Management of Immature Teeth

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Dental School, UWA


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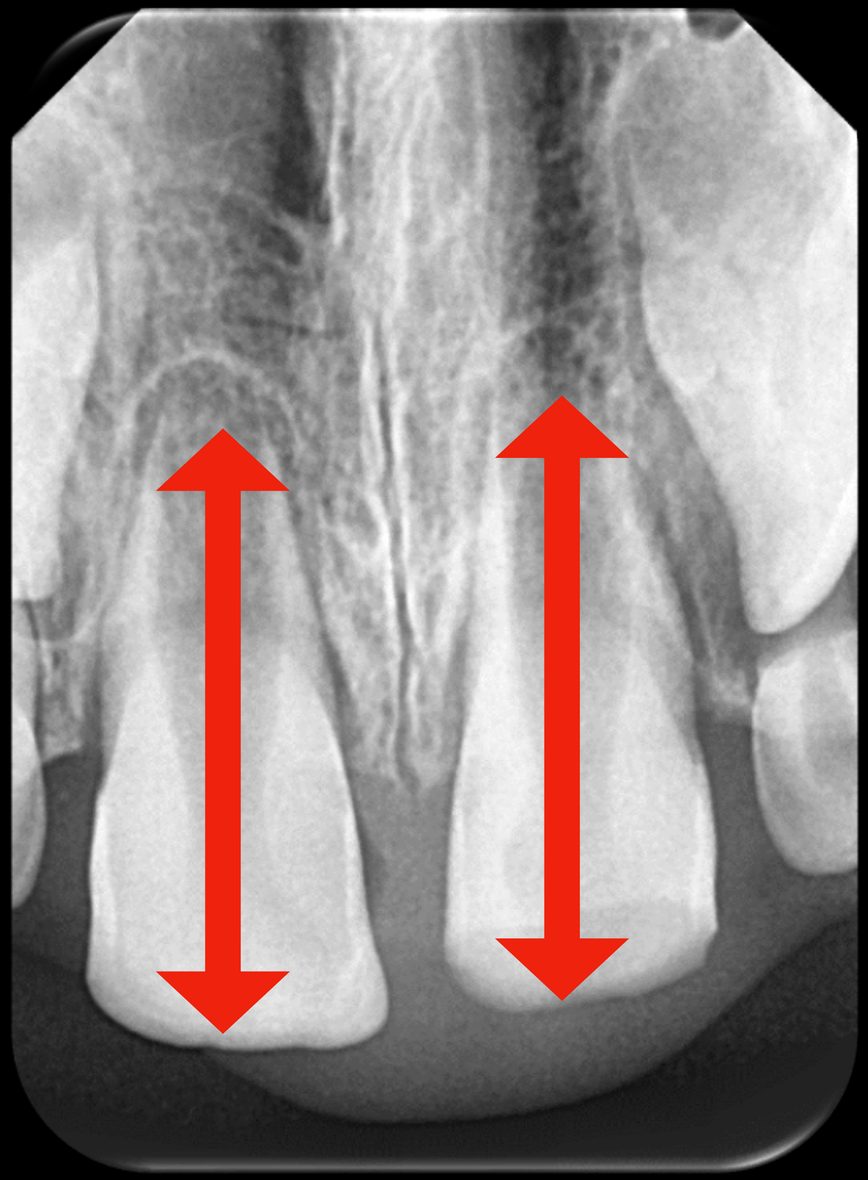




Dr Mostafa Elkholy

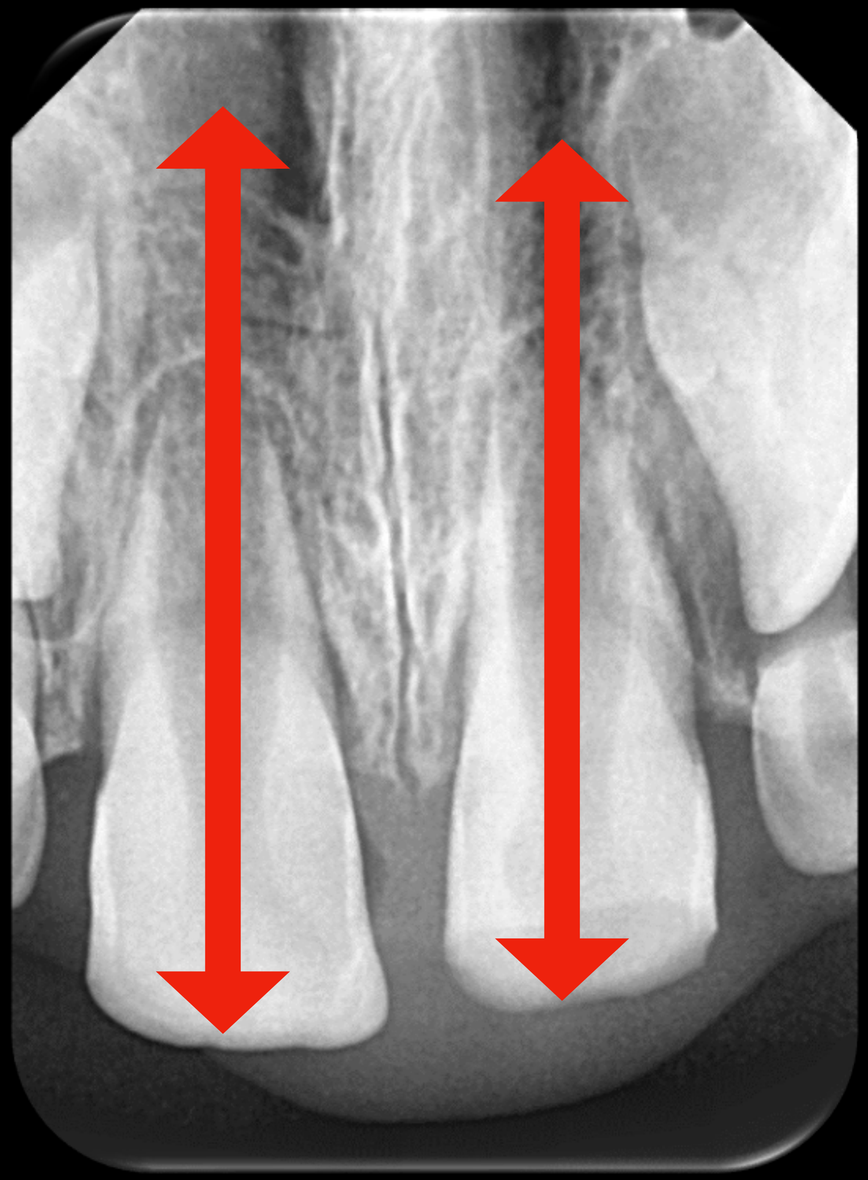
Problems with Immature Root

1. **Short root that will affect long term retention of the tooth**



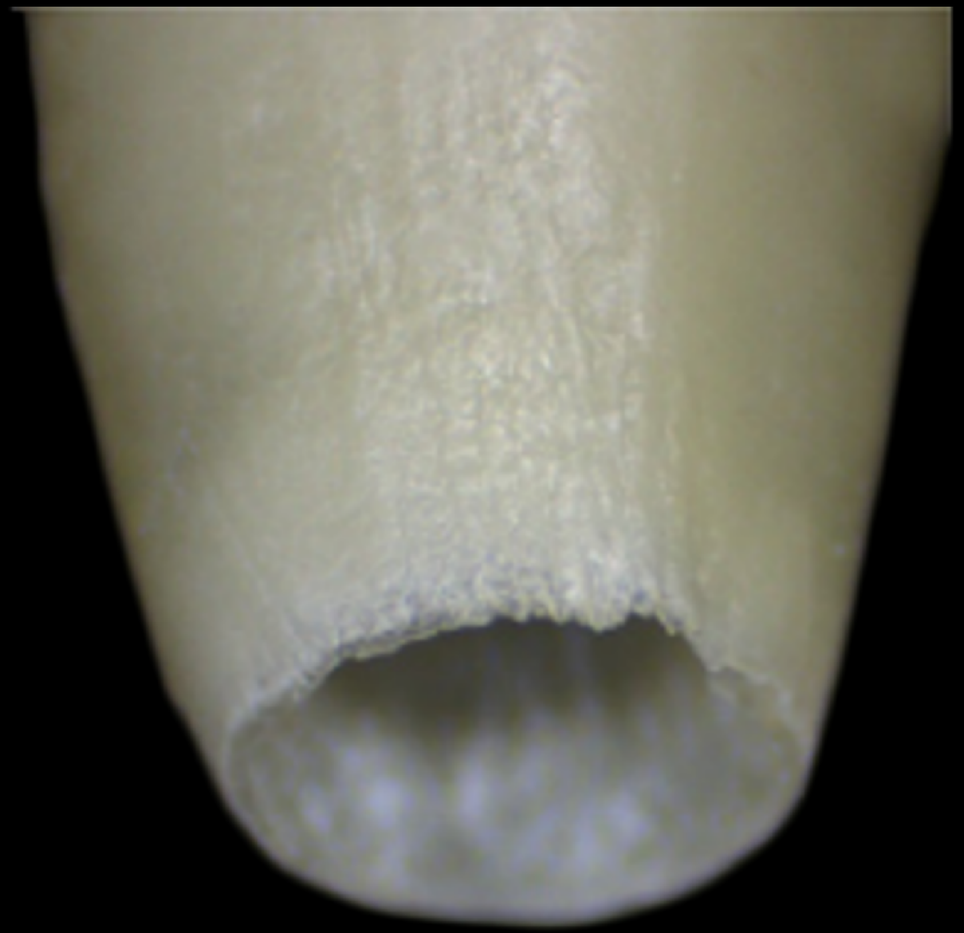
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Problems with Immature Root

