

**Tannfrakturer etter funksjonelle
og behandlingsrelaterte
belastninger:
Terminologi, diagnostikk,
etiologi, forebygging og
behandling**



Delvis lånt fra:

Longitudinal Tooth Fractures: Classification, Identification and Treatment



Eric M. Rivera, DDS, MS

Diplomate, American Board of Endodontics

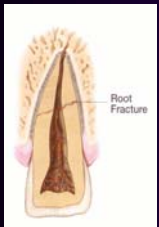
Department of Endodontics, University of North Carolina at Chapel Hill



Akutte vs repeterte/induserte traumer

■ Akutte

- Konkusjon
- Subluksasjon
- Luksasjon
- Avulsjon
- Frakturer
 - Typisk horisontale eller skrå



■ Repeterte/induserte

- Infraksjoner
- Kuspefraktur
- Sprekker
- Vertikale frakturer: vi mangler norsk presis terminologi
- Horisontale: interne i kroner



Definitions

- Craze Line
- Cuspal fracture
- Cracked Tooth
- Split Tooth
- Vertical Root Fracture
- Infraksjoner
- Kuspefraktur
- Sprekk
- Vertikal kronefraktur
- Vertikal rotfraktur



Definitions

- Craze Line - **infraksjoner**
 - Location: Crown
 - Direction: Variable
 - Orientation: Occlusal
 - Symptoms: None
 - Signs: None
 - How to ID: Illumination
 - Treatment: None
 - Prognosis: Excellent

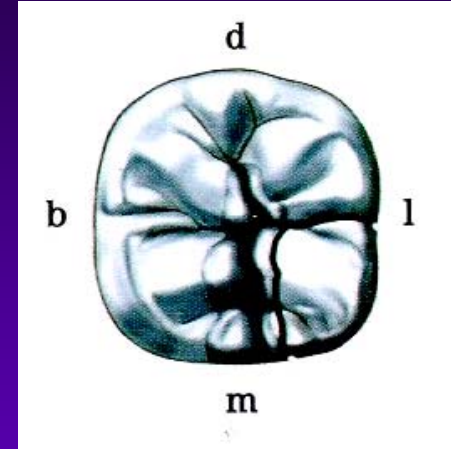
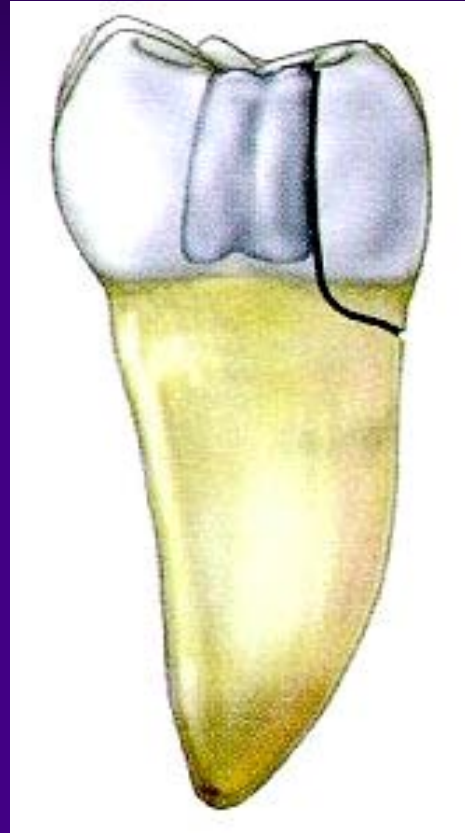


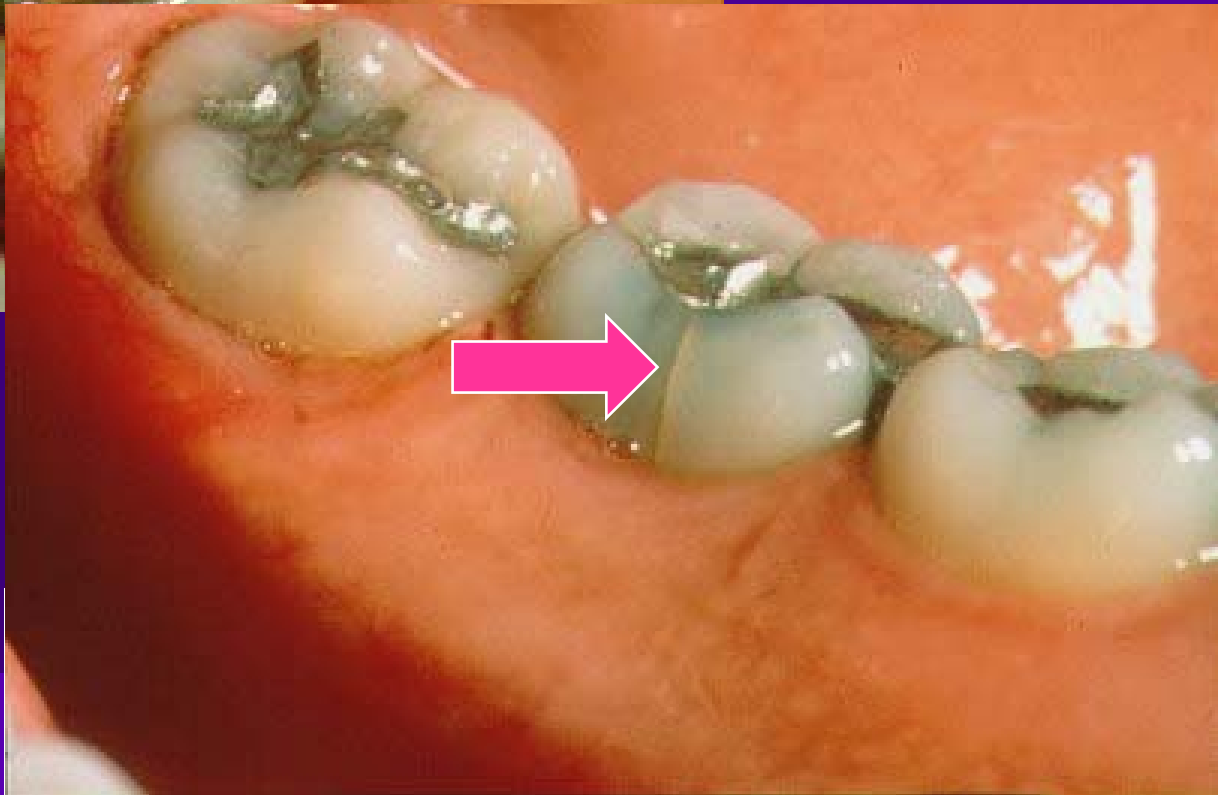
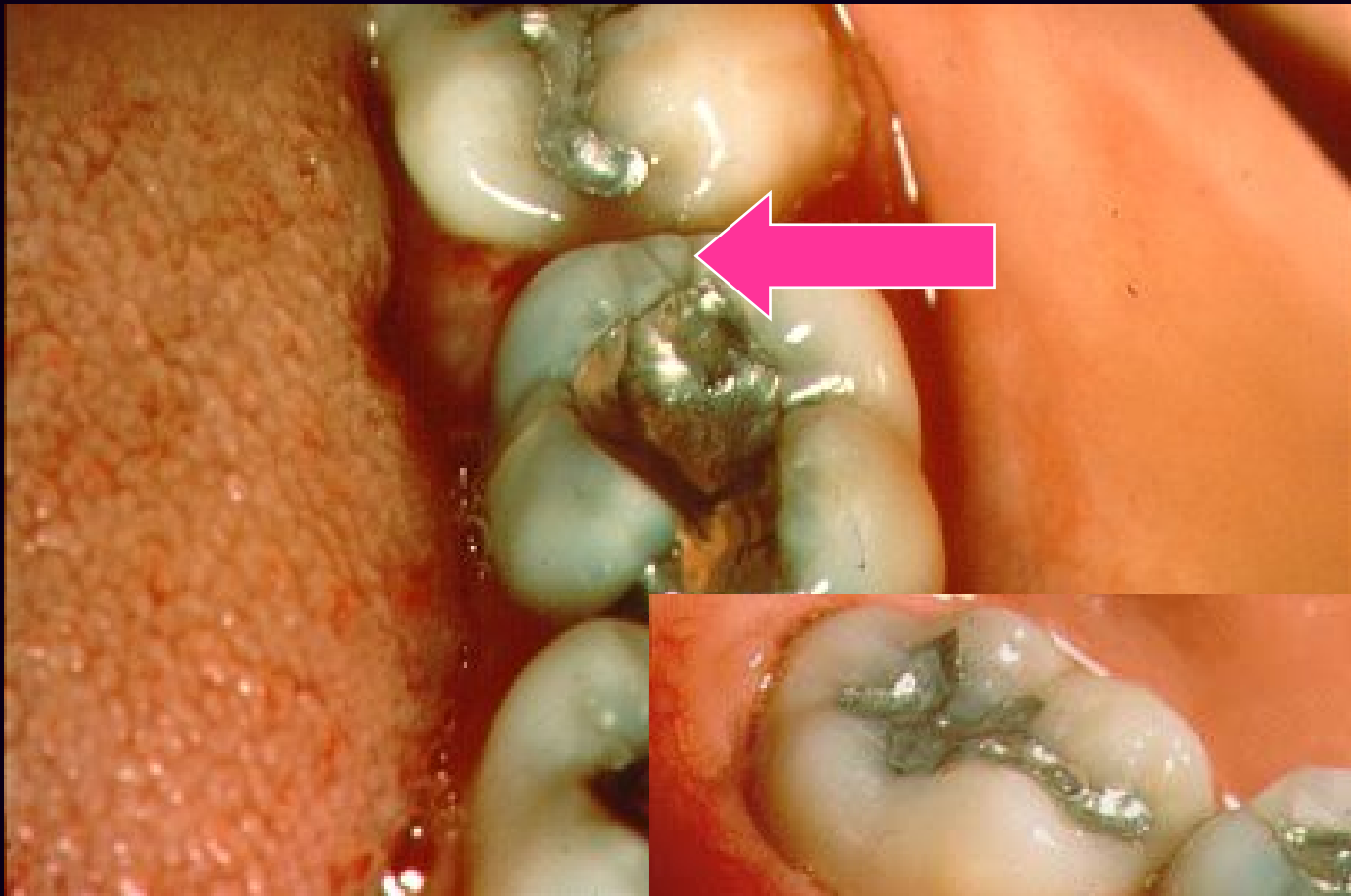
Definitions

- Cuspal Fracture - **kuspefraktur**
 - Location: Crown
 - Direction: M-D and/or F-L
 - Orientation: Occlusal
 - Symptoms: Acute
 - Signs: Separable Segments
 - How to ID: Remove Segment
 - Treatment: Remove Segment and Restore
 - Prognosis: Fair



