CASE PRESENTATION

การรักษาคลองรากฟันในฟันแท้ที่มีรูเปิดปลายรากฟันกว้างและมีรอยโรคปลายราก ด้วยวิธี MTA apexification

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DENS EVAGINATUS (DE)

- A dental anomaly exhibited by protrusion of a tubercle at occlusal surface of posterior teeth or lingual surface of anterior teeth (talon cusp)

Levitan and Himel 2006

- An anomalous outgrowth of tooth structure resulting from the folding of the inner enamel epithelium into the stellate reticulum with the projection of structure exhibiting enamel, dentin, and pulp tissue

Glossary of Endodontic Terms, AAE 2020

DENS EVAGINATUS (DE) : PREVALENCE

Occurs predominantly in Asian descent, incidence ranging from 0.5-4.3%

Levitan and Himmel 2006

Incidence 1.01-1.8% in Thai population

Reichart et al.1975, Arunyanart 2002, Sukaram 2004

One study revealed 3.2% prevalence of dens evaginatus in 9,279 Thai schoolchidren, with 33.1% of DE teeth exhibited apical periodontitis

Mostly found in premolars (ratio of lower premolars : upper premolars = 8:1)

Suksamai et al. 2008

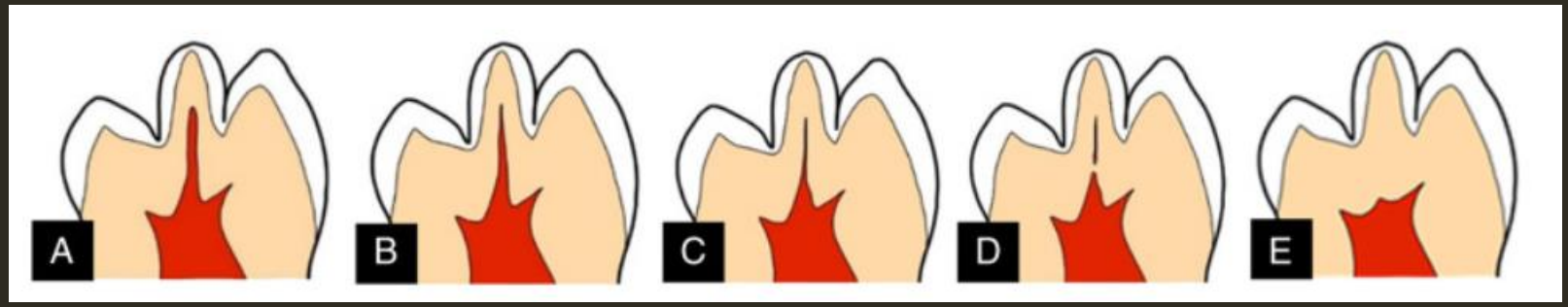
DENS EVAGINATUS (DE) : CLASSIFICATION

Oehlers classification (1967) : from histology of extracted DE teeth

1. Wide pulp horn (34%)
2. Narrow pulp horn (22%)
3. Constricted pulp horn (14%)
4. Isolated pulp horn remnants (20%)
5. No pulp horn (10%)

70% of DE teeth have extended pulpal horn into the tubercles

→ cause occlusal interferences and susceptible to pulpal complication due to wear or fracture



Oehlers et al. 1967, Lerdrungroj et al. 2023

CASE PRESENTATION

Patient Age : 11 years old

Patient Sex : female

Chief Complaint : Swelling at left lower gum

Medical History : No history involved

No known drug allergy

Present illness : Swelling at left lower gum for 2 months, no pain

Medical History : No history involved, no known drug allergy

Vital Sign : BP = 123/63 mmHg, PR = 85 bpm

CLINICAL EXAMINATION

Extraoral : WNL

Intraoral : Tooth 35

Dens evaginatus cusp attrition

Swelling buccal gingiva of 35 with sinus tract opening at buccal gingiva and deep narrow pocket 15 mm at mid-B

Tooth	EPT	Percussion	Palpation	Mobility	PD			
35	-ve	+ve	+ve	1st degree	3	15	3	B
					3	3	3	Li

Initial film 30/3/2023

Sinus tracing 30/3/2023

DIAGNOSIS

35 pulp necrosis with chronic apical abscess (incompleted root formation)

Tooth	EPT	Percussion	Palpation	Mobility	PD			
35	-ve	+ve	+ve	1st degree	3	15	3	B
					3	3	3	Li

TREATMENT OPTIONS

1. Regenerative endodontic procedures
2. MTA apexification
3. Extraction + removable prosthesis/ orthodontic treatment if possible

MTA apexification

Tooth	EPT	Percussion	Palpation	Mobility	PD			
35	-ve	+ve	+ve	1st degree	3	15	3	B
					3	3	3	Li

Dens Evaginatus: Literature Review, Pathophysiology, and Comprehensive Treatment Regimen

Marc E. Levitan, DDS, and Van T. Himel, DDS

TABLE 1. Treatment Regimen for Dens Evaginatus

Prophylaxis Tubercle Intact or Without Enamel		Intervention Tubercle with Pulp Exposure			
Normal Pulp		Inflamed Pulp		Necrotic Pulp	
Type I Mature Apex	Type II Immature Apex	Type III Mature Apex	Type IV Immature Apex	Type V Mature Apex	Type VI Immature Apex
Reduce opposing occluding tooth	Same as Type I except:	Conventional root canal therapy	Shallow MTA pulpotomy	Conventional root canal therapy	MTA root-end barrier
Apply acid-etched flowable light-cured resin to tubercle	Reevaluation every 3–4 months until development of mature apex	Restoration	Glass ionomer layer	Restoration	Glass ionomer layer
Yearly reevaluation to assess occlusion, resin, pulp and periapex			Acid-etched light-cured resin		Acid-etched light-cured resin
When reevaluation demonstrates adequate pulp recession, remove tubercle and apply resin					