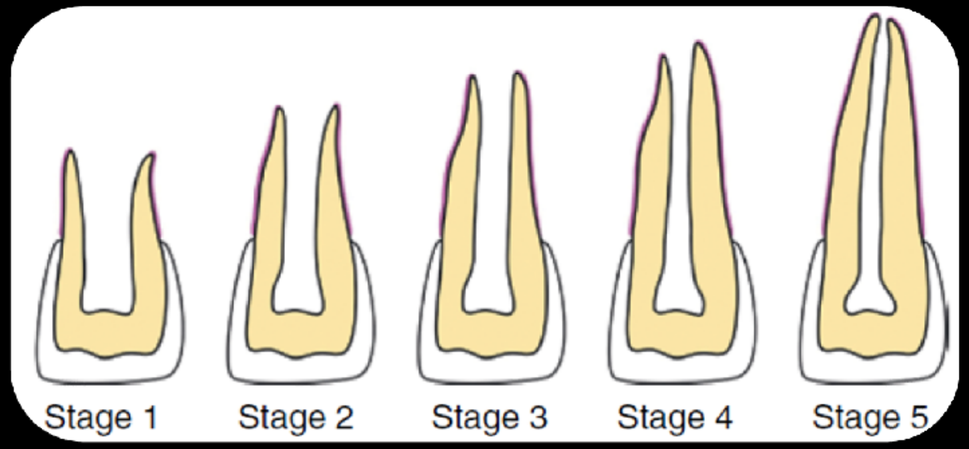
2. **Thin dentinal walls that will make the tooth susceptible to cervical fracture**

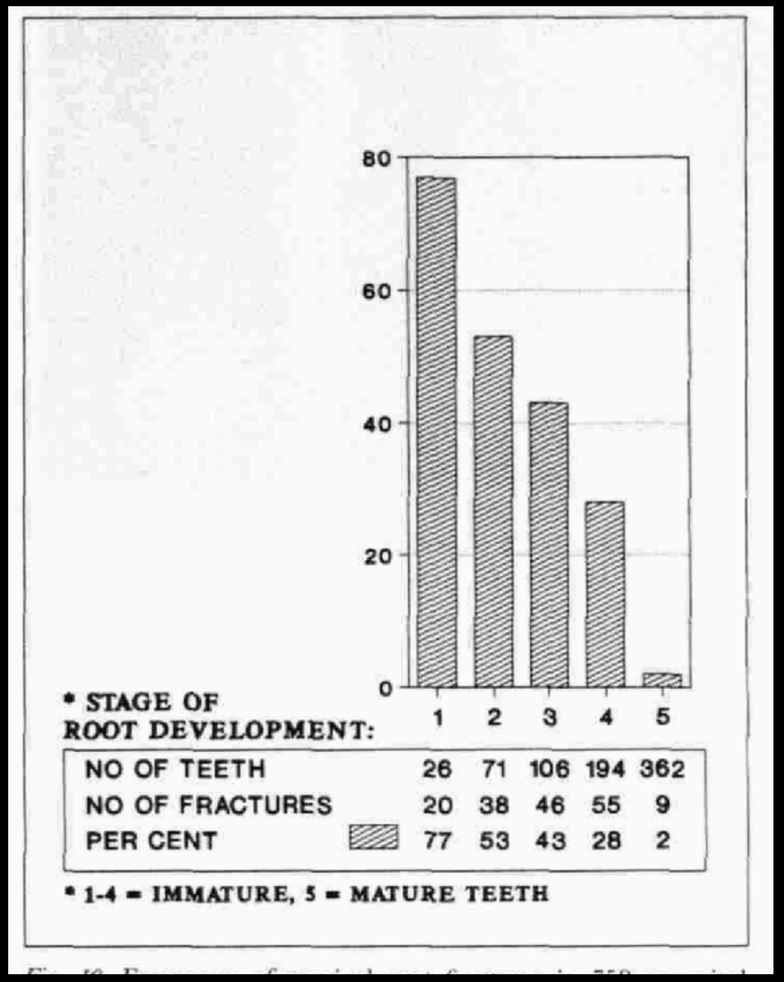


Cvek M. Prognosis of luxated non-vital maxillary incisors treated with calcium hydroxide and filled with gutta-percha. A retrospective study. Endod Dent Traumatol 1992;8:45–55.

Problems with Immature Root

Prognosis of luxated non-vital maxillary incisors treated with calcium hydroxide and filled with gutta-percha.
A retrospective clinical study

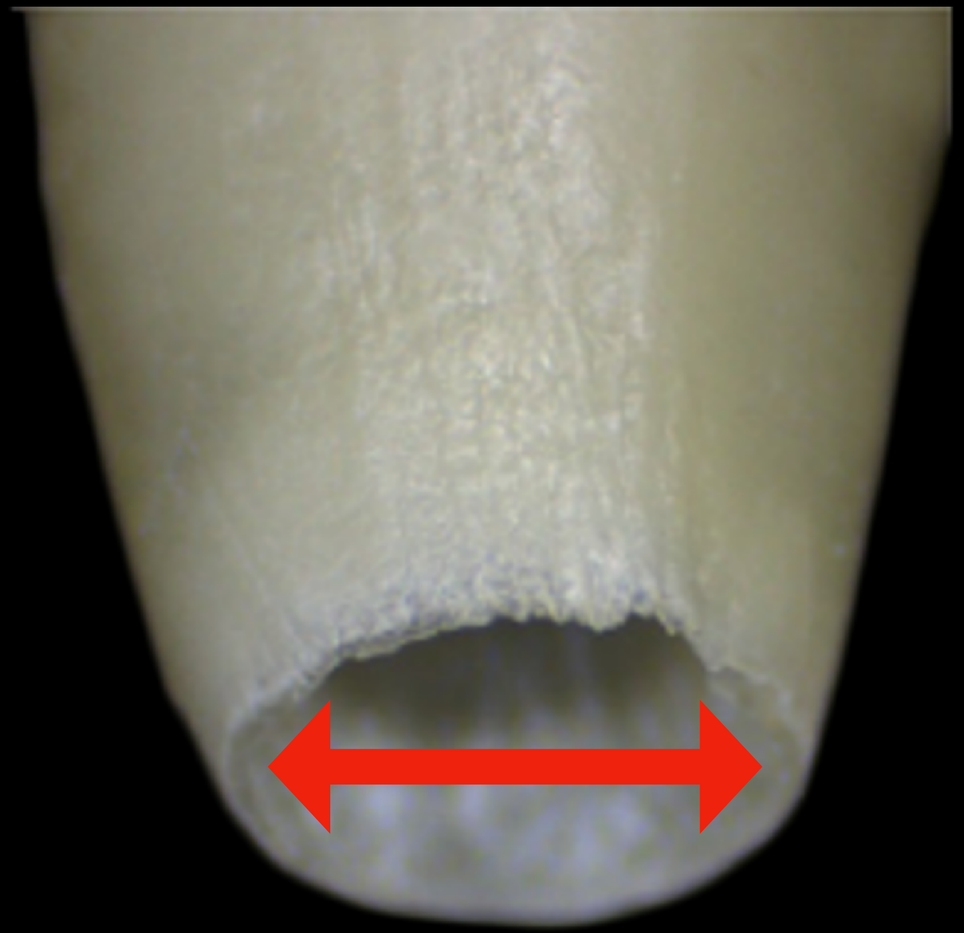




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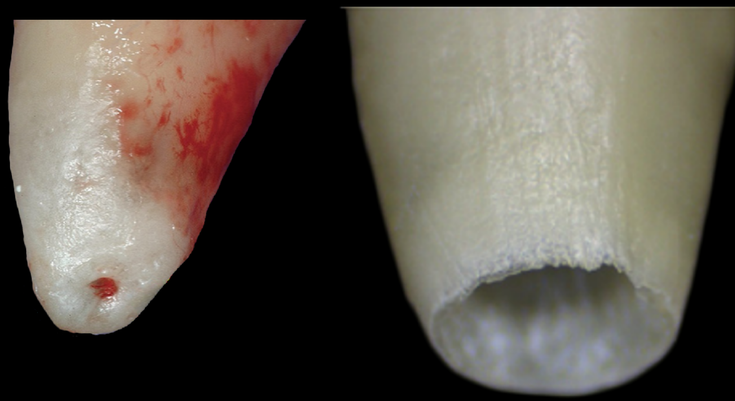
Problems with Immature Root





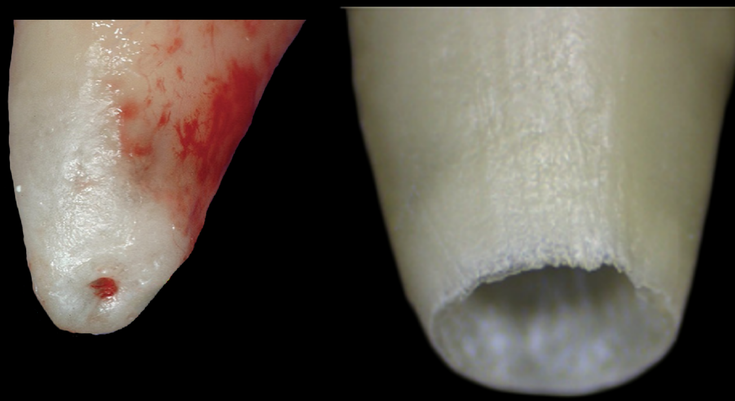
Problems with Immature Root

3. **Larger apical diameter potentially lead to more apical leakage and extrusion of the filling material**



Problems with Immature Root

1. Short root that will affect long term retention of the tooth.
2. Thin dentinal walls that will make the tooth susceptible to cervical fracture.
3. Larger apical diameter potentially lead to more apical leakage and extrusion of the filling material



