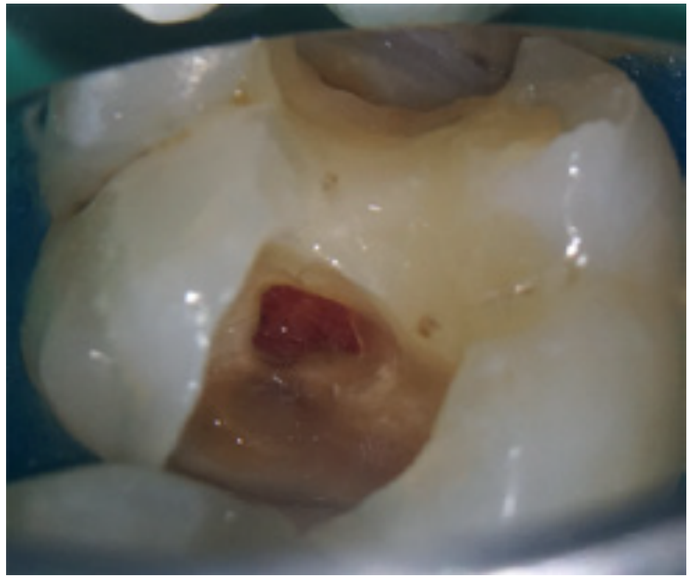
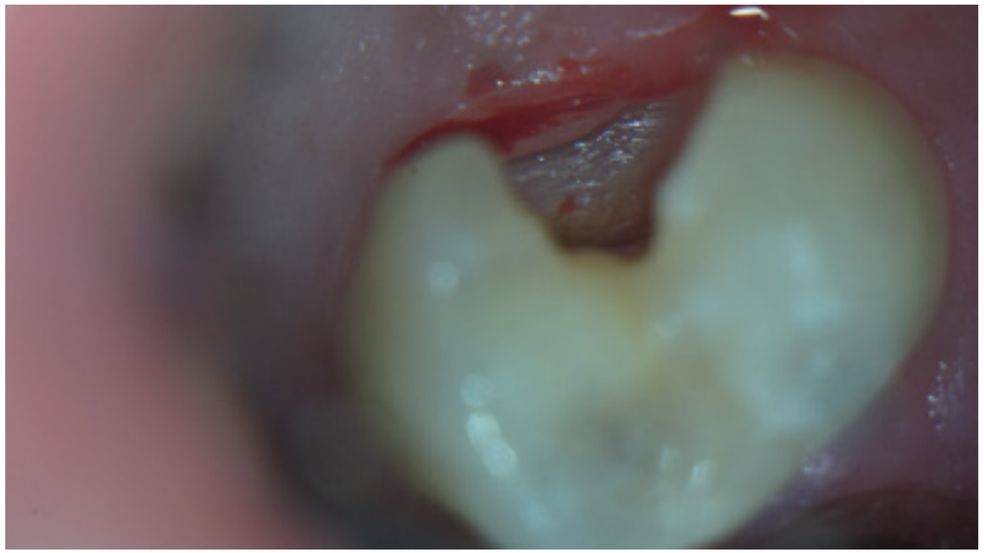
Vital Pulp Treatment

Dr Mostafa Elkholy

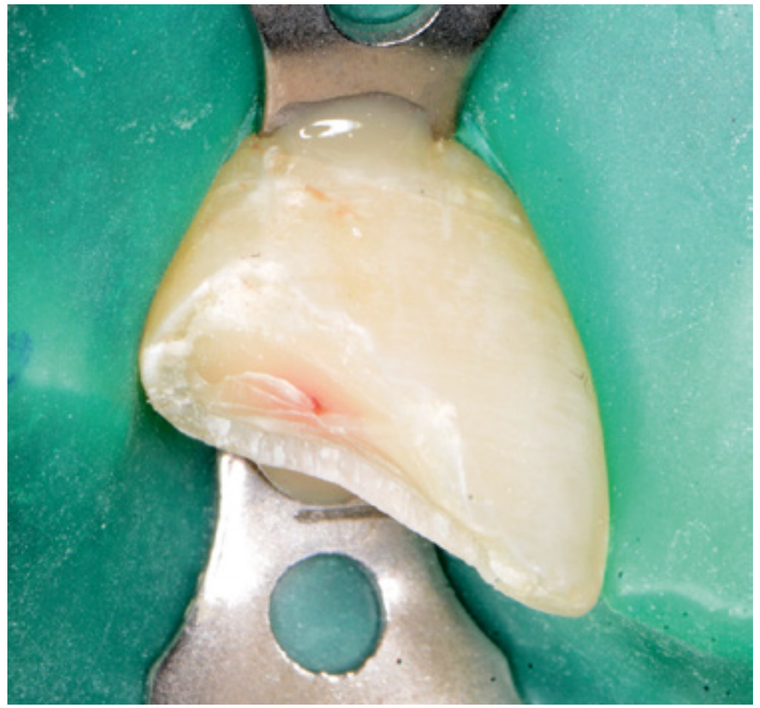












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History of Pulp Capping

In the18th century, when a piece of gold was placed over the exposed vital pulp in an attempt to promote healing.

