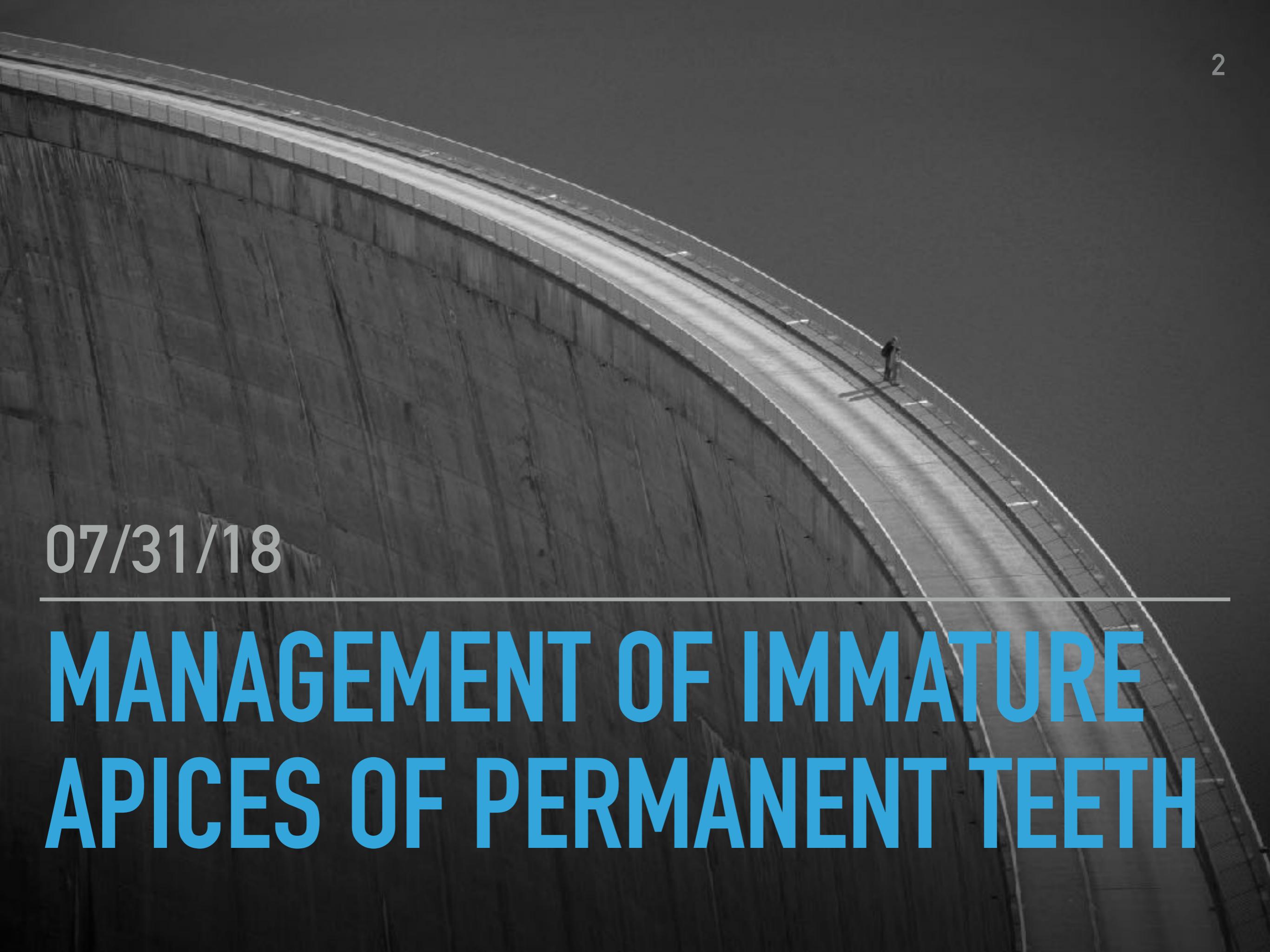


FINANCIAL DISCLOSURE

- ▶ Speaker Name: Brian Lu, DDS
 - ▶ Name of Institution: IQ Dental Specialists
 - ▶ Relationship to Institution: Associate dentist
-
- ▶ *Neither I nor members of my immediate family have any financial interests to disclose relating to the content of this presentation.*



07/31/18

MANAGEMENT OF IMMATURE APICES OF PERMANENT TEETH

OVERVIEW

1. Immature permanent tooth with a vital pulp

- ▶ Apexogenesis
 - Pulpotomy (partial or full)

2. Immature permanent tooth with a non-vital pulp

- ▶ Apexification
 - Traditional technique
 - Artificial apical barrier technique
- ▶ Revascularization/Regeneration



THE OPEN OR IMMATURE APEX

CAUSES

- ▶ Pulp undergoes necrosis before root development is complete
 - Caries/decay
 - Trauma
 - Unique dental anatomy (ex: Den Evaginatus)
- ▶ Exposure of a vital tooth
- ▶ Resorption of the mature apex

PROBLEMS/ISSUES

- ▶ Debridement is difficult
- ▶ Obturation is virtually impossible
- ▶ Thin walls are prone to fracture

