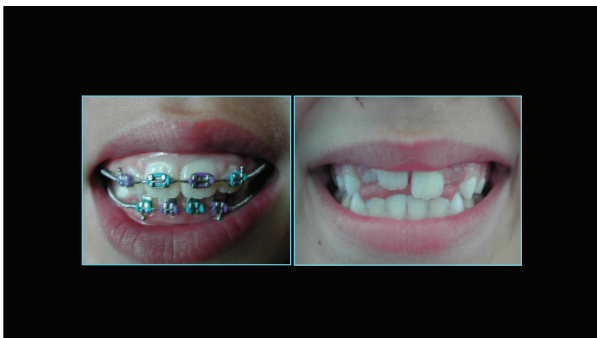
Mouthguards and Concussions

- Dissipation of forces
- Increased condylar separation
- Increased head stabilization

These are all theories only

Reproducing concussions

**Biomechanically Tested AND Proven to -
"Reduce Jaw Impact Energy to the Teeth, TMJ,
& Base of Skull !"**



History

- Chief complaint
- How:
 - Blow to lips and ant. teeth can give crown, root, and bone fractures. Not likely to damage posterior teeth.
 - Blow under chin can fracture any tooth.
 - Padded blows are likely to give root fractures and tooth displacements.
 - Sharp blows will give coronal fractures.



Family Violence



RADAR

R - RECOGNIZE SIGNS AND SYMPTOMS OF ABUSE/NEGLECT; ROUTINELY SCREEN WITH PERMISSION.
 "Please tell me about _____ injury."
 "Have you been hit, kicked, punched, or otherwise hurt by someone within the past year? If so, by whom?"
 "Do you feel safe in your current relationship?"
 "Does a partner from a previous relationship make you feel unsafe now?"

D - DOCUMENT YOUR FINDINGS
 The dental chart is a legal document.

A - ASSESS PATIENT SAFETY
 "Is there a weapon involved? Is patient in immediate danger?"

R - REVIEW, REFER, REPORT

Important numbers:
 National Child Abuse Hotline: 1-800-4-A-CHILD (1-800-422-4443)
 California Youth Crisis Line: 1-800-952-0099
 California Elder and Dependent Adult Abuse Hotline: 1-800-422-3800
 National Domestic Violence Hotline: 1-800-799-7233 or 1-800-785-2214 (TTS)
 These numbers can be found in the front of your local phone book.

Child Protective Services: _____
 Law enforcement/medical examiner: _____
 Adult Protective Services: _____

History cont.

Where:

- Important for tetanus, insurance, litigation

When:

- Very important for treatment decisions

Is there a history of previous trauma or treatment?

Exam

Neurologic:

- Can the patient communicate coherently?
- Can the patient rotate his/her head?
- Is there parasthesia of any area?
- Is the patient drowsy, dizzy, or nauseated?
- Does the patient have vision problems?
- Is there amnesia of events before or after injury?

REFER FOR MEDICAL EVALUATION

Cranial Nerves

- Olfactory
- Optic
- Oculomotor
- Trochlear
- Trigeminal
- Abducens

Cranial Nerves

- Facial
- Vestibulocochlear
- Glossopharyngeal
- Vagus
- Spinal Accessory
- Hypoglossal



Exam cont.

External:

check for opening and symmetry (condylar or mandibular fracture)

Soft tissues:

check for lacerations

palpate lips and mucosa



Exam cont.

Hard Tissues

Examine for:

- number of teeth
- malpositioned teeth
- occlusal plane discrepancies
- mobility
- crown/cusp fractures
- Transillumination

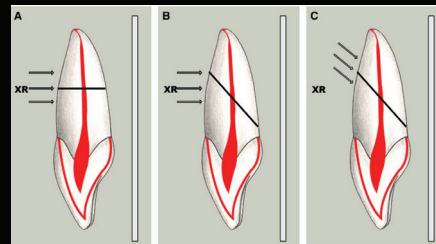
Exam cont.

Pulp tests:

- use as baseline only
- cold and electric pulp tests
- be aware of false negative response
- Transient lack of neural response and undifferentiation of A-Delta fibers in young teeth
- retest at 3 weeks, 3, 6 and 12 months.

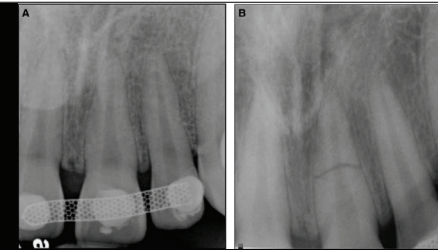
Radiographs

- Take multiple angles
- Record:
 - apical closure
 - pulp space appearance
 - proximity of fracture to pulp
 - root fractures
- Re-eval in 6 wks, 3 months 6 mo, 12mo, yearly
- If there is any ambiguity, CBCT



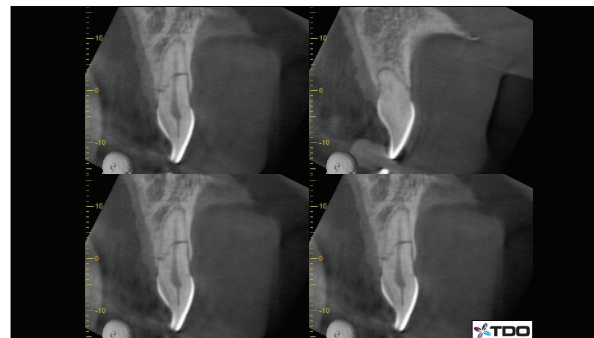
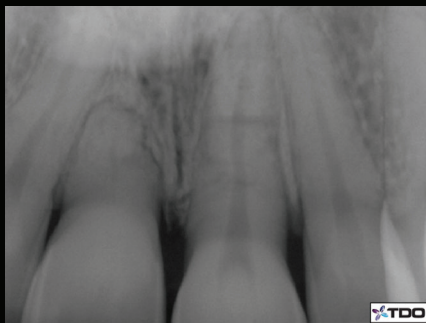
Endodontic Topics

Bakland, L. K. (2015). Trauma-related fractures. *Endod Topics*, 33: 157-168.



Endodontic Topics

Bakland, L. K. (2015). Trauma-related fractures. *Endod Topics*, 33: 157-168.



Patient instructions following dental injuries

- Soft diet for two weeks
- Brush teeth with soft toothbrush after each meal
- Avoid contact sports
- CHX 0.12% BID
- Diligent recall
- Teeth are damaged

Treatment timing

Acute:

- Immediately. Prognosis is decreased if time elapses before treatment.

Subacute:

- Within 24 to 48 hrs.

Delayed:

- Mutual convenience.

General Principles

- Immature pulp vs mature pulp
- Root development
- Alveolar development
- Pulp is dynamic

TDI Complications

- Pulp Necrosis and infection
- Pulp space obliteration
- Various types of root resorption
- Breakdown of marginal gingiva and bone.

Crown fractures

• Infraction:

- no treatment
- Possible bonding agent

• Enamel only:

- smooth sharp edges, restore if needed

SA/D



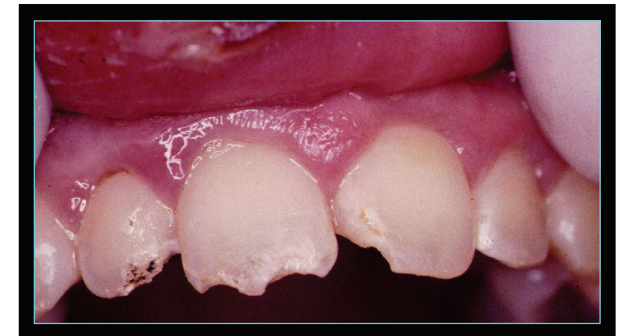
Crown fractures cont.

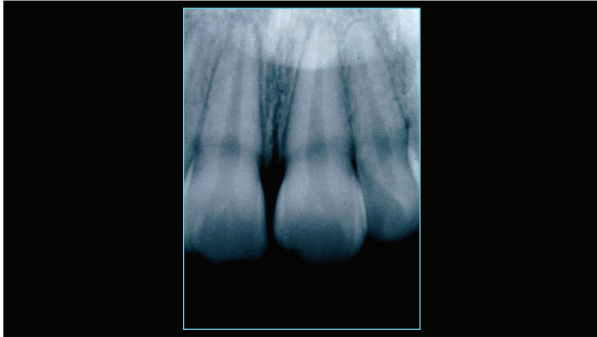
Enamel and dentin: Uncomplicated

• Seal tubules by placing a suitable composite restoration with base. If there is 0.5mm dentin, any restoration may be placed.

- SA/D
- F/U: 6-8 weeks, year
- Good prognosis

Crown Fracture





Crown fractures cont.

Enamel, Dentin, and Pulp:

- Complicated
- Maintain vitality of pulp if at all possible by vital pulp therapy.

Vital Pulp Therapy

- Affected tooth is anesthetized and isolated.
- The Exposure site is cleaned with saline and 0.12%CHX or NaOCl
- Bioceramic (MTA) is placed over exposure. Glass Ionomer is placed over bioceramic
- Surrounding dentin is etched and restored.
- Alternative material is Ca (OH)₂
- New materials are BC putty and Biodentine
- MTA will stain tooth

Bioceramics

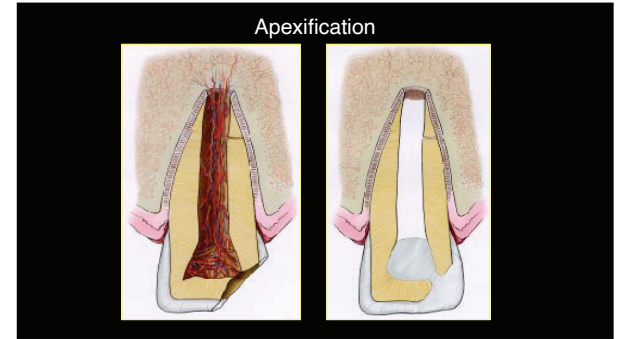
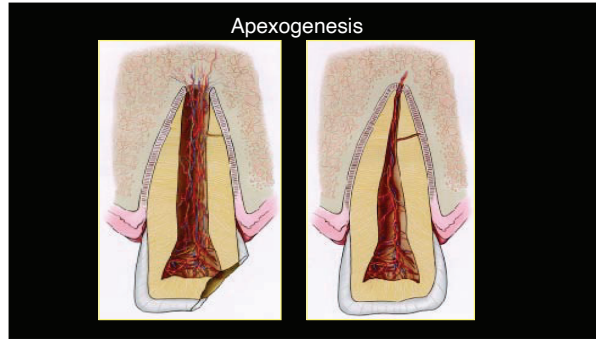
- Initial material was MTA
- Modified portland cement
- High pH
- Induce mineralization



Bioactive is not the same as Bioceramic!



EndoSequence BC RRM (fast set)



Crown fractures cont.

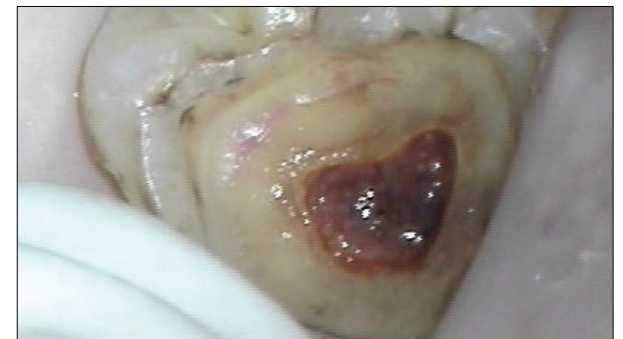
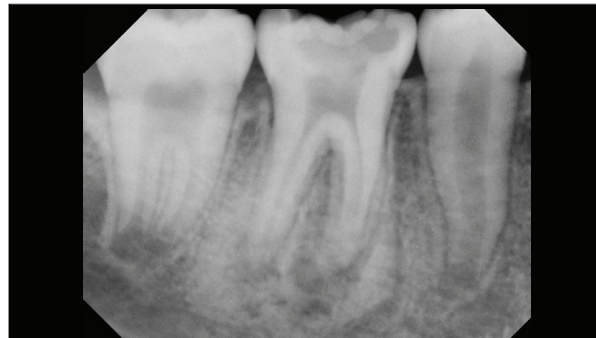
Virtual pulp therapy is recommended for:

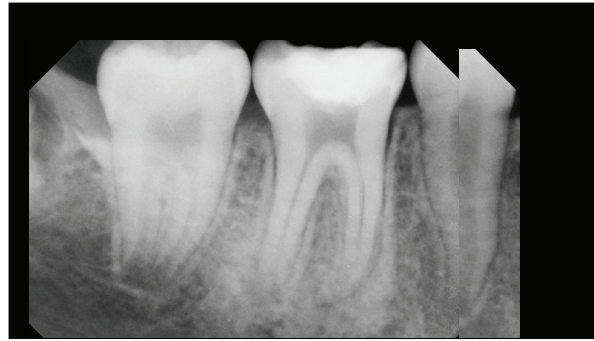
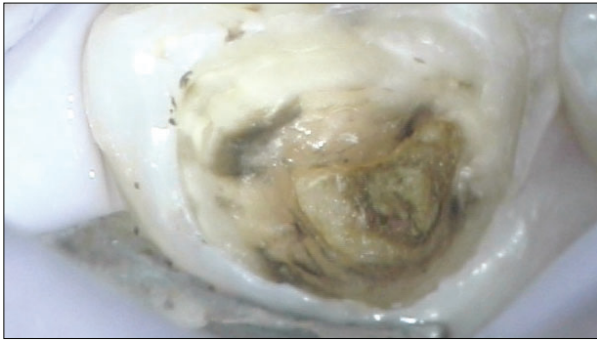
- Teeth with incompletely formed roots.
- Teeth with small exposures where bleeding can be easily controlled

Virtual pulp therapy is not recommended for:

- Teeth with mature apices and displacement
- Teeth with calcific changes

SA





Crown fractures cont.

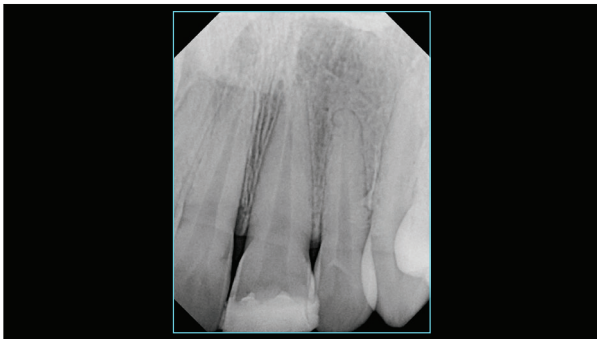
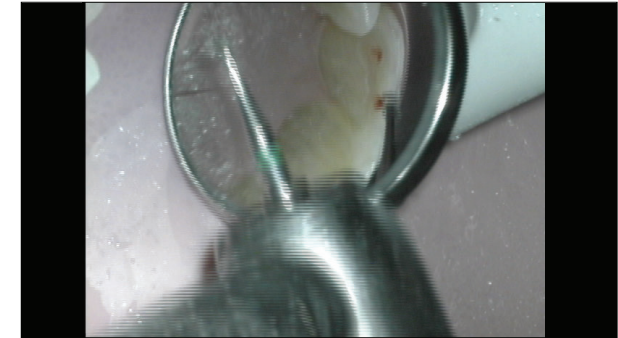
Pulpotomy is recommended for:

- Teeth with larger exposures and immature roots.

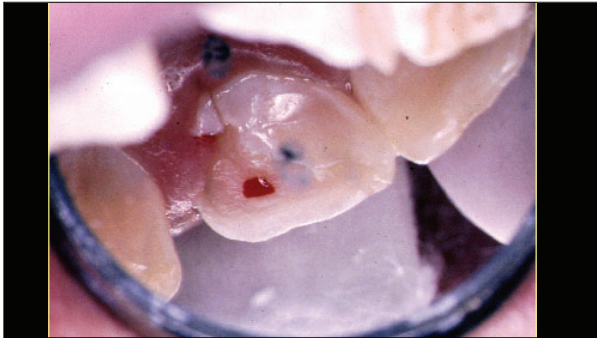
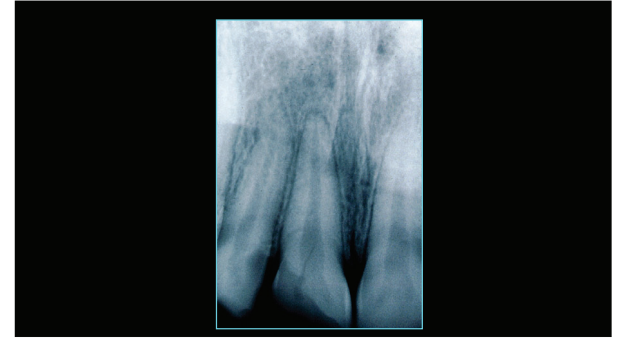
Pulpectomy (RCT) usually not warranted after pulpotomy.