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COMPREHENSIVE REVIEW

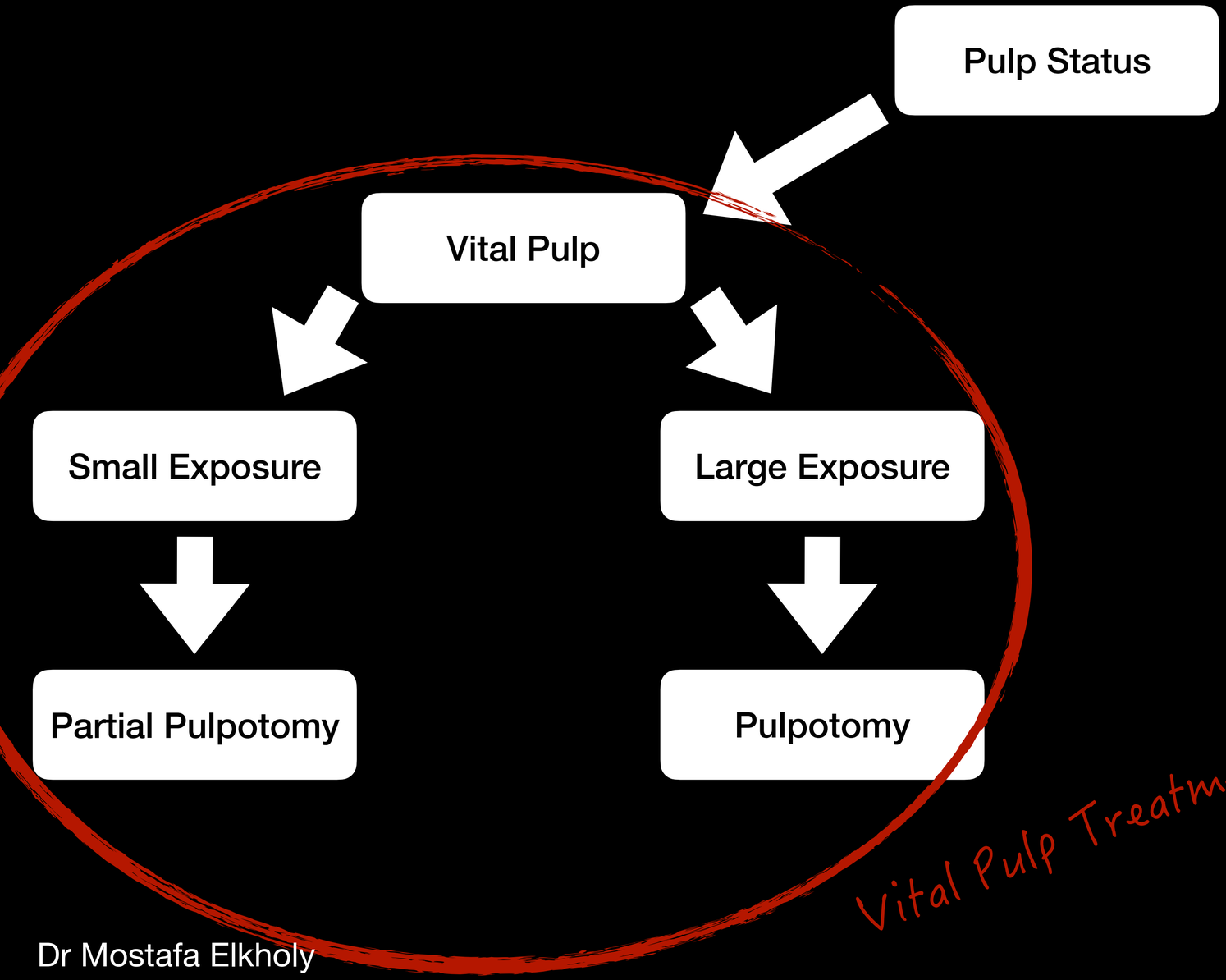
Dental Traumatology WILEY

International Association of Dental Traumatology guidelines for the management of traumatic dental injuries: 1. Fractures and luxations

STAGE OF ROOT DEVELOPMENT—IMMATURE (OPEN APEX) VS MATURE (CLOSED APEX) PERMANENT TEETH

Every effort should be made to preserve the pulp, in both mature and immature teeth. In immature permanent teeth, this is of utmost importance in order to allow continued root development and apex formation.

Manangement

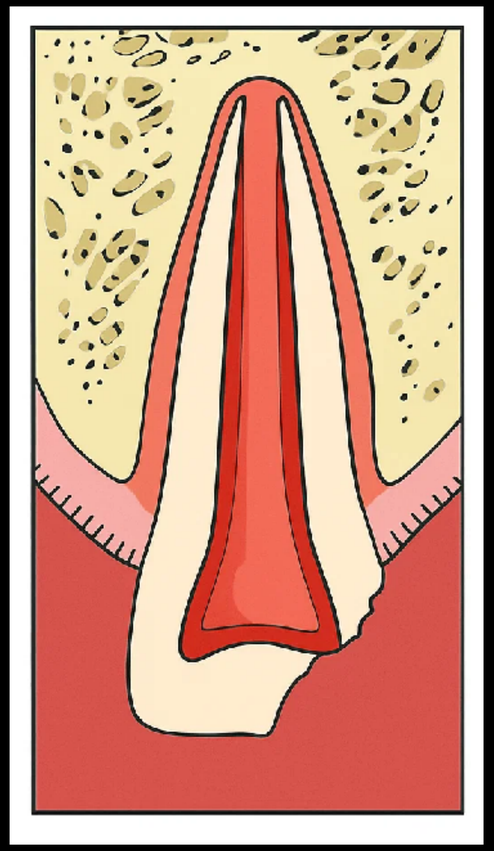


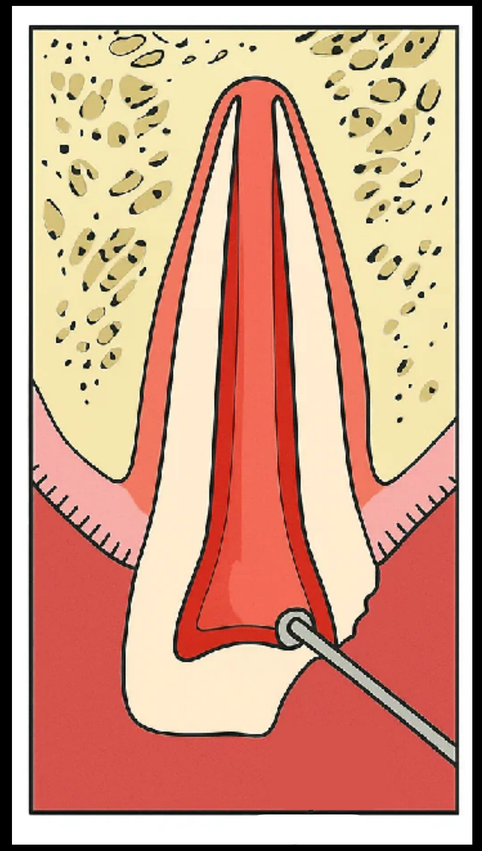
Vital Pulp Treatment = apexogenesis

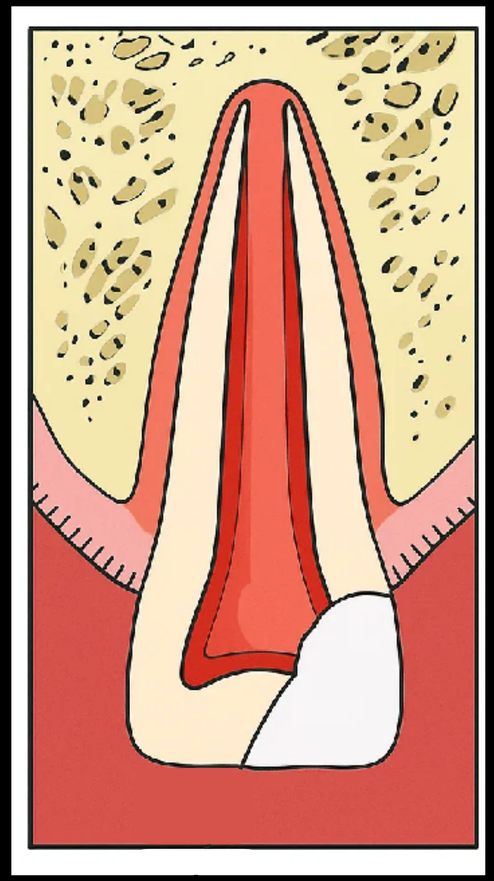
Manangement

There are two essential objectives for treatment of the vital pulp that make the level of pulpal amputation important:

1. **a wound dressing should be placed on non-inflamed tissue,**
2. **the loss of tooth structure should be kept to a minimum.**



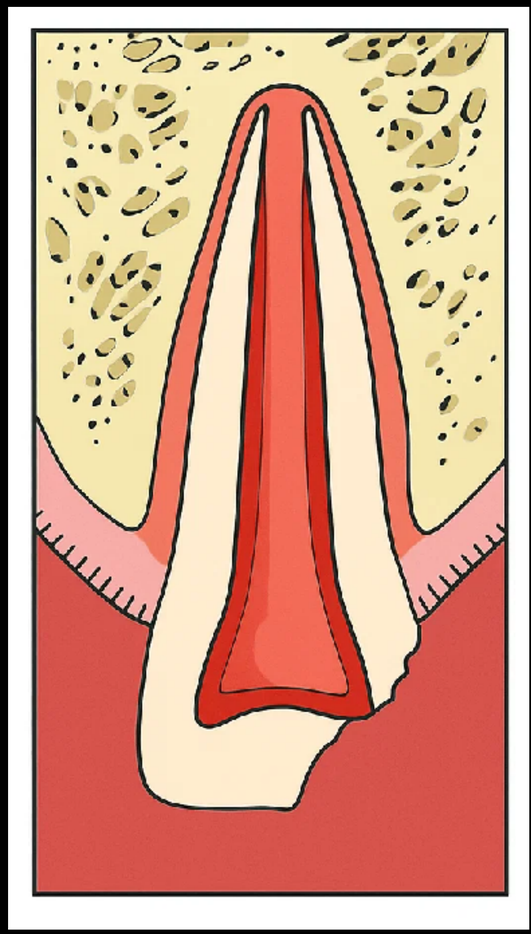




Manangement

Apexogenesis refers to a vital pulp therapy procedure performed to encourage physiological development and formation of the root end.

S Goldstein, A Sedaghat-Zandi, M Greenberg, S Friedman N Y State Dent J 1999 May;65(5):23-5.