Cuspal Fracture - kuspEFRaktur



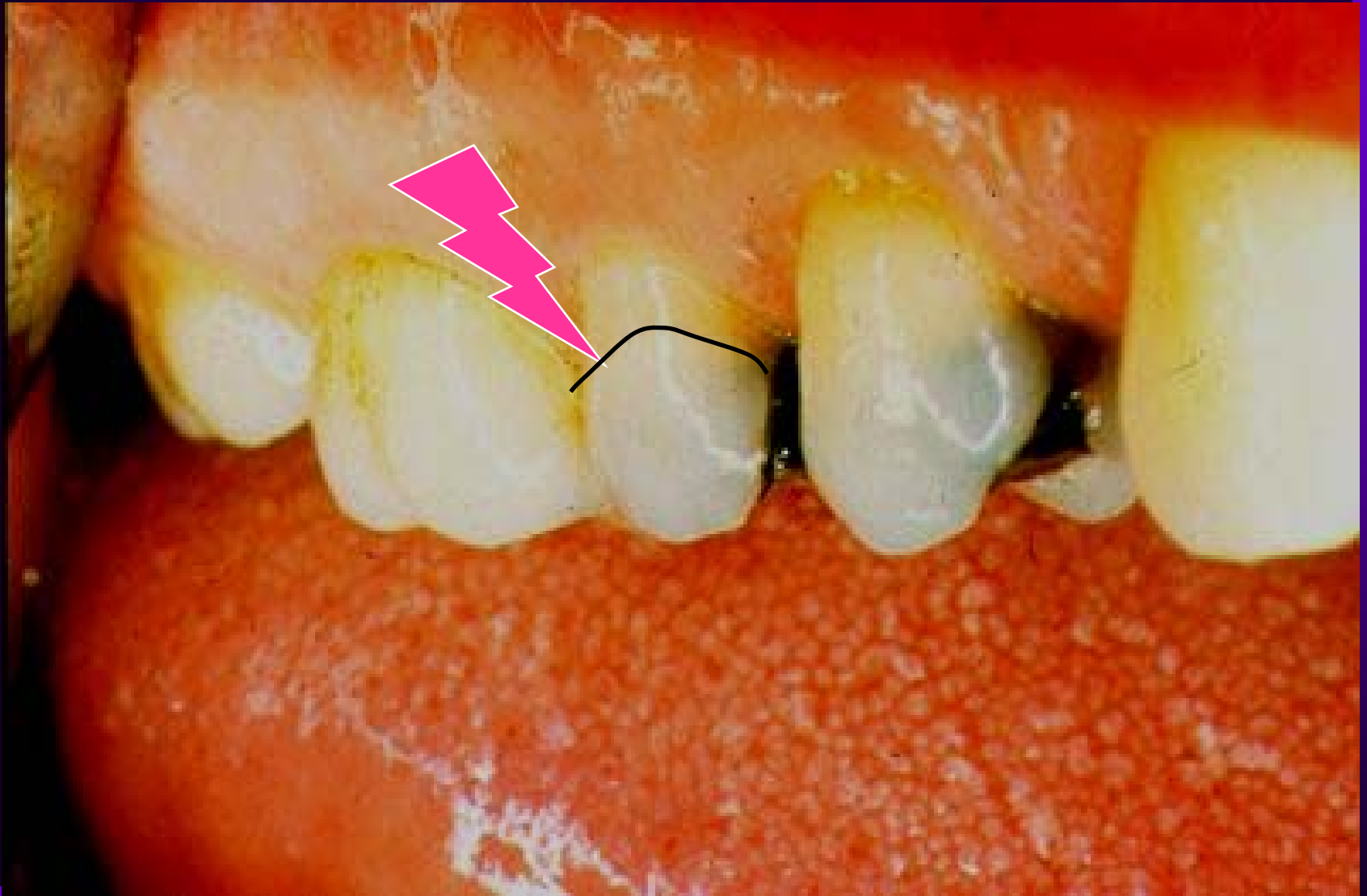


EMR



EMR



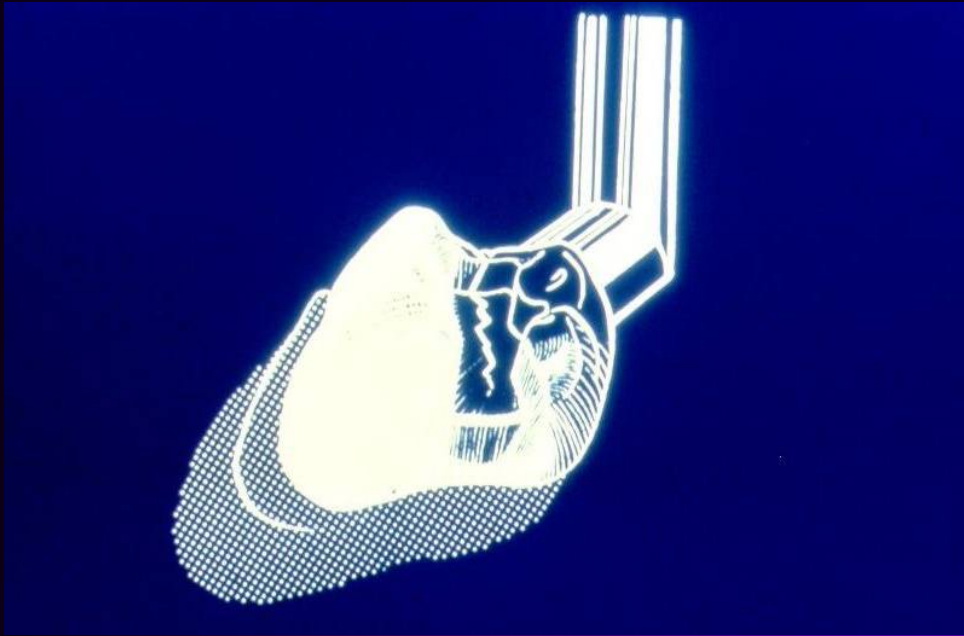


EMR





EMR



EMR

Cracked Tooth

■ Definition

- An incomplete fracture initiated from the crown and extending subgingivally, usually directed mesio-distally.
- The fracture may extend through either or both of the marginal ridges and through the proximal surfaces.

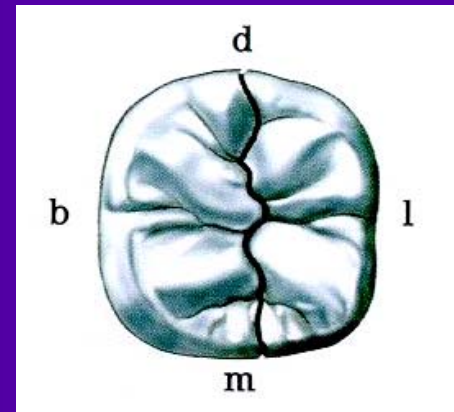
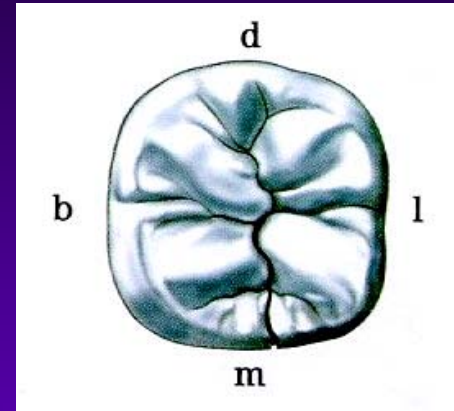
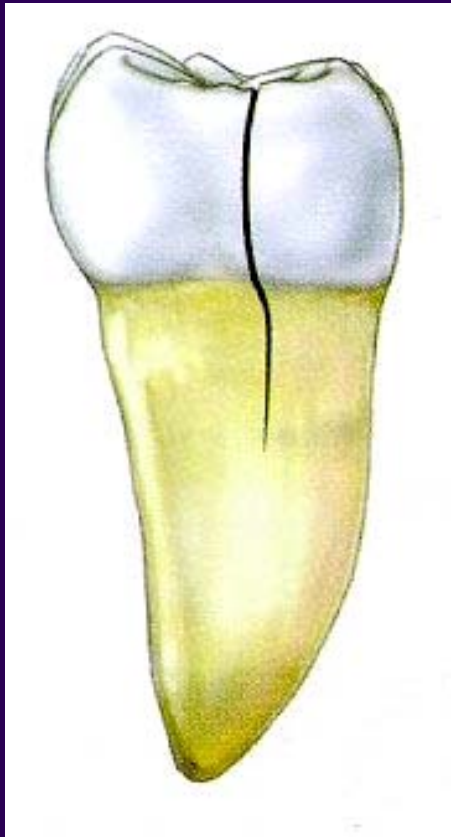


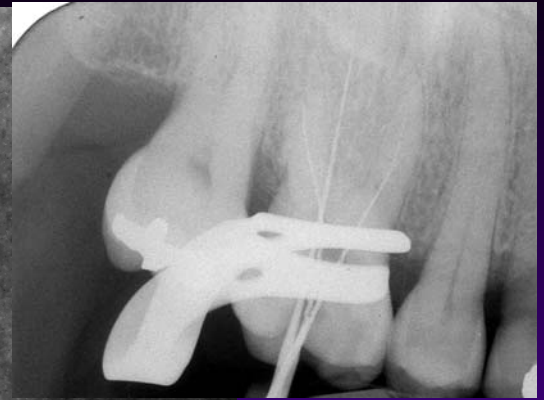
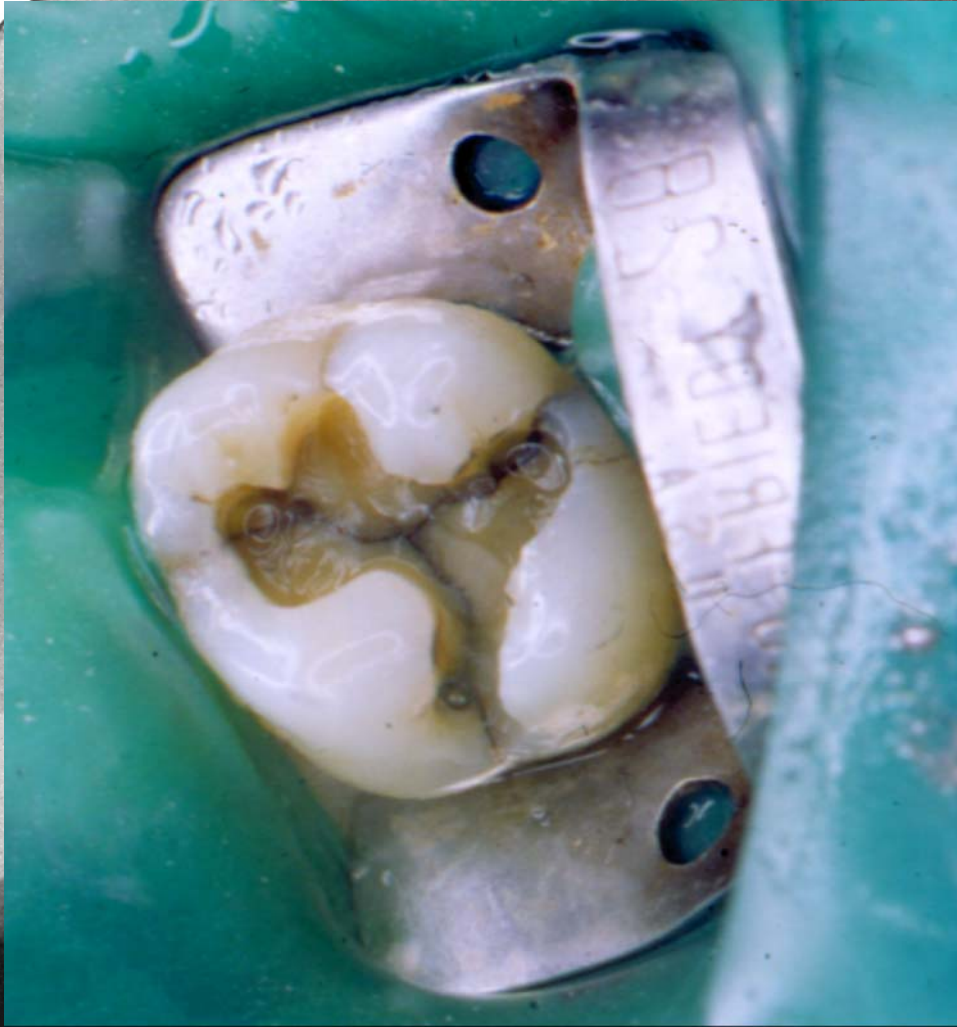
Definitions

- Cracked Tooth - **Vertikal sprekk**
 - Location: Crown
 - Direction: M-D
 - Orientation: Occlusal
 - Symptoms: Highly Variable
 - Signs: Variable
 - How to ID: Illumination, Stain, Remove Restoration, Biting, Magnification
 - Treatment: Varied
 - Prognosis: Varied



Cracked Tooth – Sprekk





Cracked Tooth

- Hiatt, J Periodontol 1973;44:369
 - Teeth with incomplete crown-root fractures have good cusp/fossa relationships.
 - The fractures run in a mesio-distal direction.
 - Only posterior teeth are involved.
 - 74% of involved teeth had no proximal restorations.
 - 71% of fractures were found in mandibular molars.