Pulpotomy (Cvek)


- Anesthesia, isolation disinfection as in pulp capping
- Remove 1-2mm of pulp with a round diamond and water coolant to moderate hemorrhage.
- Place Ca(OH)₂ or Bioceramic
- Restore
- SA
- F/U 6-8 weeks, 3mo, 6mo, yearly
- Good prognosis



Crown-root Fractures



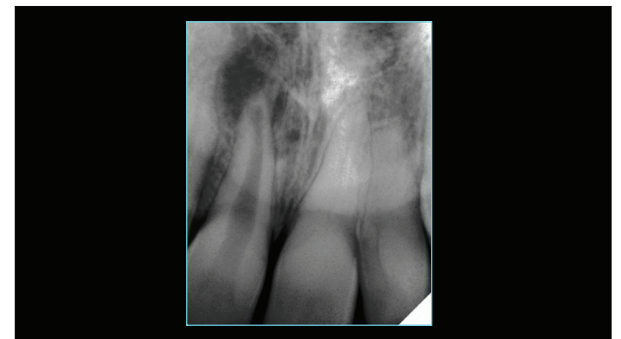
F/U
1 week, 6-8 weeks,
3mo, 6mo, yearly
Good prognosis

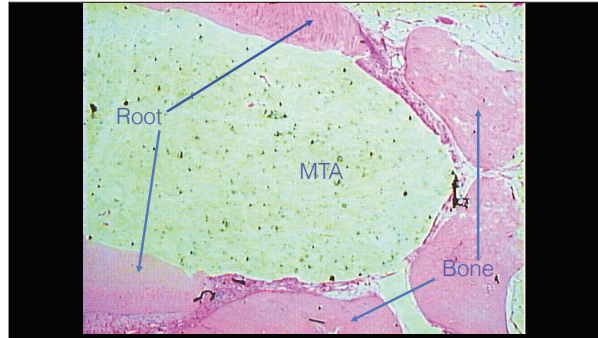
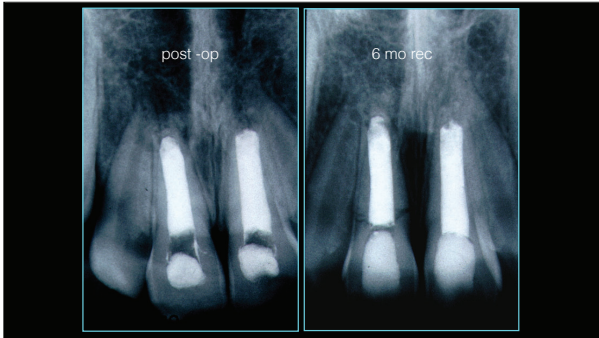
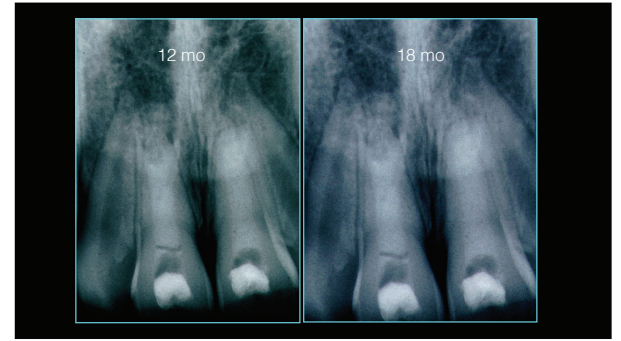
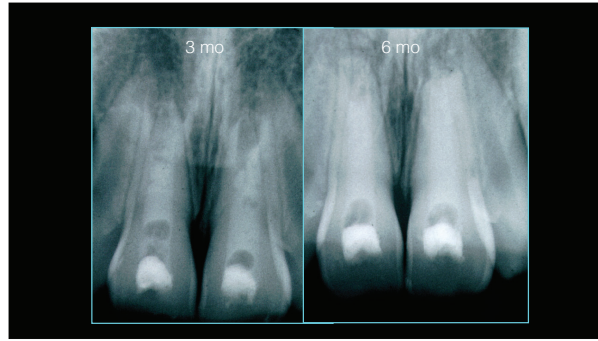
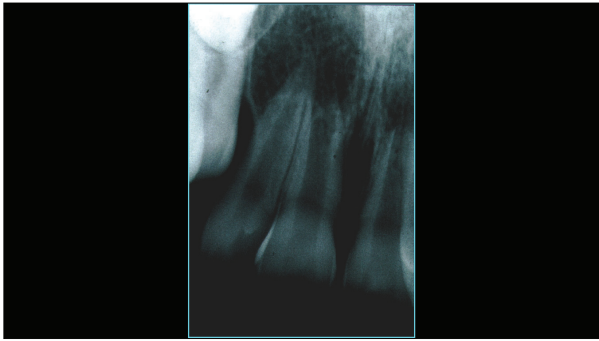


Follow-up

Pulpal response to trauma:

1. Repair
2. Mineralization/Obliteration
3. Internal resorption
4. Necrosis





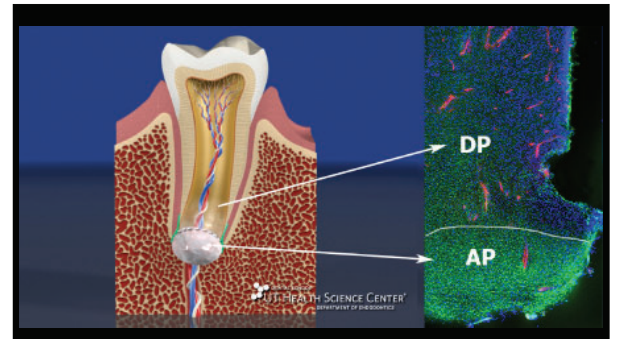
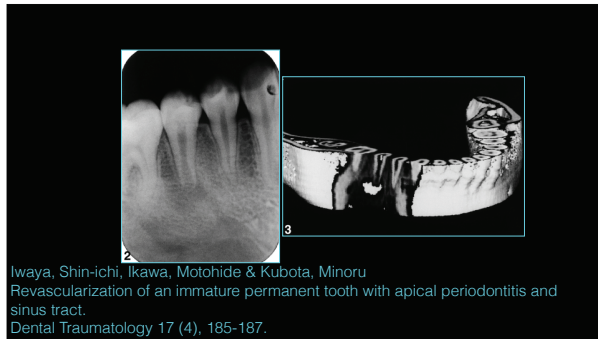
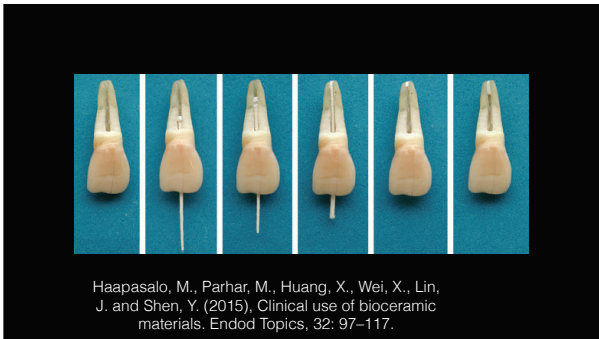
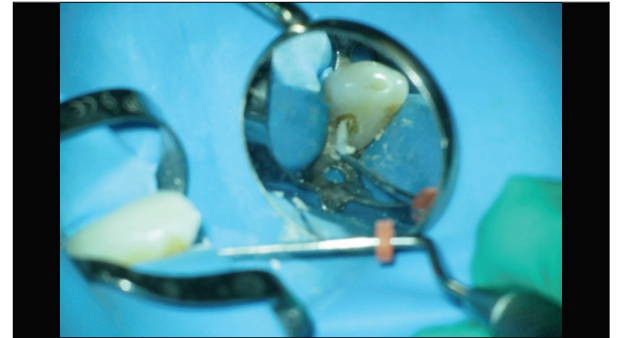
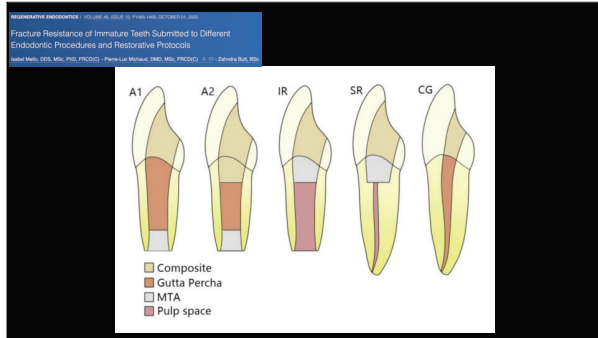
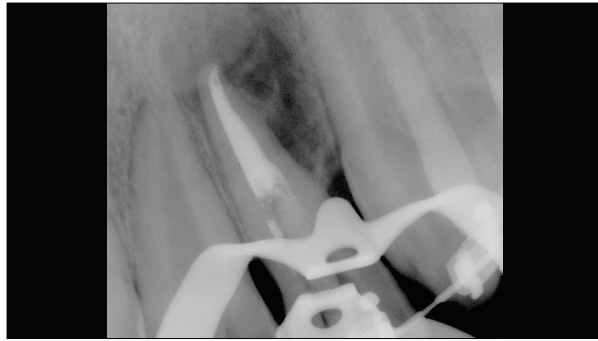
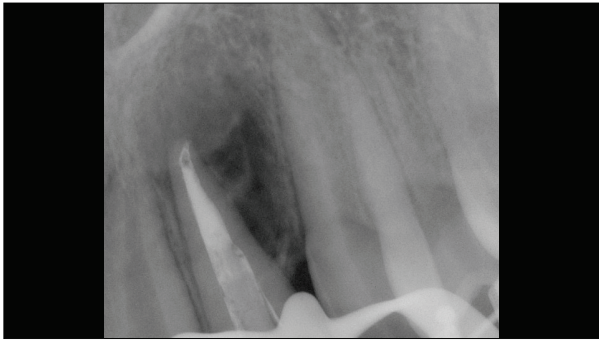
BASIC RESEARCH-BIOLOGY | ARTICLES IN PRESS

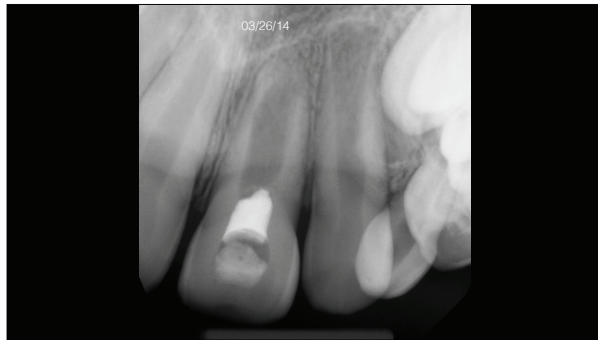
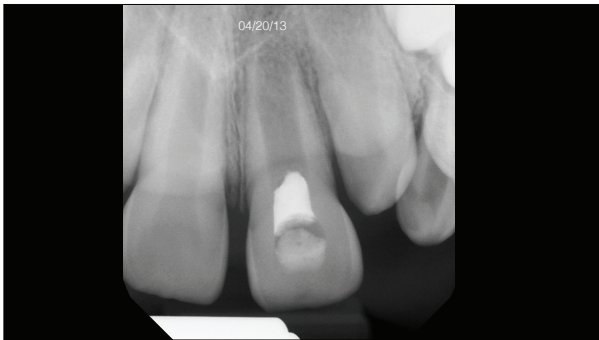
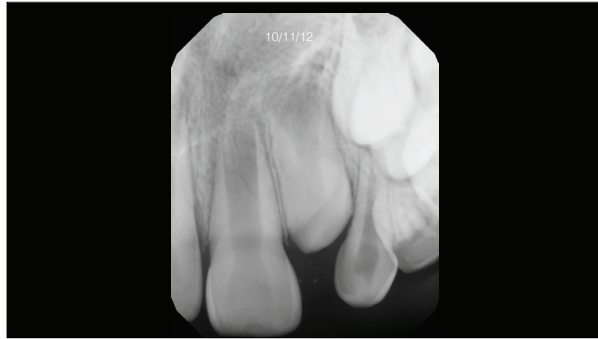
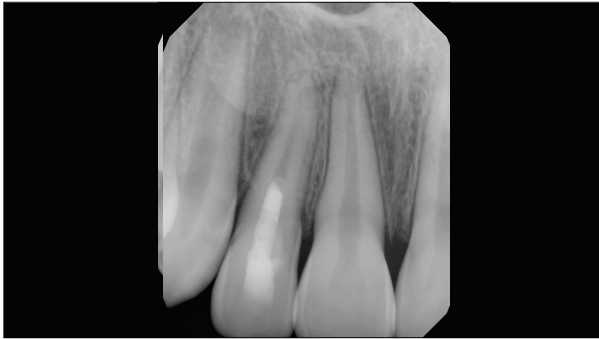
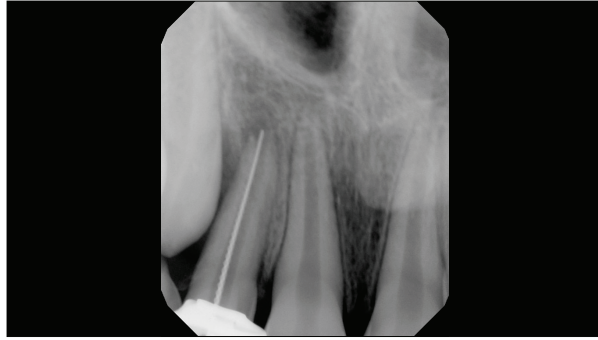
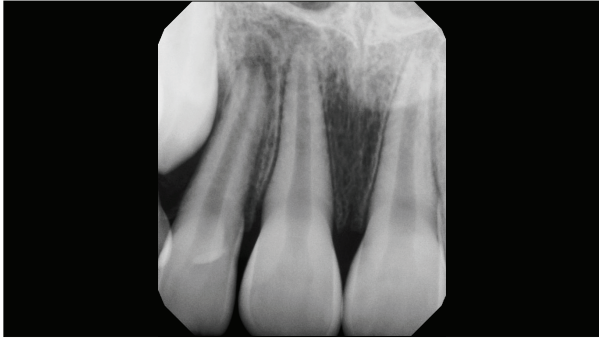
The effect of transforming growth factor- β 1 on the mineralization of human cementoblasts

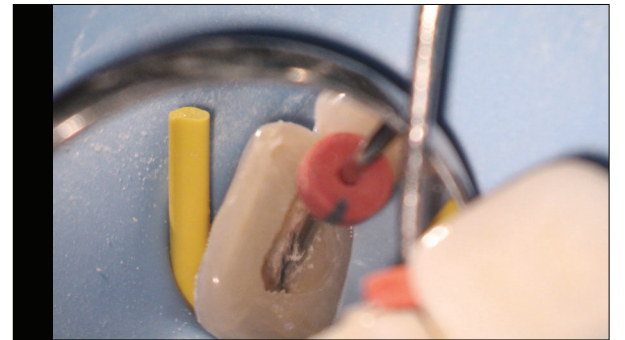
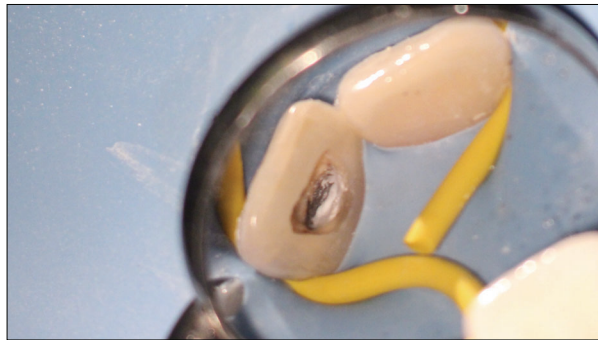
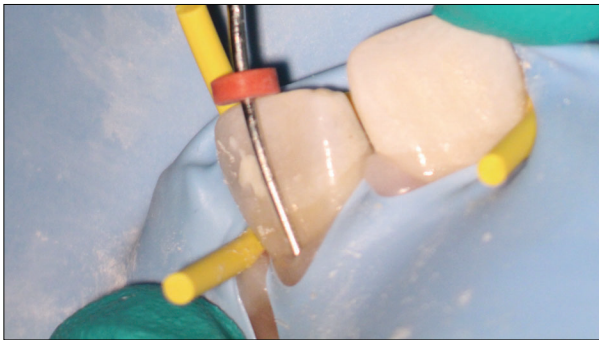
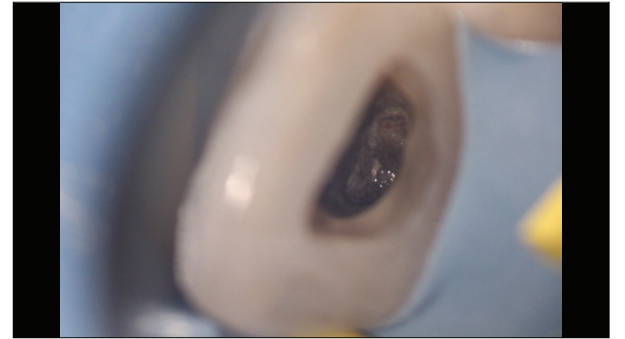
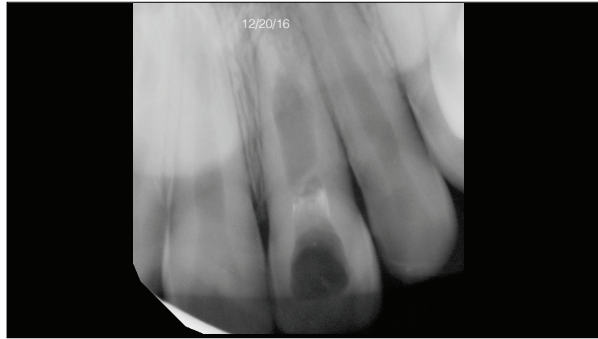
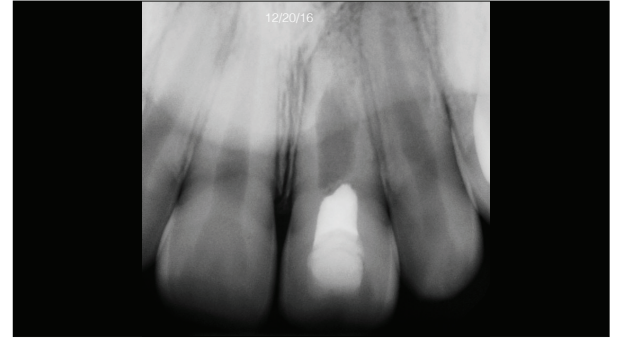
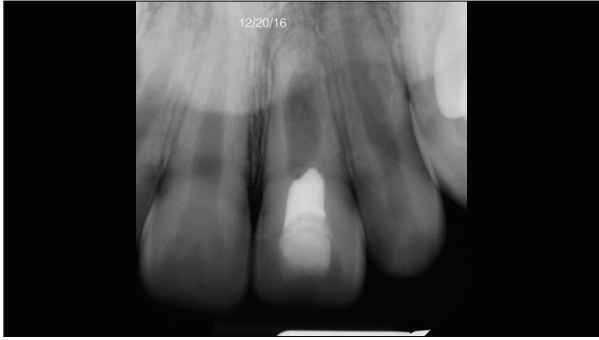
Taki Koba, DDS · Kiyoko Watanabe, BS, PhD · Seiji Goto, DDS, PhD · Noriko Mutoh, DDS, PhD · Nobuhiro Hamada, DDS, PhD · Nobuyuki Tanaka, DDS, PhD · Show all authors