Levitan and Himel, 2006

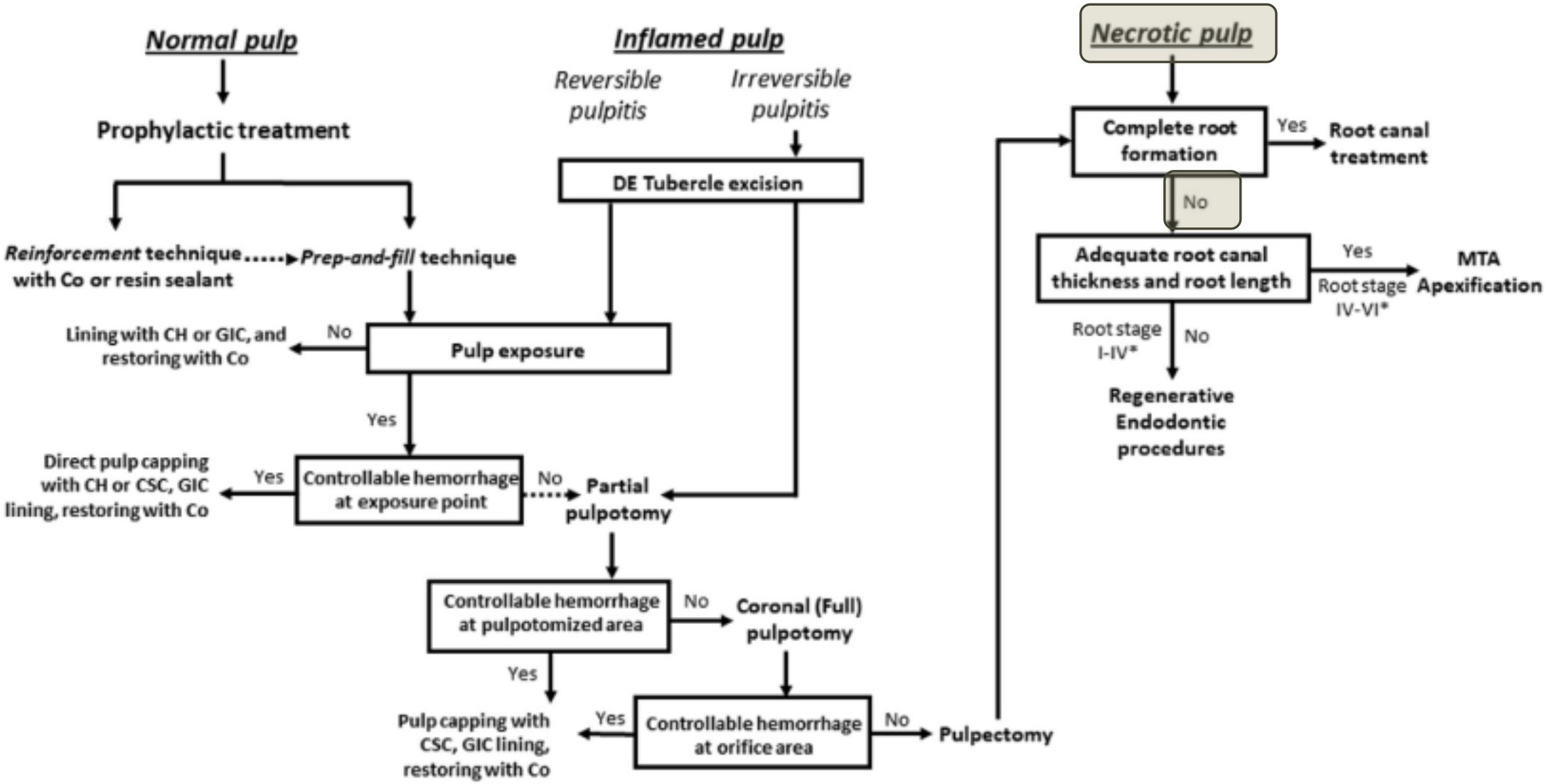


FIGURE 2 – Recommendations for DE management according to the clinical diagnosis and clinical conditions. CH, Calcium Hydroxide; Co, Composite; CSC, Calcium Silicate based Cement; DE, dens evaginatus; GIC, Glass-Ionomer Cement; MTA, Mineral Tricalcium Aggregate. *According to Moorrees' classification in 1963.

Lerdrungroj et al. 2023

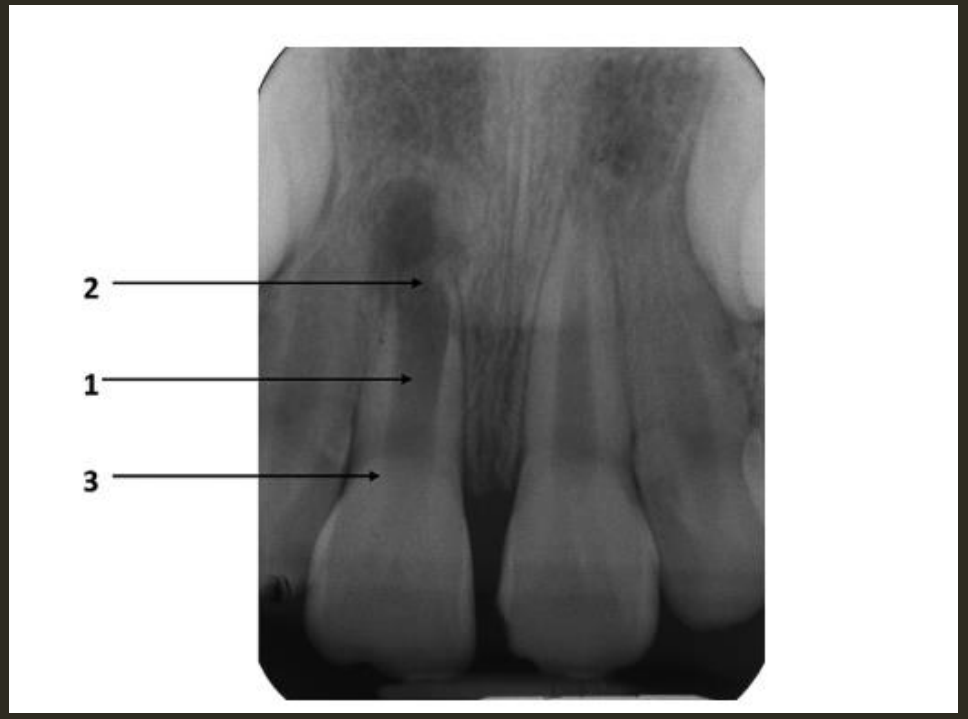
MOORREES' STAGE OF ROOT DEVELOPMENT

	R 1/4: root length less than crown length		Rc: root length completed with parallel ends
	R 1/2: root length equals crown length		A 1/2: apex closed (root ends converge) with wide PDL
	R 3/4: three quarters of root length developed with diverge ends		Ac: apex closed with normal PDL width