J Dent Res 1949;39:97- 107.

In 1922, it was stated that ‘the exposed pulp is a doomed organ’

Heft 1922;16:3-83.

Studies in the 1950s reported a successful outcome of between 60 to 70% for direct pulp capping compared with over 80% for conventional RCT.

Acta Odontol Scand 1955;13:1-130.
Odontol Tidsk 1958;66:296-364.
Acta Odontol Scand 1956;14:1-175.

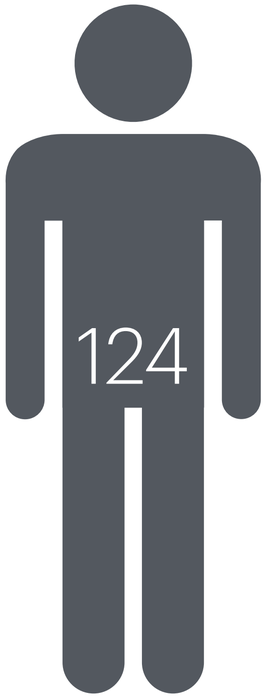
Later studies demonstrated a successful outcome of 80 to 90%

J Am Dent Assoc 1978;97:607-612.
Int Dent J 1981;31:251-260
J Am Dent Assoc 2008;139:305-315.
J Clin Pediatr Dent 2006;31:72-76.

The Sequela of Loss of Pulp Vitality

- The tooth become more vulnerable to irreparable fracture because of the loss of proprioceptive mechanisms.

J Endod 2017;43: 871





The Sequela of Loss of Pulp Vitality

Moisture depletion from dentine and Reduction of tooth stiffness after root canal treatment due to moisture depletion from dentine

Oral Surg Oral Med Oral Pathol 1972;34: 661.



The Sequela of Loss of Pulp Vitality

The cumulative loss of tooth structure from endodontic and restorative treatment weakens teeth.

J Endod 2021 Sep;47(9):1472-1480.

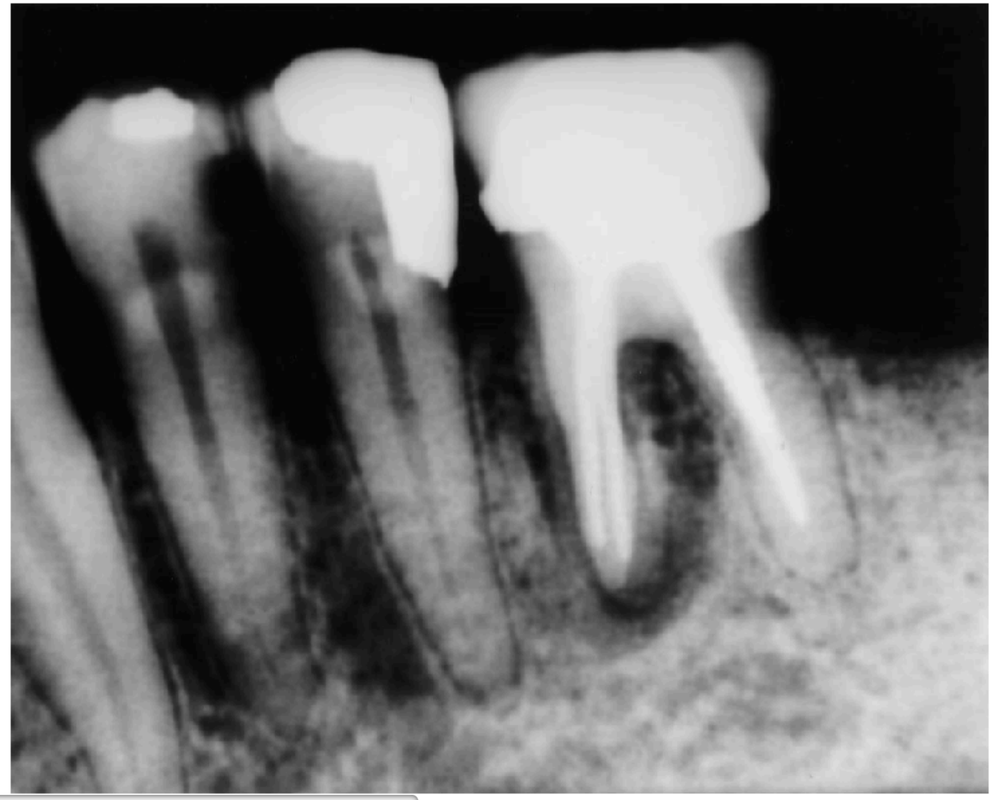


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The Sequela of Loss of Pulp Vitality

Changes in root canal geometry are inevitable in the course of canal preparation and may lead to a higher incidence of fractures

J Endod 2001;27: 46.