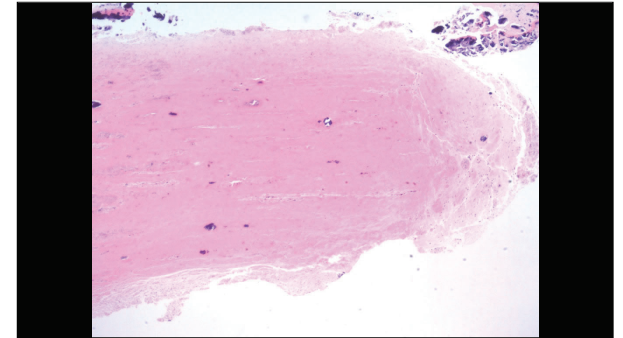
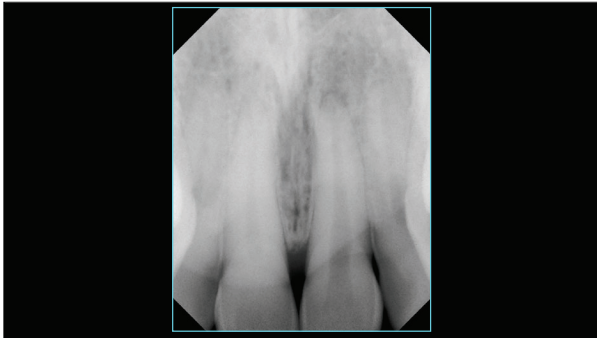
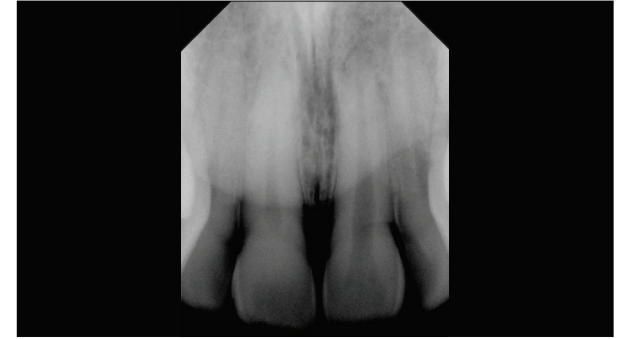
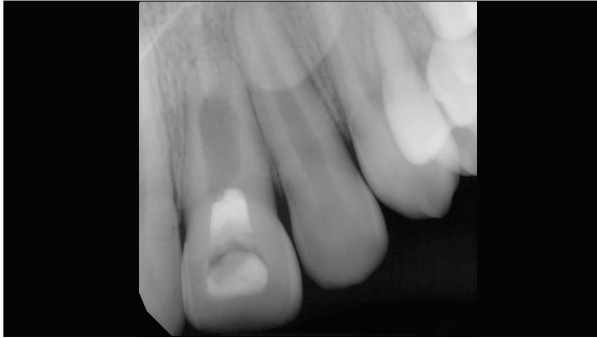
Published: January 09, 2021 · DOI: <https://doi.org/10.1016/j.jcr.2020.12.019>





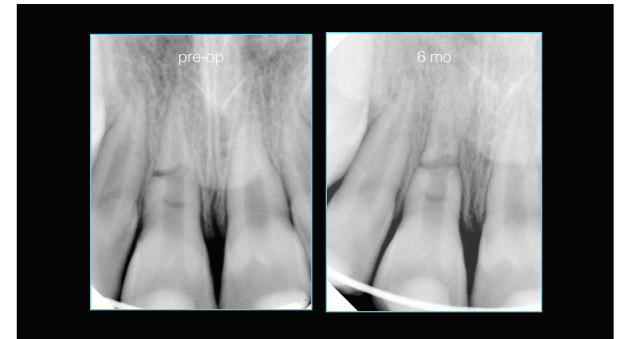
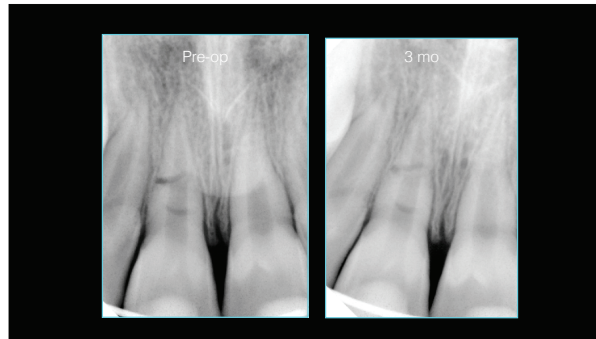


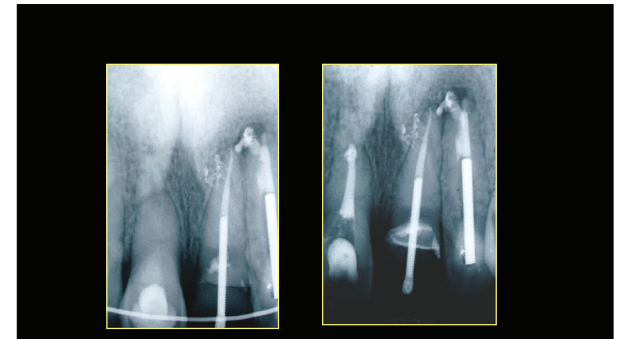
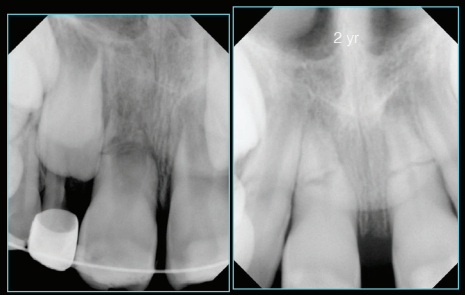
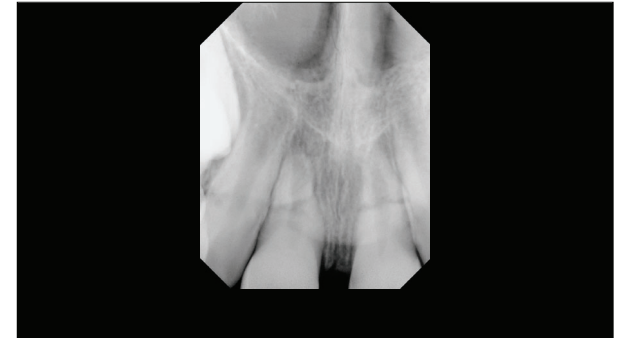
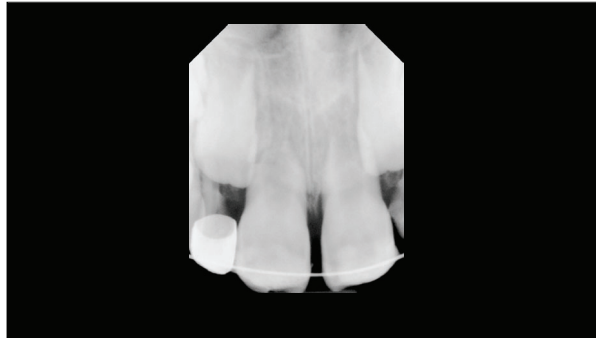
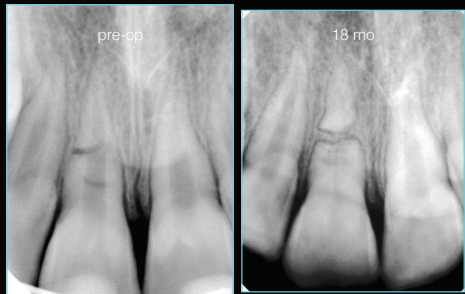
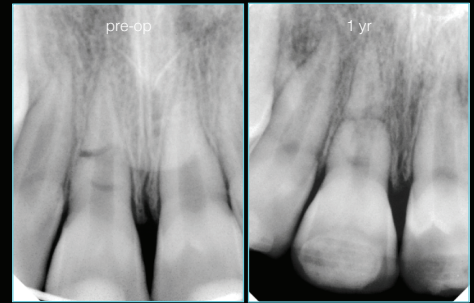
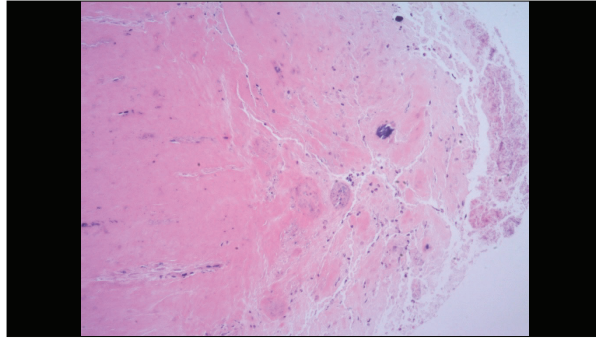
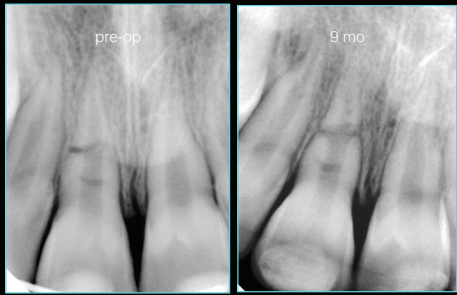


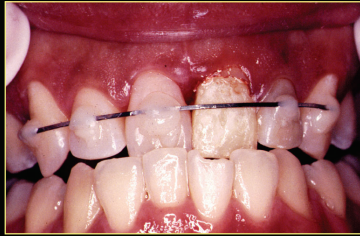


Root Fractures

- Many will require no treatment (especially undeveloped roots)
- Treat coronal segment only
- Minimal splinting

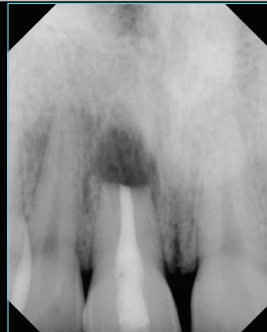
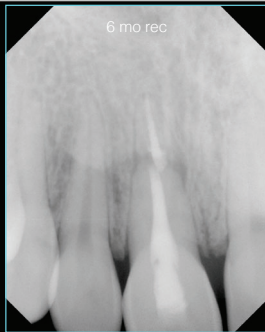
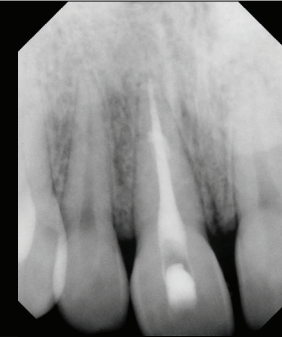






Root Fracture

- Splint 4 weeks up to 4 months if fracture located cervically
- Monitor pulp status for extended period
- Healing with various patterns
- F/U weeks to 4 months splint removal, 6-8weeks, 6 months, yearly



Prognosis of Root Fractures

- Apical third
 - good
- Middle third
 - fair
- Coronal third
 - poor if above alveolar crest.

Alveolar fracture

- Similar to root fracture
- Suture soft tissue lacerations
- No long term splint

Management of Tooth Luxations

Luxation injuries

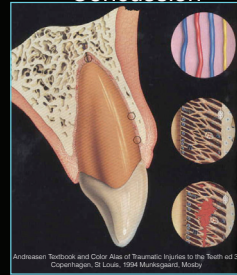
Concussion

- Adjust occlusion.
- F/U 4 weeks, 1 year
- SA

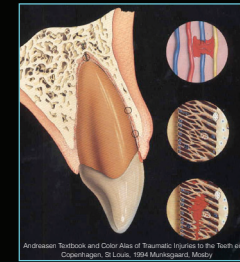
Subluxation

- Splint if needed for 2 weeks
- F/U 2 weeks, 4 weeks, 6-8 weeks, 6 months, 12 months
- Good prognosis
- SA

Concussion



Subluxation

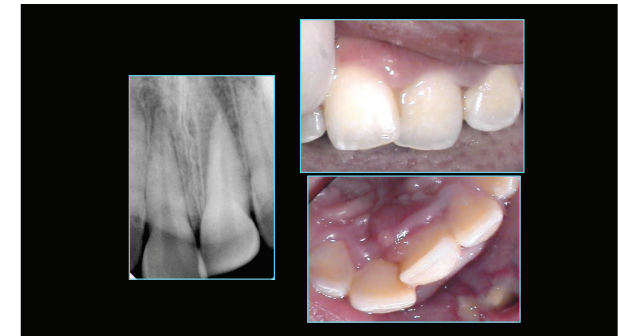
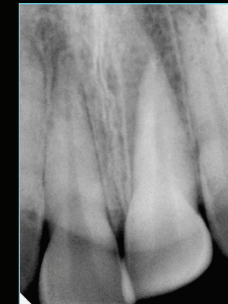
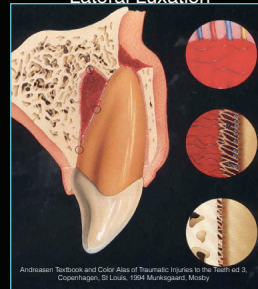


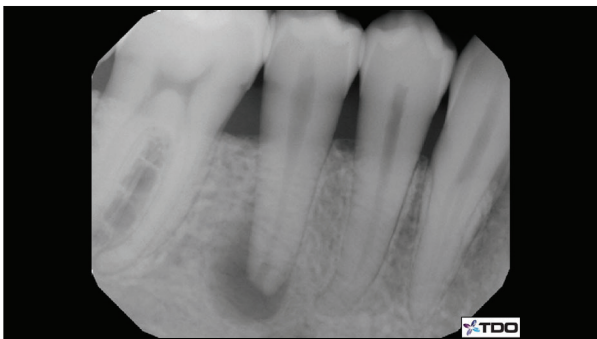
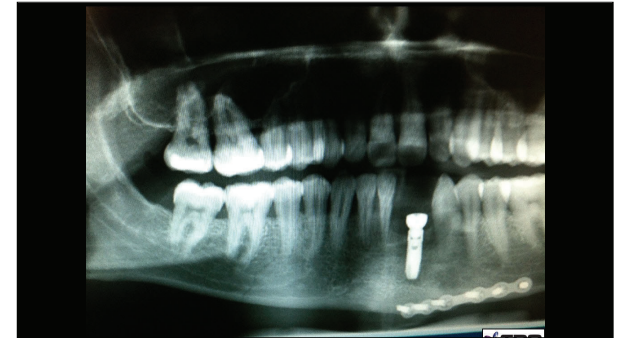
Luxation injuries cont.

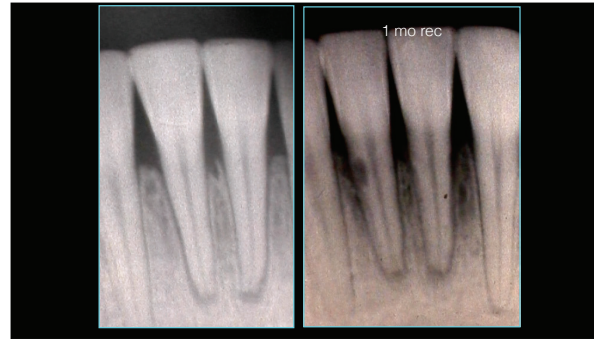
Major displacements (over 5mm)

- Lateral and extrusive:
- Reposition and splint for 4 weeks. If apex is closed, begin RCT with Ca(OH)₂ in 1-2 weeks.
- F/U 2 weeks, 4 weeks, 6-8 weeks, 6 months, 12 months, for 5 years
- Fair prognosis
- A/SA

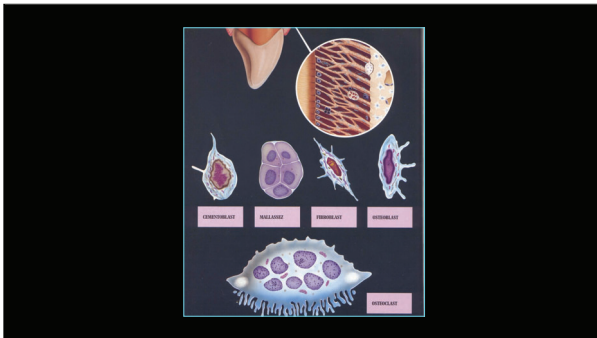
Lateral Luxation







Homeostasis of Pulp and PDL

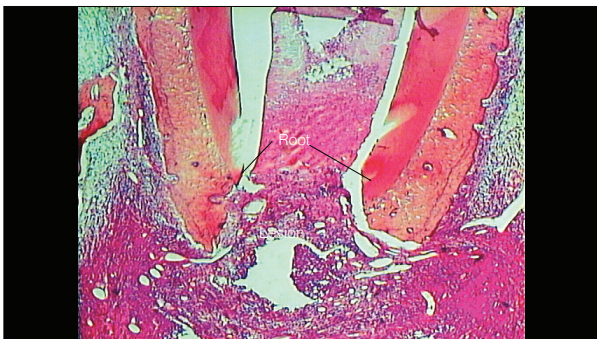


Resistance to Resorption

- Bone constantly being resorbed and replaced
- Root resorption is rare
- Epithelial root sheath
- Cementum and predentin

Beneficial Effects of Osteoclast

- Tooth eruption
- Bone turnover
- Healing
- Microbial defense



Osteoclast in Repair

- Resorption creates space for new vascular tissue
- Transient apical breakdown, transient marginal breakdown, transient ankylosis, transient internal surface resorption