R 3/4

Moorrees et al. 1963

Immature tooth challenges



Minimal mechanical instrumentation

Copious irrigation with cautions

Ca(OH)2 medication is recommended

1) Infected root canals cannot be disinfected by the aggressive use of files
2) No apical barrier → filling the canal is difficult
3) Thin roots → more susceptible to fracture

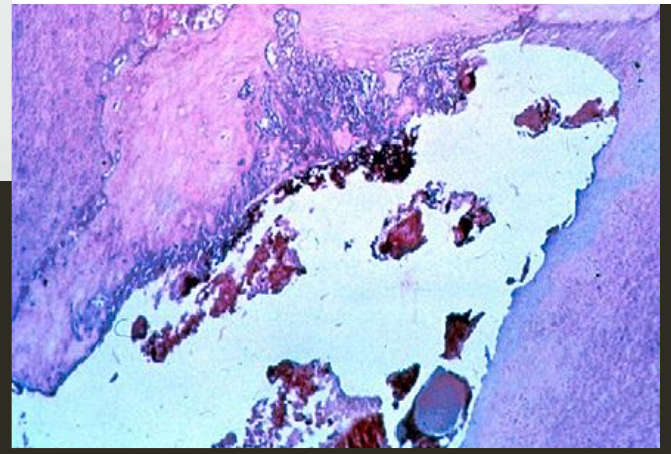
Trope 2010

APEXIFICATION

‘‘a method of inducing a calcified barrier in a root with an open apex or the continued apical development of an incompletely formed root in teeth with necrotic pulp’’

Glossary of Endodontic terms, AAE 2020

CALCIUM HYDROXIDE



- Antimicrobial property
- Induce hard tissue formation
- "Swiss cheese-like" apical hard tissue barrier
- Take multiple visits to achieve apical barrier (3-24 months)

Trope 2002

- Ca(OH)2 dressing in extended time can weakens tooth structure

Andreasen et al. 2002

MTA (MINERAL TRIOXIDE AGGREGATE)

Powder	Percentage
tricalcium silicate $(CaO)_3 \cdot SiO_2$	
dicalcium silicate $(CaO)_2 \cdot SiO_2$	75 wt%
tricalcium aluminate $(CaO)_3 \cdot Al_2O_3$	
bismuth oxide Bi_2O_3	20 wt%
gypsum $CaSO_4 \cdot 2\ H_2O$	5 wt%
Liquid	**Percentage**
distilled water H_2O	100%

- Antimicrobial property
- Excellent sealing ability
- Biocompatibility
- Stimulate cytokine release → induce hard tissue formation

Hydration reaction

pH 12.5

Setiing time 3-4 hours

Torabinejad and Parirokh 2010, Torabinejad and Abu-Tahun 2012

APEXIFICATION

	MTA	$Ca(OH)_2$
Dentin bridge	Better quality	“Swiss-cheese” porous callus bridge
Patient’s compliance	Less compliance --> apexification can be done within one visit	Need multiple appointments
Cost	More expensive	More affordable
Clinical success rate	93-100%	87-100%
Radiographic success rate	100%	87-93%

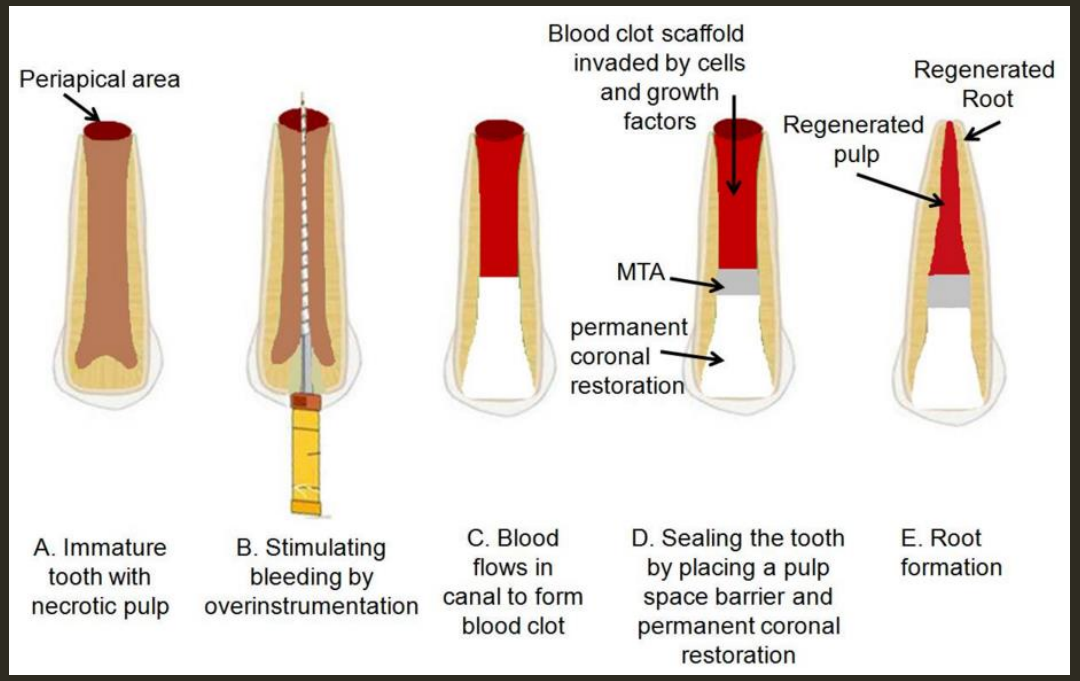
- No significantly differences in clinical and radiographic success rate.
- MTA requires shorter time to achieve apical barrier, less patient compliance due to less visit and can achieve better quality of dentin bridge.