Partial Pulpotomy vs. Direct Pulp Cap

- **The advantage of partial pulpotomy (removing 2 mm of coronal pulp) as compared with pulp capping lies in better control of the surgical wound and retention of the sealing material.**
- **Capping of the pulp is recommended only when the exposure is small (less than 1 mm in size) and when it can be treated shortly after the accident. These indications apply to only a limited number of teeth and, in the majority of cases, partial pulpotomy is therefore performed.**

Manangement

Vital Pulp Treatment



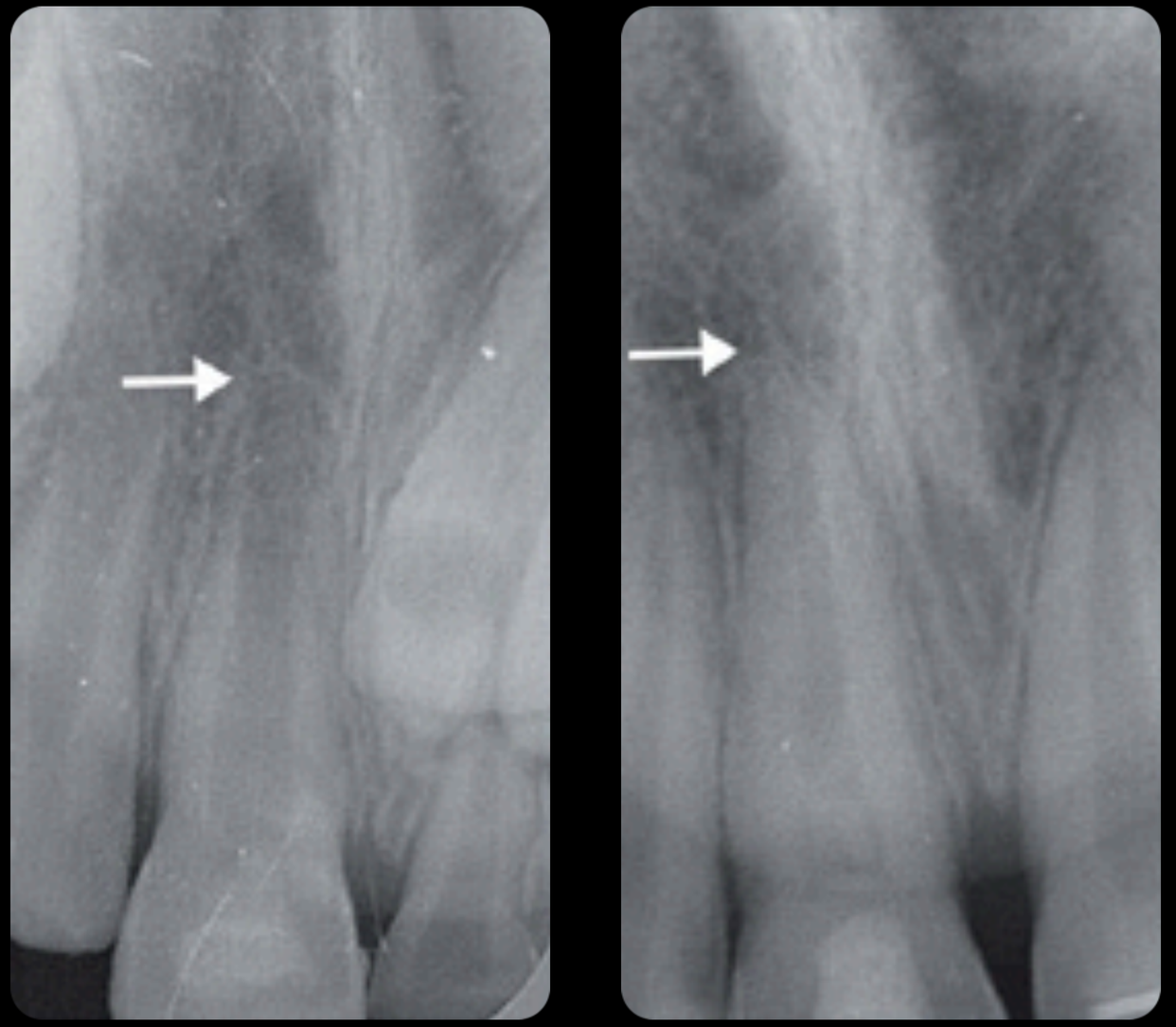




Courtesy of Dr Marga Ree. Courtesy of George Bogen. From Bogen G et al. Cohens Pathways of the Pulp, 12th ed

Manangement

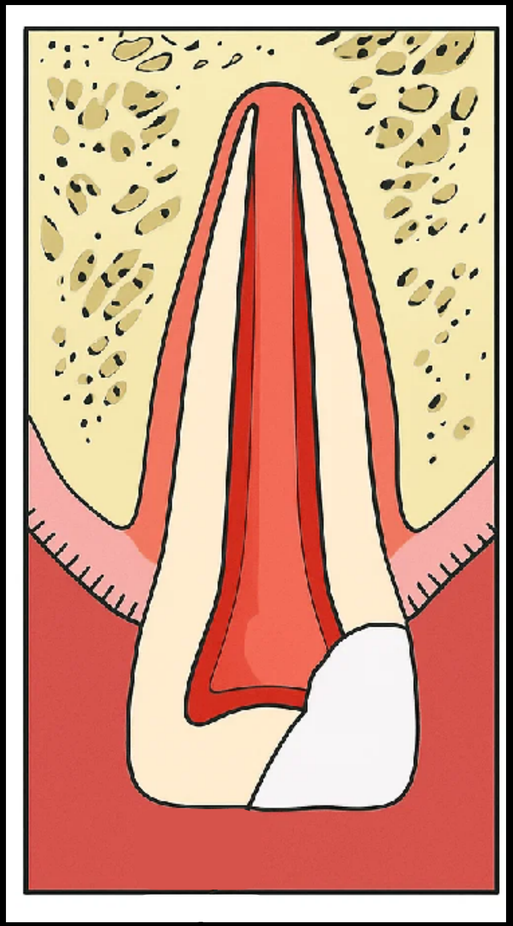
Vital Pulp Treatment



Courtesy of Dr Marga Ree. Courtesy of George Bogen. From Bogen G et al. Cohens Pathways of the Pulp, 12th ed

Goals of Apexogenesis

1 Sustaining a viable Hertwig's sheath, thus allowing continued development of root length for amore favorable crown-to-root ratio.
2 Maintaining pulpal vitality, thus allowing the remaining odontoblasts to lay down dentine, producing a thicker root and decreasing the chance of root fracture.
3 Promoting root end closure, thus creating a natural apical constriction for root canal filling.
4 Generating a dentinal bridge at the site of the pulpotomy.
While the bridging is not essential for the success of the procedure, it does suggest that the pulp has maintained its vitality

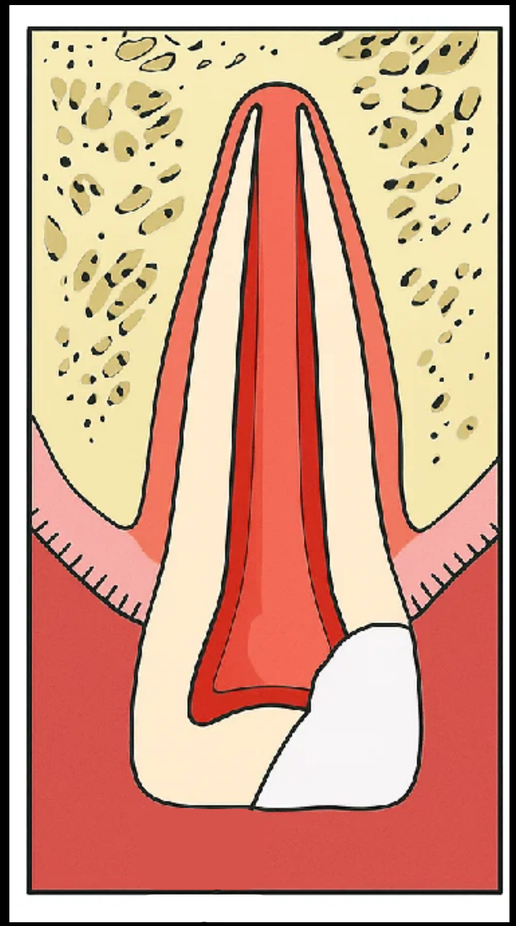


Webber RT. Apexogenesis versus apexification. Dent ClinN Am 1984;28:669–97

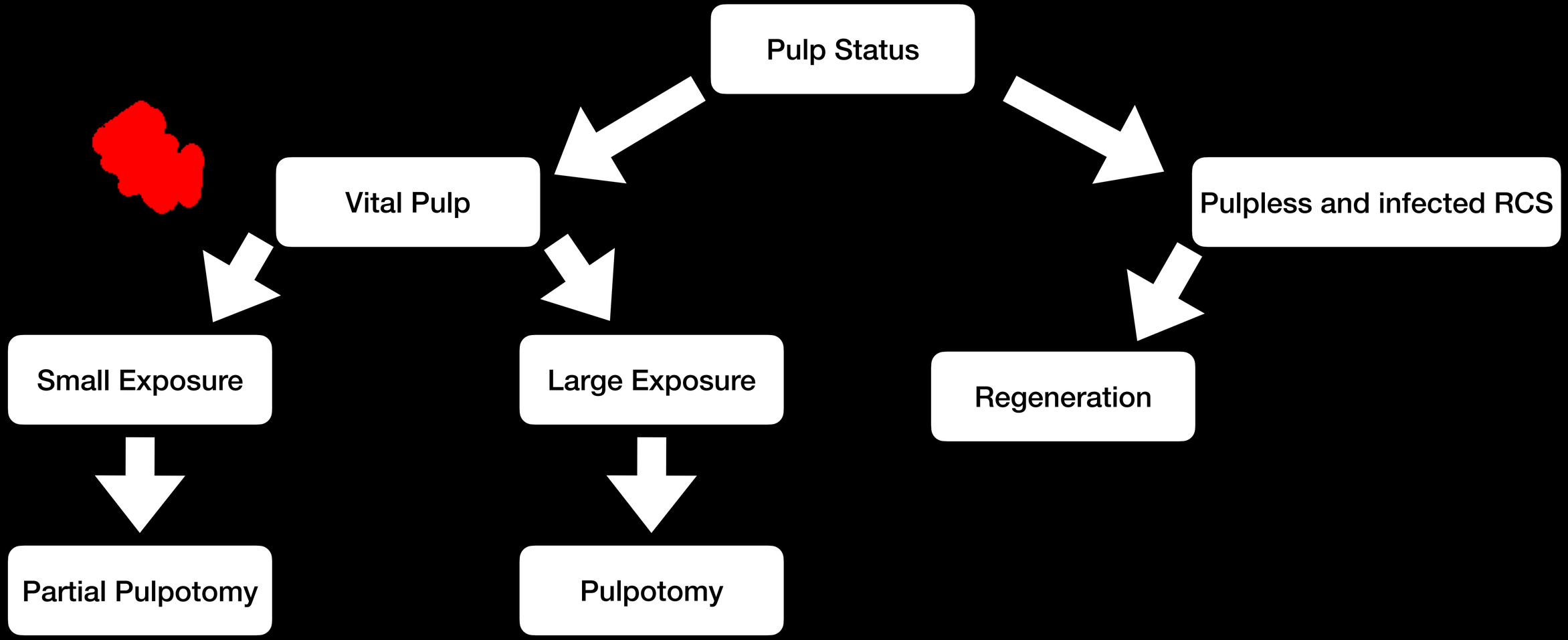
Outcomes of Apexogenisis

A successful follow up to vital pulpal treatment:

- Dentine bridge formation.
- Continued root development
- Positive response to pulp vitality testing
- No symptoms
- No radiographic development of apical periodontitis or root resorption

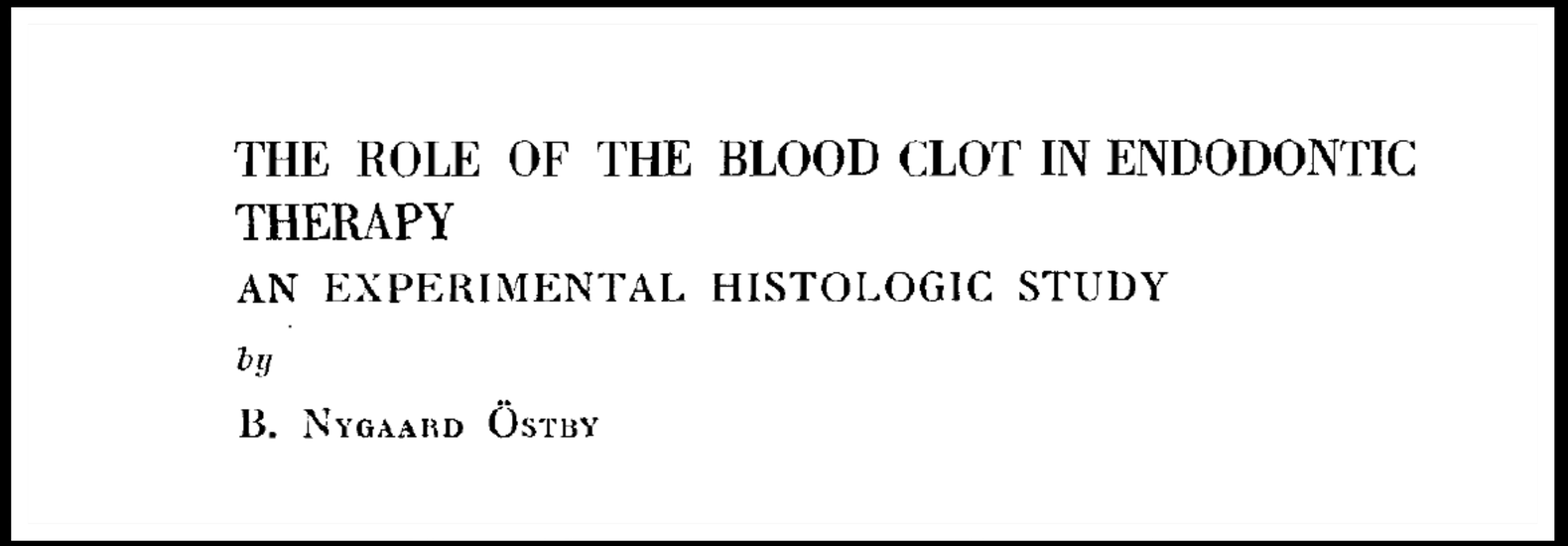


Manangement



Regenerative Endodontic

Is defined as biologically based procedures designed to replace damaged structures such as dentine, root structures, and cells of the pulp-dentin complex



THE ROLE OF THE BLOOD CLOT IN ENDODONTIC THERAPY

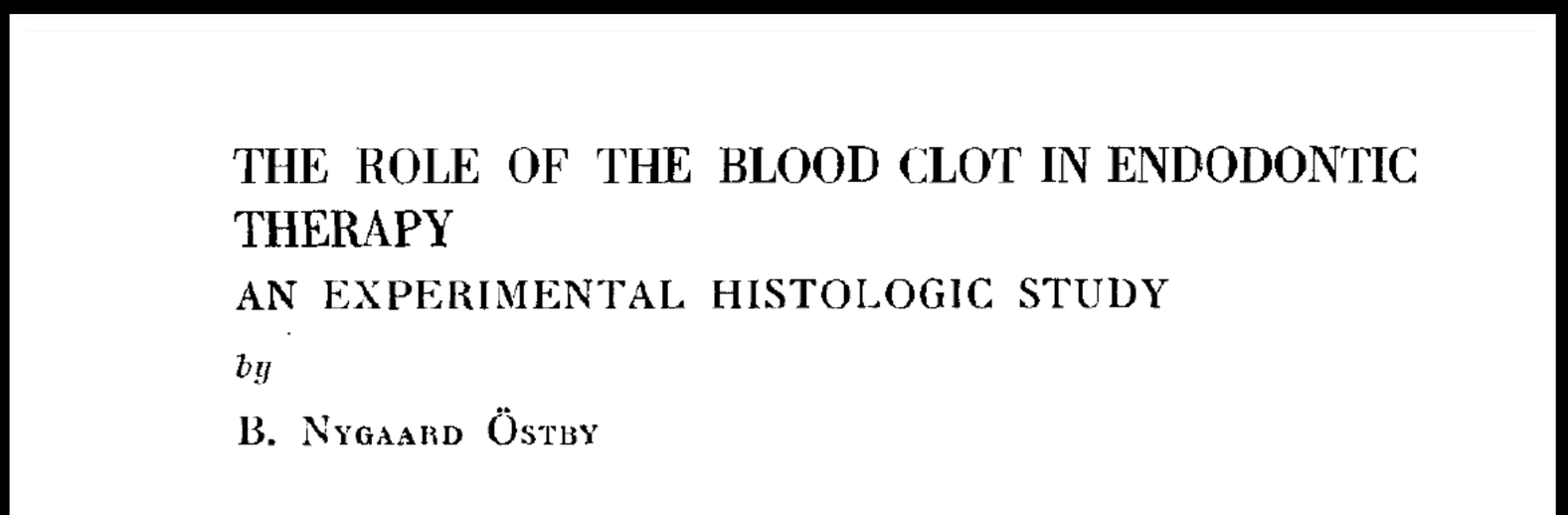
AN EXPERIMENTAL HISTOLOGIC STUDY

by

B. NYGAARD ÖSTBY

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Regenerative Endodontic



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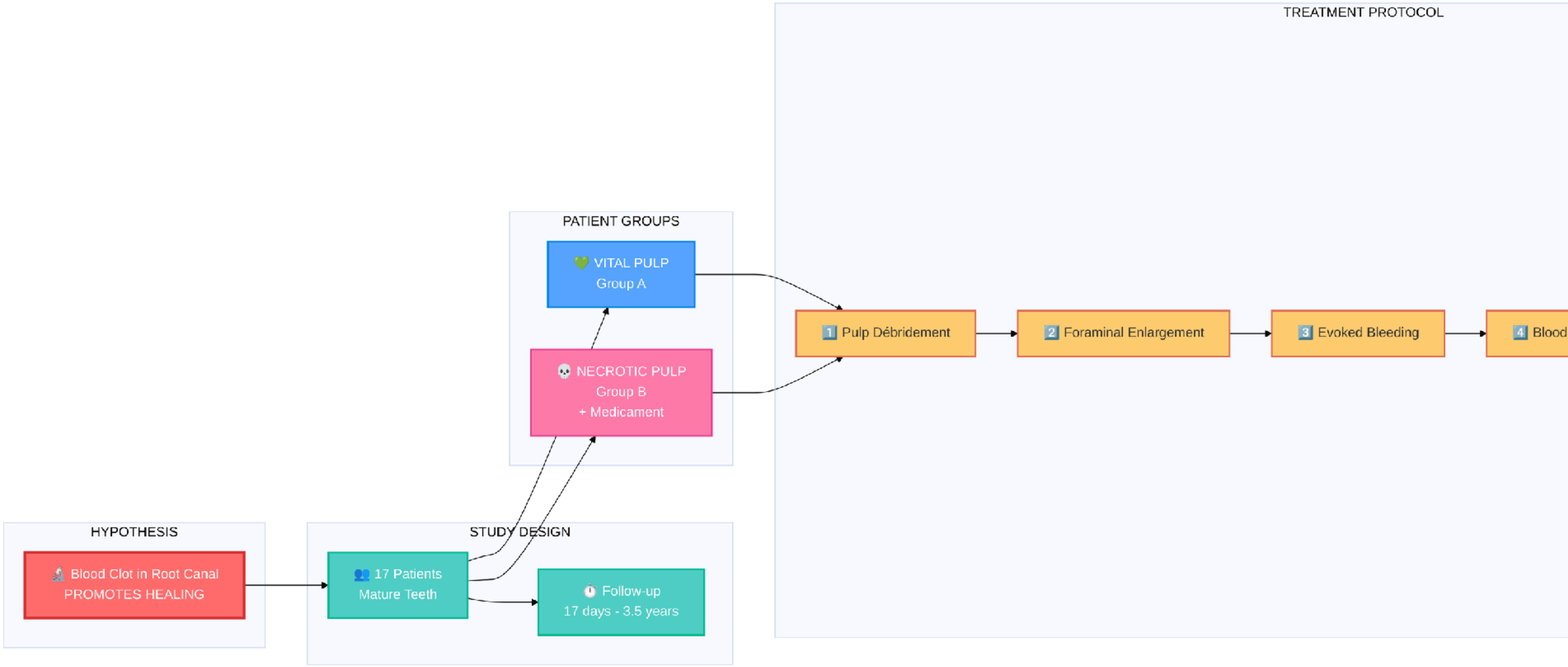
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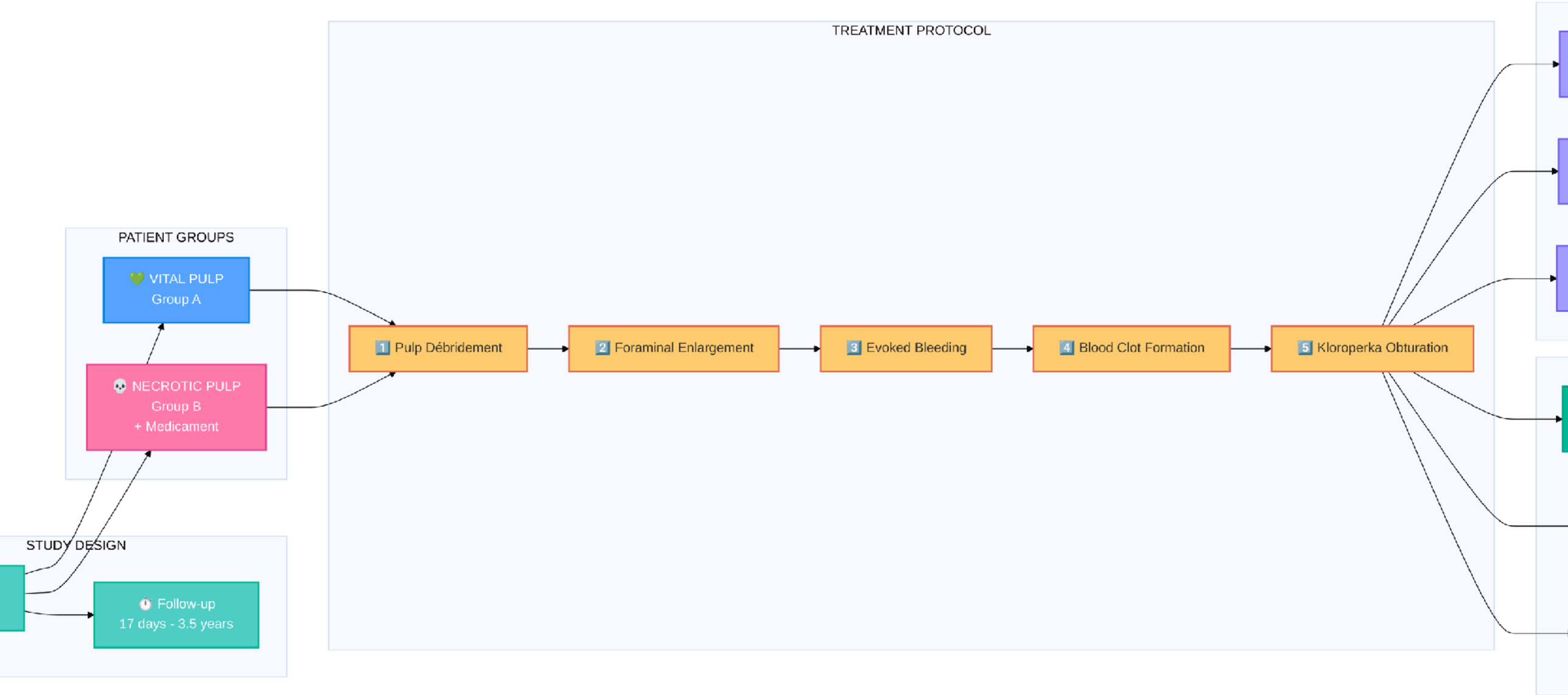
B. NYGAARD ÖSTBY