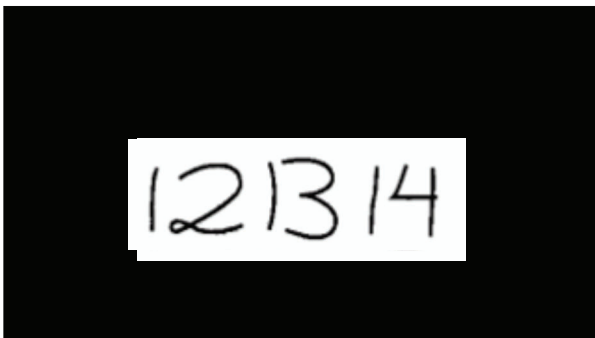
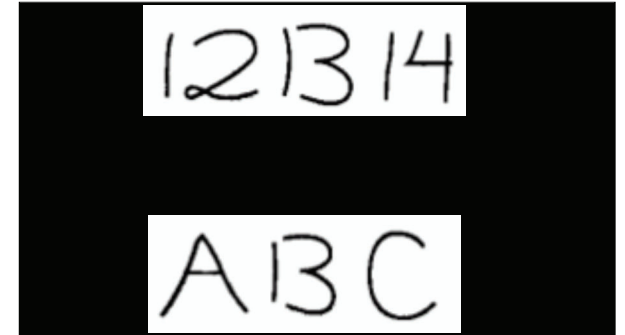
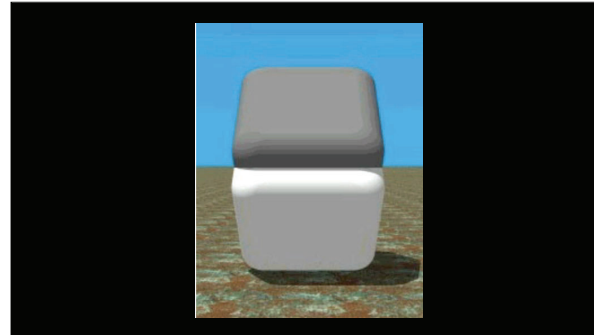
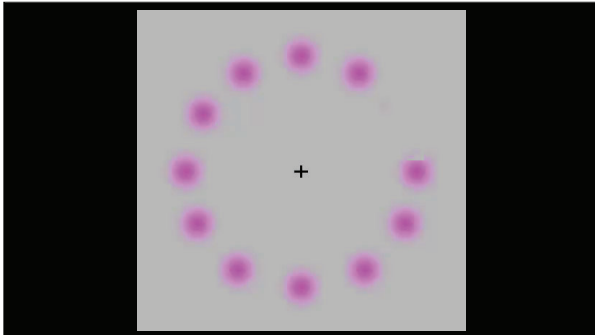
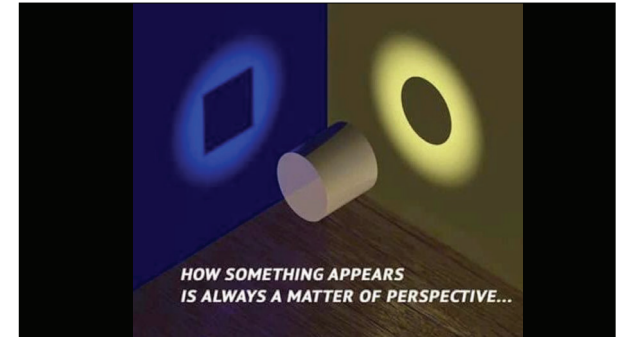
Medicine-related Osteonecrosis of the Jaws

- Bisphosphonates
- RANK ligand inhibitors
- Antiangiogenic medications

Bone/Dentin Growth Factors

- Present in dentin and bone
- Coupling of resorption/mineralization

CBCT

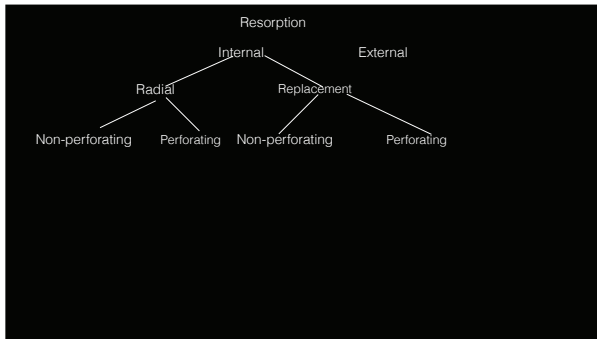


Classification of Root Resorption

- Internal root resorption
- External root resorption

Internal Root Resorption

- Radial Internal Root Resorption
- Internal Replacement Resorption



Radial Internal Root Resorption

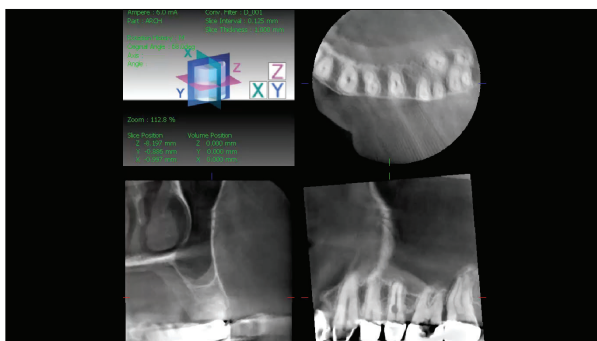
- Etiology
 - Granulation tissue at interface between diseased and healthy pulp

Diagnosis **Radial Internal Resorption**
Radiographic appearance

- Pulp space enlarges
- May have periapical lucency
- Stays centered on multiple angled radiographs
- PDL defined

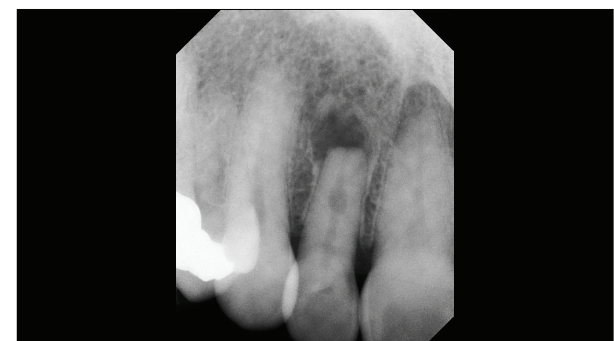
Internal Resorption

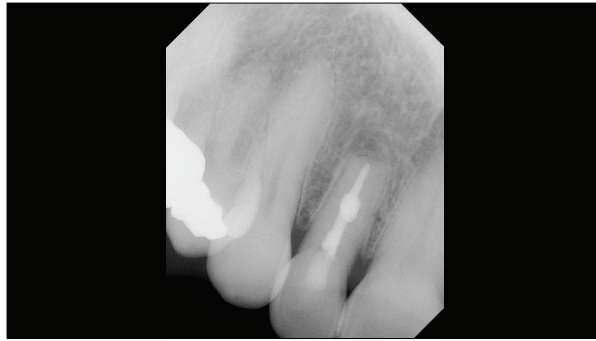
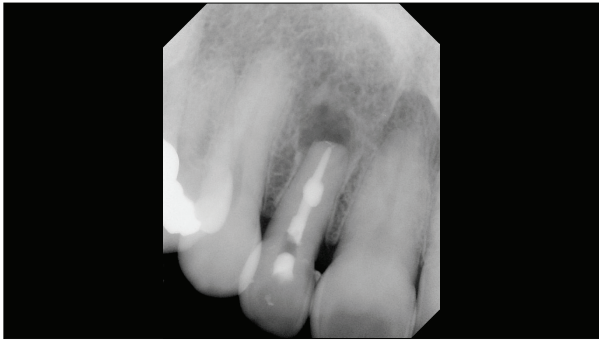
- Non-perforating
- Perforating



Radial Internal Resorption (Non-Perforating)

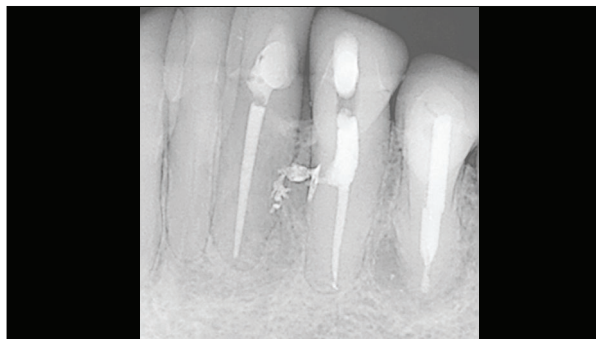
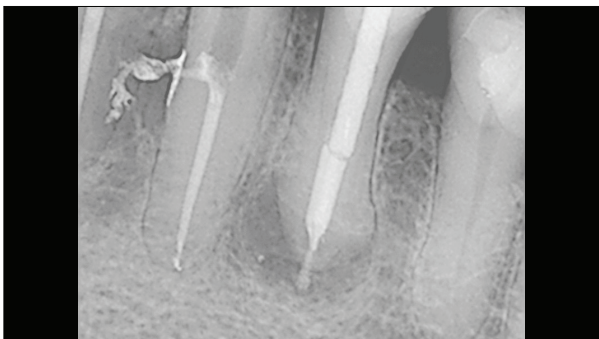
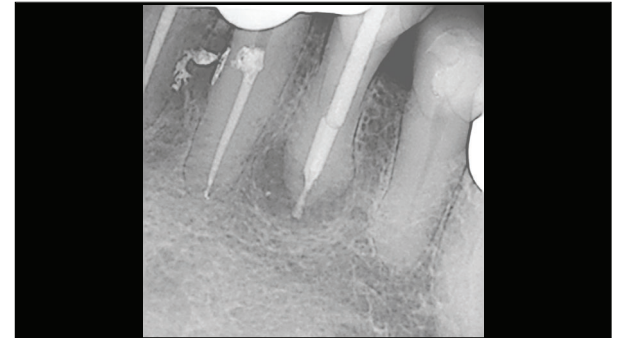
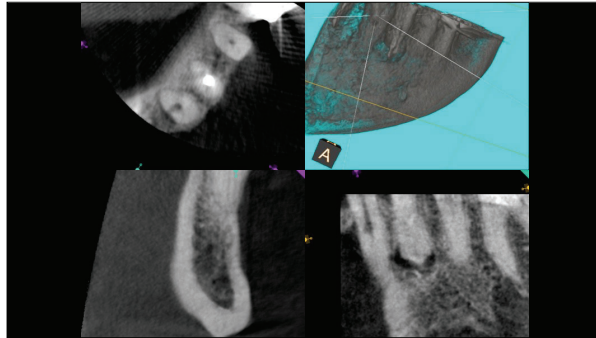
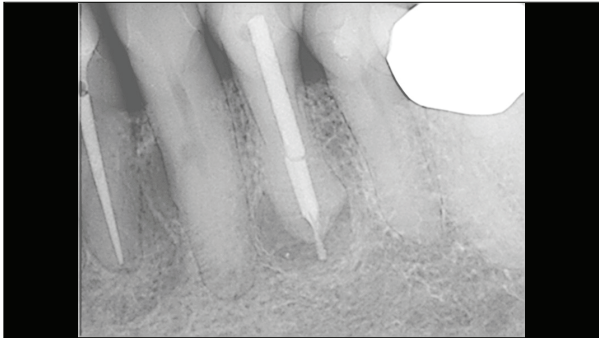
- Etiology is eliminated by thorough cleaning and shaping
- Extensive irrigation
- Ultrasonic activation of irrigants
- Thermoplasticized obturation
- Root rehabilitation





Radial Internal Resorption (Perforating)

- Dilute irrigation
- Timing of repair of perforation dependent on size and location
- Sub-osseous: MTA or other bioceramic
- Exposed to sulcus: Glass ionomer



Diagnosis

Internal Replacement Resorption

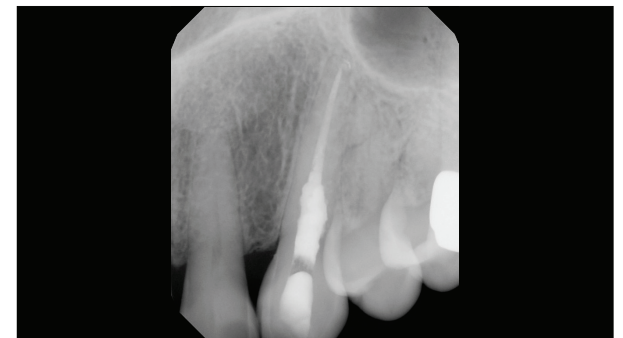
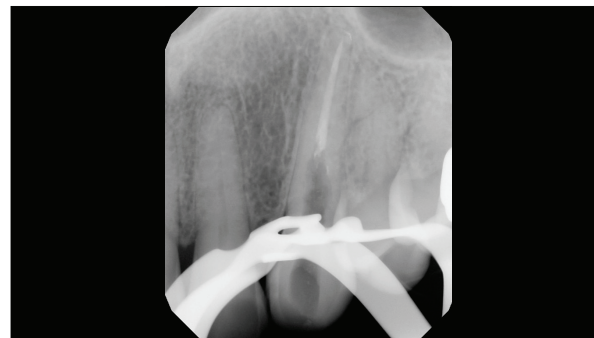
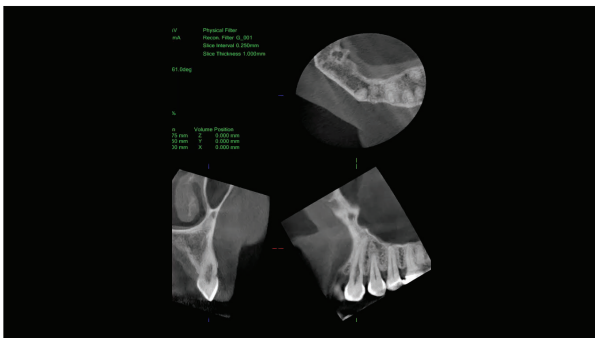
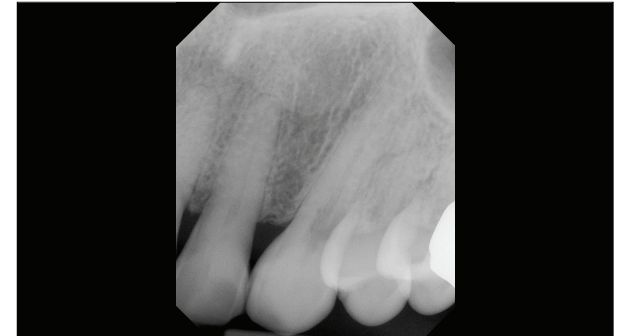
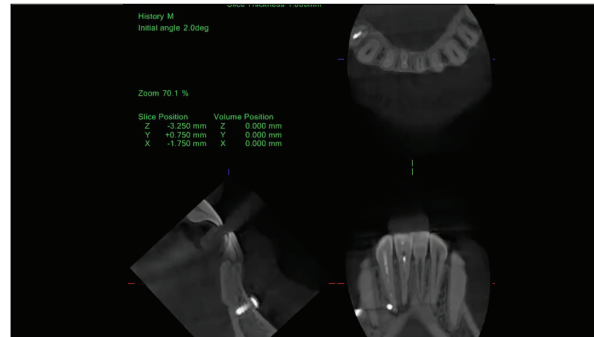
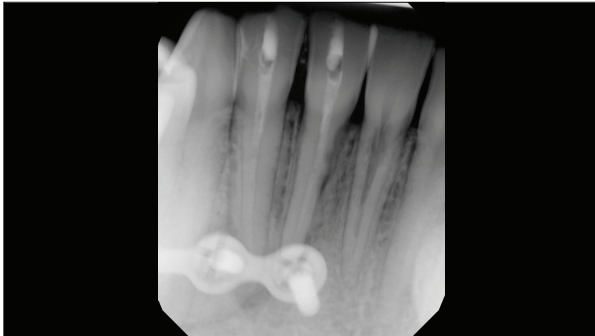
- Centered in root
- Less distinct pulp space than radial
- Hard to distinguish from cervical
- Pulp response is altered
- Critical to obtain CBCT to differentiate from invasive cervical

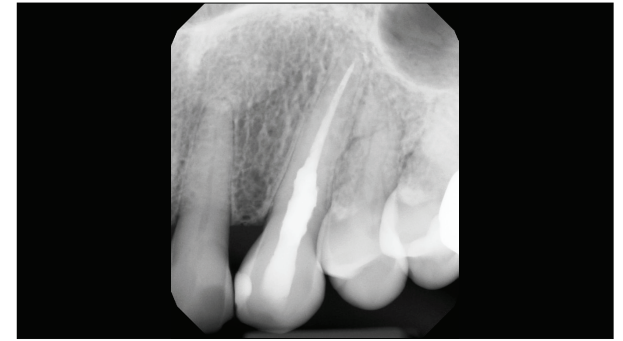
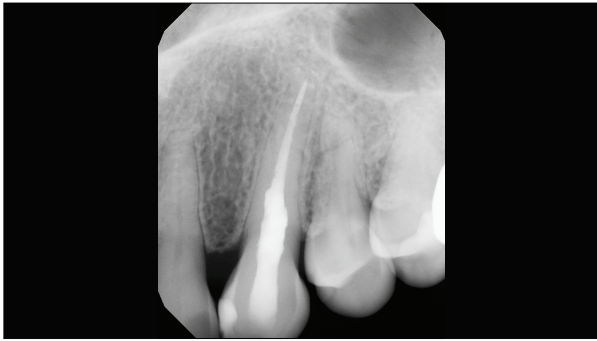
Internal Replacement Resorption

- Etiology
- Usually trauma related
- Replacement of damaged pulp tissue with bone-derived cells

Internal Replacement Resorption (Perforating)

- More aggressive removal of altered dentin
- Ultrasonics and long slow speed burs
- Gutta Percha removal instrument
- Thorough irrigation
- Consider 2 visit treatment with Ca(OH)₂





External Root Resorption

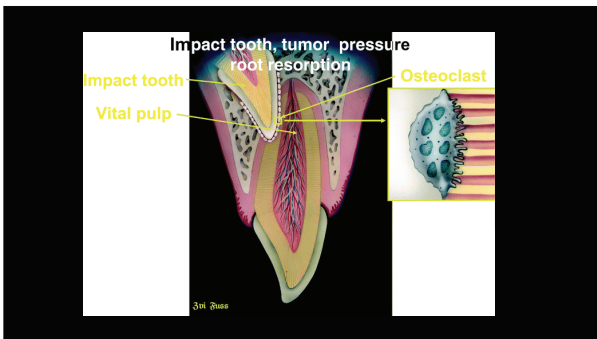
- Pressure Resorption
- Orthodontic Related (EARR)
- Infection Related Apical Resorption
- Trauma/Infection Related Resorption
- Replacement Resorption/Ankylosis
- External Cervical Resorption

External Root Resorption

- Pressure Resorption
- Orthodontic Related (EARR)
- Infection Related Apical Resorption
- Trauma/Infection Related Resorption
- Replacement Resorption/Ankylosis
- External Cervical Resorption

Pressure Resorption

- Etiology
- Pulp is not involved primarily
- Distal roots of second molar and Maxillary lateral incisor
- Presence or history of impacted tooth
- Clearly defined scalloped appearance of defect