Lin et al. 2016

REGENERATIVE ENDODONTIC PROCEDURES (REPS)

"Biologically-based procedures designed to physiologically replace damaged tooth structures, including dentin and root structures, as well as cells of the pulp-dentin complex"

Glossary of Endodontic terms, AAE 2020



Key to success are

1) The canal were effectively disinfected.

2) A matrix into which new tissues could grow were created.

3) The coronal access were effectively sealed.

Banchs and Trope 2004

Treatment Outcomes of Apexification or Revascularization in Nonvital Immature Permanent Teeth: A Retrospective Study

TABLE 2. Treatment Outcome and Follow-up Period

Variable	MTA apexification	Revascularization	Total
Success	21/26 (80.77%)	13/17 (76.47%)	34/43 (79.07%)
Failure	5/26 (19.23%)	4/17 (23.53%)	9/43 (20.93%)
Functional retention	24/29 (82.76%)	15/17 (88.24%)	39/46 (84.78%)
% change of root length (mean ± SD)	8.55% ± 8.97%	9.51% ± 18.14%	9.05% ± 14.21%
% change of root width (mean ± SD)*	−3.30% ± 14.14%	13.75% ± 19.91%	4.11% ± 18.60%
Follow-up (mean ± SD)	49 ± 31.09 months	35 ± 21.76 months	44 ± 24.55 months

MTA, mineral trioxide aggregate; SD, standard deviation.

*There was statistically significant difference between groups.

- MTA apexification and revascularization provide a reliable outcome in the aspect of resolution of disease and tooth functional retention

- None of these treatments provides satisfactory predictable further root development.

- Fracture was main cause of failure in MTA apexified teeth.

- All failed revascularized teeth presents apical periodontitis due to persistent infection.

Silujjai and Linsuwanont, 2017

Mineral Trioxide Aggregate as Apical Plug in Teeth with Necrotic Pulp and Immature Apices: A 10-year Case Series

Riccardo Pace, DMD, Valentina Giuliani, PhD(c), Michele Nieri, DMD, Luca Di Nasso, PhD(c), and Gabriella Pagavino, DMD

- 10 year study evaluated clinical and radiographic outcome of teeth with necrotic pulp, immature apices, and periapical lesions treated with MTA apical plug technique

- The apical plug with MTA was a successful and effective technique for long-term management of this group of teeth with necrotic pulps with immature root development and periapical lesions.

Pace et al.

AAE Clinical Considerations for a Regenerative Procedure
Revised 5/18/2021

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 (ASA 1
  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 nonsalvageable).

LT 30/3/2023

Med $Ca(OH)_2$

30/3/2023

CLINICAL EXAMINATION : 1 MONTH LATER

30/3/2023

24/4/2023

Tooth	EPT	Percussion	Palpation	Mobility	PD			
35	N/A	-ve	-ve	WNL	3	8	3	B
					3	3	3	Li

Extraoral : WNL

Intraoral : Tooth 35

Sinus tract has closed with deep narrow pocket 8 mm

Med $Ca(OH)_2$

25/4/2023

CLINICAL EXAMINATION : 1.5 MONTH LATER

30/3/2023

24/4/2023

12/6/2023

Extraoral : WNL

Intraoral : Tooth 35

Soft tissue WNL, no pocket formation

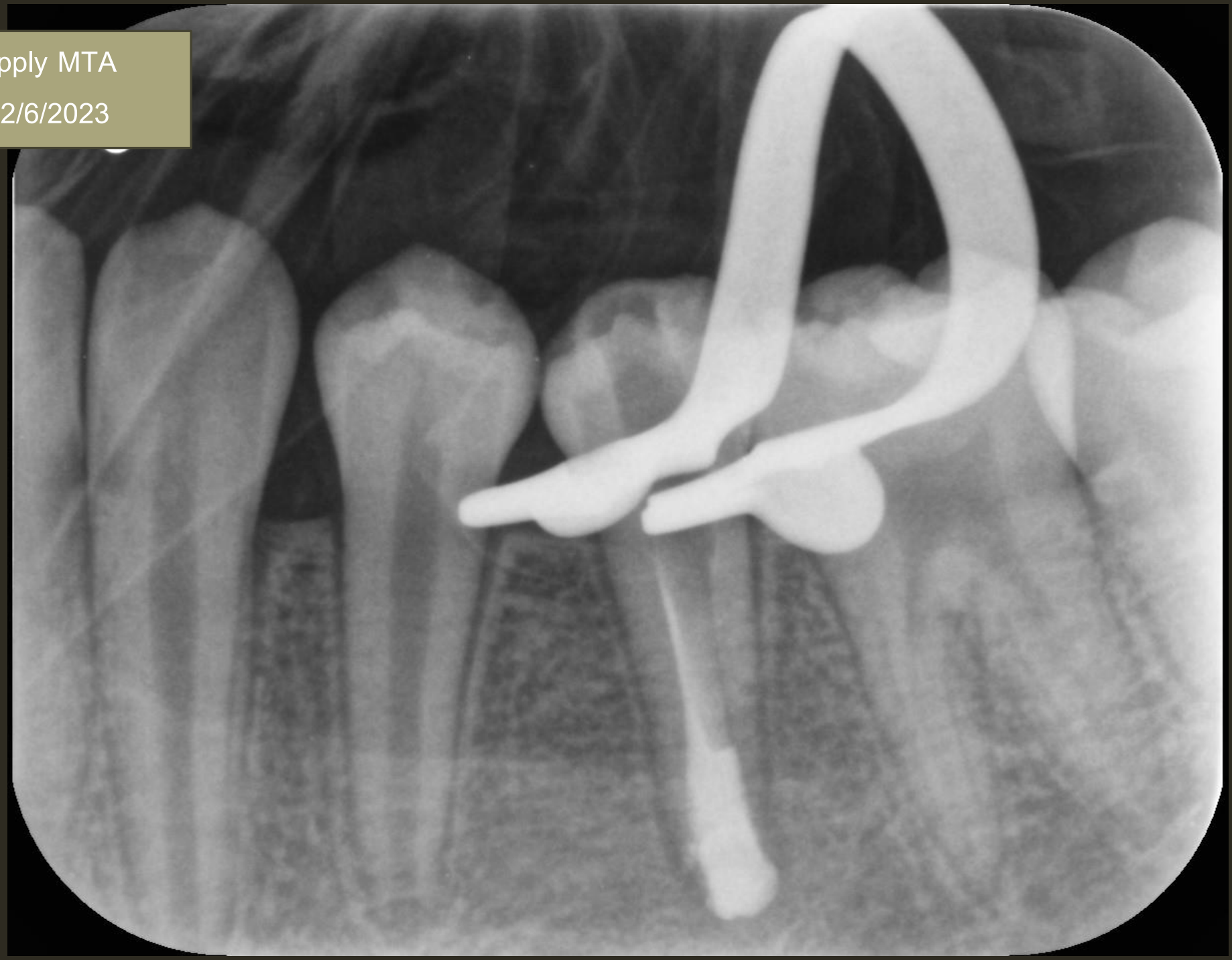
Tooth	EPT	Percussion	Palpation	Mobility	PD			
35	-ve	-ve	-ve	WNL	3	3	3	B
					3	3	3	Li