BLUNDERBUSS VS. NON-BLUNDERBUSS

- ▶ Blunderbuss
 - Apical walls are divergent and flaring
 - Narrow mid-root and flares apically
- ▶ Non-blunderbuss
 - Walls are slightly parallel and slightly convergent

APEXOGENESIS VS. APEXIFICATION

► Apexogenesis

- Is treatment designed to preserve **vital** pulp tissue in the apical part of a root canal in order to complete formation of the root apex
- The soft tissue (pulp) is covered with medication/dressing to encourage root growth

► Apexification

- AKA root-end closure
- The process whereby a **non-vital** immature, permanent tooth which has lost the capacity for further root development is induced to form a calcified barrier at the root terminus

► The prognosis of performing apexogenesis is better than apexification

- Teeth treated with apexification are at greater risk to root fracture as a consequence of thin dentinal walls resulting in the premature loss of the tooth
- If there's a chance the pulp is vital, LEAVE it even if you're not sure

APEXOGENESIS

GOALS

- ▶ Closure of apex
- ▶ Increase in root length
- ▶ Increase in root wall thickness (dental)

TECHNIQUE

- ▶ Use water coolant when accessing
- ▶ Upon approaching the pulp flush with NaOCl to decrease bacteria load so when you get the exposure there's the least amount of bacterial exposure
- ▶ Amputate coronal pulp with sharp spoon excavator or bur
- ▶ Control bleeding by irrigating with NaOCl and placing cotton pellet saturated on NaOCl **until hemostasis is achieved**

TECHNIQUE (CONT.)

- ▶ Place 2mm of MTA (or another biocompatible material ex: BC putty) over pulp stump ensuring not to fill the chamber with MTA, use cotton pellet to spread MTA over the site of exposure.
 - Reason for this is to avoid difficulty in finding the canals due to calcification if partial pulpotomy fails
- ▶ Placed moist cotton pellet for 1 week
- ▶ Remove cotton and place permanent restoration
- ▶ Recall every 1-2 months with radiographs until apices close