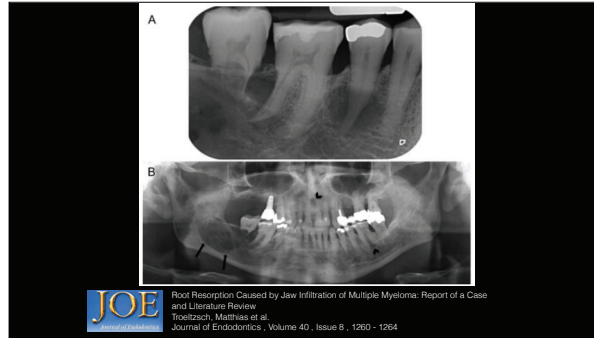
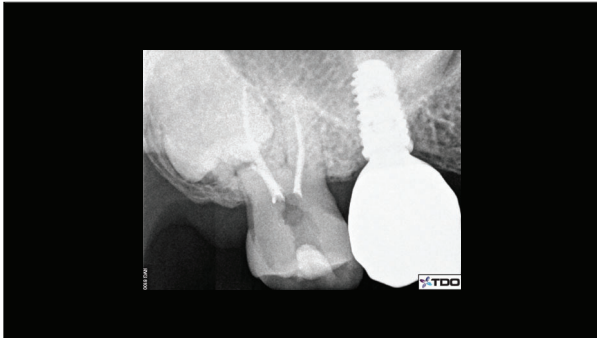
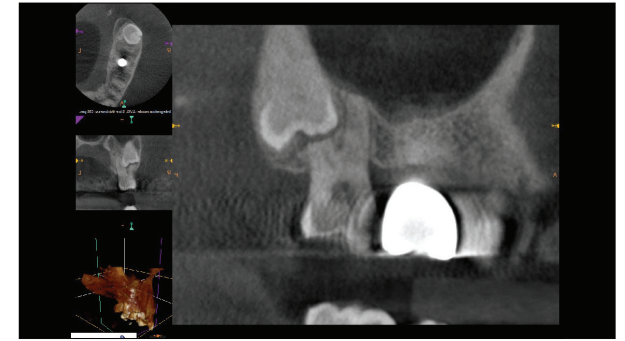
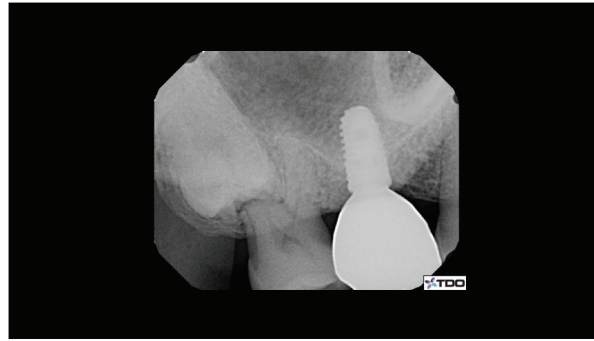
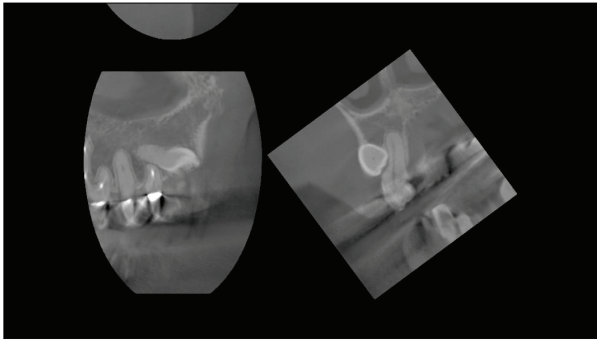


Pressure Resorption

- UP to 2.4% of Canines. 90% unilateral
- Erupting canine should be palpable by age 10.

Restoration and retention of maxillary anteriors with severe root resorption
January 2002 Volume 133, Issue 1, Pages 67-71



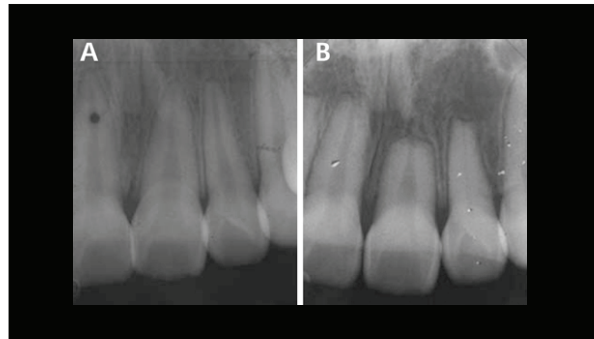


Diagnosis
Ortho Related EARR

- Characteristic blunting of roots
- Most often maxillary anteriors
- Defined PDL
- Pulp responses within normal

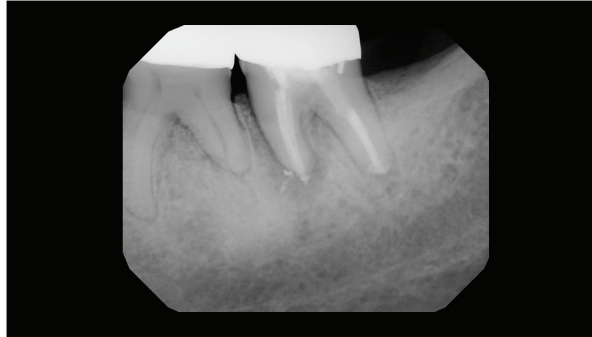
Ortho Related EARR

- Associated with heavy forces, compression more than tensile
- 4X more likely in intrusion vs extrusion
- 2-3 month pause can decrease resorption



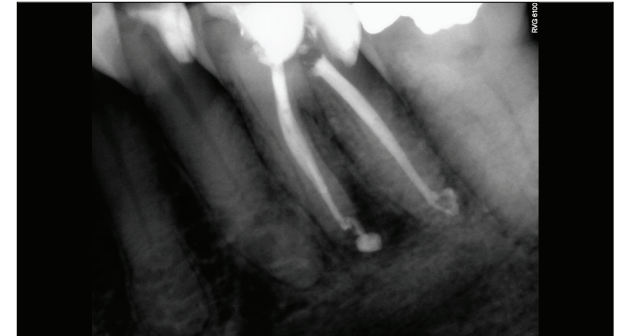
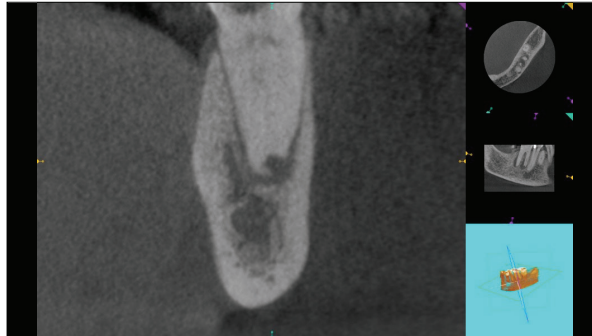
Occlusal Forces

- Most often seen in lower molars
- Dense sclerotic bone with moderately blunted roots
- Possible widening of PDL
- Must be distinguished from condensing osteitis



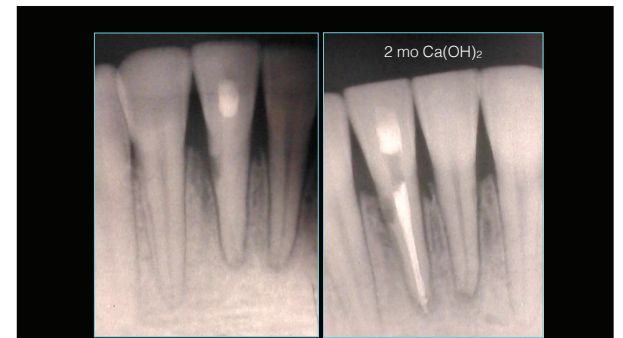
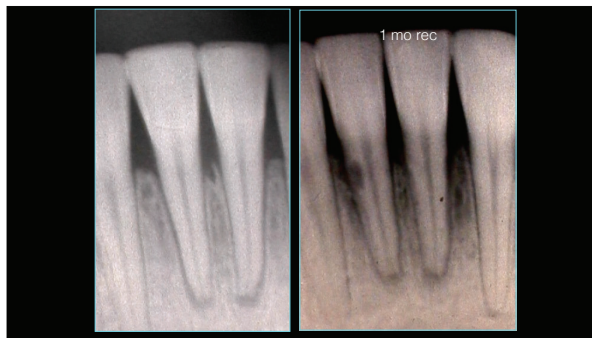
Diagnosis Infection Related Apical Resorption

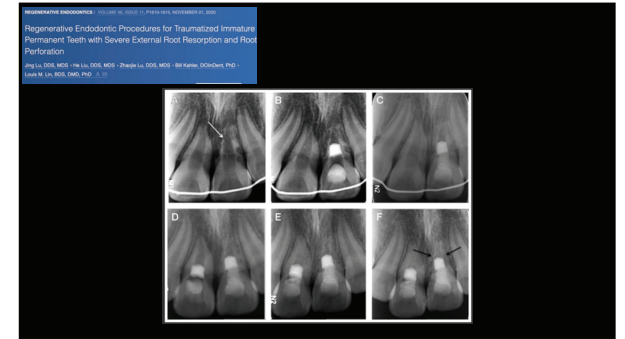
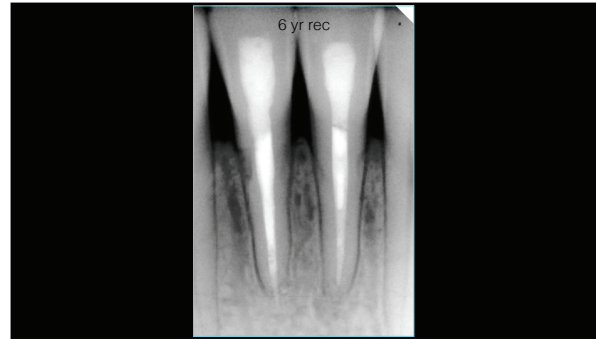
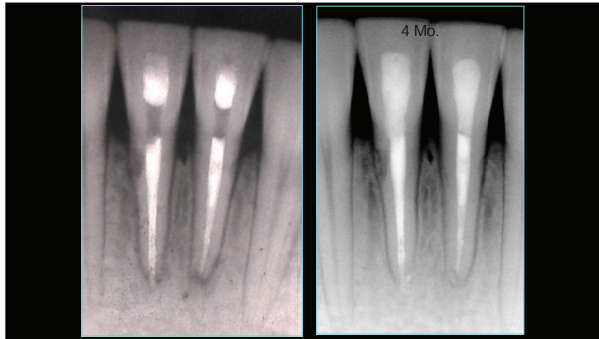
- Pulp is necrotic or previously treated
- Radiolucency in bone
- Present in all cases with PA lucency
- Irregular contour to apical portion of root



Trauma/Infection Related

- Cementum is damaged
- Antigen from necrotic pulp evoking response
- Disinfect pulp space
- Ca(OH)₂ or triple antibiotic paste
- Monitor for re-establishment of PDL
- Consider radicular reinforcement





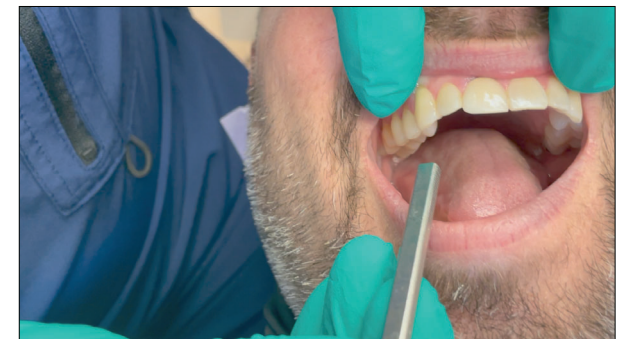
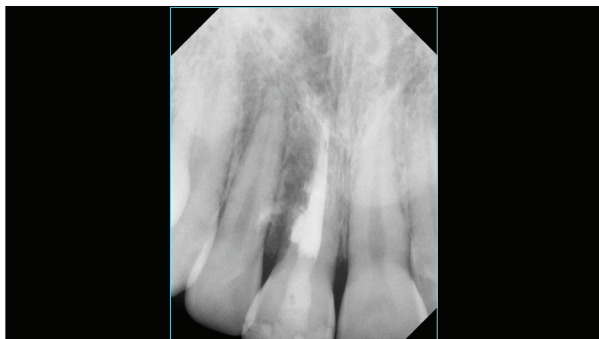
Replacement Resorption/Ankylosis

- Diffuse injury to PDL/cementum
- Area of root is devoid of cementum
- Bone to root contact
- Localized area can heal with cementum
- Pulp is usually necrotic from injury but not causative

Diagnosis

Replacement Resorption/Ankylosis

- History of trauma
- PDL space indistinct or lacking
- No physiologic movement
- Ringing upon percussion



External Cervical Root Resorption

- Sulcular inflammation?
- Pathogenesis is unclear
- Possibly defective CEJ
- Pulp is not involved

Synonymous Terms

- Odontoclastoma
- Idiopathic external resorption
- Fibrous dysplasia of teeth
- Burrowing resorption
- Peripheral cervical resorption
- Late cervical resorption
-

Synonymous Terms

- Cervical external resorption
- Extra canal invasive resorption
- Supraosseous extra canal invasive resorption
- Peripheral inflammatory resorption
- Invasive cervical resorption
- Subepithelial inflammatory root resorption
- Periodontal infection resorption

External Cervical Root Resorption

Radiography

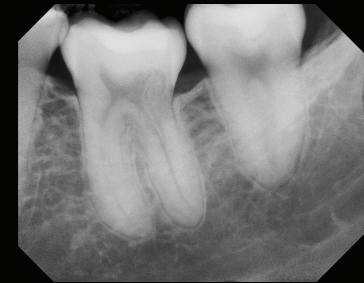
- Diffuse radiolucency within the root
- Pulp space is spared
- Predentin outline often visible
- Often only detectable on mesial or distal surface

Diagnosis

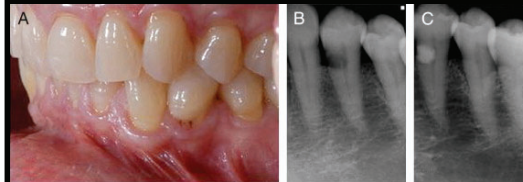
External Cervical Root Resorption

Clinical signs

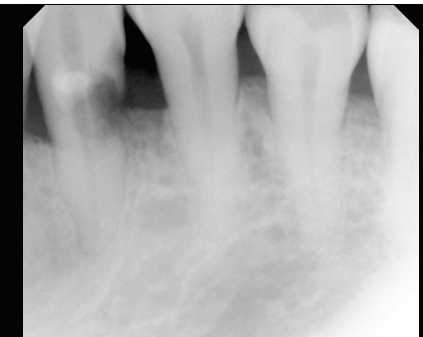
- Usually asymptomatic
- Located at cervical area
- Pulp will test WNL
- Discoloration
- Infraocclusion
- **Ringing sound upon percussion**
- Spontaneous bleeding upon probing

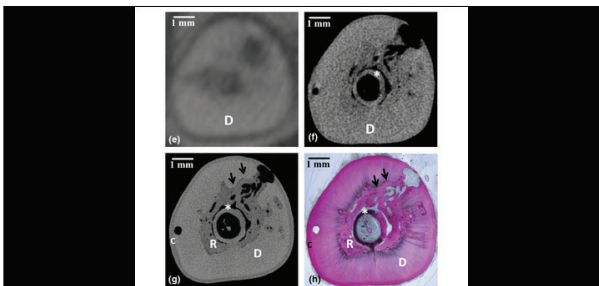
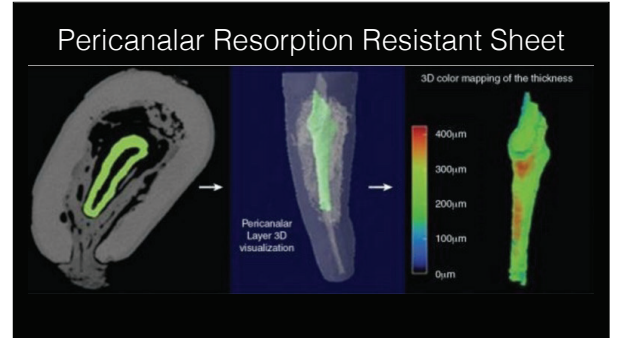
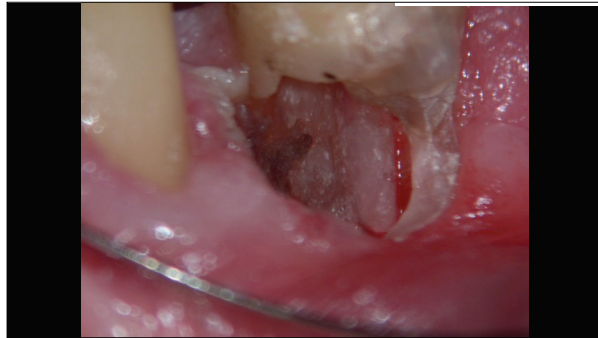
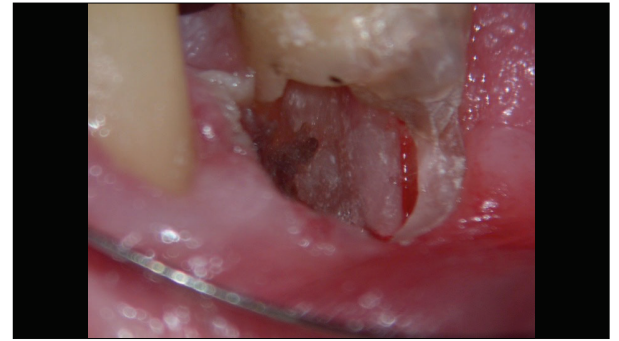
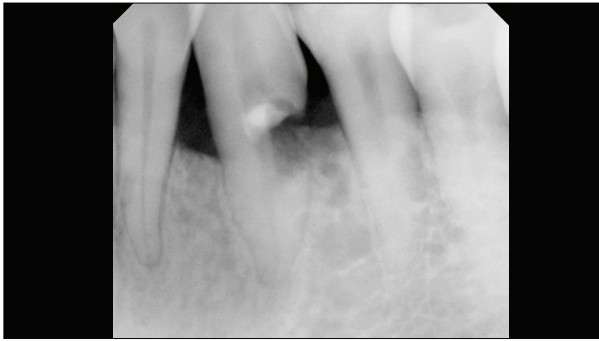


JOE External Cervical Resorption: A Review Shanon Patel, Shalini Kanagasingam, Thomas Pitt Ford JENDOD May 2009



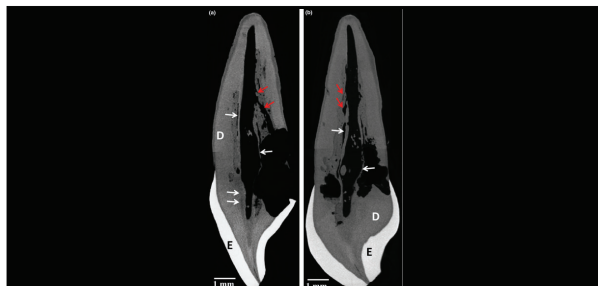
External Cervical Resorption: A Review
Shanon Patel, Shalini Kanagasingam,
Thomas Pitt Ford
JENDOD May 2009





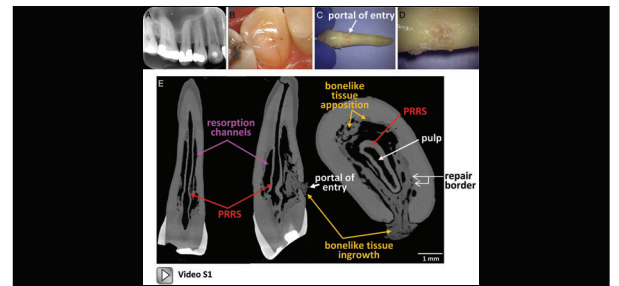
INTERNATIONAL ENDODONTIC JOURNAL
The official journal of the British Endodontic Society and the European Society of Endodontology

Mavridou AM, et al. A novel multimodular methodology to investigate external cervical tooth resorption. International Endodontic Journal, 49, 287-300, 2016.