1.5 month later

12/6/2023

Apply MTA

12/6/2023



Final film 12/6/2023

Final restoration

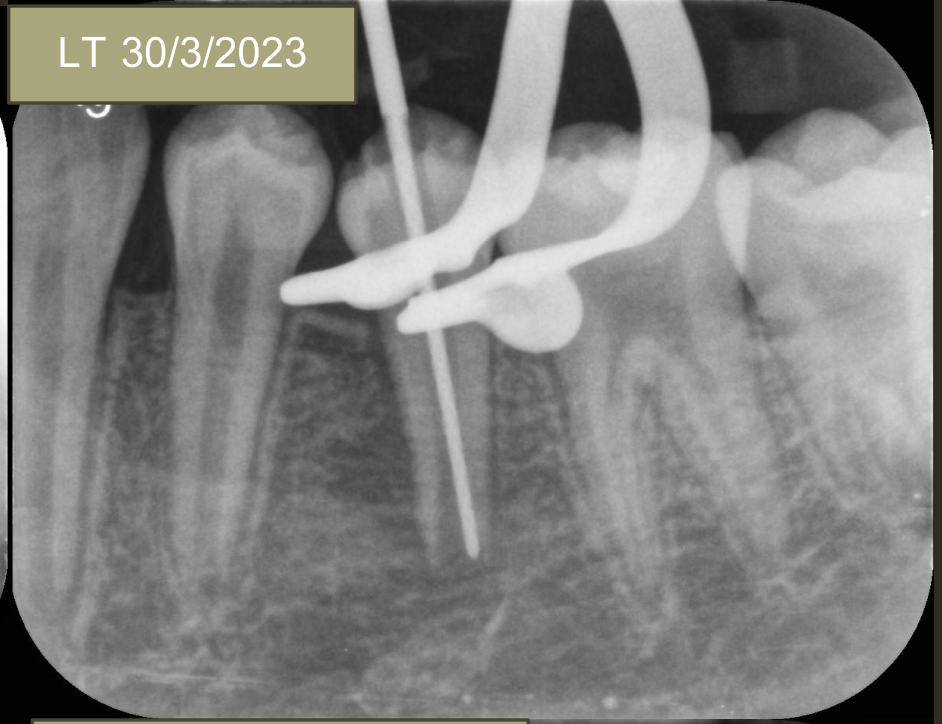
9/10/2023

Recall 11 months

14/5/2024

Tooth	EPT	Percussion	Palpation	Mobility	PD		
35	N/A	-ve	-ve	WNL	3	3	3
					3	3	3


Initial film 30/3/2023


LT 30/3/2023


Final film 12/6/2023


Recall 11 months
9/5/2024

Initial film 30/3/2023

Final film 12/6/2023

Recall 11 months

9/5/2024

Reinforcement of Simulated Immature Roots Restored with Composite Resin, Mineral Trioxide Aggregate, Gutta-percha, or a Fiber Post after Thermocycling

Steven J. Schmoldt, DDS, Timothy C. Kirkpatrick, DDS, Richard E. Rutledge, DDS, and John M. Yaccino, DDS

Figure 3. Radiographic examples of typical teeth from each group. 1, Negative control; 2, positive control; 3, Build-It + fiber post; 4, Build-It; 5, MTA; 6, FluoroCore 2+; 7, gutta-percha.

84 bovine mandibular incisors was simulated as immature teeth and divided into 7 groups.

The only material that significantly strengthened the simulated immature teeth was the fiber-reinforced composite with a fiber post.

Schmoldt et al. 2005

Fracture resistance of simulated immature maxillary anterior teeth restored with fiber posts and composite to varying depths