Cracked Tooth

- Cameron J Am Dent Assoc 1976;93:971
 - 2/3 of 102 fractures occurred in mandibular molars.
 - 35% of patients gave a history of previous cracked tooth.
 - 25% of patients could make their own diagnosis.
 - Pulp testing and radiographic findings often do not contribute to the diagnosis.



Cracked Tooth

- Cameron J Am Dent Assoc 1976;93:971
 - 75% of the cracked teeth were vital (ie. responsive to Sensitivity Testing).
 - 81% of the cases revealed normal radiographic structures.

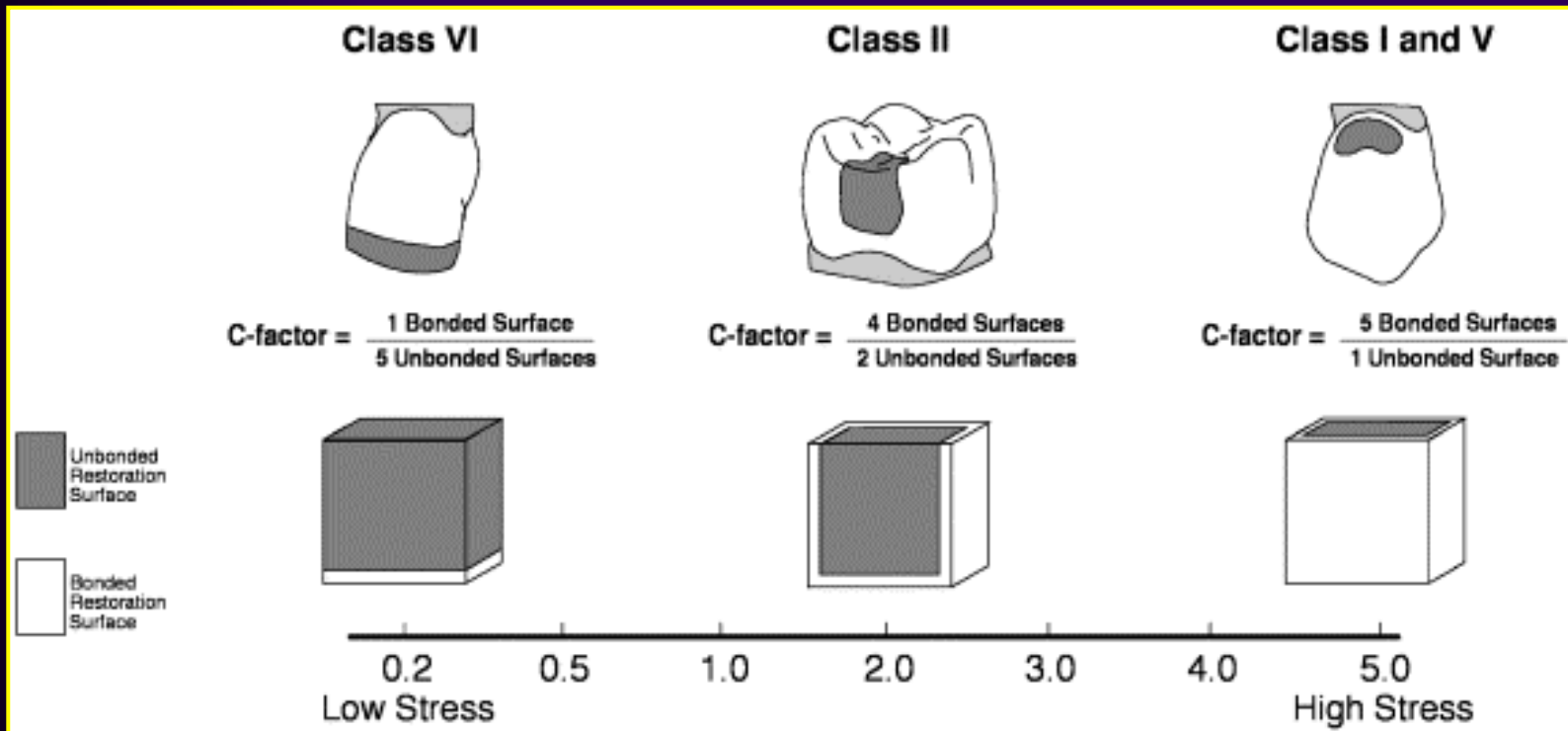


Cracked Tooth

- Suggested Etiologies
 - Heavy masticatory musculature
 - Crunching habit
 - Steep cuspal inclines
 - Large MOD restorations
 - Teeth that have had RCT and not been (properly) restored
 - *??Bonding and shrinkage??*



"C factor" for contraction stress

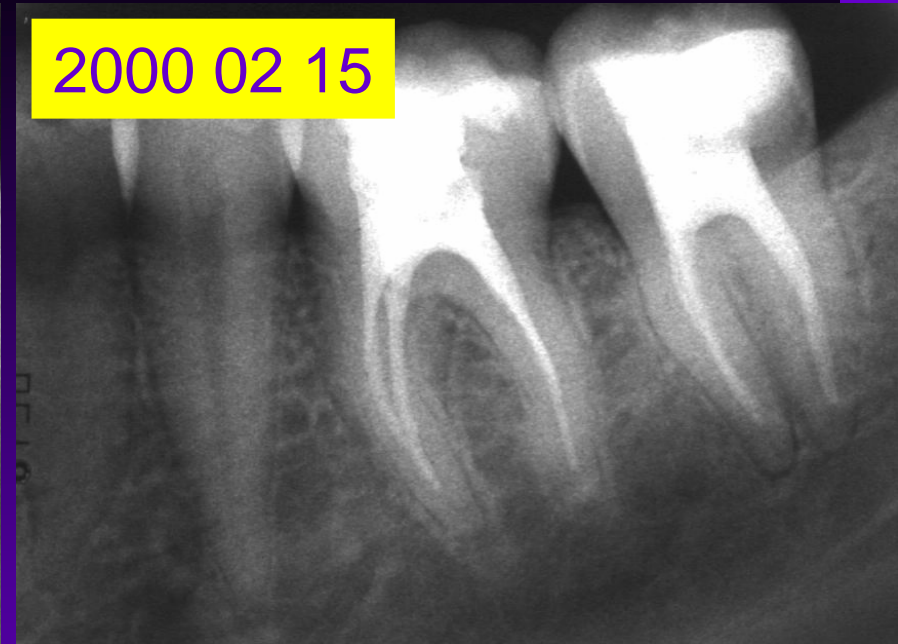


Feltzer et al 1987,
Price et al 2003

1999 11 16



2000 02 15



2001 03 27



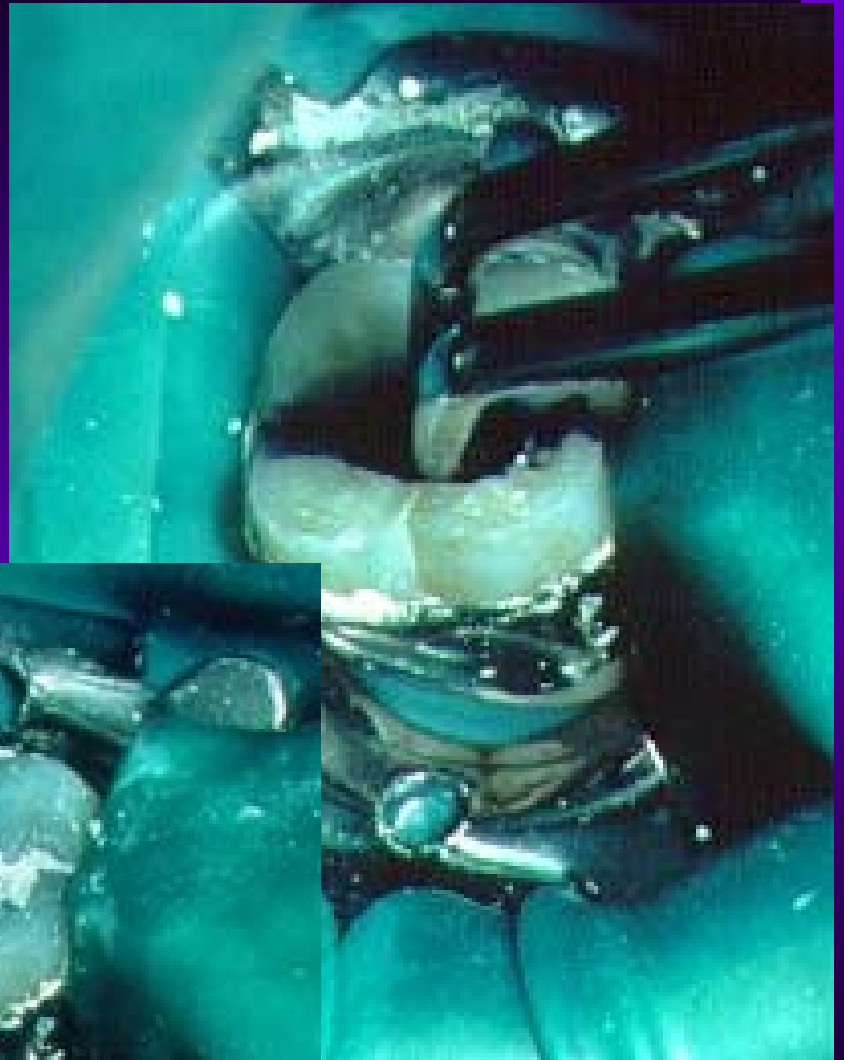
2001 05 29



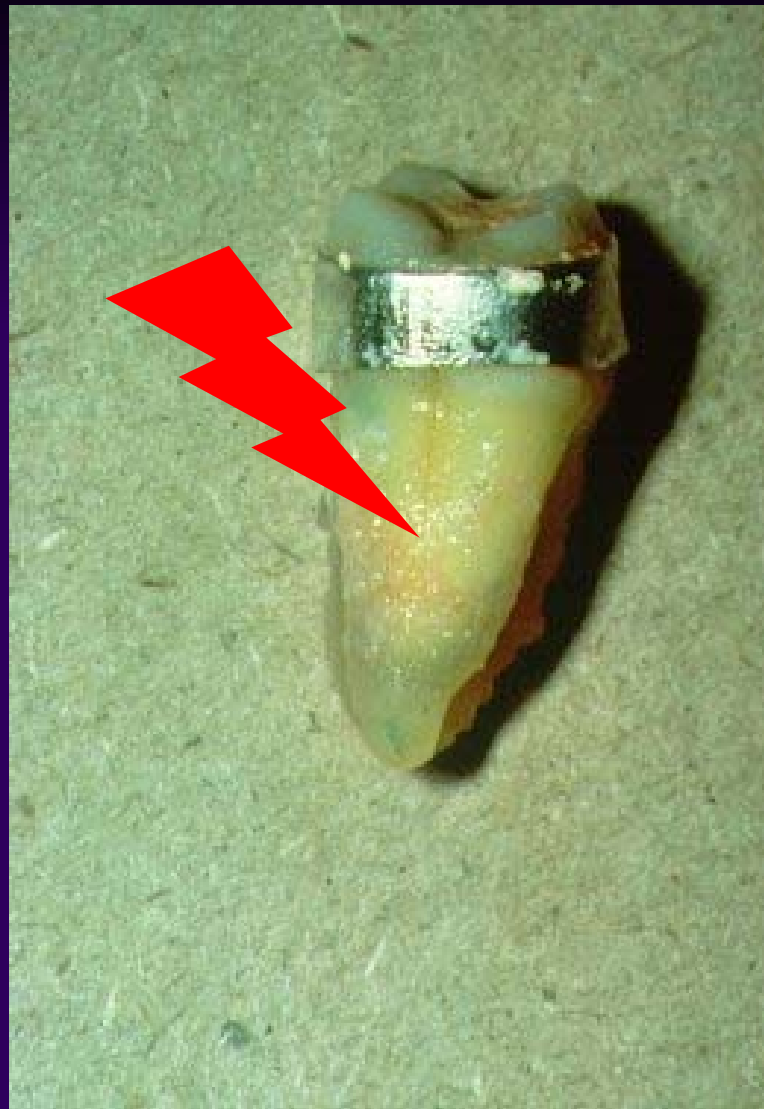
Cracked Tooth Syndrome???