LITERATURE

- ▶ Inflammation occurring in different sites of the pulp

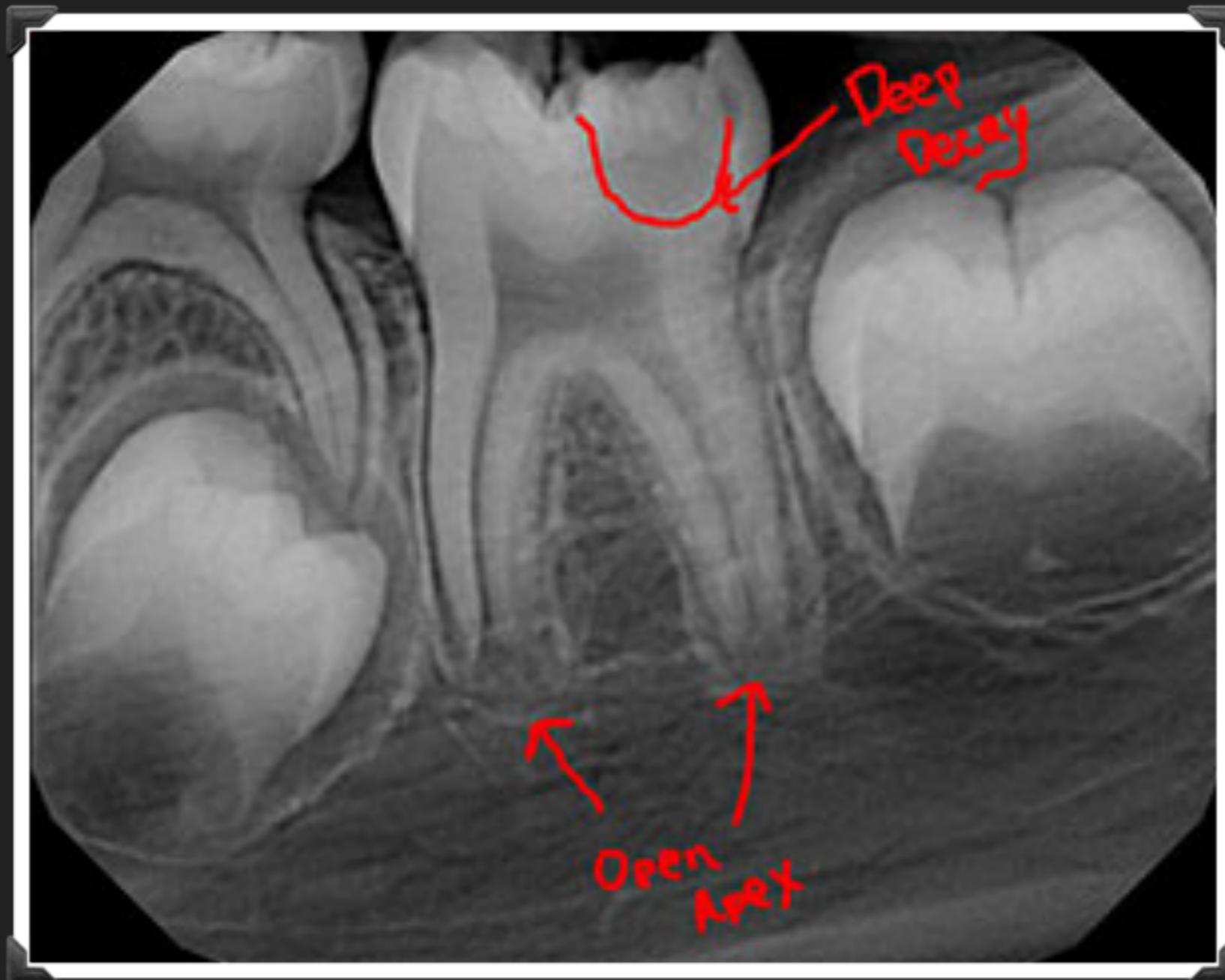


APEXOGENESIS

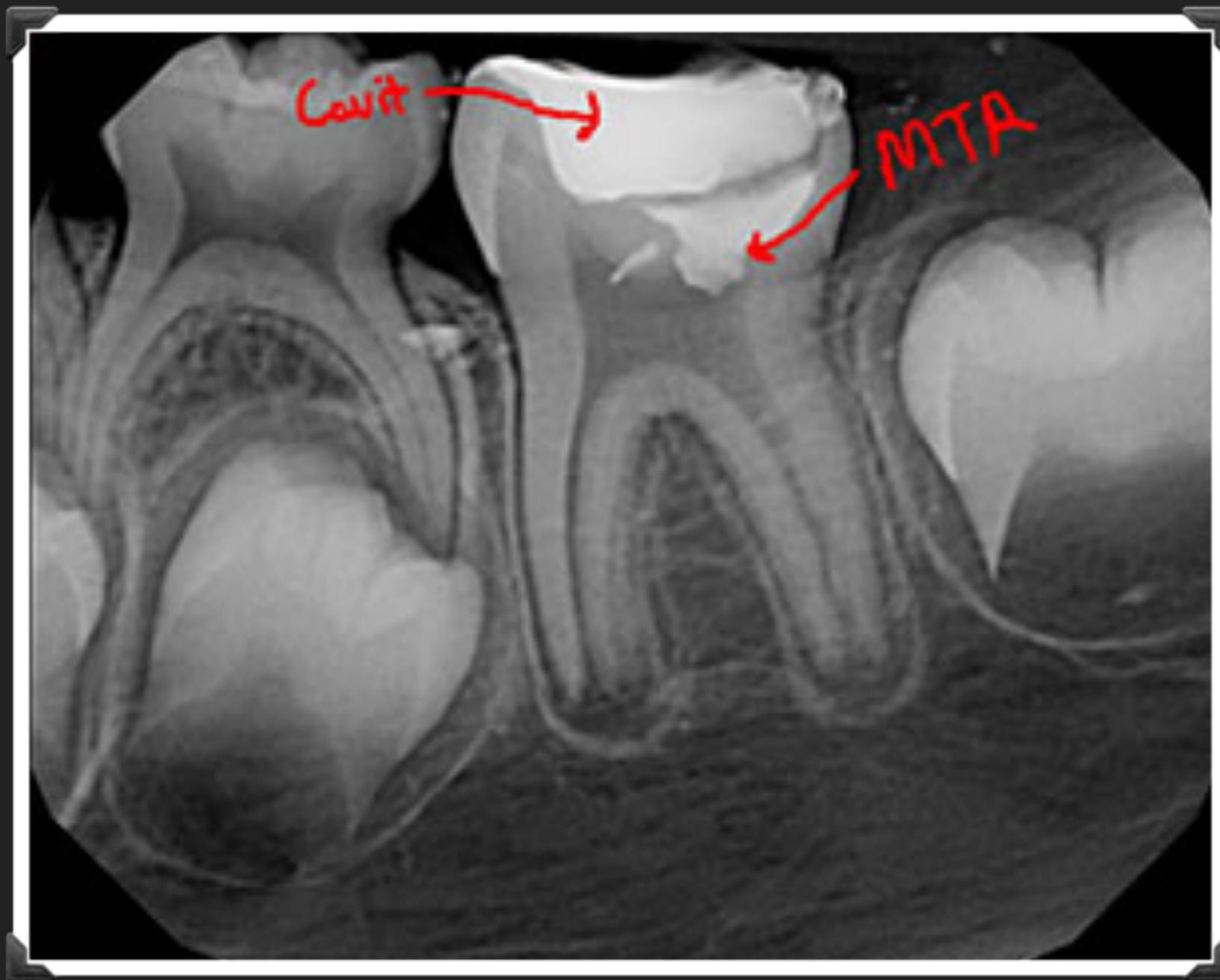
CASE ONE

CASE STUDY INFO

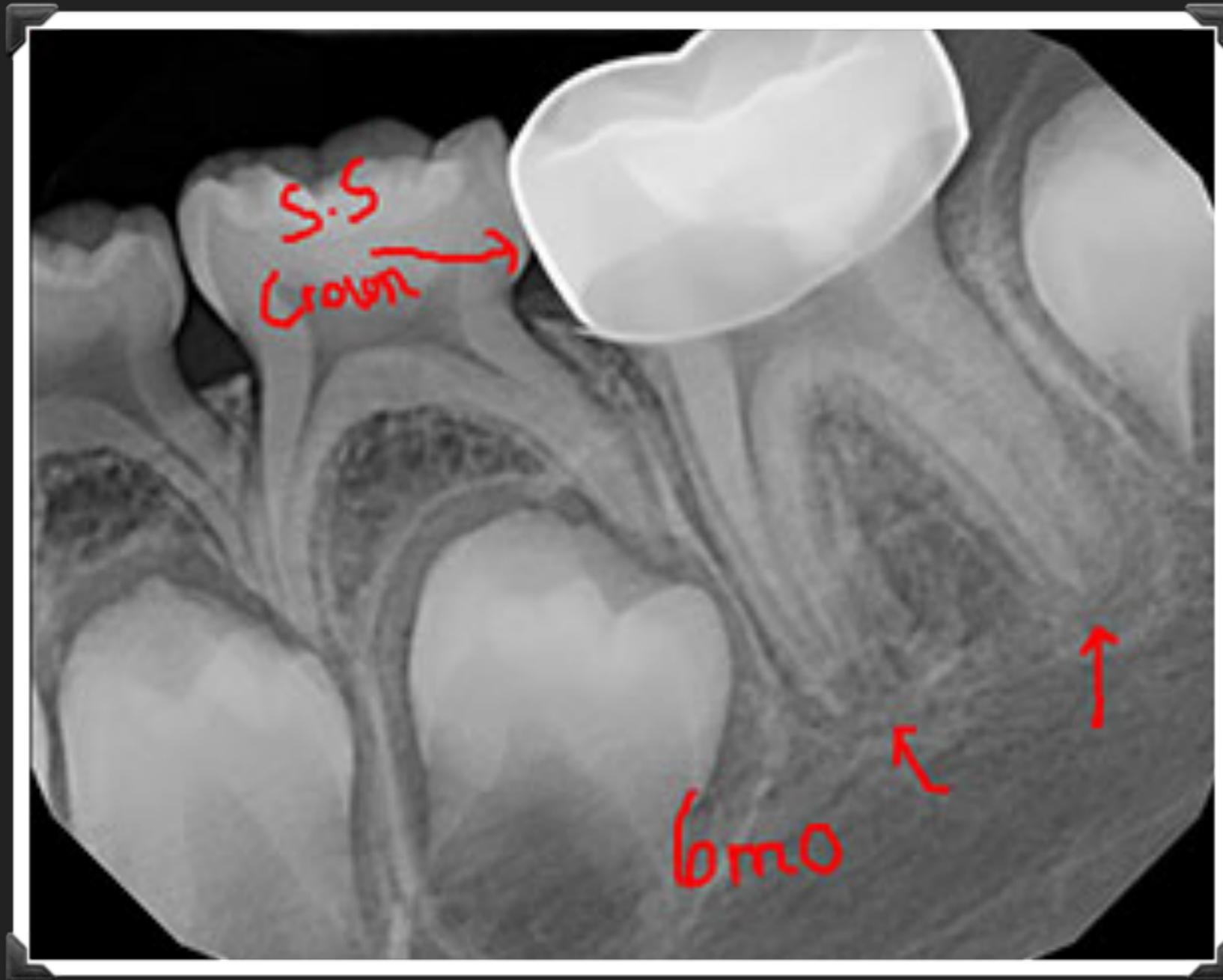
- ▶ Case Study posted in Dentistry Today on March 5th, 2017
- ▶ All credit for case study goes to Rico D. Short, DMD
 - ▶ This case featured a 6-year-old who had a large cavity into the pulp on tooth #19



DEEP CARIES NEAR DISTAL PULP HORN WITH OPEN OR IMMATURE APICES



APEXOCENTESIS PERFORMED WITH MTA/ COTON PELLET AND CAVIT AS TEMPORARY RESTORATION



6 MONTH RECALL - TOOTH HAS A SSC AND YOU CAN START TO SEE THE APICES BEGINNING TO CLOSE



2.5 YEAR RECALL - APICES ARE FULLY CLOSED

APEXIFICATION

GOALS

- ▶ To induce or form a calcified barrier across the open apex
- ▶ May see little increase in root length
- ▶ No increase in root thickness

TRADITIONAL VS. ARTIFICIAL APICAL BARRIER TECHNIQUE

- ▶ Traditional technique
 - ▶ Repeated dressing over many months with Calcium Hydroxide
 - ▶ Canal is subsequently filled with gutta-percha and sealer before coronal restoration
 - ▶ Tx typically extends over 0 to 24 months
 - ▶ Main disadvantages
 - Patience compliance
 - Tooth brittleness and cervical root fracture following long-term medication with calcium hydroxide

LITERATURE

- ▶ Andreasen et al. 2004
 - ▶ Long-term calcium hydroxide as a root canal dressing may increase risk of root fracture
 - ▶ The results showed a markedly decrease in fracture strength with increasing storage time for group 1 (calcium hydroxide dressing). **The results indicate that the fracture strength of calcium hydroxide-filled immature teeth will be halved in about a year due to the root filling.** The finding may explain the frequent reported fractures of immature teeth filled with calcium hydroxide for extended periods.