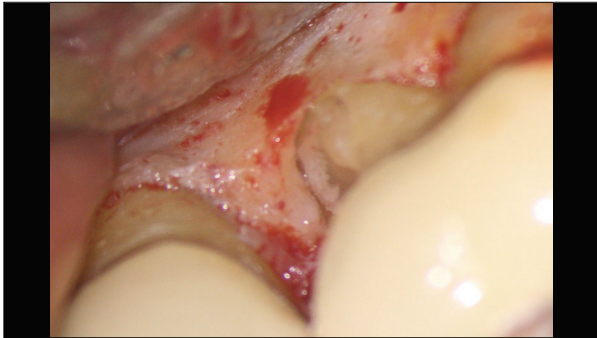
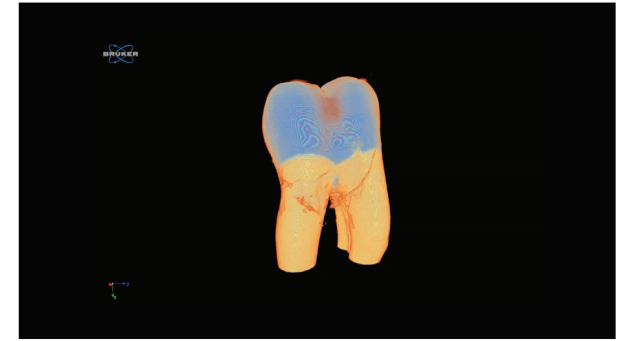
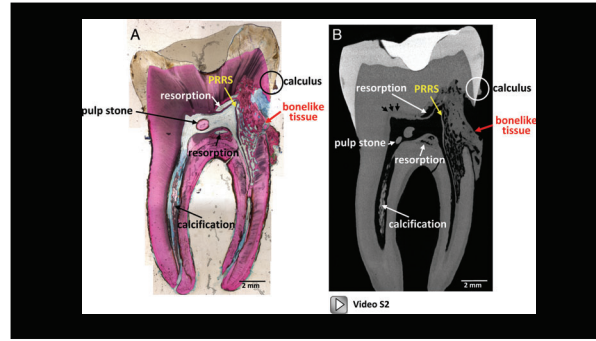
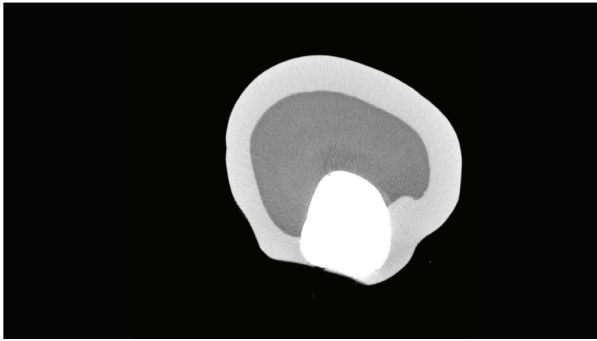


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Mavridou AM, et al. A novel multimodular methodology to investigate external cervical tooth resorption. International Endodontic Journal, 49, 287-300, 2016.



Understanding External Cervical Resorption in Visit Team
Alfina M. Mavridou, DDS, MSc, Esther Hauben, MD, PhD, Martine Wevers, PhD, Evert Schepers, DDS, PhD, Lars Bergmans, DDS, MSc, PhD, Paul Lambrechts, DDS, PhD
Journal of Endodontics, Pages 1127-1131 (December 2016)



Predisposing Factors

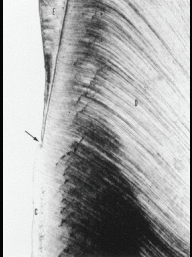
- Trauma
- Intracoronal bleaching
- Surgery
- Orthodontics
- Periodontics
- Bruxism
- Delayed eruption
- Unknown

Intrinsic Factors to Teeth

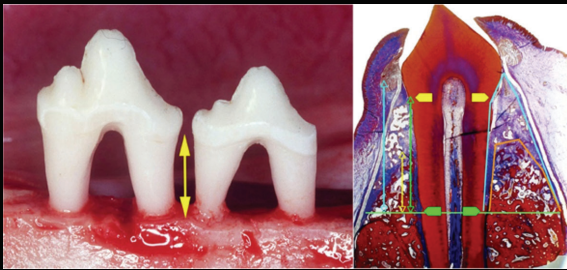
- CEJ defect
- Disruption in mineralization
- Non-Collagenous proteins

Intrinsic Factors to Teeth

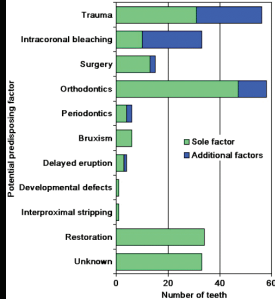
- CEJ defect
- Disruption in mineralization
- Non-Collagenous proteins



JOE Cementoenamel Junction: Microscopic Analysis and External Cervical Resorption
Neuvald, Lilian et al. 2009
Journal of Endodontics, Volume 26, Issue 9, 503 - 508



Endodontic Topics Wikesjö, U. M.E., Susin, C., Lee, J., Dickinson, D. P. and Polimeni, G. (2012). Periodontal regeneration: experimental observations—clinical consequences. Endodontic Topics, 26: 4-17.



Predisposing factor	Sole factor	Additional factors
Trauma	~10	~15
Intracoronal bleaching	~10	~10
Surgery	~10	~5
Orthodontics	~45	~10
Periodontics	~5	~5
Bruxism	~5	~5
Delayed eruption	~5	~5
Developmental defects	~5	~5
Interproximal stripping	~5	~5
Restoration	~35	~5
Unknown	~35	~5

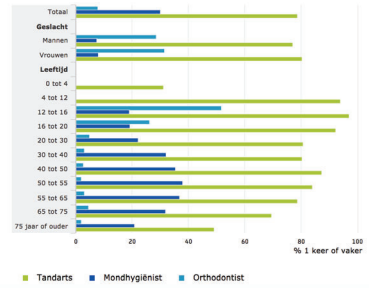
Endodontic Topics Heithersay, G. S. (2004). Invasive cervical resorption. Endodontic Topics, 7: 73-92. doi: 10.1111/j.1601-1546.2004.00060.x

Descriptive Analysis of Factors Associated with External Cervical Resorption

The most frequently appearing factor was orthodontics (45.7%). Other frequently observed factors were trauma (28.5%), parafunctional habits (23.2%), poor oral health (22.9%), malocclusion (17.5%), and extraction of a neighboring tooth (14%).

JOE Descriptive Analysis of Factors Associated with External Cervical Resorption
Mavridou, Athina M. et al.
Journal of Endodontics, October, 2017, 1602 - 1610

Bezoek aan tandarts, mondhygiënist, of orthodontist, 2015



JOE CLINICAL RESEARCH | VOLUME 46, ISSUE 4, P470-482, APRIL 01, 2020
Invasive Cervical Resorption—Distribution, Potential Predisposing Factors, and Clinical Characteristics
Po-Yuan Jeng, DDS, Li-Deh Liu, DDS, PhD, Shu-Hui Chang, PhD, Cheng-Ying Wang, DDS, PhD, Jiang-Huai Jeng, DDS, PhD, Yi-Ling Tsai, DDS, PhD

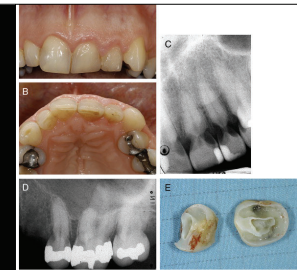
Maxillary teeth (76.19%) were more prone to ICR than mandibular teeth (23.81%). Most patients denied all major systemic diseases. The most common dental-related factors were dental/orofacial trauma (33.33%), periodontal treatment (26.98%), restoration/crown (17.46%), and orthodontic treatment (15.87%)

External Cervical Resorption: A Retrospective Case-Control Study
Mehmet Ozkan, DDS, MSc, Denta Aksoydemir, DDS, PhD, Yi-Shen, DDS, PhD, Mustafa Haktanir, DDS, PhD

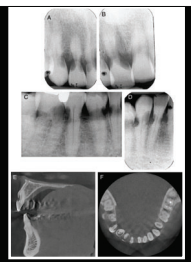
The overall ECR prevalence among endodontic patients during the 10-year follow-up was 2.3%. ECR was most frequent in maxillary anterior teeth (31.6%), and the Heithersay class 2 was the most frequent (38.8%) ECR diagnosis. Diabetes was the only significant systemic risk factor ($P < .05$). Trauma, as a local risk factor, was significantly ($P < .05$) more frequently reported in cases than in controls.

Feline Cervical Root Resorption

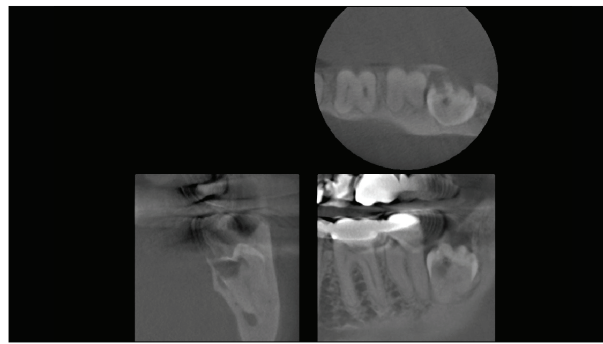
- Feline Odontoclastic Resorptive Lesions (FORL)
- Feline Herpes Virus type I (FeHV-1)



JOE Human and Feline Invasive Cervical Resorptions: The Missing Link?—Presentation of Four Cases
Thomas von Arx, Prof Dr med dent, Peter Schawalder, Prof Dr med vet, Mathias Ackermann, Prof Dr med vet and Dieter D. Bosshardt, PD Dr sc nat
Journal of Endodontics
Volume 35, Issue 6, Pages 904-913 (June 2009)



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Treatment

Table 1 Heithersay's Classification of External Cervical Resorption (Invasive Cervical Resorption)²¹

Class I	A small invasive resorptive lesion near the cervical area with shallow penetration into dentin
Class II	A well-defined invasive resorptive lesion that has penetrated close to the coronal pulp chamber but shows little or no extension into the radicular dentin
Class III	A deeper invasion of dentin by resorbing tissue, not only involving the coronal dentin but also extending into the coronal third of the root
Class IV	A large, invasive resorptive process that has extended beyond the coronal third of the root

Clinical Classification



Endodontic Topics Heithersay, G. S. (2004). Invasive cervical resorption. Endodontic Topics, 7: 73-92. doi: 10.1111/j.1601-1546.2004.00060.x

Table 2 Patel's 3-dimensional Classification of External Cervical Resorption¹⁸

Height	Circumferential spread	Proximity to the root canal
1: At the cementoenamel junction level or coronal to the bone crest (supracrestal)	A: $\leq 90^\circ$	d: lesion confined to the dentin
2: Extends into the coronal third of the root and apical to the bone crest (subcrestal)	B: $> 90^\circ$ to $\leq 180^\circ$	p: probable pulpal involvement
3: Extends into the midthird of the root	C: $> 180^\circ$ to $\leq 270^\circ$	
4: Extends into the apical third of the root	D: $> 270^\circ$	

Clinical Research | Volume 46, Issue 4 | February 2008, pp 269-271 | DOI: 10.1177/0000725608315111

A Volumetric Assessment of External Cervical Resorption Cases and Its Correlation to Classification, Treatment Planning, and Expected Prognosis

and P. Murray, DDS, MS, Mark B. Rupert, DDS, MS, PhD, Mark D. Levin, DMD, and David H. Nussey, DDS, MS, J. Endodontol, 2008, 34, 269-271

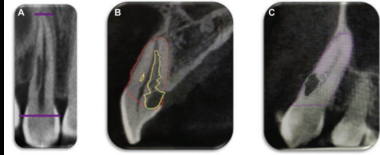


Figure 1 Representative reference points and ECR tracing used for the calculation of lesion volume in Amira. (A) The radiographic apex and 2 mm above the cementoenamel junction were used as reference points for the root. The root, based on (A) reference points, was traced followed by tracing the ECR lesion in both (B) sagittal and (C) coronal slices. The percent of the root affected by ECR was calculated by dividing the ECR volume by the total volume of the root.

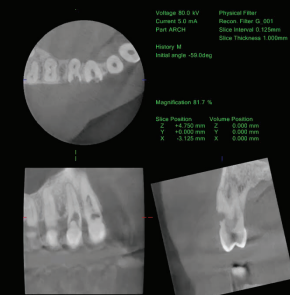
Structural Issues

Start With The End In Mind

- Load/stresses of affected area
- Apical destruction most forgiving
- Coronal routine to repair
- Pericervical dentin cross sectional area critical

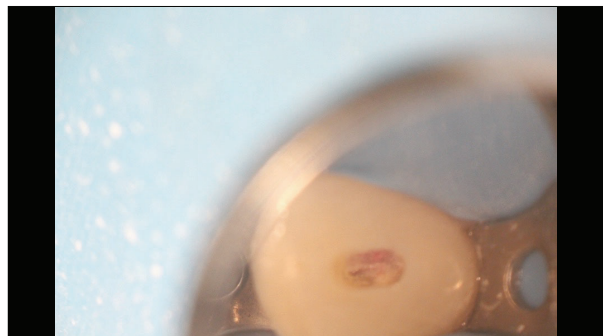
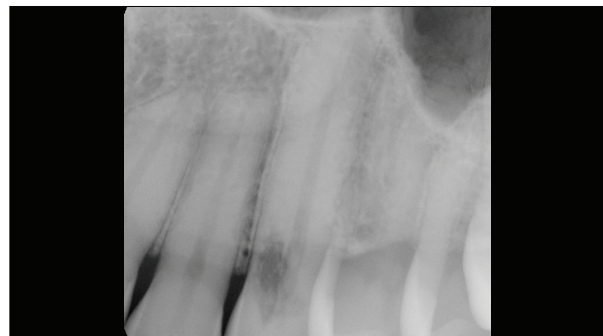
Elimination of Etiology

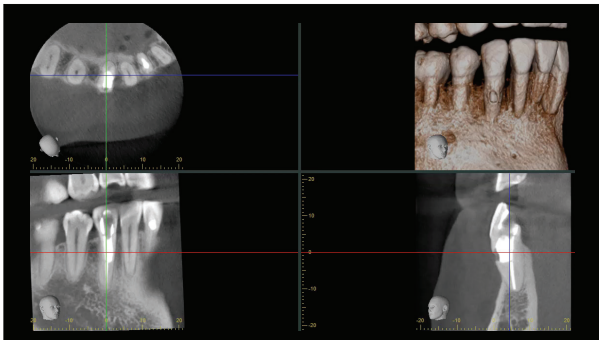
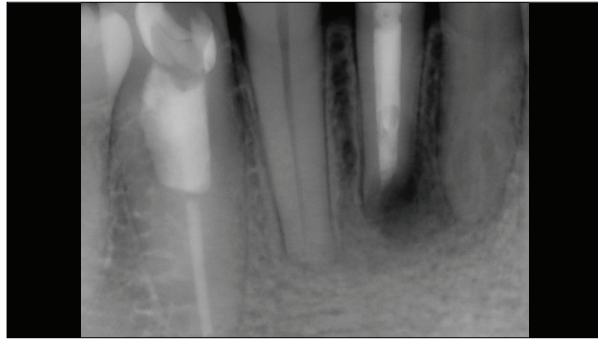
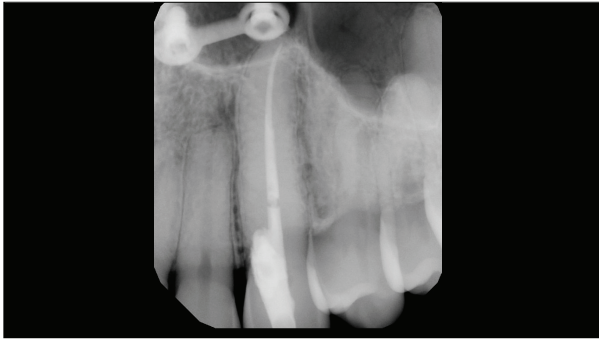
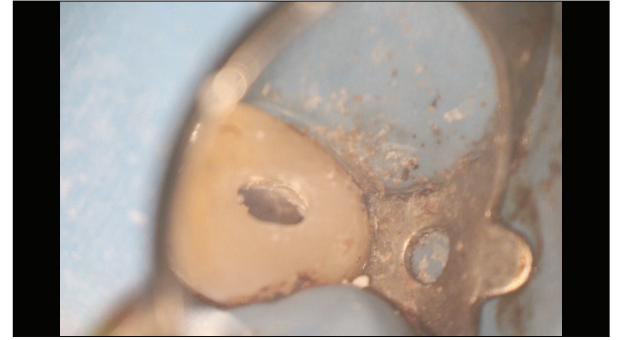
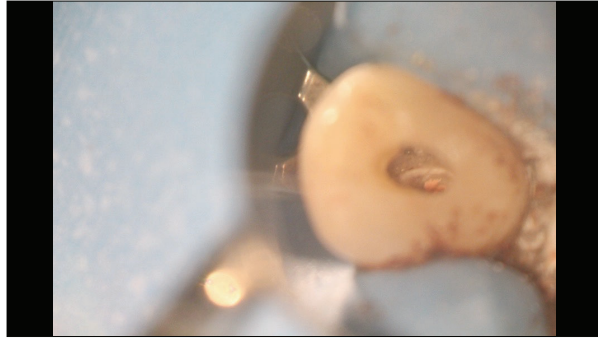
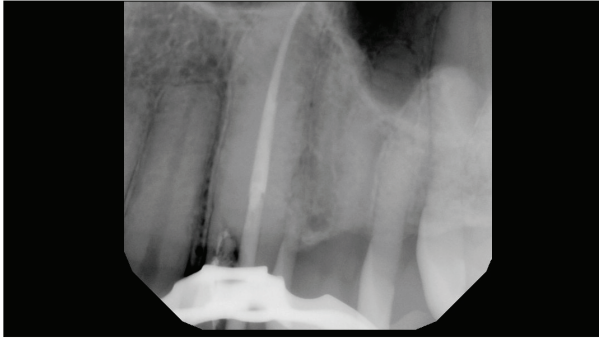
- Diagnosis driven
- Do we understand etiology?
- Predictability?