He hypothesized that a blood clot could be the first step in the healing of a damaged dental pulp, similar to the role of the blood clot in the healing process observed in other areas

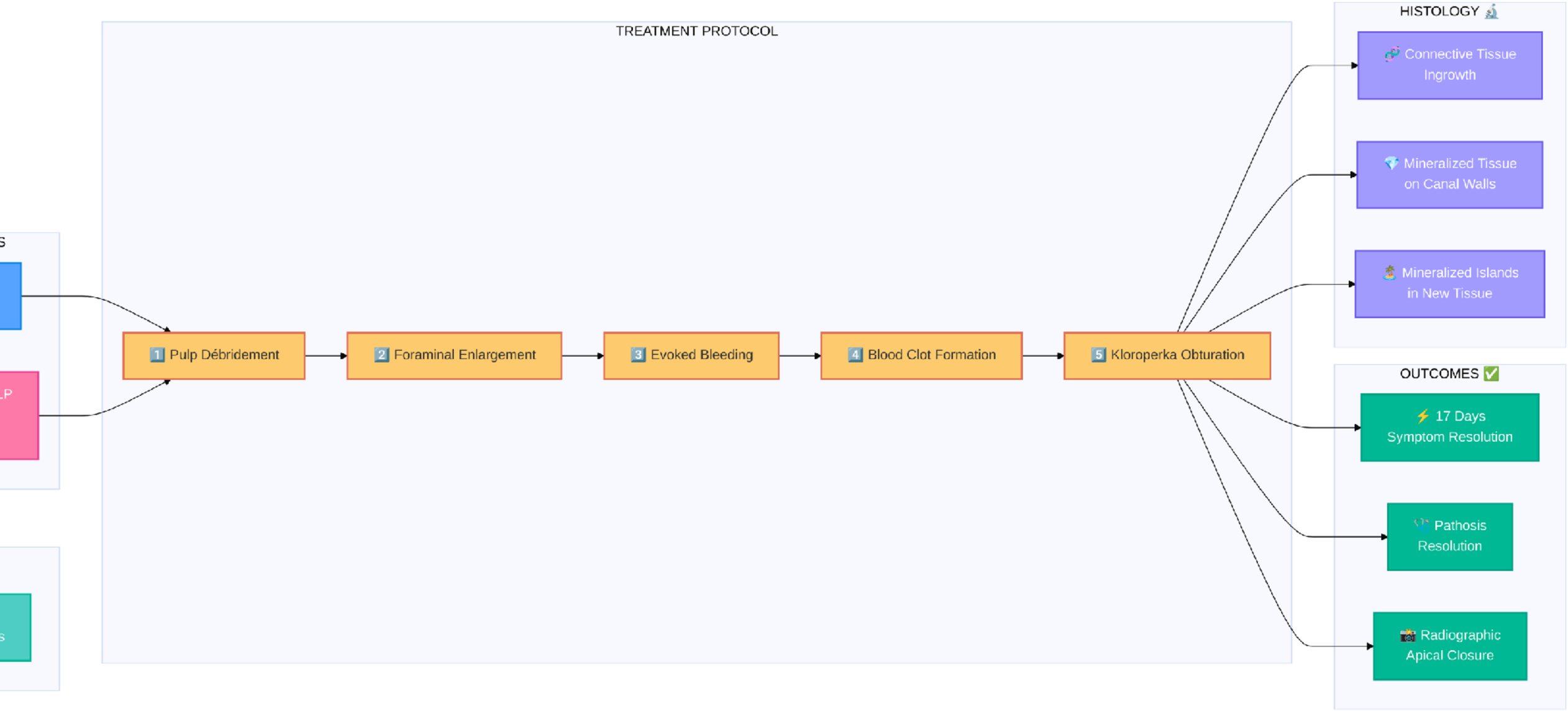
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Regenerative Endodontic

Dental Traumatology 2001; 17: 185–187
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Revascularization of an immature permanent tooth with apical periodontitis and sinus tract

Iwaya S, Ikawa M, Kubota M. Revascularization of an immature permanent tooth with apical periodontitis and sinus tract. Dent Traumatol 2001; 17: 185–187. © Munksgaard, 2001.

Shin-ichi Iwaya[1], Motohide Ikawa[2], Minoru Kubota[3]

[1]Department of Dentistry, Tohoku Welfare Pension Hospital, Sendai, [2]Division of Periodontics and



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Regenerative Endodontic

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CLINICAL RESEARCH

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Francisco Banchs, DDS, MS, and Martin Trope, DMD

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The Biology of Regenerative Endodontics

CELLS

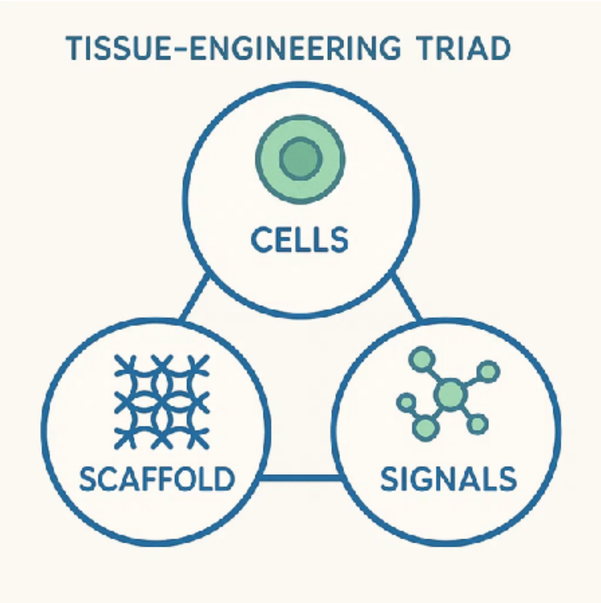
Viable progenitor/stem cells that can differentiate into pulp and dentin-forming cells

SCAFFOLD

Physical matrix to host cells and provide structural support for tissue formation

SIGNALS

Biochemical and mechanical cues that instruct cell proliferation and differentiation



These three components work together to rebuild a functional pulp-dentin complex

Key Cellular Players

SCAP

Stem Cells from Apical Papilla

- Highly proliferative mesenchymal stem cells
- Main 'workhorse' for continued root development
- Produce dentine-forming cells and pulp-like tissue