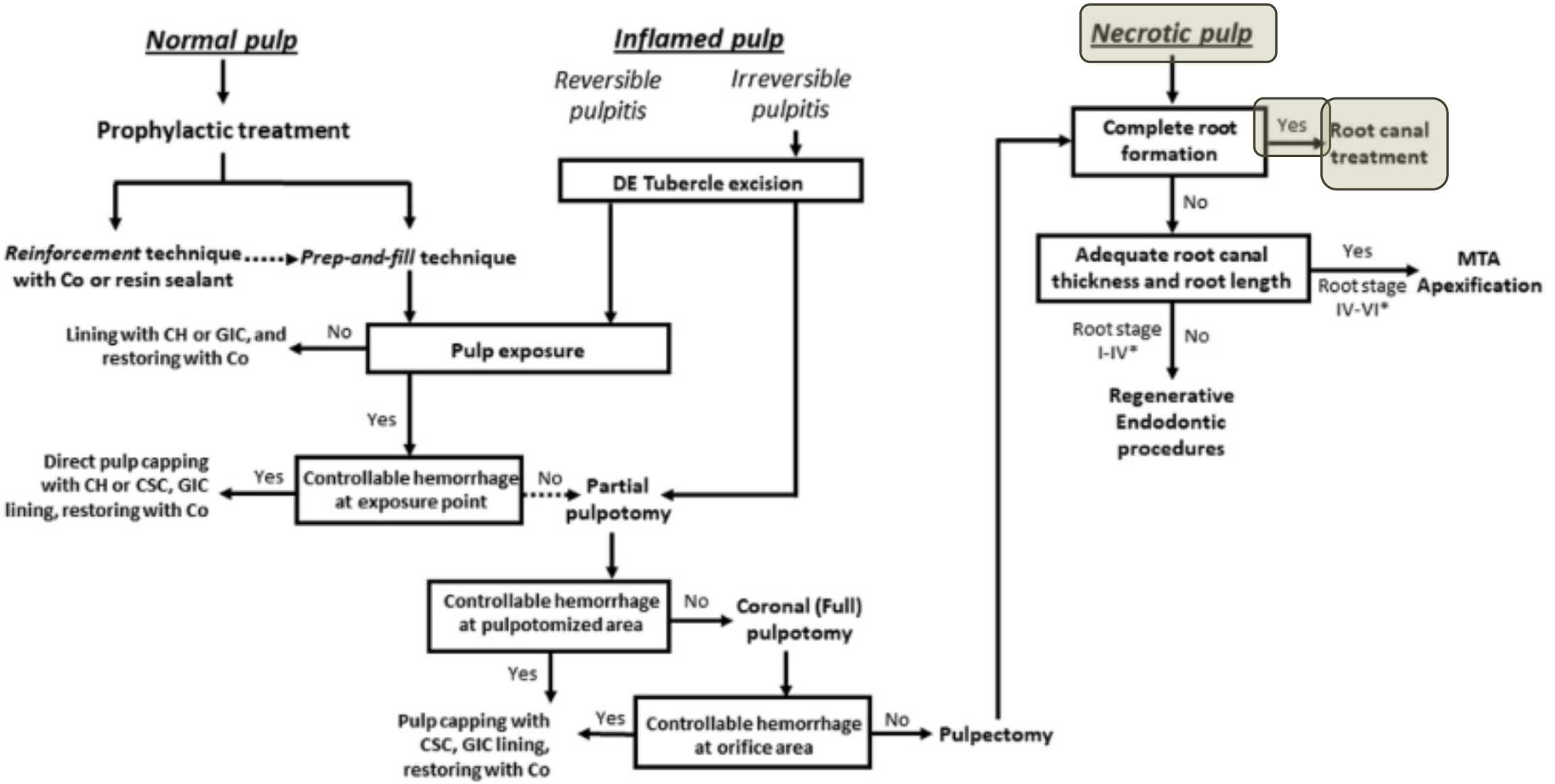
Brandon Seto[1], Kwok-Hung Chung[2], James Johnson[1], Avina Paranjpe[1]

[1]Department of Endodontics, University of Washington; [2]Department of Restorative Dentistry, University of Washington, Seattle, WA, USA

75 extracted human maxillary incisors was simulated as immature teeth and divided into 7 groups.

Either dual cure composite or a quartz fiber post with composite resin with a depth of 3mm would significantly strengthen the roots in immature teeth.

Seto et al. 2005



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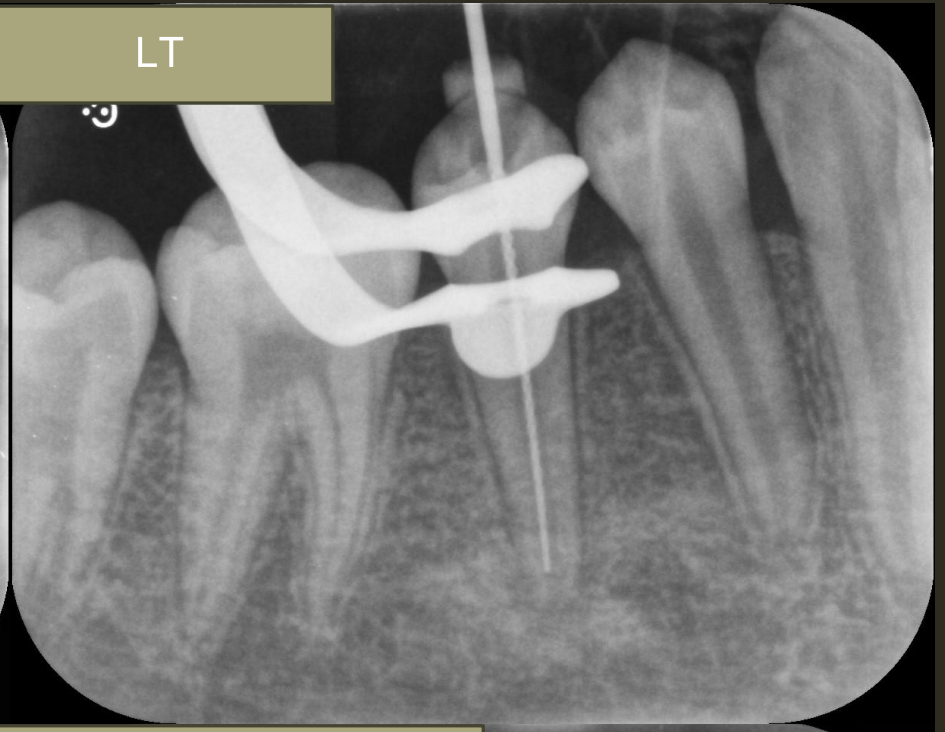
Lerdrungroj et al. 2023