TRADITIONAL VS. ARTIFICIAL APICAL BARRIER TECHNIQUE

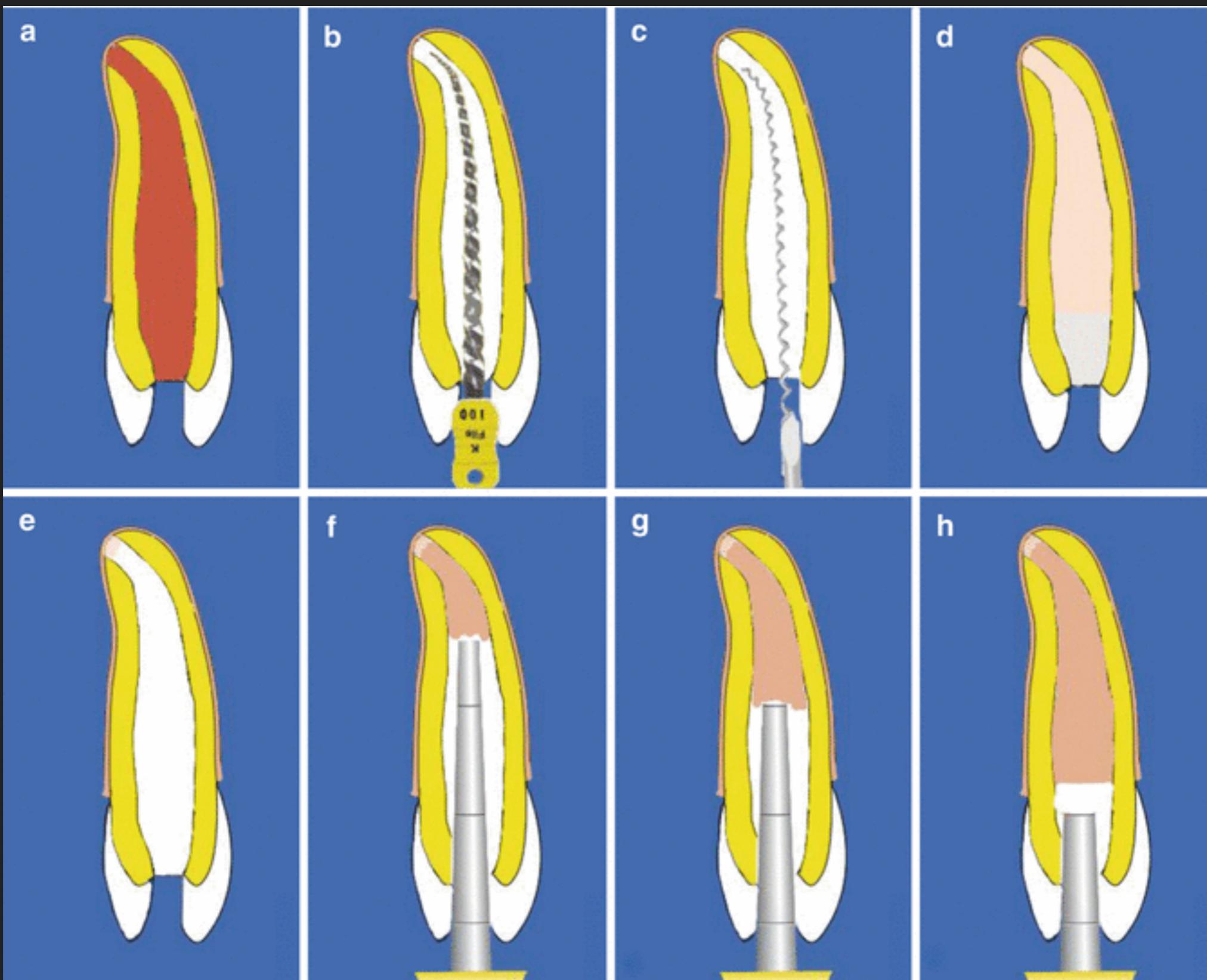
► Artificial apical barrier technique

- ▶ Following disinfection of canal, a 4 - 5 mm plug of MTA (or another silicate cement) is placed at the root end
 - Condensors
 - Ultrasonics with condensers
 - Fitting paper points to condense
- ▶ Canal space is subsequently restored with dual-curing composite resin
- ▶ Technique of choice vs. traditional:
 - ▶ Short treatment time
 - 1 to 2 visits
 - ▶ Forms a more consistent hard tissue barrier

LITERATURE

- ▶ Shabahang et al. 1999
 - ▶ A comparative study of root-end induction using osteogenic protein-1, calcium hydroxide, and mineral trioxide aggregate in dogs
 - ▶ The purpose of this study was to compare the efficacy of osteogenic protein-1 and mineral trioxide aggregate with that of calcium hydroxide in the formation of hard tissue in immature roots of dogs
 - ▶ **Mineral trioxide aggregate produced apical hard tissue formation with significantly greater consistency.** The difference in the amount of hard tissue produced among the three test materials was not statistically significant. Furthermore, the degree of inflammation was not significantly different between the various test groups.