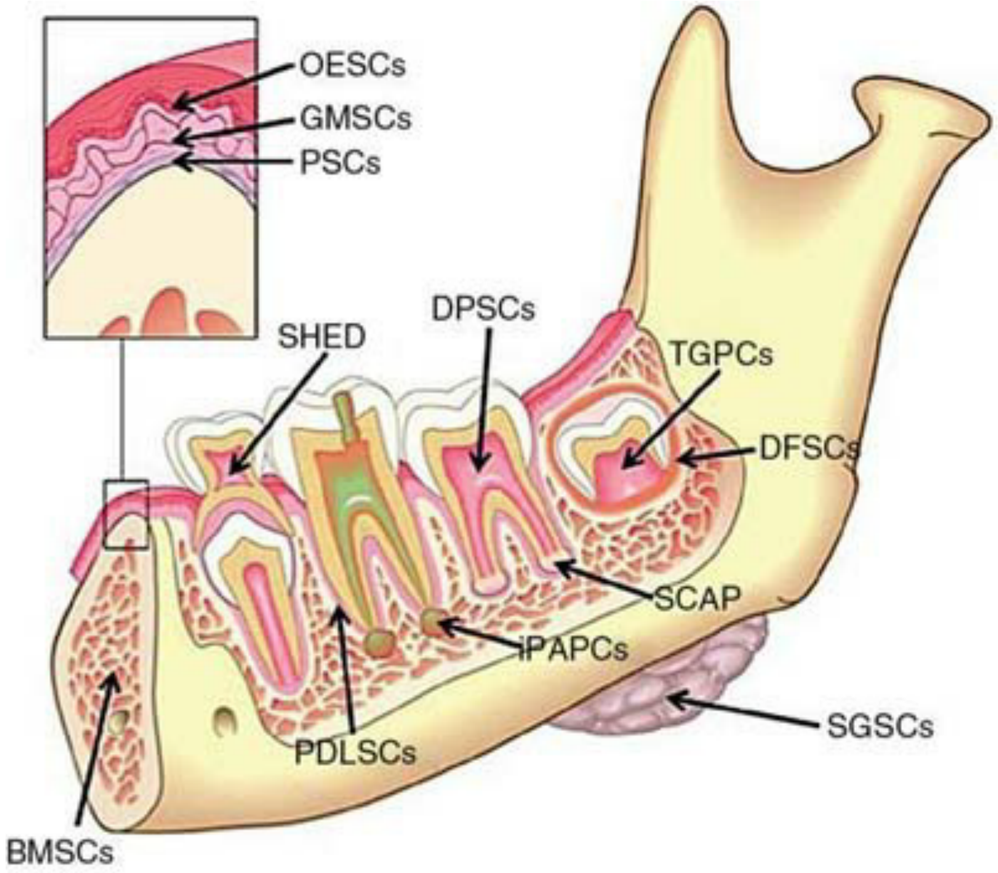
DPSCs

Dental Pulp Stem Cells

- Found in residual pulp tissue
- Contribute to regeneration when present
- Support tissue repair processes

Other Contributors

- Periodontal ligament stem cells
- Bone marrow-derived MSCs
- Creates mixed-origin regenerated tissue



Multiple cell types work together to regenerate pulp-dentin complex

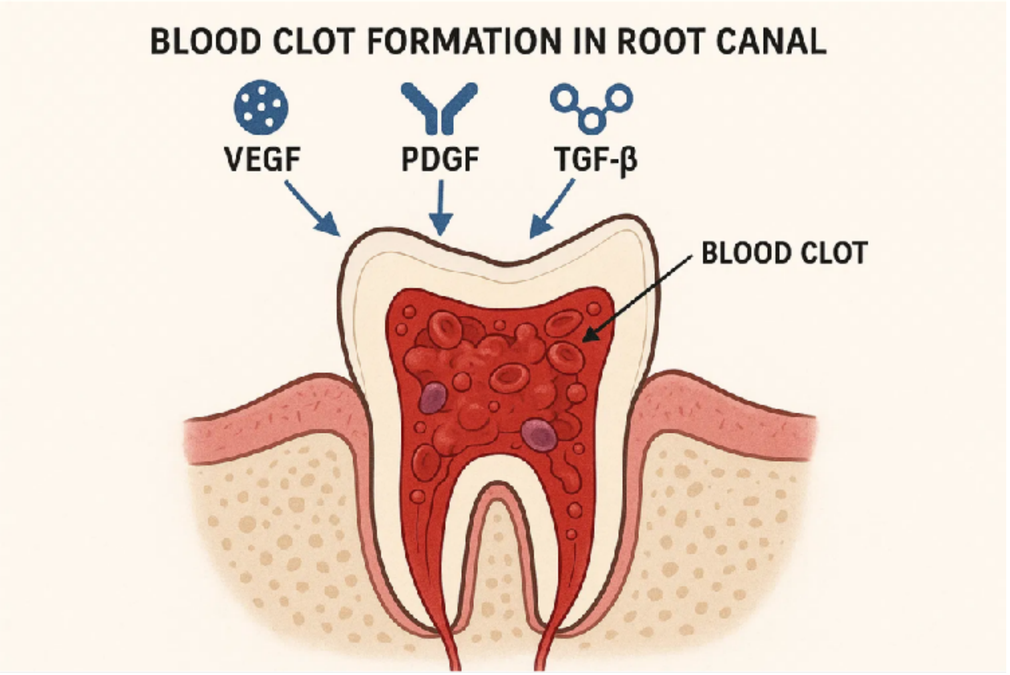
Scaffold and Growth Factors

Blood Clot as Natural Scaffold

- Provides fibrin matrix structure
- Contains platelets releasing growth factors
- Simplest clinical scaffold option

Alternative Scaffolds

- Autologous concentrates (PRF/PRP/CGF)
- Synthetic biomaterials (hydrogels, collagen)
- Polymer scaffolds (experimental)



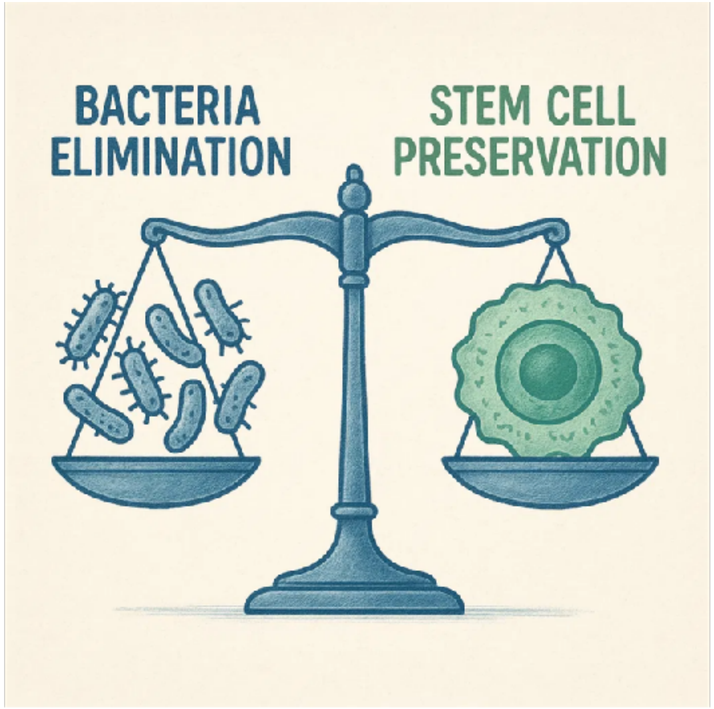
Key Growth Factors

VEGF
Promotes angiogenesis and vascular growth

PDGF
Stimulates cell proliferation and migration

TGF-β
Regulates cell differentiation and matrix formation

Microenvironment and Antimicrobial Balance



The critical balance in regenerative endodontics

Infection Control

Elimination of bacteria is essential for successful regeneration, but harsh disinfection can damage stem cells

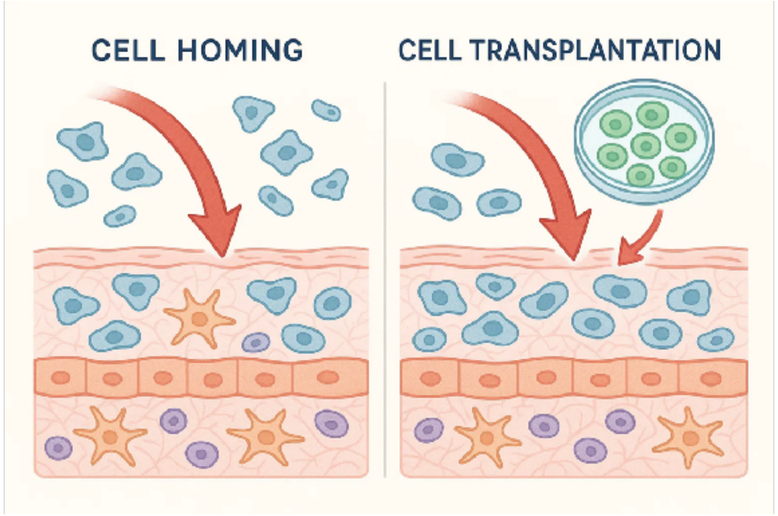
Stem Cell Viability

Preserving SCAP/DPSCs viability is crucial for tissue regeneration and continued root development

Balanced Protocols

- Lower NaOCl concentrations
- EDTA irrigation to expose dentine-bound growth factors
- Gentle intracanal medicaments

Cell Homing vs Cell Transplantation



Cell Homing

Recruiting the patient's own stem/progenitor cells from periapical tissues into the canal using a scaffold and growth cues

- \+ Common clinical approach
- \+ Simpler chairside procedure
- \+ No cell culture required
- − Less predictable cell types

Cell Transplantation

Lab-grown stem cells (DPSCs/SCAP) seeded into engineered scaffolds and implanted into the root canal system

- \+ Controlled cell selection
- \+ Potentially more predictable outcomes
- − Complex laboratory procedures
- − Regulatory and logistic challenges

What Forms Inside the Canal?