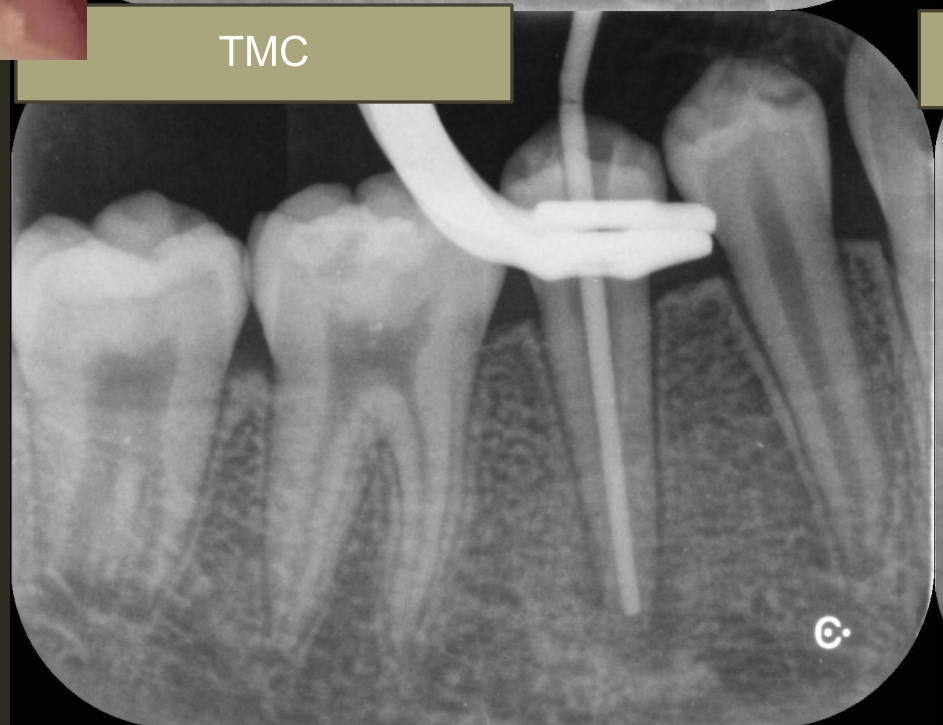
Tooth 45

Initial film

LT



TMC

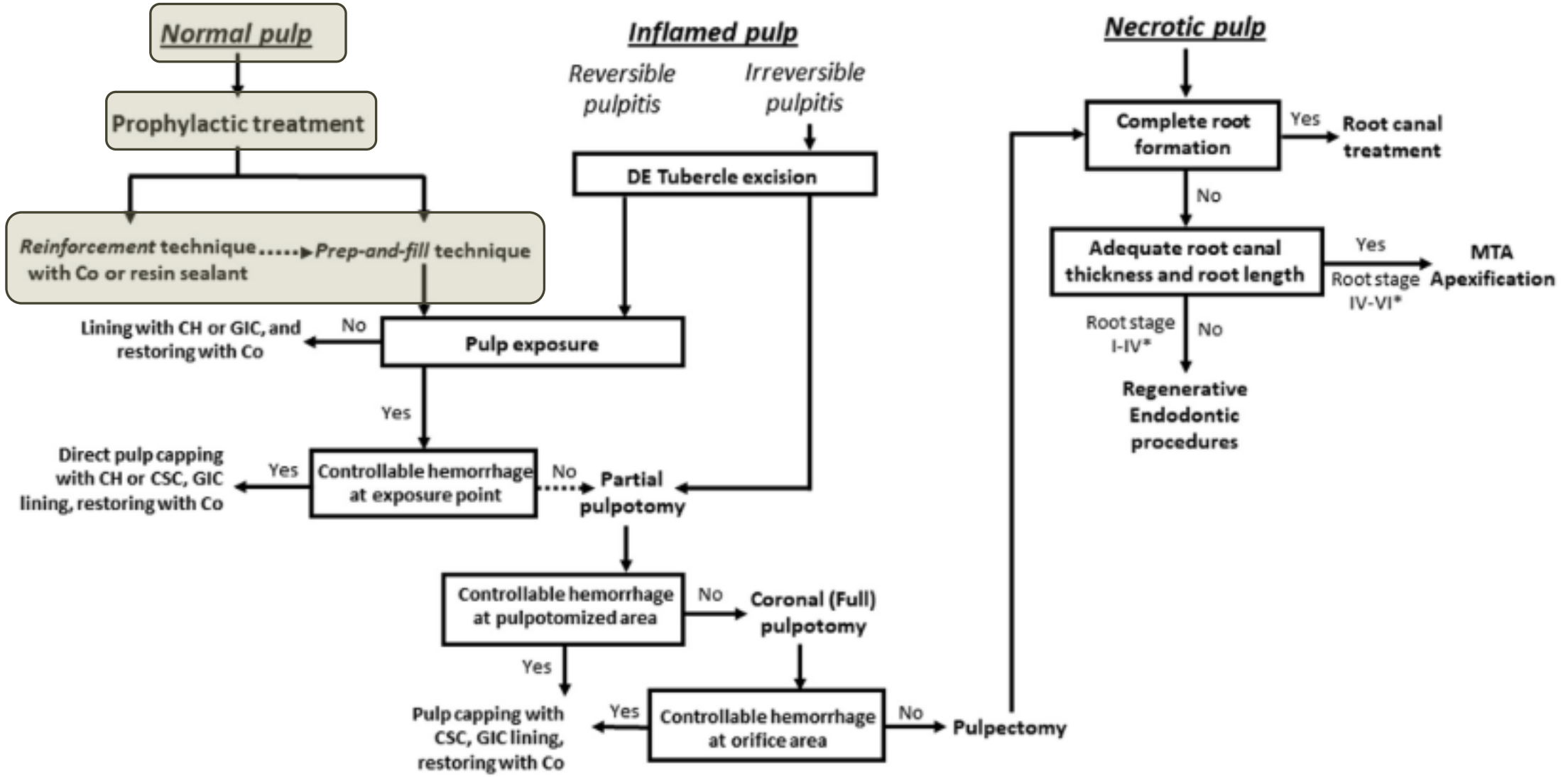


Final film

Initial film

Final film

Recall 6 months



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Tooth 44

Tooth 34

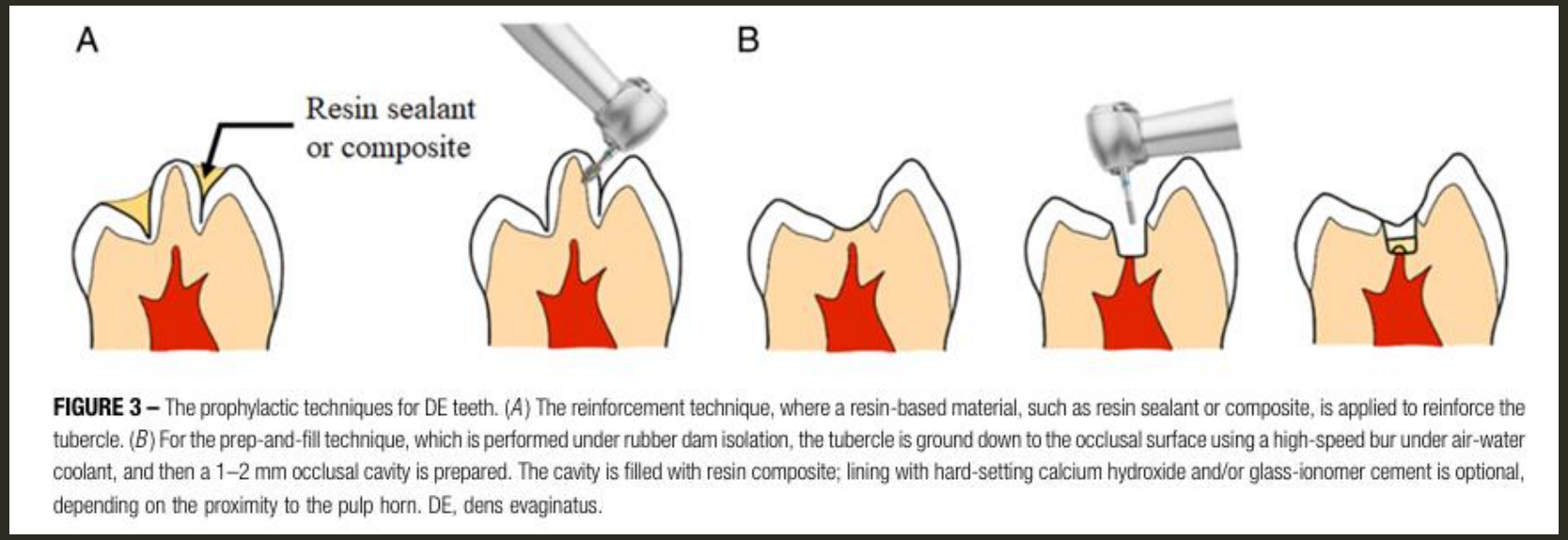

FIGURE 3 – The prophylactic techniques for DE teeth. (*A*) The reinforcement technique, where a resin-based material, such as resin sealant or composite, is applied to reinforce the tubercle. (*B*) For the prep-and-fill technique, which is performed under rubber dam isolation, the tubercle is ground down to the occlusal surface using a high-speed bur under air-water coolant, and then a 1–2 mm occlusal cavity is prepared. The cavity is filled with resin composite; lining with hard-setting calcium hydroxide and/or glass-ionomer cement is optional, depending on the proximity to the pulp horn. DE, dens evaginatus.