APEXIFICATION



PULPAL REVASCULARIZATION/ REGENERATION

3 REQUIREMENTS/COMPONENTS TO REGENERATION

- ▶ Scaffold
 - Support cell organization
 - Biocompatible material such as MTA or Bioceramics
- ▶ Stem Cells
 - Undifferentiated cells found in SCAP
- ▶ Growth factors
 - TGF beta
 - Found in platelets and dentin

AAE CLINICAL CONSIDERATIONS FOR A REGENERATIVE PROCEDURE

Case Selection:

- ▶ Tooth with necrotic pulp and an immature apex.
- ▶ Pulp space not needed for post/core, final restoration.
- ▶ Compliant patient/parent.
- ▶ Patients not allergic to medicaments and antibiotics necessary to complete procedure (ASA1 or 2).

Informed Consent

- ▶ Two (or more) appointments.
- ▶ Use of antimicrobial(s).
- ▶ Possible adverse effects: staining of crown/root, lack of response to treatment, pain/infection.
- ▶ Alternatives: MTA apexification, no treatment, extraction (when deemed non-salvageable).

AAE CLINICAL CONSIDERATIONS FOR A REGENERATIVE PROCEDURE

First Appointment

- ▶ Local anesthesia, dental dam isolation and access.
- ▶ Copious, gentle irrigation with 20ml NaOCl using an irrigation system that minimizes the possibility of extrusion of irrigants into the periapical space (e.g., needle with closed end and side-vents, or EndoVac). Lower concentrations of NaOCl are advised [**1.5% NaOCl** (20mL/canal, 5 min) and then irrigated with saline or EDTA (20 mL/canal, 5 min), with irrigating needle positioned about 1 mm from root end, to minimize cytotoxicity to stem cells in the apical tissues.
- ▶ Dry canals with paper points.
- ▶ Place calcium hydroxide or low concentration of triple antibiotic paste. If the triple antibiotic paste is used: 1) consider sealing pulp chamber with a dentin bonding agent [to minimize risk of staining] and 2) mix **1:1:1 ciprofloxacin: metronidazole: minocycline** to a final concentration of 0.1 mg/ml.
- ▶ Deliver into canal system via syringe
- ▶ If triple antibiotic is used, ensure that it remains below CEJ (minimize crown staining).
- ▶ Seal with 3-4mm of a temporary restorative material such as Cavit, IRM, glass-ionomer or another temporary material. **Dismiss patient for 1-4 weeks.**

LITERATURE

- ▶ Nygaard-Ostby 1971
- ▶ Banchs F, Trope M 2004
 - ▶ A new technique is presented to revascularize immature permanent teeth with apical periodontitis. The canal is disinfected with copious irrigation and a combination of three antibiotics. After the disinfection protocol is complete, the apex is mechanically irrigated to initiate bleeding into the canal to produce a blood clot to the level of the cemento-enamel junction. The double seal of the coronal access is then made. In this case, **the combination of a disinfected canal, a matrix into which new tissue could grow, and an effective coronal seal appears to have produced the environment necessary for successful revascularization.**
- ▶ Hoshino et al. 1996
 - ▶ The aim of this study was to clarify the antibacterial effect of a mixture of **ciprofloxacin, metronidazole and minocycline**, with and without the addition of rifampicin, on bacteria taken from infected dentine of root canal walls....These results may indicate that the bactericidal efficacy of the drug combination is sufficiently potent to eradicate bacteria from the infected dentine of root canals.

AAE CLINICAL CONSIDERATIONS FOR A REGENERATIVE PROCEDURE

Second Appointment (1-4 weeks after 1st visit)

- ▶ Assess response to initial treatment. If there are signs/symptoms of persistent infection, consider additional treatment time with antimicrobial, or alternative antimicrobial.
- ▶ Anesthesia with 3% mepivacaine without vasoconstrictor, dental dam isolation.
- ▶ Copious, gentle irrigation with 20ml of 17% EDTA.
- ▶ Dry with paper points.
- ▶ Create bleeding into canal system by over-instrumenting (endo file, endo explorer) (induce by rotating a pre-curved K-file at 2 mm past the apical foramen with the goal of having the entire canal filled with blood to the level of the cemento-enamel junction). An alternative to creating of a blood clot is the use of platelet-rich plasma (PRP), platelet rich fibrin (PRF) or autologous fibrin matrix (AFM).
- ▶ Stop bleeding at a level that allows for 3-4 mm of restorative material.
- ▶ Place a resorbable matrix such as CollaPlugTM, CollacoteTM, CollaTapeTM or other material over the blood clot if necessary and white MTA as capping material.
- ▶ A 3-4 mm layer of glass ionomer (e.g. Fuji IXTM, GC America, Alsip, IL) is flowed gently over the capping material and light-cured for 40 s. MTA has been associated with discoloration. Alternatives to MTA (such as resin-modified glass ionomer [RMGI] or bioceramics [e.g., Biodentine[®]]) should be considered in teeth where there is an esthetic