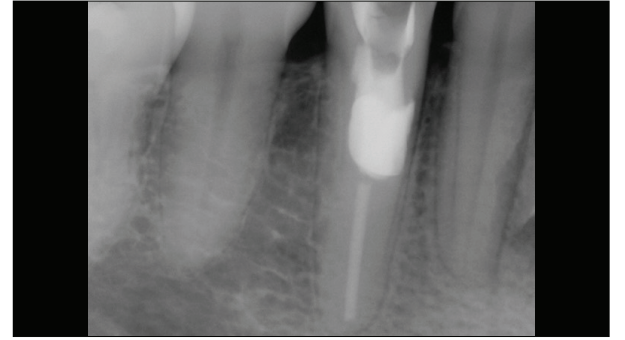


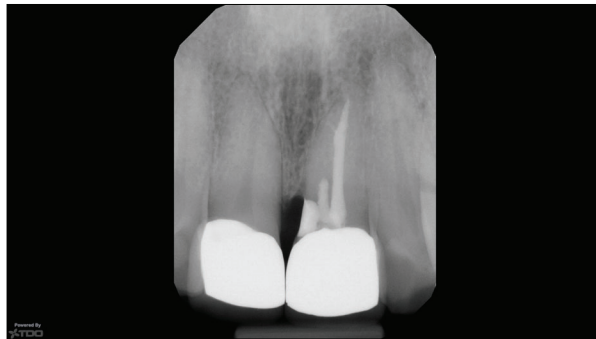
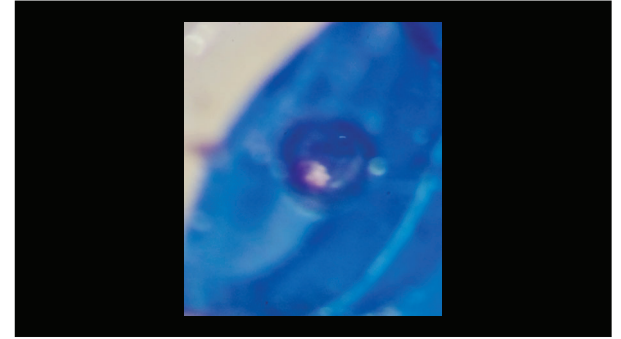
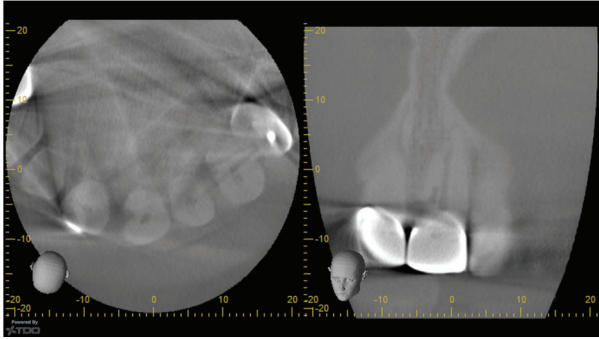
Treatment Options for External Cervical Root Resorption

- Internal debridement
- Crown lengthening
- Orthodontic extrusion
- Implant
- FPD
- Autotransplantation
- Intentional replantation
- No treatment









Cautery Methods

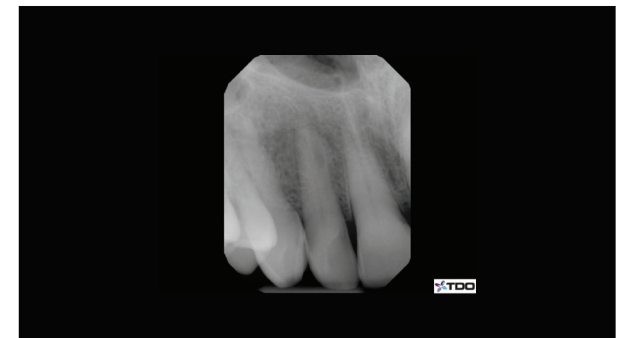
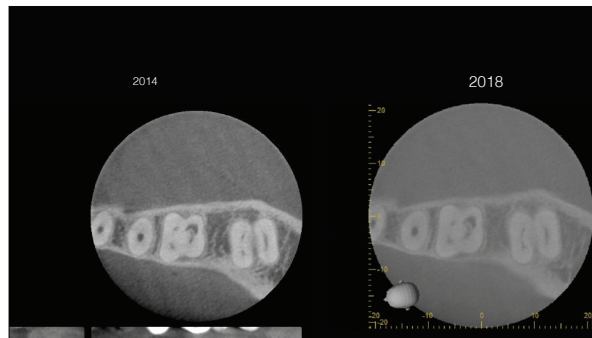
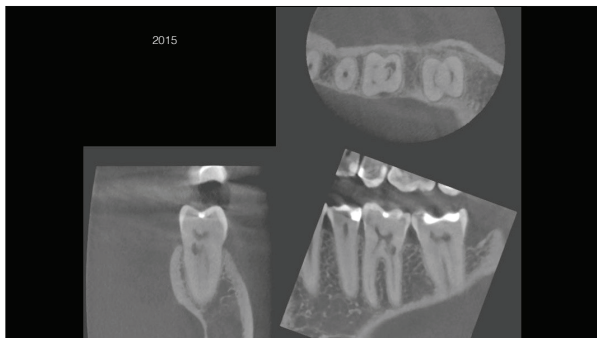
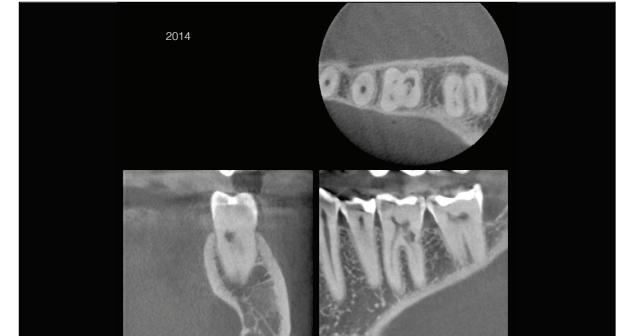
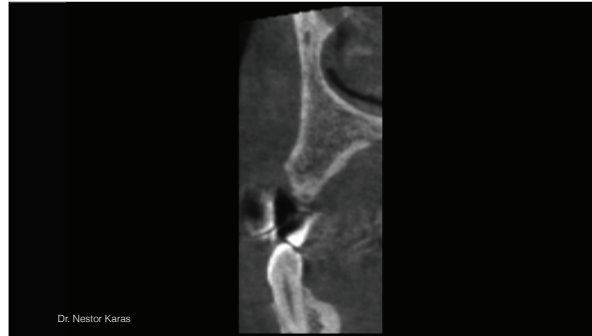
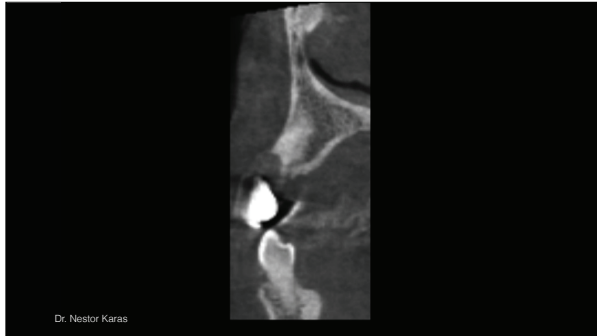
- TCA
- $\text{Ca}(\text{OH})_2$
- Heat

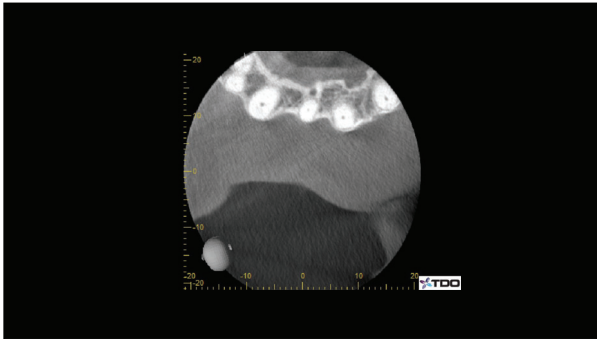
Recurrence

- Etiology eliminated?



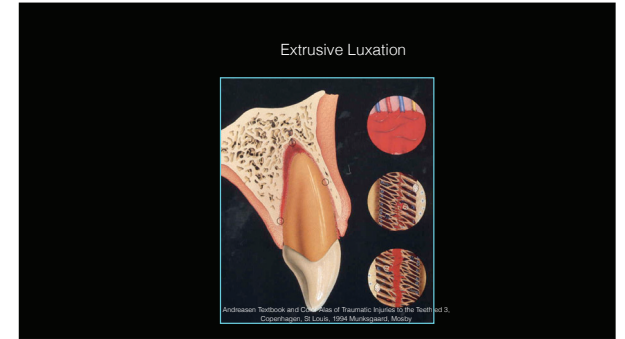
Post Extraction





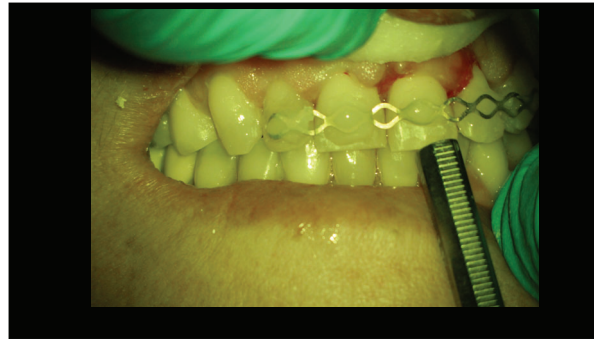
Luxation injuries cont.

- Extrusive luxation
- Reposition and stabilize for 2 weeks
- F/U 2 weeks, 4 weeks, 6-8 weeks, 12 weeks 6 months, 12 months, 5 years
- A



Titanium Trauma Splint



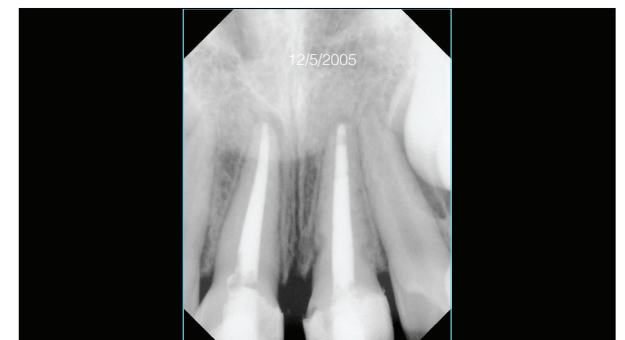
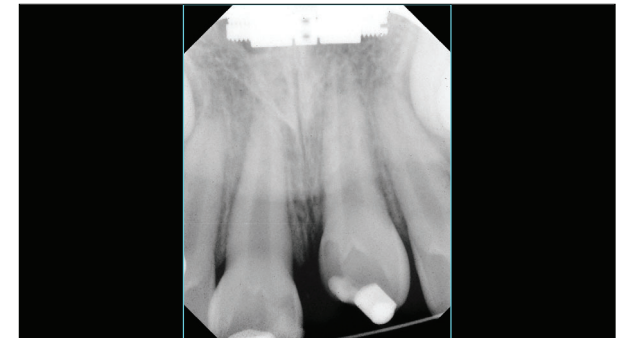
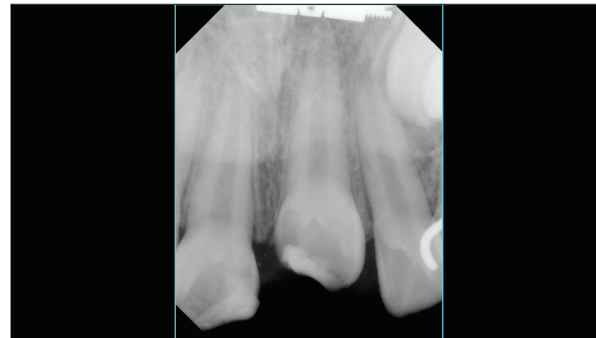
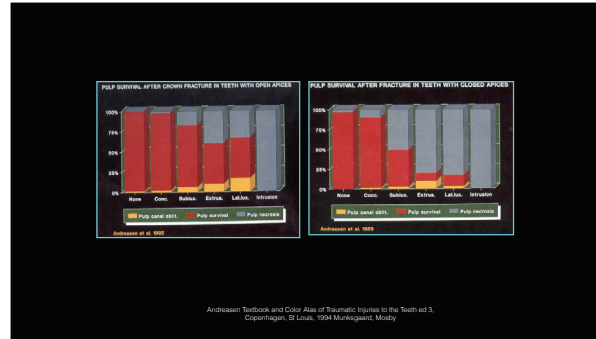
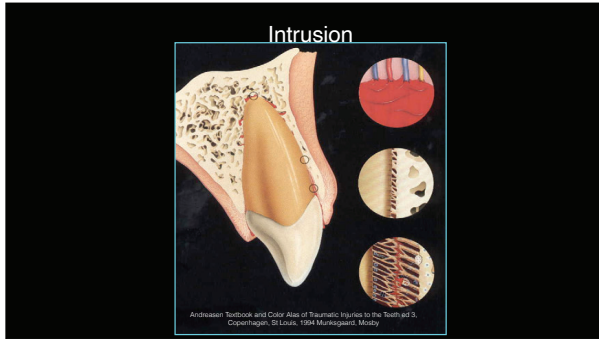


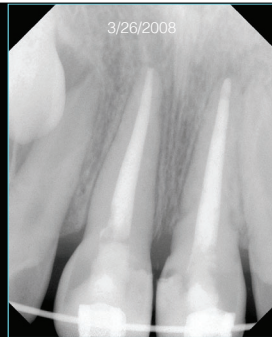
Luxation injuries cont.

- Intrusive: Open Apex
- Minimal intrusion (less than 7mm) may erupt spontaneously in immature teeth.
- If no movement within 4 weeks, orthodontic extrusion

Luxation injuries cont.

- Intrusive: Closed apex
- Less than 3mm allow re-eruption fro 8 weeks
- Reposition surgically or orthodontically if intruded 3-7mm and stabilize for 2 weeks
- More than 7mm reposition surgically
- F/U 2 weeks, 4 weeks, 6-8 weeks, 12 weeks 6 months, 12 months yearly for 5 years
- Fair/poor prognosis



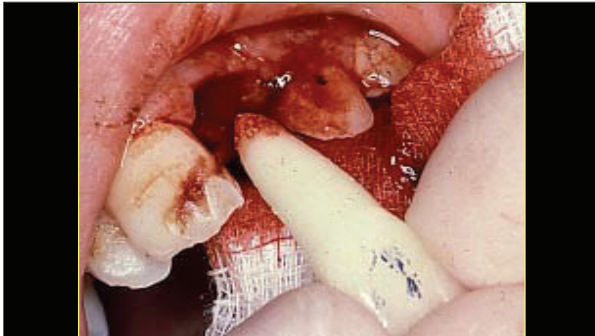


Avulsions

- Extraoral time is a key factor. 90% success if replanted in less than 30 min.
- 5 Min is critical.
- Teeth can be replanted after 6-48 hrs, but ankylosis will likely result.

Treatment at scene of accident

1. Gently clean tooth in water or saliva and replace tooth in the socket
2. If replantation is not possible, place tooth in:
 - HBSS (Save-A-Tooth)
 - Milk
 - Vestibule
3. Never allow to dry. Wrap tooth in plastic. Keep cold



Treatment at office (closed apex)

- Remove obvious contamination with saline.
- Do not remove PDL
- Do not sterilize tooth
- Do not start RCT
- Place tooth in storage media while taking history.
- If extraoral dry time is over 1hr. Expect ankylosis

Treatment at office cont.