- A Syndrome is a group of signs and symptoms that characterize and specify a particular abnormality.
- A Syndrome is a set of concurrent and repeatable things that form a distinct identifiable pattern.





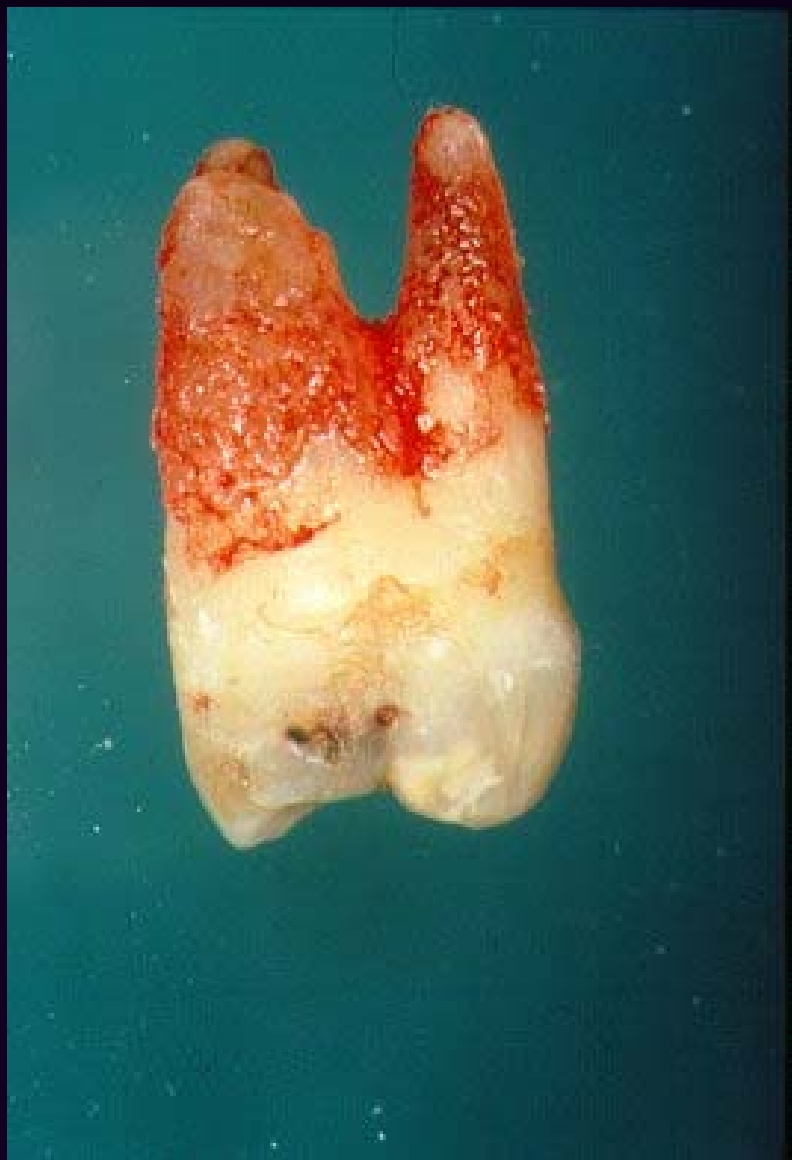
EMR



EMR



EMR



EMR

Cracked Tooth

■ Treatment

- Providing the tooth is responsive to Sensitivity Testing and there are no periodontal defects, a cast restoration is placed to prevent progression of crack???
- If endodontic and/or periodontal problems exist, they should be treated prior to fabrication of a cast restoration????
- Prognosis: **Dubious**



Cracked Tooth

■ Treatment

- Dentin and enamel bonding with adhesive resins, if placed with special techniques, may reinforce weakened tooth structure and provide cuspal protection.
 - Boyer DB, Roth L (1994). Fracture resistance of teeth with bonded amalgams. *Am J Dent* 7(2):91-4.
 - Reeh ES, Douglas WH, Messer HH (1989). Stiffness of endodontically-treated teeth related to restoration technique. *J Dent Res* 68(11):1540-4.
 - Trope M, Langer I, Maltz D, Tronstad L (1986). Resistance to fracture of restored endodontically treated premolars. *Endod Dent Traumatol* 2(1):35-8.
 - Trope M, Tronstad L (1991). Resistance to fracture of endodontically treated premolars restored with glass ionomer cement or adhesive composite. *Endod* 17(6):257-9.



Cracked Tooth

■ Treatment

- Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2001 Nov;92(5):553-5
- **Vertical root fracture** in endodontically treated teeth: a review of 25 cases.
- Llena-Puy MC, Forner-Navarro L, Barbero-Navarro I. Department of Somatology, Faculty of Medicine and Dentistry, University of Valencia, Spain.
- NB: Gjelder egentlig ***cracked teeth***, hvilket bekrefter behovet for presis terminologi!



Cracked Tooth

■ Treatment

- OBJECTIVE: We sought to examine the clinical conditions under which 25 endodontically treated teeth underwent vertical root fracture (VRF) and to relate this condition to the time elapsed from endodontic treatment to fracture.



Cracked Tooth

■ Treatment

- **STUDY DESIGN:** This was a retrospective study in which we reviewed 25 case histories of patients with postendodontic VRF and studied the effect of various pretreatment and posttreatment factors as they related to VRF.



Table III. Restorative materials used in 25 teeth with VRF and the time elapsed from restorative treatment to VRF

<i>Restorative material</i>	<i>Frequency</i>	<i>Percentage</i>	<i>Mean, range (mo)</i>
Composite resin	11	44%	25; 21-28
Amalgam	9	36%	104; 84-124*
Bonded amalgam	5	20%	29; 21-37

*Teeth restored with conventional amalgam took a significantly longer time to fracture ($P < .05$).