AAE CLINICAL CONSIDERATIONS FOR A REGENERATIVE PROCEDURE

Follow-up

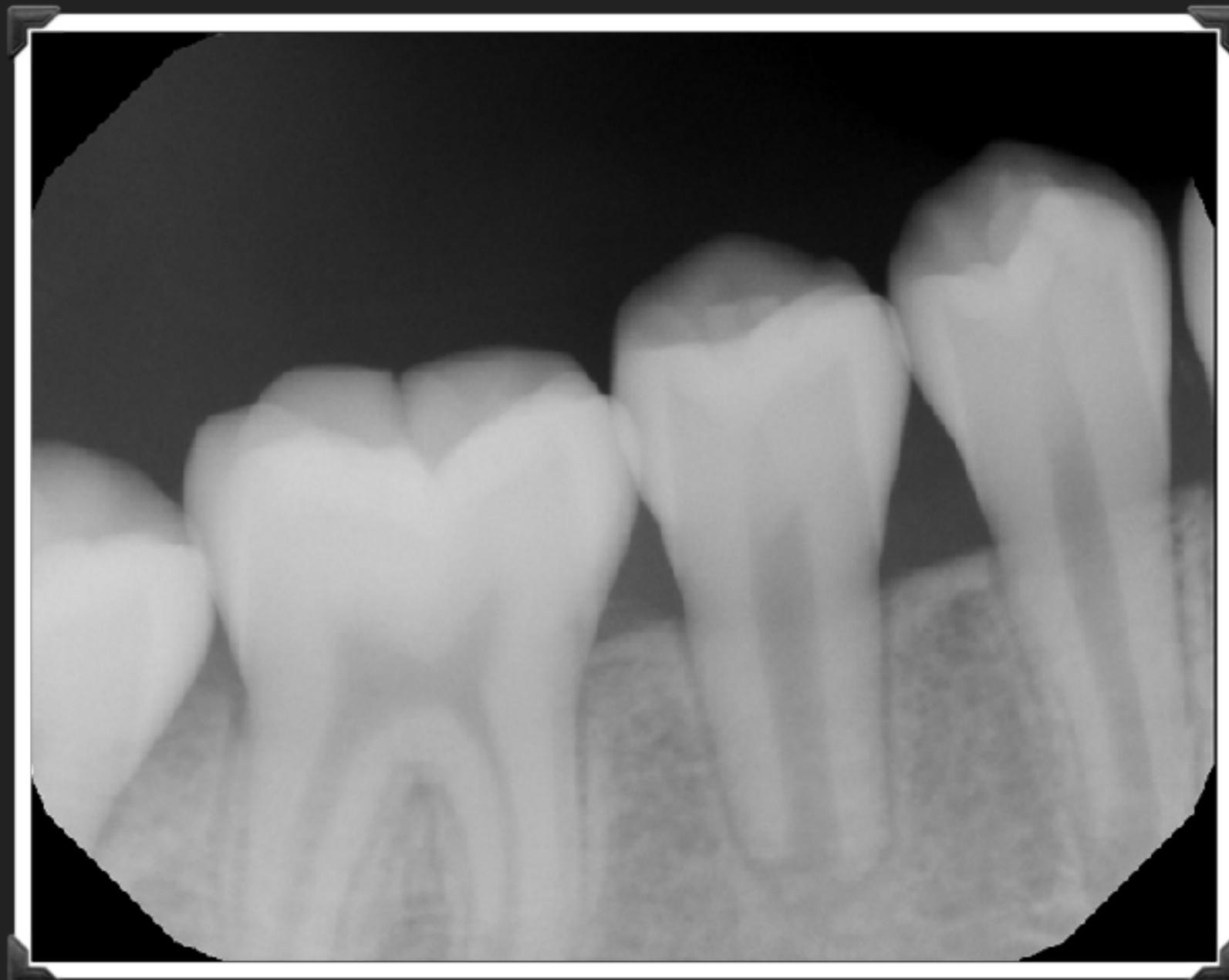
- ▶ Clinical and Radiographic exam
 - ▶ No pain, soft tissue swelling or sinus tract (often observed between first and second appointments).
 - ▶ Resolution of apical radiolucency (often observed 6-12 months after treatment)
 - ▶ Increased width of root walls (this is generally observed before apparent increase in root length and often occurs 12-24 months after treatment).
 - ▶ Increased root length.
 - ▶ Positive Pulp vitality test response