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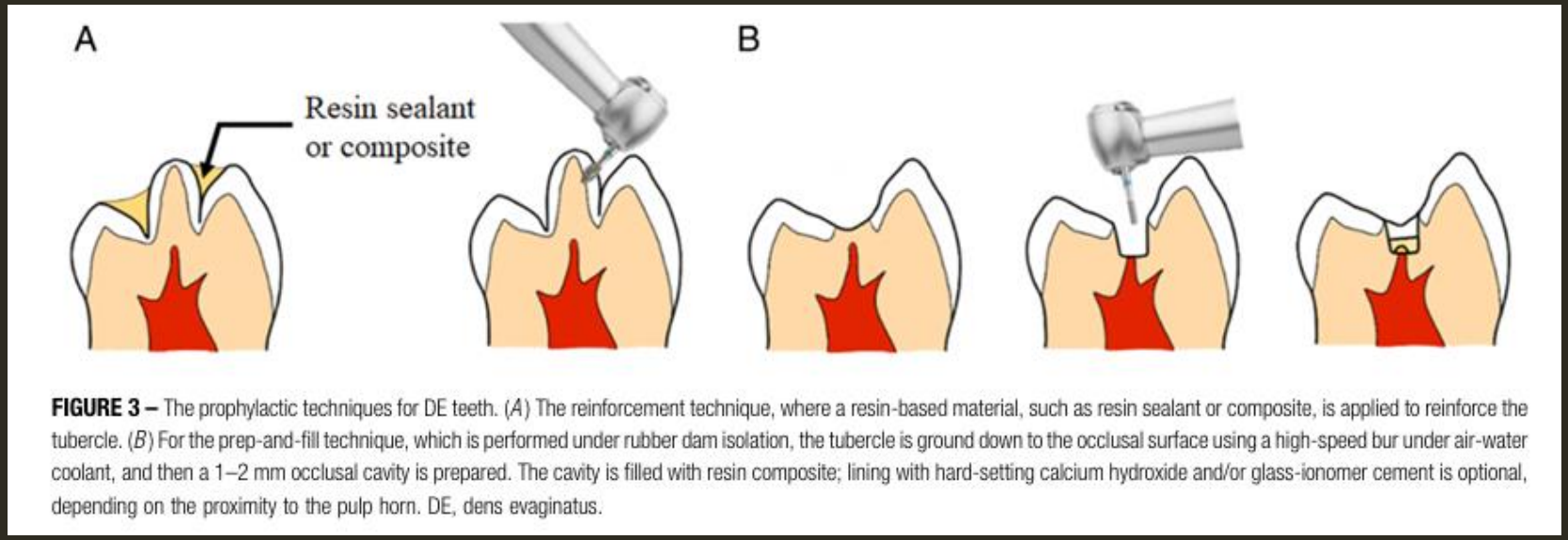
Tooth 14, 15

Tooth 24, 25



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Lerdrungroj et al. 2023

SUMMARY

- The early detection and prophylaxis of DE teeth while the pulp status is still normal are important to preserve pulp vitality and continued root formation by preventing uncontrolled tubercle fracture.

- Necrotic immature teeth require precautions in endodontic treatment due to thin walls, no apical stop and prone to fracture.

- Treatment options for necrotic immature teeth are MTA apexification and regenerative endodontic procedures, both can give reliable success rate if the treatment was done properly.

- Therefore the keys to success apexification are to disinfecting the canal, applying MTA properly as apical barrier and providing good restoration after endodontic treatment.

THANK YOU