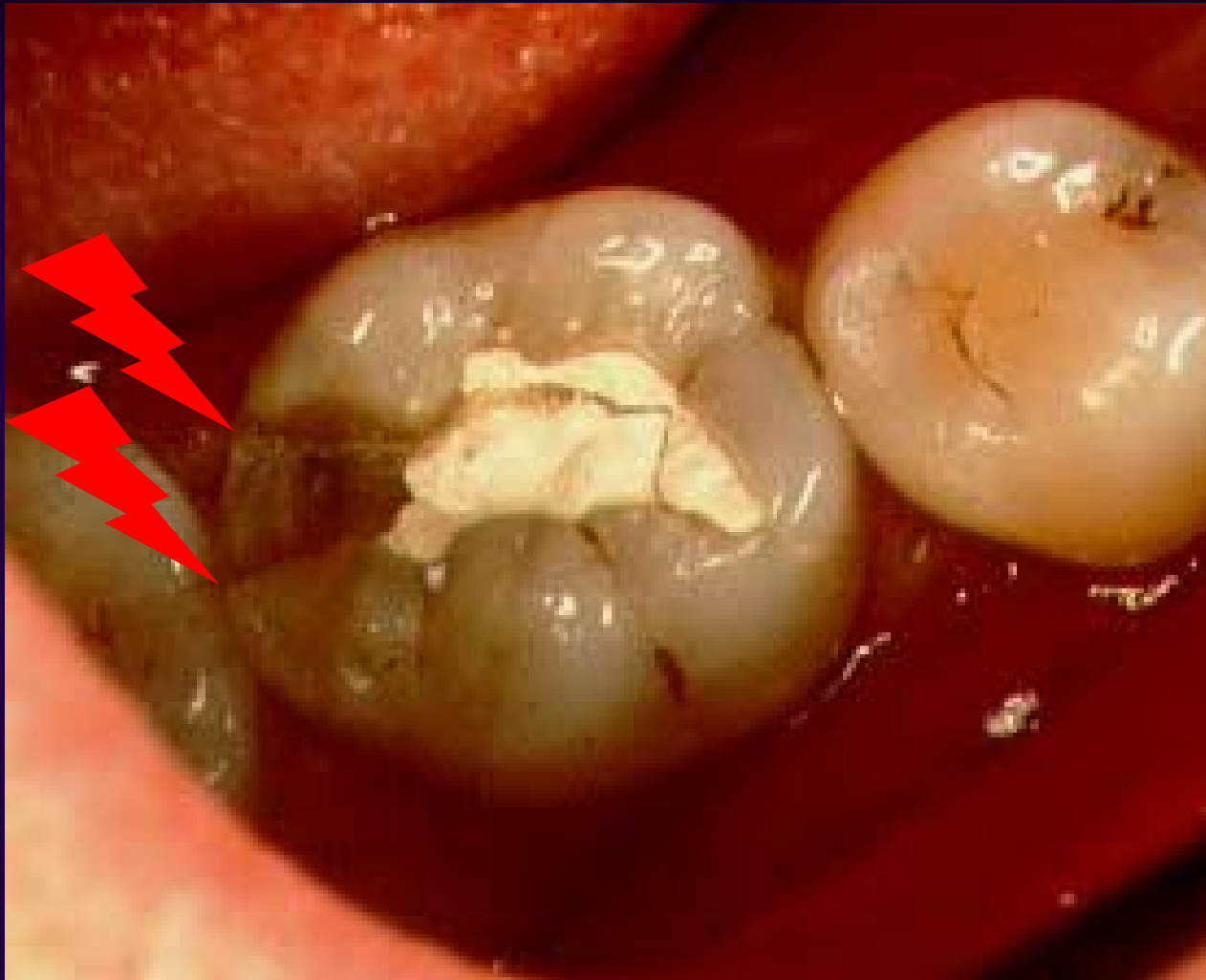


Cracked Tooth

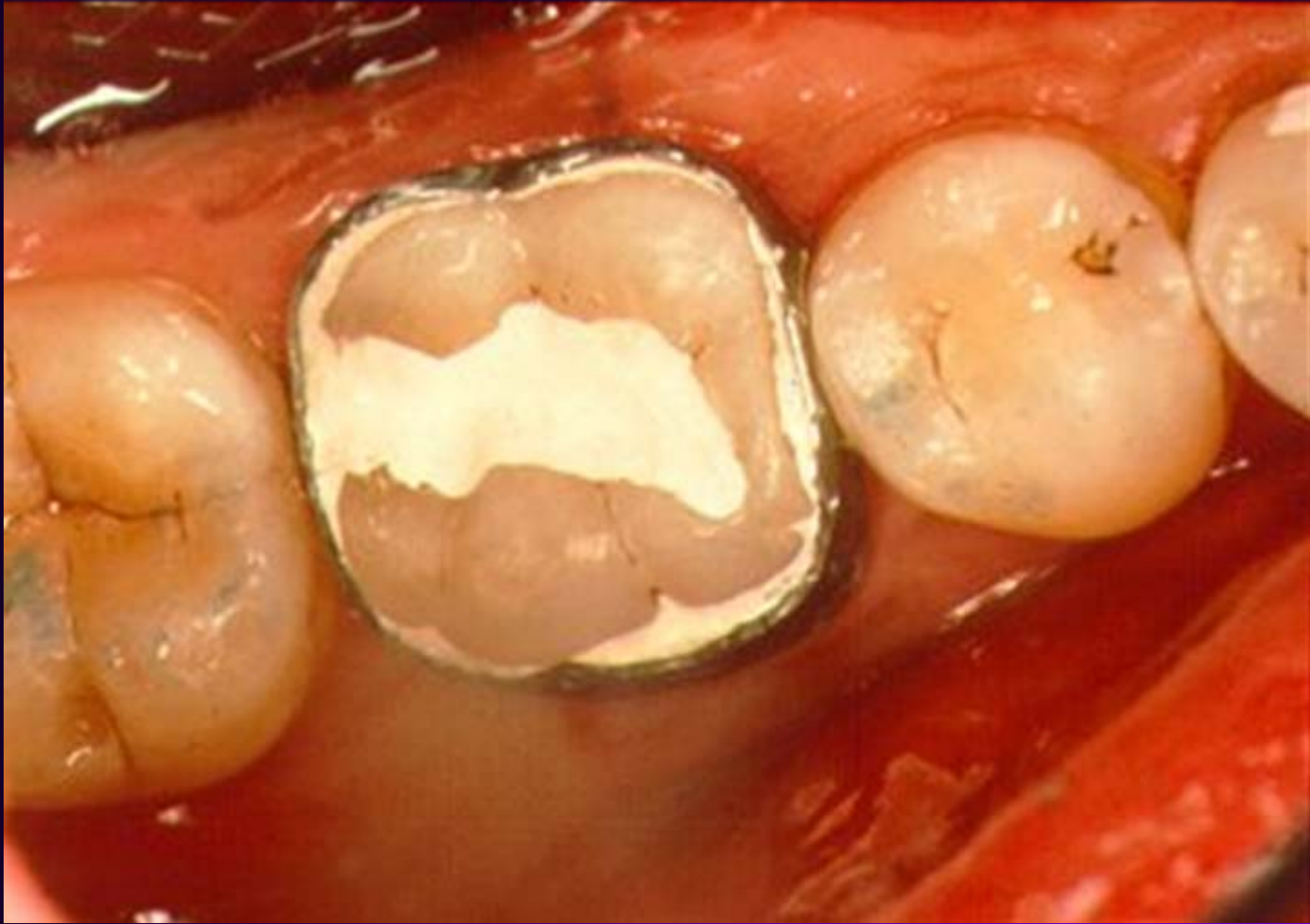
■ Treatment

- RESULTS AND CONCLUSIONS: The mean time to VRF was 54 months; this was not significantly influenced by the presence or absence of prior restoration or by the presence or absence of a crown fitting. The use of a prefabricated, cylindrical, cemented intraradicular retainer increased the time between endodontics and VRF. **Teeth restored with conventional amalgam took significantly longer to undergo VRF than those restored with composite or bonded amalgam.** In contrast, amalgam-restored teeth suffered more coronal fractures before VRF than did teeth in the other 2 groups.





EMR



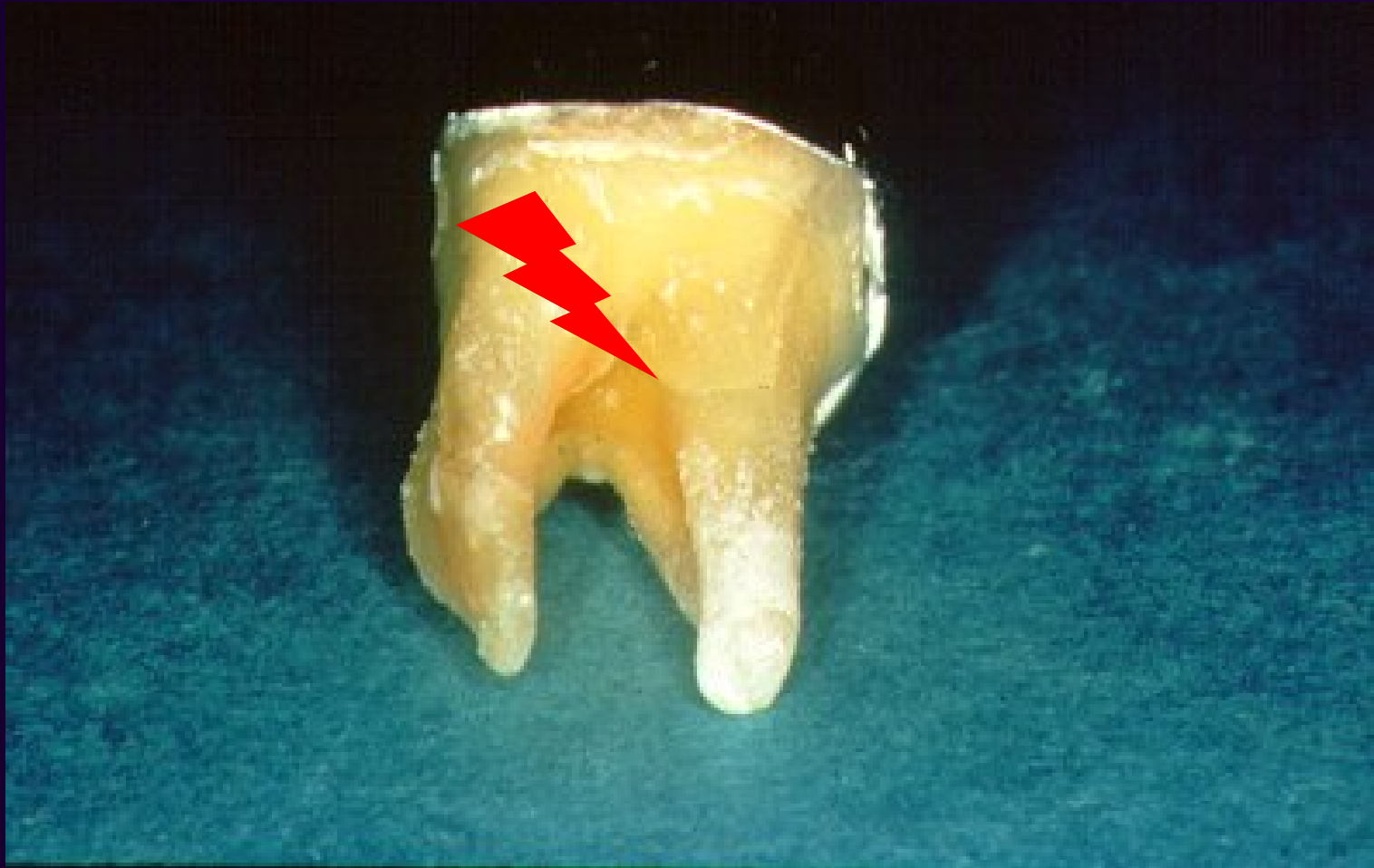
EMR



EMR



EMR



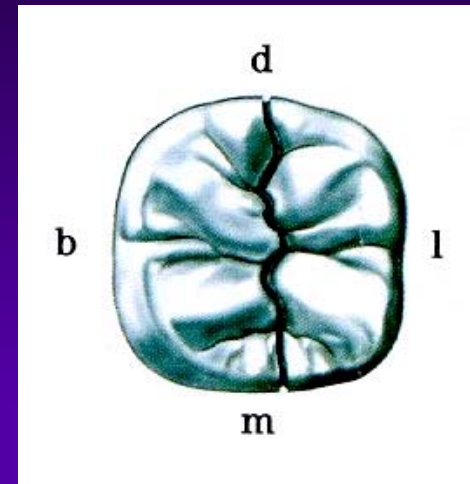
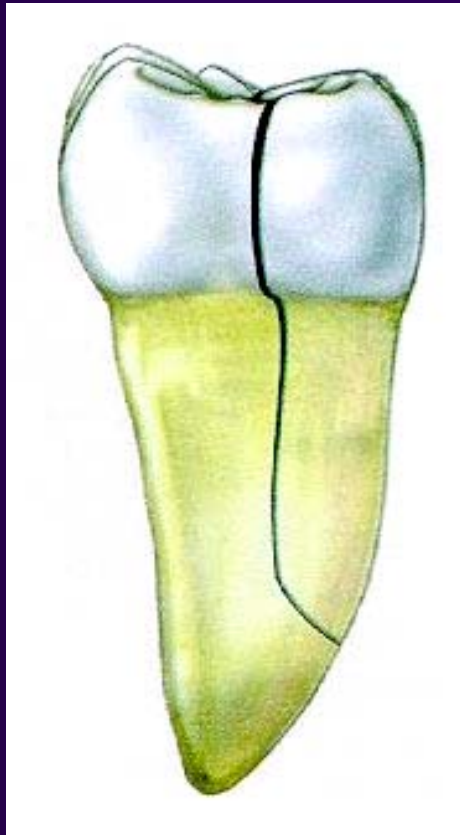
EMR

Definitions

- Split Tooth - **Vertikal kronefraktur**
 - Location: Crown
 - Direction: M-D
 - Orientation: Occlusal
 - Symptoms: Acute, Mastication
 - Signs: Separable Segments
 - How to ID: Separable Segments
 - Treatment: Remove Separable Segment
 - Prognosis: Hopeless



Split Tooth – Vertikal kronefraktur





EMR



EMR



EMR



EMR

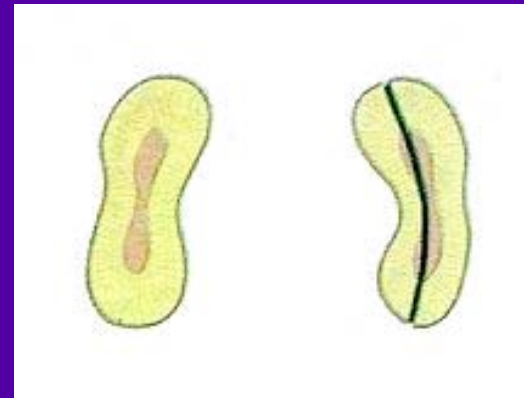
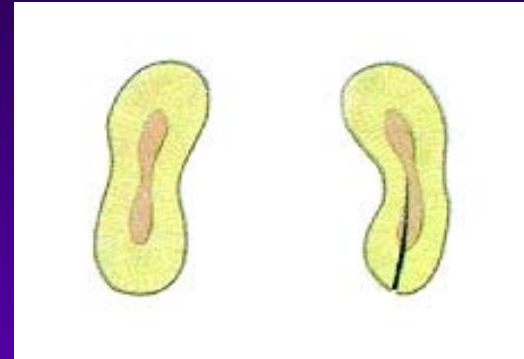
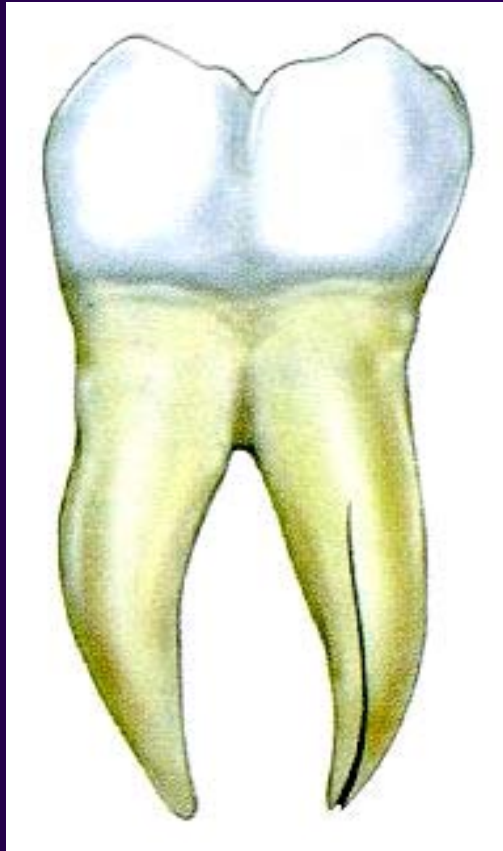