PULPAL
REVASCULARIZATION/
REGENERATION

CASE TWO

#29 - PREOPERATIVE PERIAPICAL IMAGE



#29 - FILE SHOT



#29 - CAOH FILL



#29 - MTA FILL



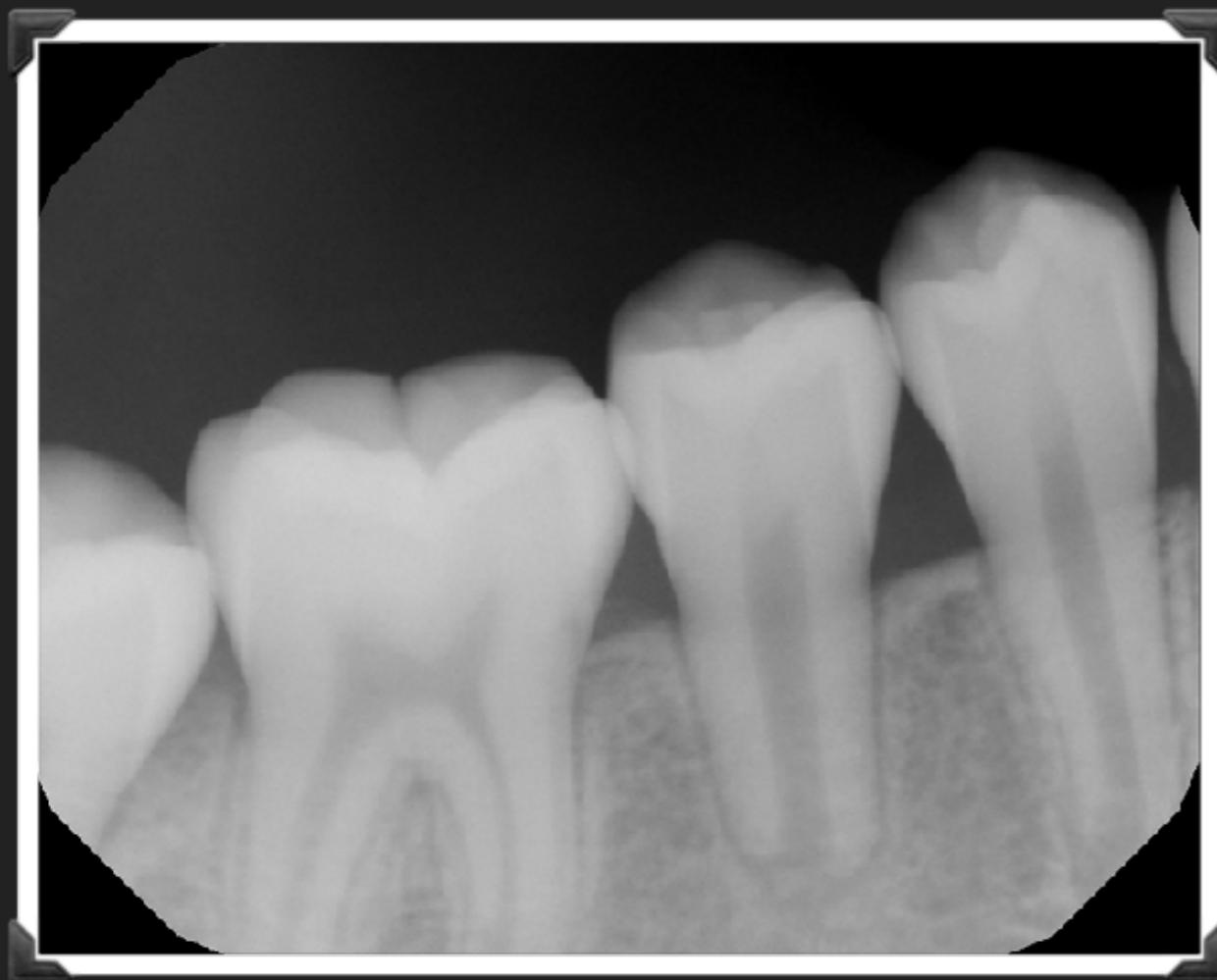
6 MONTH RECALL



9 MONTH RECALL



PREOPERATIVE PERIAPICAL IMAGE VS 9 MONTH RECALL



**SO WHAT'S ACTUALLY
IN THERE?????**

DEFINITIONS

- ▶ AAE Glossary of Endodontic Terms
 - ▶ Regenerative endodontics are biologically-based procedures designed to physiologically replace damaged tooth structures, including dentin and root structures, as well as cells of the pulp-dentin complex
- ▶ Shimizu et al.
 - ▶ Regeneration is defined as the replacement of damaged tissue by the same parenchymal cells

LITERATURE

- ▶ Torabinejad et al. 2012
 - ▶ Collagen fibers, cells, and blood vessels in pulp-like connective tissue. No odontoblast like cells could be observed in the canal (only soft tissue in the canal).
- ▶ Shimizu et al. 2012
 - ▶ Connective tissue, odontoblast like cells and epithelial-like HERS. No nerve like fibers and hard tissue was formed in the canal.
- ▶ Martin et al. 2013
 - ▶ Cementoid/osteoid tissue and uninflamed fibrous connective tissue. No HERS or odontoblast like cells could be observed in the canal.
- ▶ Shimizu et al. 2013
 - ▶ Cementum- or bonelike tissue and fibrous connective tissue. No pulp like tissue was present as characterized by the presence of polarized odontoblast like cells.
- ▶ Becerra et al. 2014
 - ▶ Connective tissue similar to that in the periodontal ligament and cementum like or bonelike hard tissue. No tubule like structures of mineralized tissue or odontoblast like cells could be observed in the canal.

QUESTIONS?