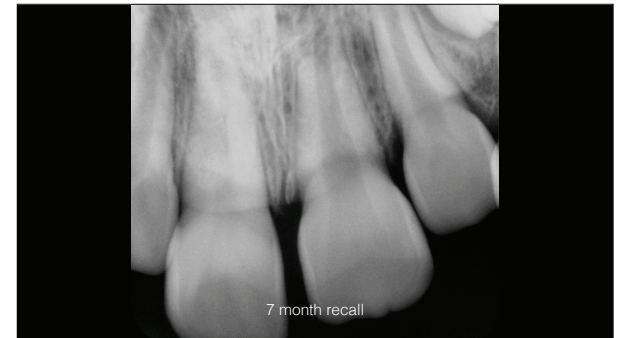
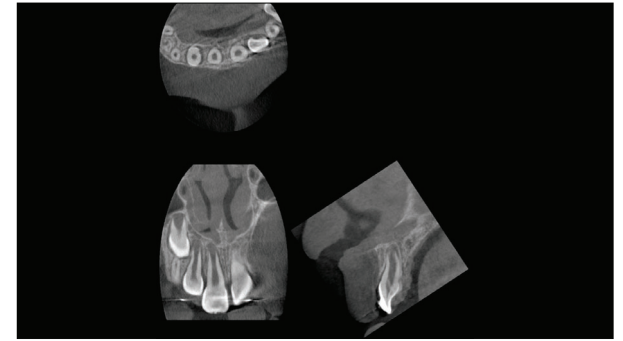
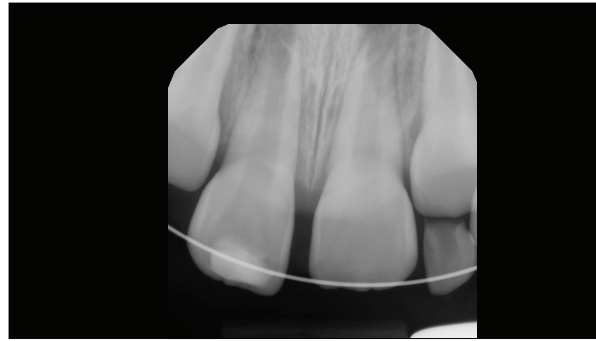
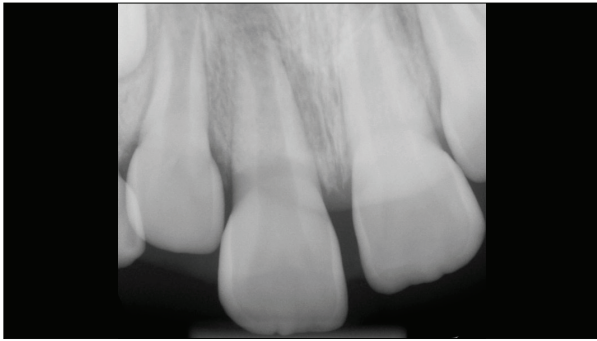
- Clean the root surface and apical foramen with a stream of saline and soak the tooth in saline thereby removing contamination and dead cells from the root surface.
- Reposition fractures of alveolar socket
- Irrigate the socket with saline.
- Examine socket wall, reposition bone.
- Replant and take radiograph.
- Suture gingival lacerations
- Apply a flexible splint for up to 2 weeks
- Institute antibiotic therapy (Doxycycline if over 12) and tetanus booster.

Treatment at Office Cont.

- Start RCT 1-2 weeks later with $\text{Ca}(\text{OH})_2$ (may not be required in immature teeth with short extraoral time).
- $\text{Ca}(\text{OH})_2$ for up to 1 month
- **Fair/poor prognosis. Ankylosis likely.**

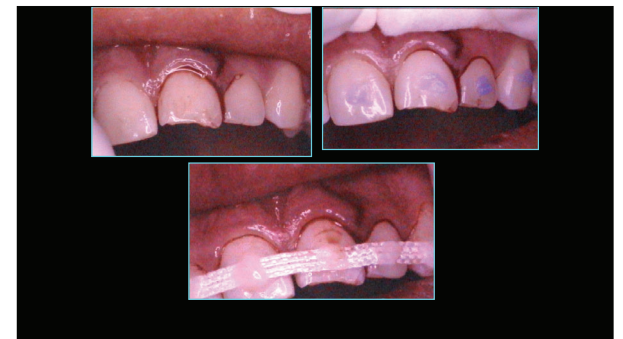
Treatment at office (open apex) E. O time < 60 min

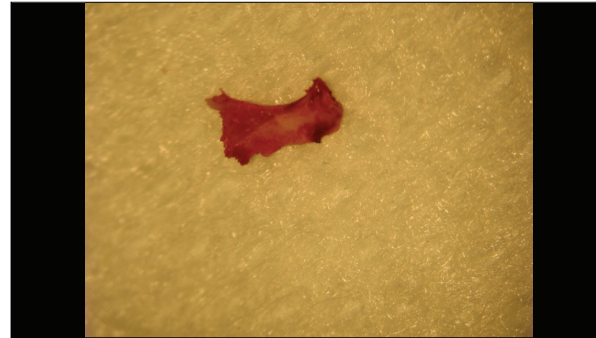
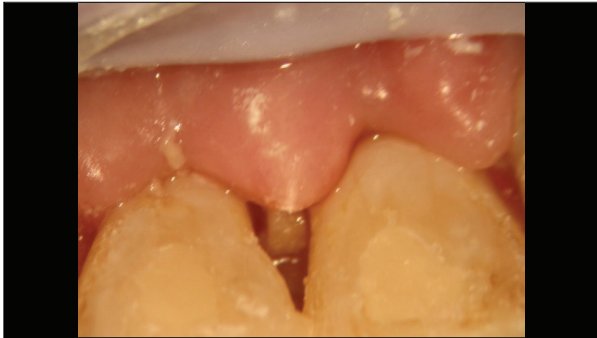
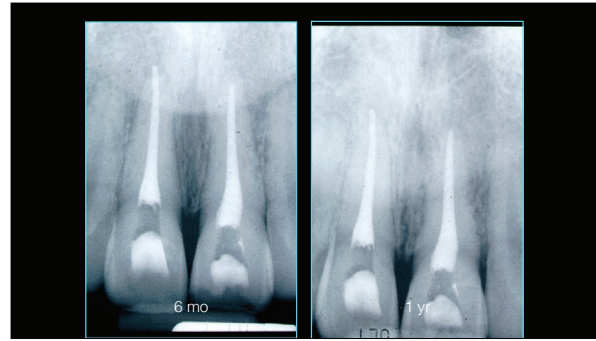
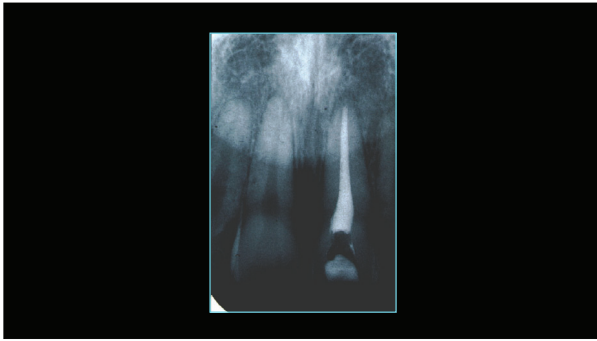
- Same as closed with possible longer splint time



Open Apex E. O time > 60 min Old guidelines

- Remove tissue with gauze
- RCT can be done extra orally
- Retrofill with Vitapex
- New guidelines are same as for E.O. time < 60 min





- Treatment options for ankylosed tooth affecting Maxilla
- Luxate tooth and force eruption
 - Extract tooth and place large particle graft.
 - Remove crown and Gutttta Percha and submerge tooth.
 - Remove tooth and move lateral into central position.
 - Autotransplantation

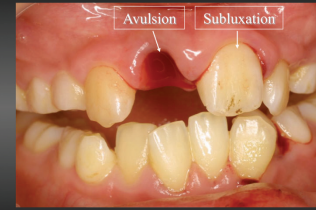




Mitsuhiro Tsukiboshi 10 y 3 m old, Male



Mitsuhiro Tsukiboshi 10 y 3 m old, Male



Mitsuhiro Tsukiboshi 10 y 3 m old, Male



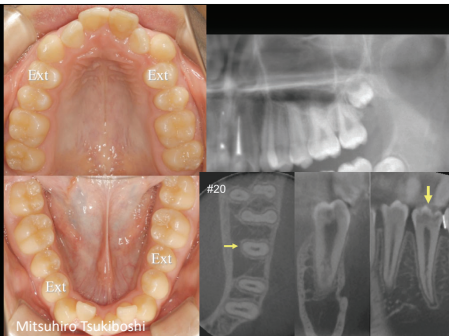
Mitsuhiro Tsukiboshi



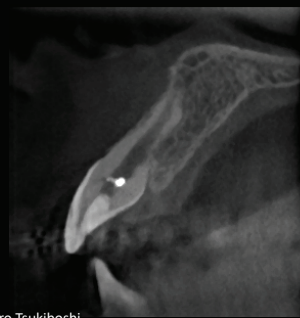
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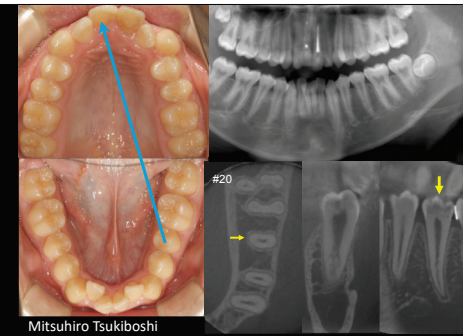
Mitsuhiro Tsukiboshi 13 y 10 m old



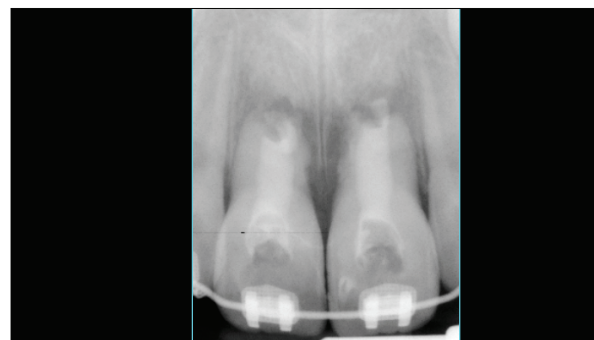
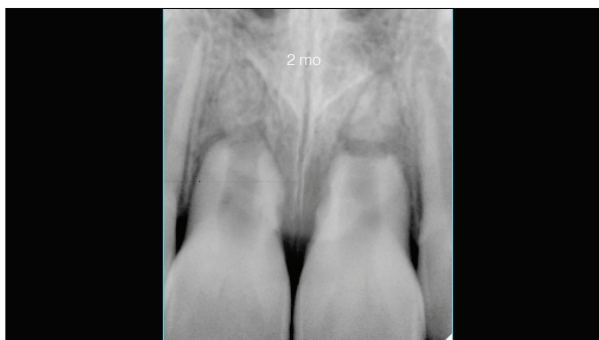
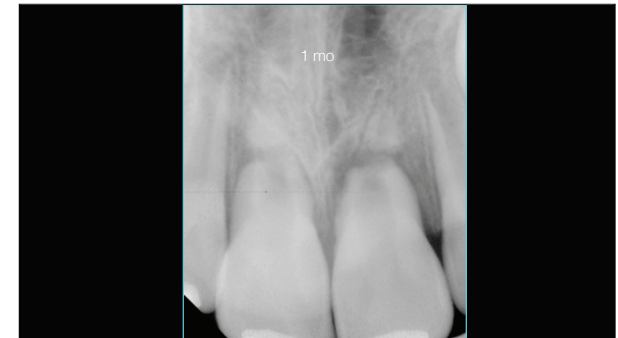
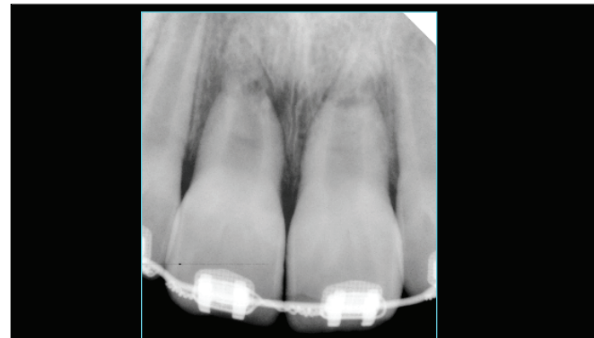
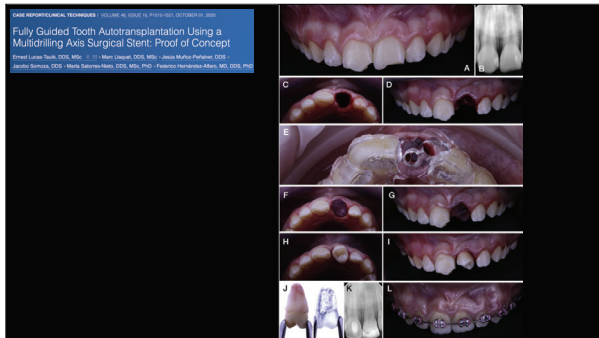
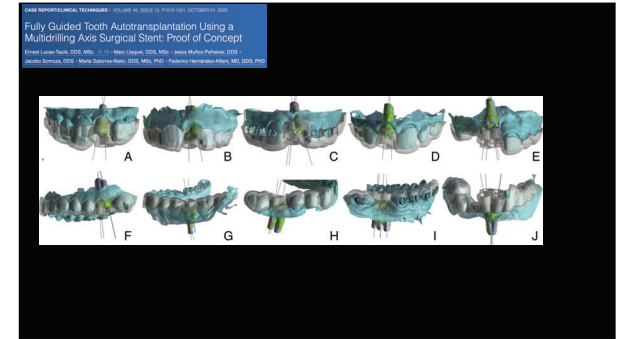
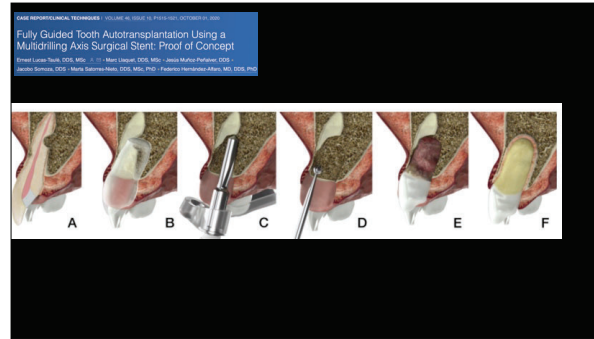
Mitsuhiro Tsukiboshi

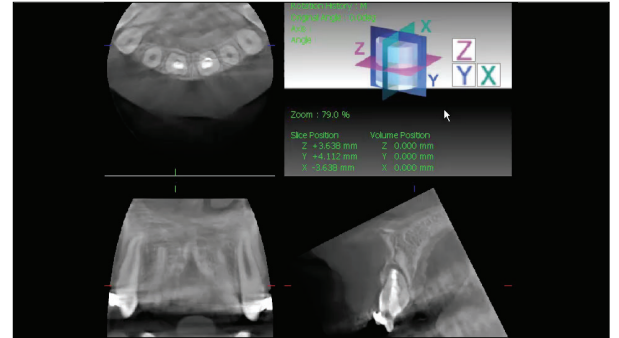
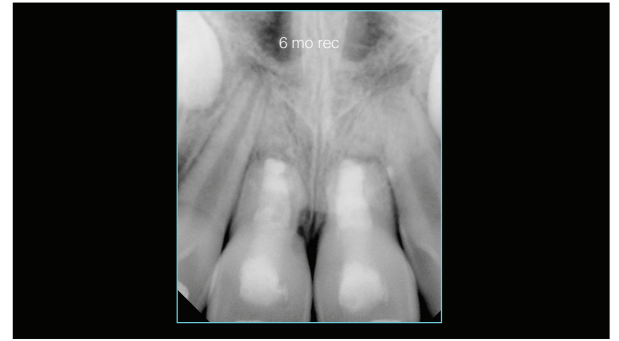
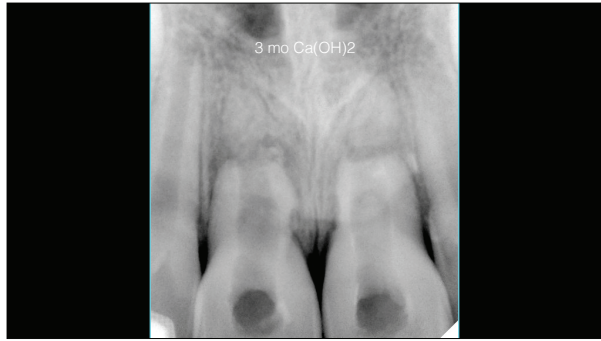
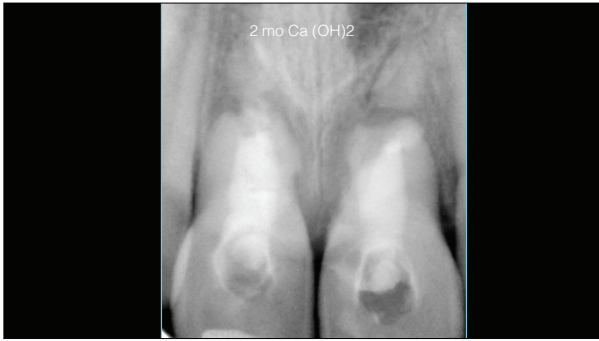


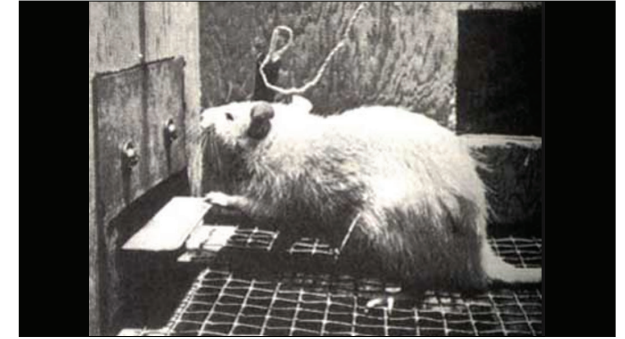
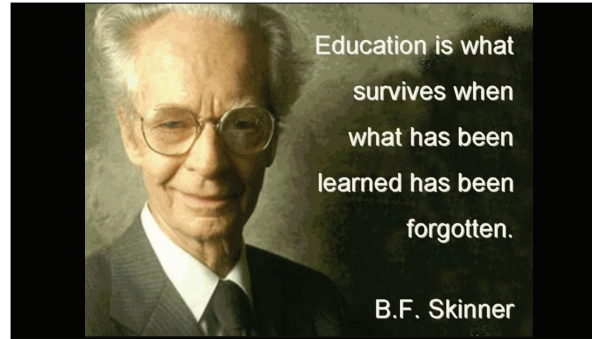
Mitsuhiro Tsukiboshi



Mitsuhiro Tsukiboshi







“Before enlightenment, I chopped
wood and carried water. After
enlightenment, I chopped wood
and carried water”

Zen saying

Kenneth W. Tittle, DDS, MS
kennethtittle@gmail.com