Definitions

- Vertical Root Fracture – vertikāl rotfraktur
 - Location: Roots
 - Direction: F-L
 - Orientation: Root
 - Symptoms: Usually None
 - Signs: Variable
 - How to ID: Flap Reflection
 - Treatment: Removal
 - Prognosis: Hopeless



Vertical Root Fracture

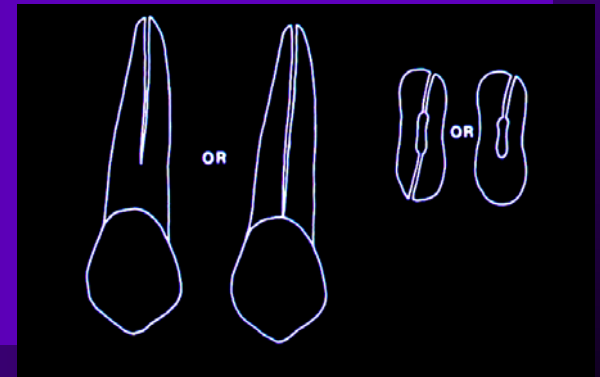


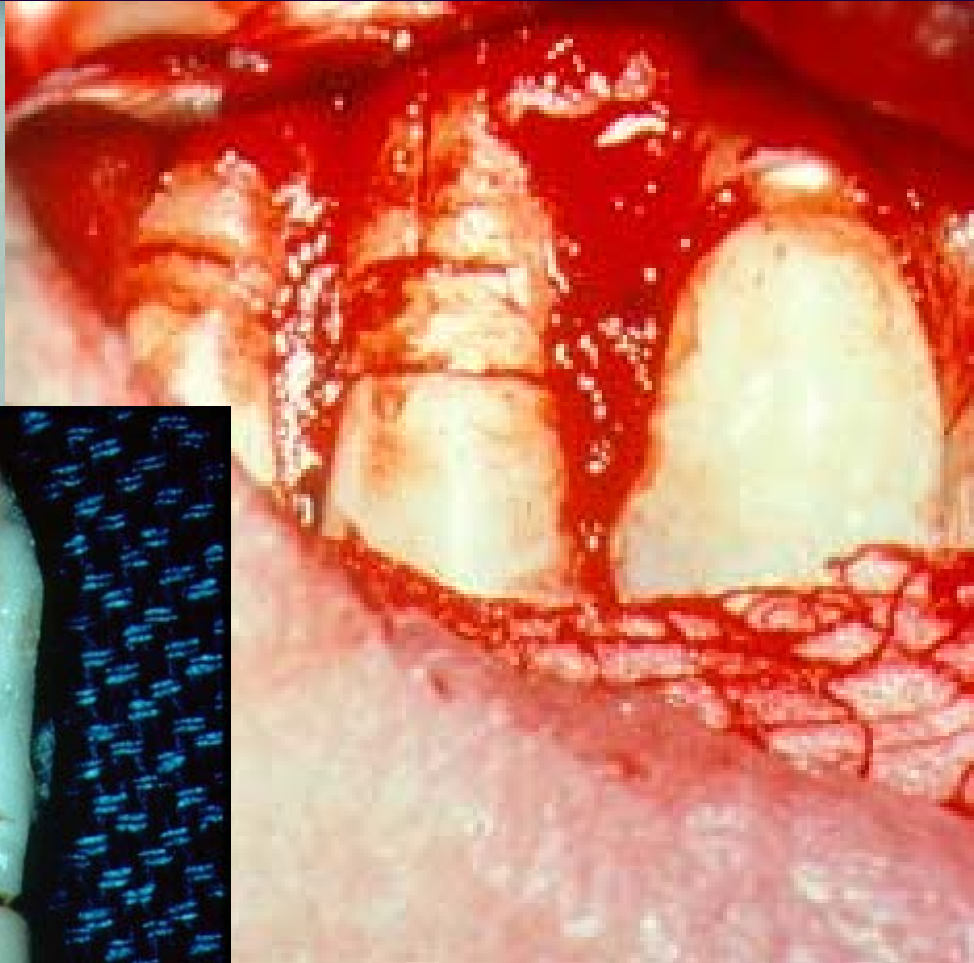


EMR

Vertical Root Fractures

- What direction is the fracture?
- Primarily facial-lingual
 - Pitts DL, Natkin E (1983). Diagnosis and treatment of vertical root fractures. *J Endod* 9(8):338-46.
 - Pitts DL, Matheny HE, Nicholls JI (1983). An in vitro study of spreader loads required to cause vertical root fracture during lateral condensation. *J Endod* 9(12):544-50.
 - Ricks-Williamson LJ, Fotos PG, Goel VK, Spivey JD, Rivera EM (1995). A three-dimensional finite-element stress analysis of an endodontically prepared maxillary central incisor. *J Endodon* 21(7):362-367.
 - Tamse A, Fuss Z, Lustig J, Kaplavi J (1999). An evaluation of endodontically treated vertically fractured teeth. *J Endod* 25(7):506-8.
 - Lustig JP, Tamse A, Fuss Z (2000). Pattern of bone resorption in vertically fractured, endodontically treated teeth. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 90(2):224-7.





EMR

Vertical Root Fractures

- What is the etiology for these fractures?
- **Post placement and condensation forces during obturation are the two major etiologies.**

- Meister F, Jr., Lommel TJ, Gerstein H (1980). Diagnosis and possible causes of vertical root fractures. *Oral Surg Oral Med Oral Pathol* 49(3):243-53.
- Harvey TE, White JT, Leeb IJ (1981). Lateral condensation stress in root canals. *J Endodon* 7(4):151-55.
- Pitts DL, Matheny HE, Nicholls JI (1983). An in vitro study of spreader loads required to cause vertical root fracture during lateral condensation. *J Endod* 9(12):544-50.
- Tamse A (1988). Iatrogenic vertical root fractures in endodontically treated teeth. *Endod Dent Traumatol* 4(5):190-6.
- Obermayr G, Walton RE, Leary JM, Krell KV (1991). Vertical root fracture and relative deformation during obturation and post cementation. *J Prosthet Dent* 66(2):181-7.
- Murgel CA, Walton RE (1990). Vertical root fracture and dentin deformation in curved roots: the influence of spreader design. *Endod Dent Traumatol* 6(6):273-8.
- Dang DA, Walton RE (1989). Vertical root fracture and root distortion: effect of spreader design. *J Endod* 15(7):294-301.
- Holcomb JQ, Pitts DL, Nicholls JI (1987). Further investigation of spreader loads required to cause vertical root fracture during lateral condensation. *J Endod* 13(6):277-84.



Vertical Root Fractures

- What about probing patterns?
- Probing patterns may be normal, but also may be narrow or rectangular and isolated to a specific area.
 - Lustig JP, Tamse A, Fuss Z (2000). Pattern of bone resorption in vertically fractured, endodontically treated teeth. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 90(2):224-7.
 - Tamse A, Fuss Z, Lustig J, Kaplavi J (1999). An evaluation of endodontically treated vertically fractured teeth. *J Endod* 25(7):506-8.
 - Harrington GW (1979). The perio-endo question: differential diagnosis. *Dent Clin N Amer* 23(4):673-90.





EMR



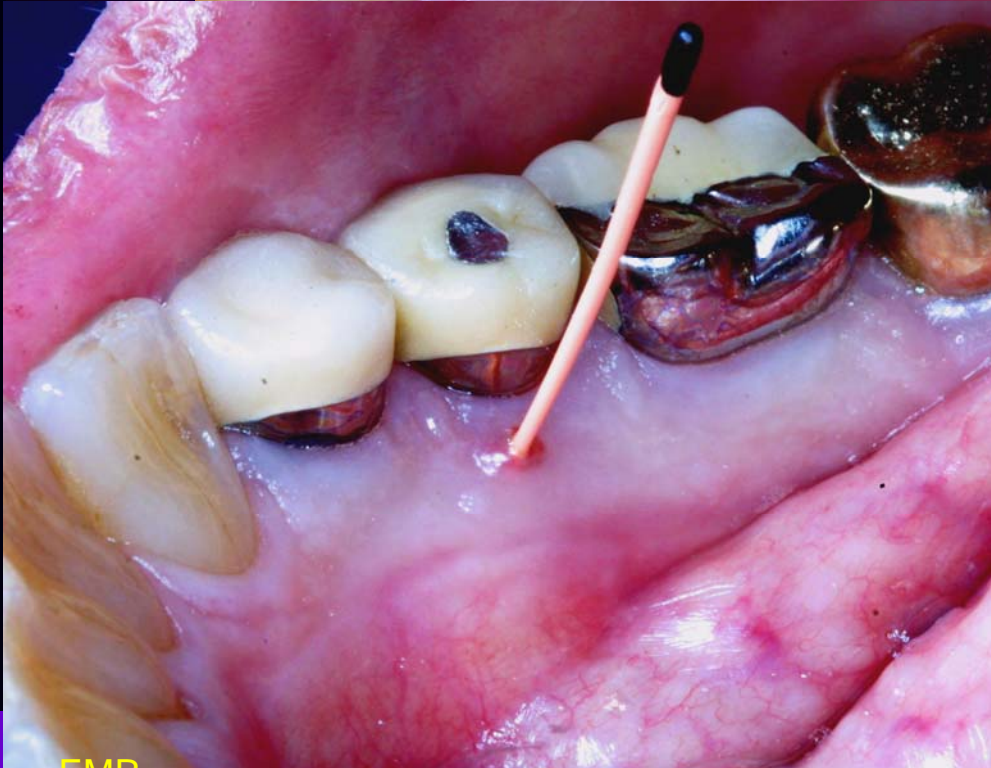
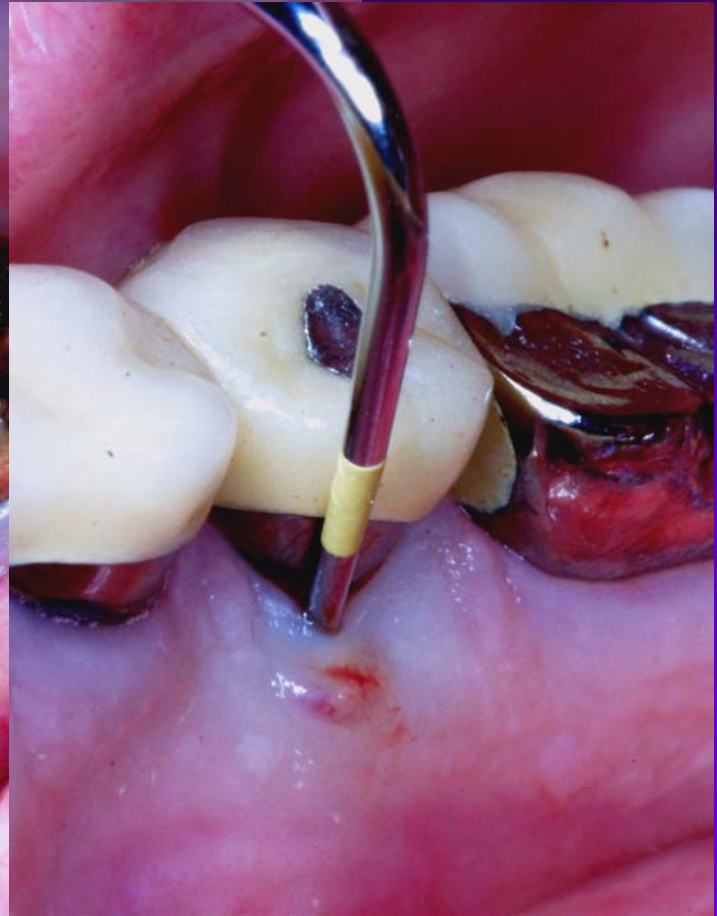
EMR



Vertical Root Fractures

- Does a sinus tract have to be present?
- A sinus tract may be present.
 - Tamse A, Fuss Z, Lustig J, Kaplavi J (1999). An evaluation of endodontically treated vertically fractured teeth. *J Endod* 25(7):506-8.
 - Torabinejad (Personal Communication)





EMR





EMR

Vertical Root Fractures

- Radiographic changes are variable.
 - Some teeth show no radiographic changes.
 - Many resorptive patterns resemble failed root canal treatment (hanging drop).
 - Bone resorption, when present, tends to be marked, extending from the apex along the lateral surface of the root.
 - Tamse A, Fuss Z, Lustig J, Ganor Y, Kaffe I (1999). Radiographic features of vertically fractured, endodontically treated maxillary premolars. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 88(3):348-52.
 - Tamse A, Fuss Z, Lustig J, Kaplavi J (1999). An evaluation of endodontically treated vertically fractured teeth. *J Endod* 25(7):506-8.
 - Michelich (Personal Communication)



Vertical Root Fractures

- Radiographic changes are variable.
 - Some show visible separation of fractured root segments.
 - A radiolucent line that seems to separate filling (ie. gutta percha) from the dentin wall may be diagnostic.