Fibrovascular Connective Tissue

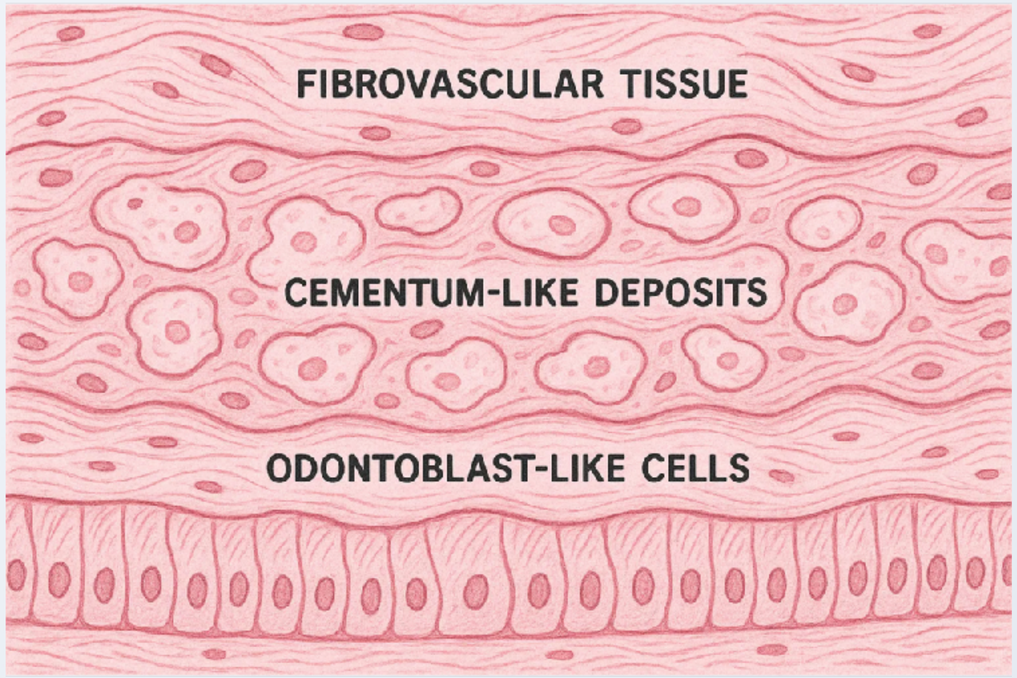
Most common finding in regenerated canals. Contains collagen fibers, blood vessels, and various cell types but lacks the organized structure of normal pulp.

Cementum-like Deposits

Hard tissue formation along canal walls resembling cementum or bone-like tissue. Contributes to root strengthening but differs from normal dentine.

Odontoblast-like Cells

Occasionally observed cells resembling odontoblasts that may produce dentine-like tissue. True odontoblast layer with tubular dentine is uncommon.



Histological outcomes are variable and often differ from normal pulp architecture

Clinical Success ≠ Complete Biological Restoration

Root maturation and infection resolution can occur even without perfect pulp regeneration

Current Challenges and Future Directions

Current Challenges

Organised Pulp Formation

Directing stem cells to form organised pulp with proper odontoblast layer

Predictable Re-innervation

Achieving consistent restoration of pulp sensibility

Disinfection Protocols

Standardizing protocols that preserve cell viability

Future Research Directions

Advanced Scaffolds

Development of bioactive scaffolds with controlled release of growth factors

Exosome Therapy

Utilising stem cell-derived exosomes for targeted regeneration

Gene Therapy

Genetic modification to enhance regenerative potential

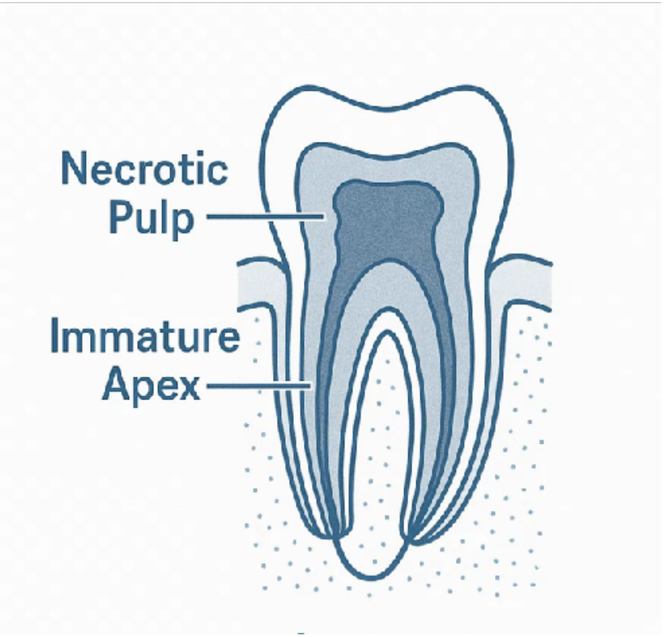
> “Full pulp regeneration with organized tissue architecture remains an active research goal”

AAE Clinical Considerations for a Regenerative Endodontic Procedure

Revised 5/18/2021

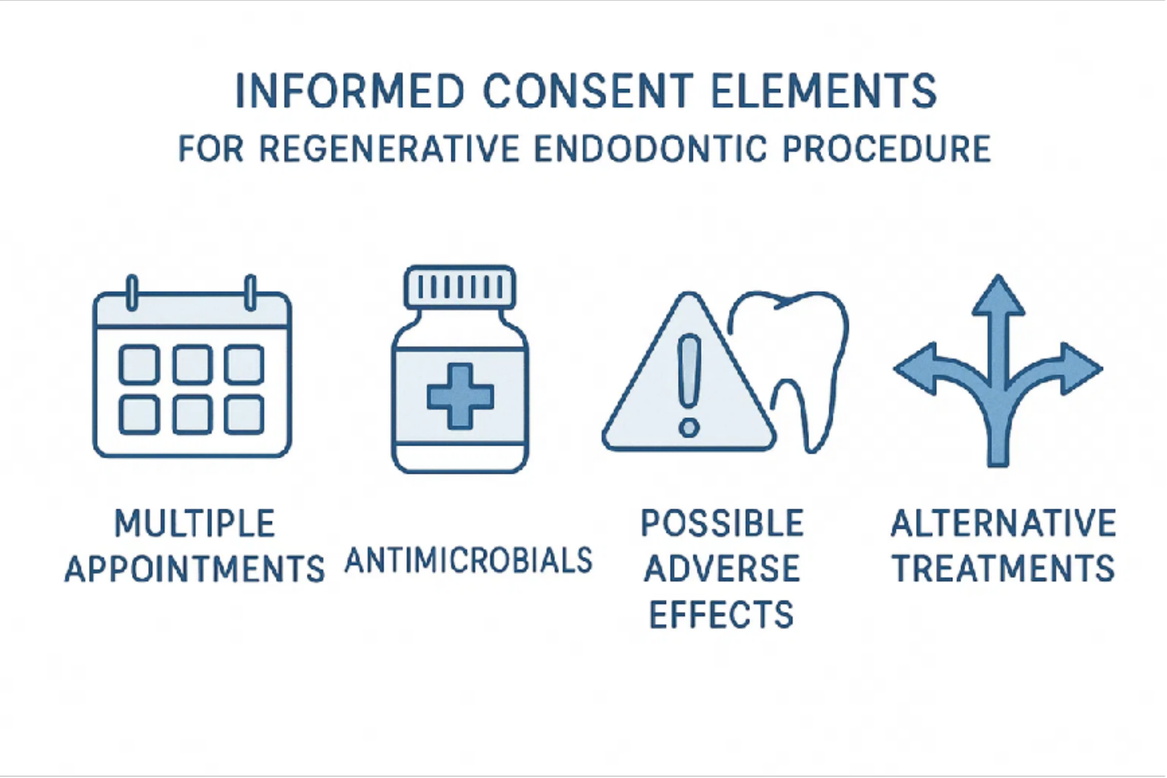
Case Selection Criteria

- **Tooth Condition:** Necrotic pulp with immature apex
- **Pulp Space:** Not needed for post/core or final restoration
- **Patient Compliance:** Compliant patient/parent
- **Medical History:** No allergies to medications and antibiotics necessary for procedure (ASA 1 or 2)
- **Contraindications:** Allergies to required medications, non-compliant patients



Informed Consent Requirements

- **Multiple Appointments:** Two (or more) appointments required
- **Medications:** Use of antimicrobial(s) during treatment
- **Possible Adverse Effects:** Staining of crown/root, lack of response to treatment, pain/infection
- **Alternatives:** MTA apexification, no treatment, extraction (when deemed nonsalvageable)



First Appointment Protocol

Anesthesia & Access

Local anesthesia, dental dam isolation and access

Irrigation Protocol

Copious, gentle irrigation with 20ml NaOCl

- **Lower concentration** : 1.5%-3% NaOCl

Secondary irrigation with saline or EDTA

Needle positioned ~1mm from root end

Medication Placement

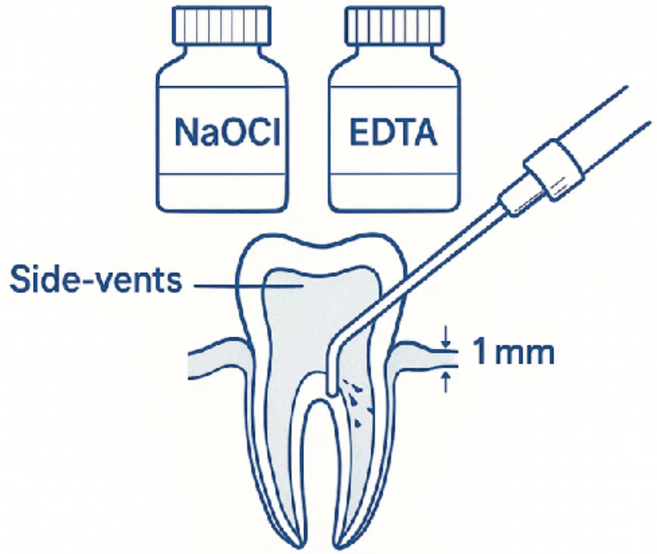
Dry canals with paper points

Place calcium hydroxide or triple antibiotic paste

- **Keep below CEJ** to minimize staining

Temporary Restoration

Seal with 3-4mm temporary material Dismiss patient for 1-4 weeks



Proper Irrigation Technique for Regenerative Endodontic Procedure

Second Appointment Protocol

(1-4 weeks after first visit)

Assessment and Preparation

1. Assess response to initial treatment; if persistent infection, consider additional antimicrobial treatment
2. Anesthesia with **3% mepivacaine without vasoconstrictor**
3. Copious, gentle irrigation with **20ml of 17% EDTA**

Blood Clot Formation

4. Create bleeding by over-instrumenting with pre-curved K-file **2mm past apical foramen**
5. Goal: Fill entire canal with blood to level of cemento-enamel junction

Restoration Placement

6. Place resorbable matrix over blood clot with white MTA as capping material
7. Apply 3-4mm layer of glass ionomer, followed by final restoration

Follow-up Protocol

6-Month Follow-up

12-Month Follow-up

24-Month Follow-up

Clinical Examination:
No pain, soft tissue swelling or sinus tract

Radiographic Examination:
Resolution of apical radiolucency (6-12 months)

Root Development:
Increased width of root walls (12-24 months)

Root Length: Increased root length (12-24 months)

Pulp Testing: Positive response to vitality testing

Long-term: Yearly follow-up after first 2 years