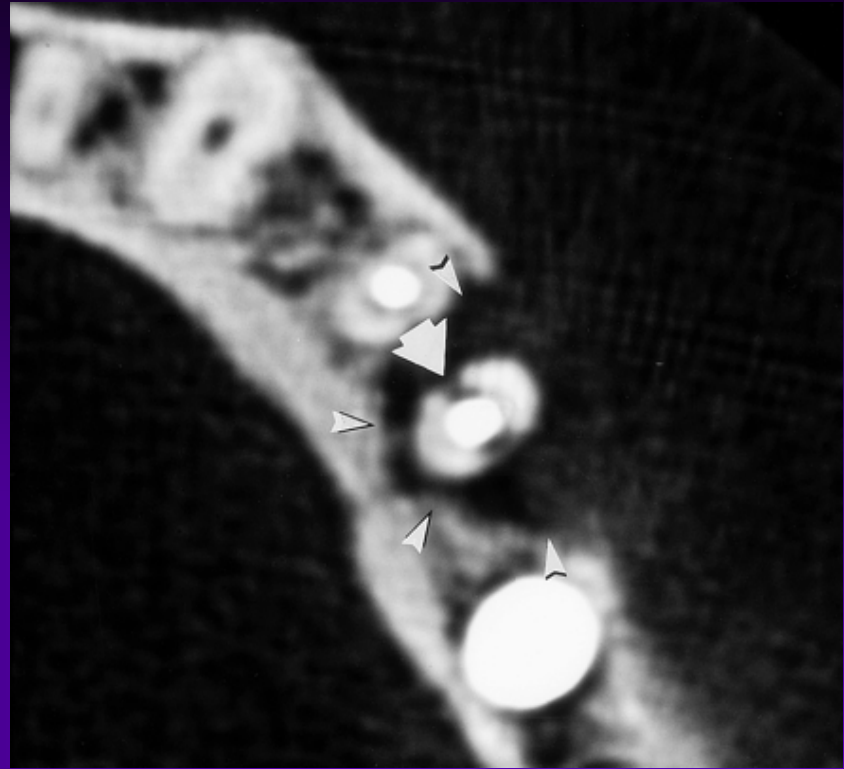
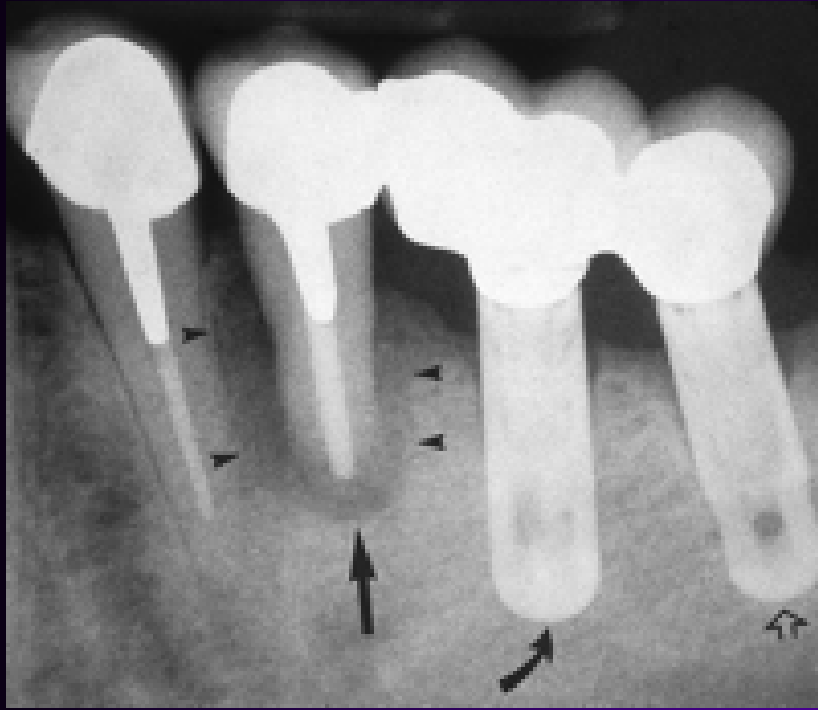
Vertical Root Fractures

"Halo" lesion, perilateral radiolucency, and angular resorption of the crestal bone, combined with diffuse or defined but not corticated borders, indicated a high probability of vertical root fracture in maxillary premolars.

Lustig JP, Tamse
A, Fuss Z. 2000

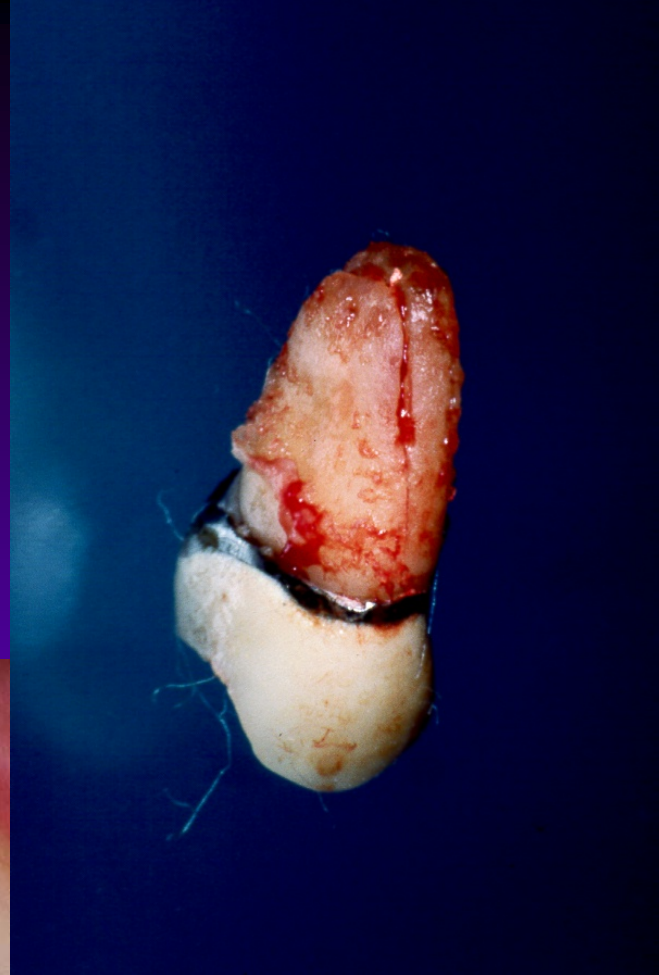


Vertical Root Fractures



Youssefzadeh 1999





EMR

Vertical Root Fractures

■ Histopathogenesis

- Walton RE, Michelich RJ, Smith GN (1984). The histopathogenesis of vertical root fractures. *J Endod* 10(2):48-56.



Okitsu et al. 2005 DMJ 24:66-69:

Effective factors including periodontal ligament on vertical root fractures



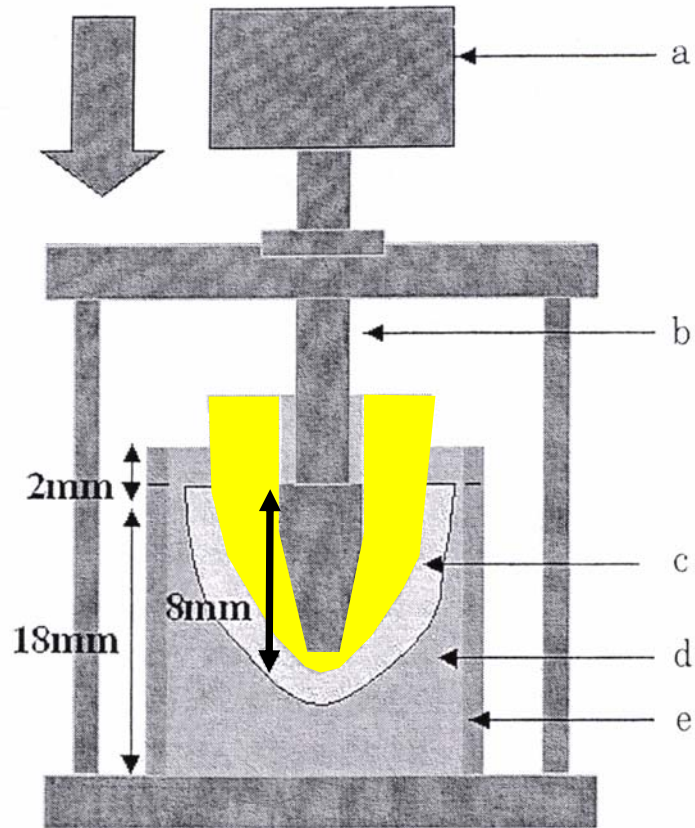


Fig. 1 Schema of loading apparatus. a: cross-head of universal testing machine, b: Co-Cr rod, c: simulated periodontal ligament, d: autopolymerizing resin, e: acrylic tube.

C: Al-folie erstattet med polysiloxan avtrykksmateriale



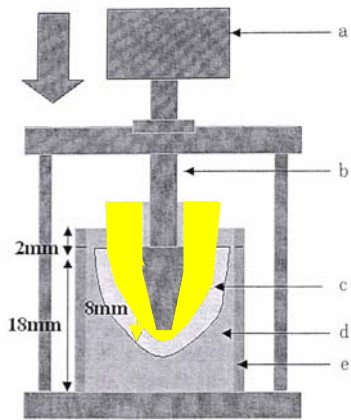
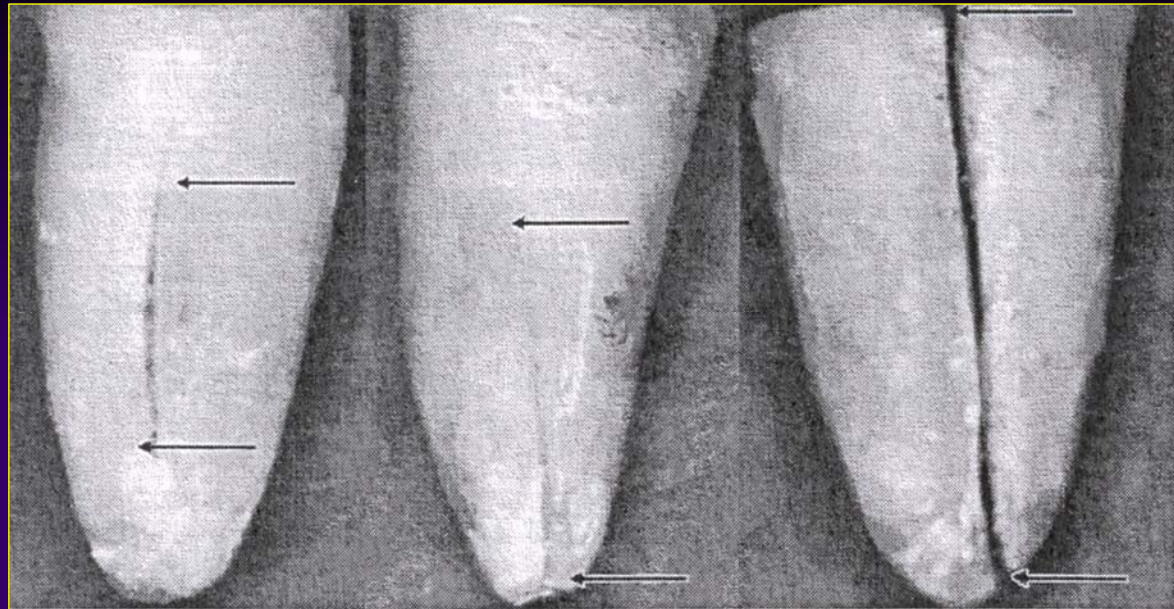


Fig. 1 Schema of loading apparatus. a: cross-head of universal testing machine, b: Co-Cr rod, c: simulated periodontal ligament, d: autopolymerizing resin, e: acrylic tube.



PF

AF

CF

Fig. 2 Typical fracture patterns. PF: partial fracture not involving the root apex, AF: partial fracture involving the root apex, CF: complete fracture.

Okitsu et al. 2005 DMJ 24:66-69



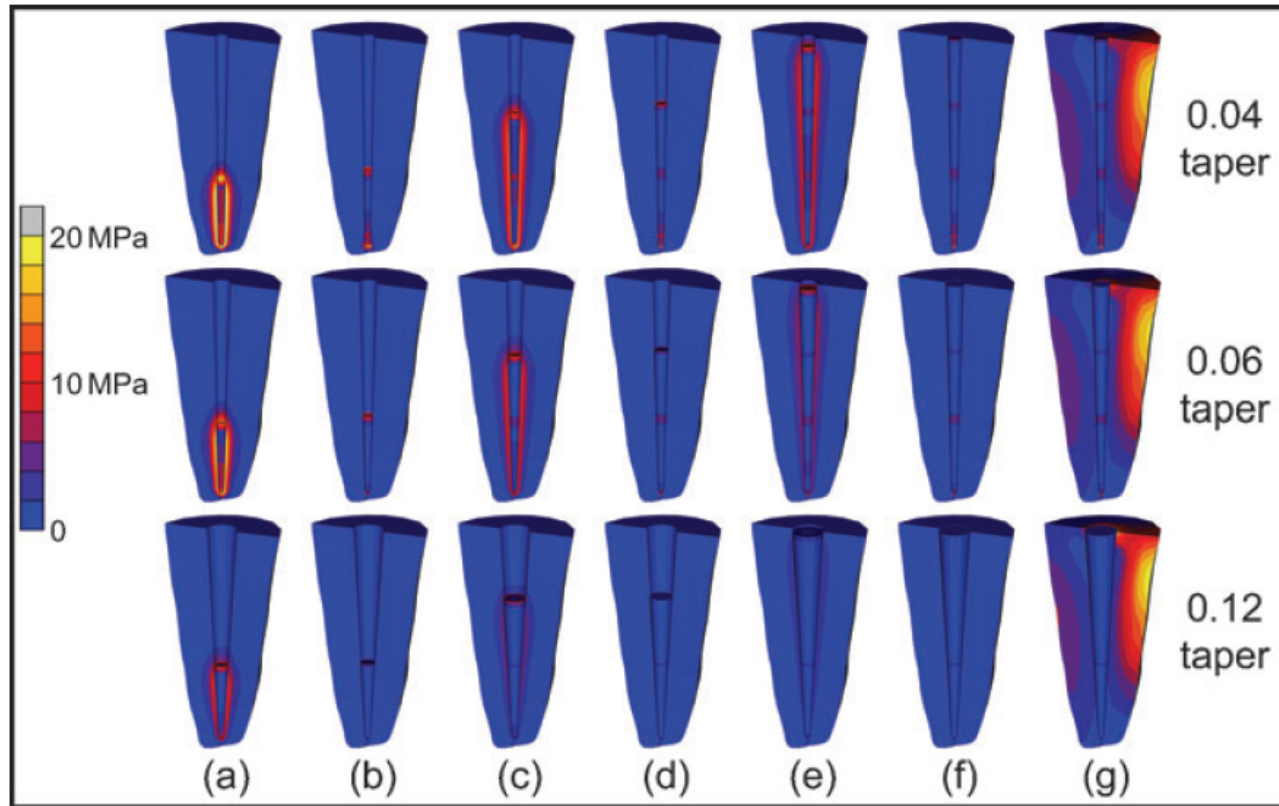
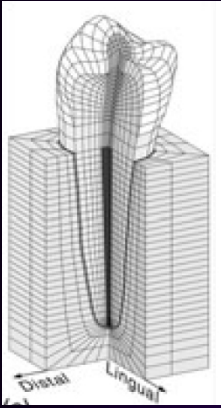
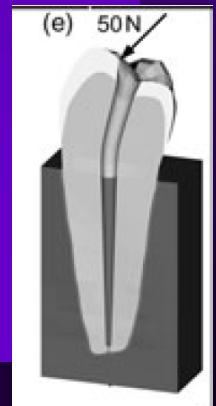


Figure 4 Equivalent stress distributions in a root with three different canal tapers: (a–f) during filling; and (g) followed by a 50 N occlusal loading on the buccal cusp incline. The compaction force was 10 N.



Yang SF, Rivera EM, Walton RE (1995). Vertical root fractures in nonendodontically treated teeth. *J Endod* 21(6):337-39.



Yang SF, Rivera EM, Walton RE (1995).

Vertical root fractures in nonendodontically treated teeth.

J Endodon 21(6):337-39.

Vertical root fractures have been reported to occur primarily in endodontically treated teeth due to condensation forces and/or with post placement. This study describes 11 Chinese patients with 12 molars that developed vertical root fractures without endodontic or post procedures. These showed characteristics of a true vertical root fracture as confirmed after extraction. Fractured teeth showed a consistent pattern. The majority were severely attrited mandibular molars in males. All had clinically intact crowns with no or minimal restorations.



01-1999



02-1999



06-1999



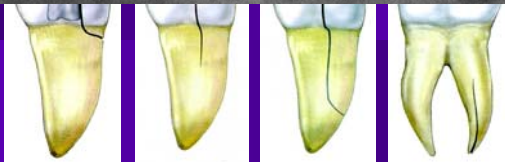
12-2004



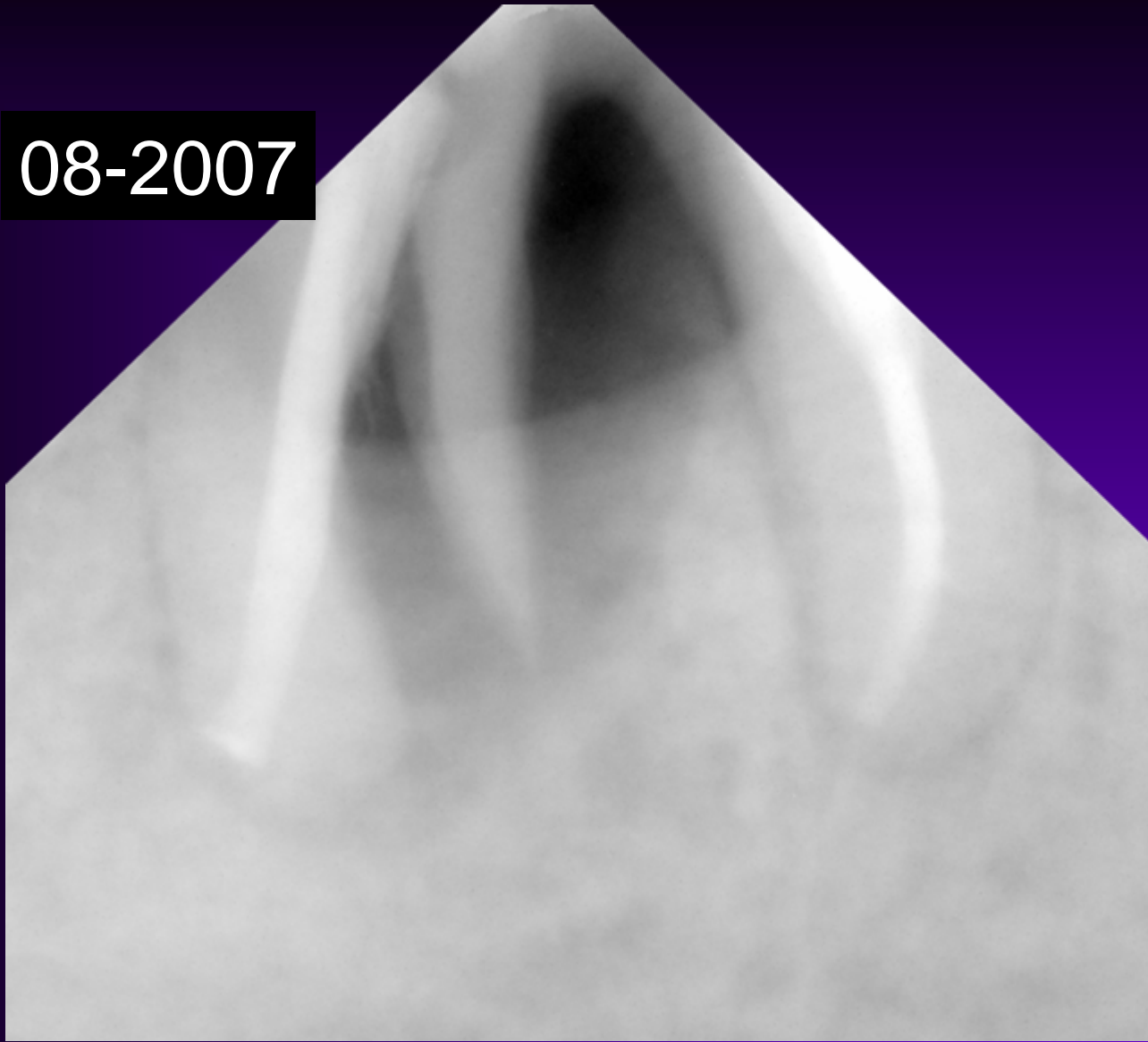
12-2004



08-2005



08-2007





Tamse A, Kaffe I, Lustig J, Ganor Y, Fuss Z. OOOOE 2006



EMR

Overview

	<i>Location</i>	<i>Direction</i>	<i>Orientation</i>	<i>Symptoms</i>	<i>Signs</i>	<i>Diagnosis</i>	<i>Treatment</i>	<i>Prognosis</i>
Craze line	Crown	Variable	Occlusal	None	None	Illumination	None	Excellent
Cuspal fracture	Crown	M-D or F-L	Occlusal	Acute	Separable segment	Remove segment	Remove and restore	Location dependent
Cracked tooth	Crown	M-D	Occlusal	Variable	Variable	Illu, stain, biting	Enforce; extract	Dubious
Split tooth	Crown	M-D	Occlusal	Variable; acute; mastication	Separable segment	Separable segment	Remove segments	Hopeless
Vertical root fracture	Root	F-L	Root	Usually none	Variable	Flap reflection	Extract	Hopeless



Prevention

- Prevention of Cracked Tooth
 - Change Patients' Habits – **gjelder kanskje alle kategorier?**
 - Restore to Protect Occlusion
- Split Tooth Prevention
 - Restore with Crown
 - Protect Weakened Structures
- Cusp Fracture Prevention
 - Protect Weakened Cusps
 - Minimize Class II Width/Depth?





- Apex er nær, men enden er her.