The Sequela of Loss of Pulp Vitality

Potential problems:

- Tooth discoloration.

Dent Traumatol 2013;29: 2

- Susceptibility to recurrent caries because of poor marginal integrity of restorations or modification of their biologic environment.

J Public Health Dent 1997;57: 31.

- Root canal treatments may be more complex than initially thought, while procedures for maintaining vitality are conservative, easy to implement, and often cost-effective.

J Endod 2014;40: 1764.

Rational of Vital Pulp Treatment

- Maintaining a healthy pulp is preferable so it can do its developmental, defensive, and proprioceptive functions.

- Preserving the dental pulp, especially in vital teeth with exposed pulp or immature teeth with incomplete root formation, supports continued root development.

- There has been a call for a more conservative approach in endodontics, emphasizing the importance of preserving rather than removing pulp tissue.

- Preserving the pulp is encouraged in modern endodontics due to its conservative nature, biological acceptance, and lower technical demands compared to complete pulpectomy and more cost effective.

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Biological Basis of Vital Pulp Treatment

Dental Pulp – Structure and Function

Odontoblasts

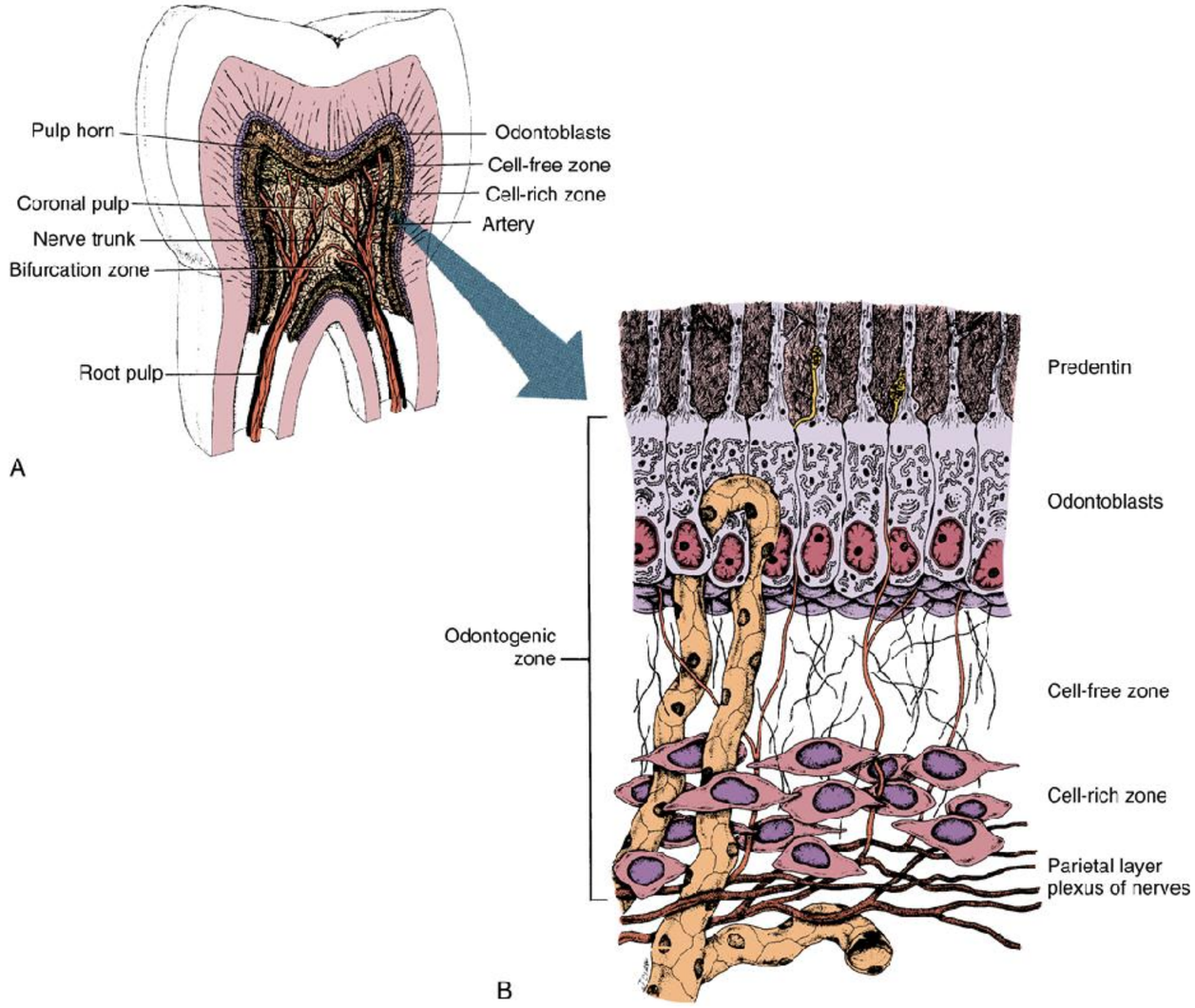
Fibroblasts

Immune Cells

ECM

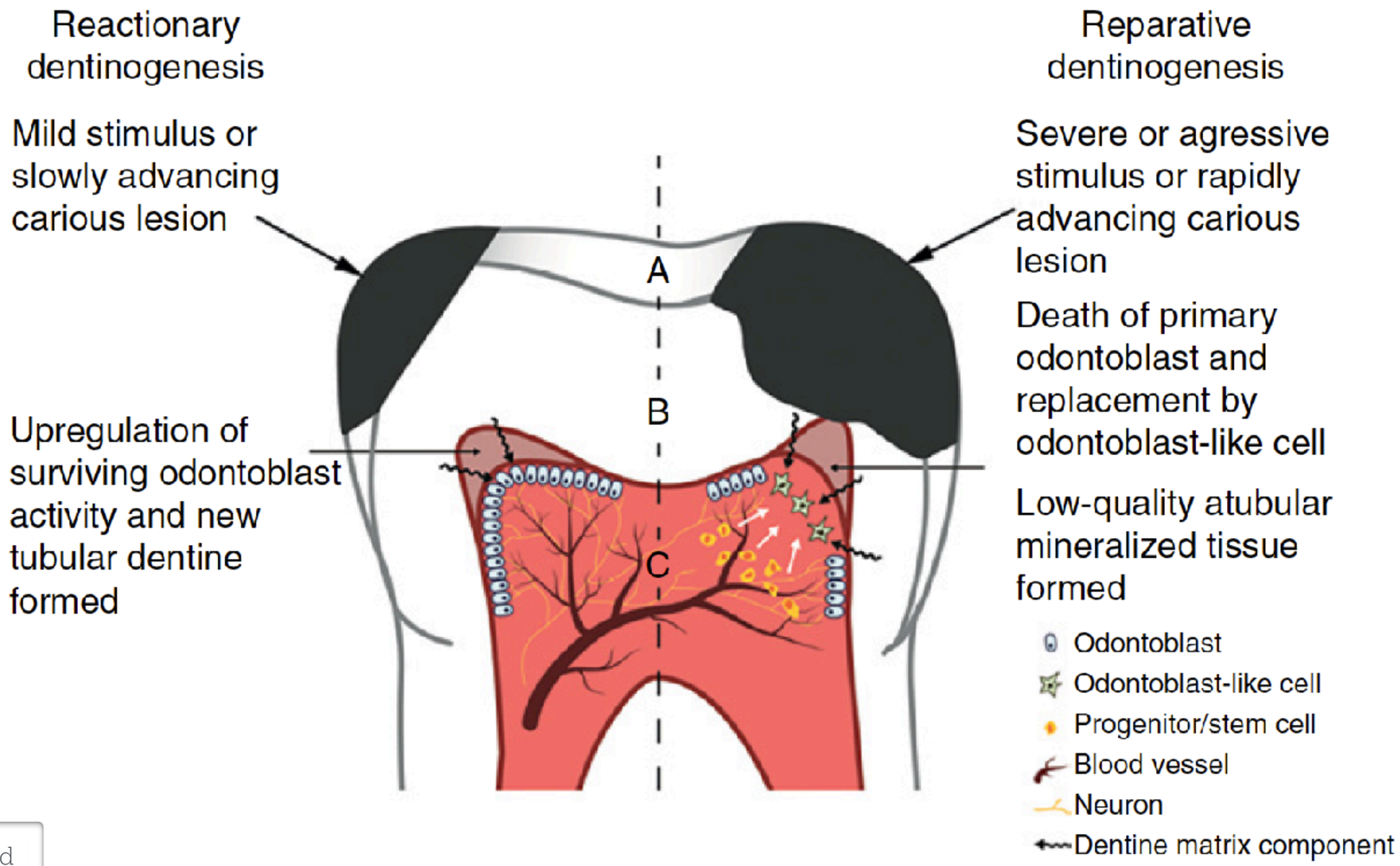
Nerves

Vasculature



Biological Basis of Vital Pulp Treatment

Healing Capability of Dental Pulp



Dr Mostafa Elkholy, BDS, MSc, Phd

Pulpal Diagnosis

The conundrum



What do we have?

Pulp ibility Te

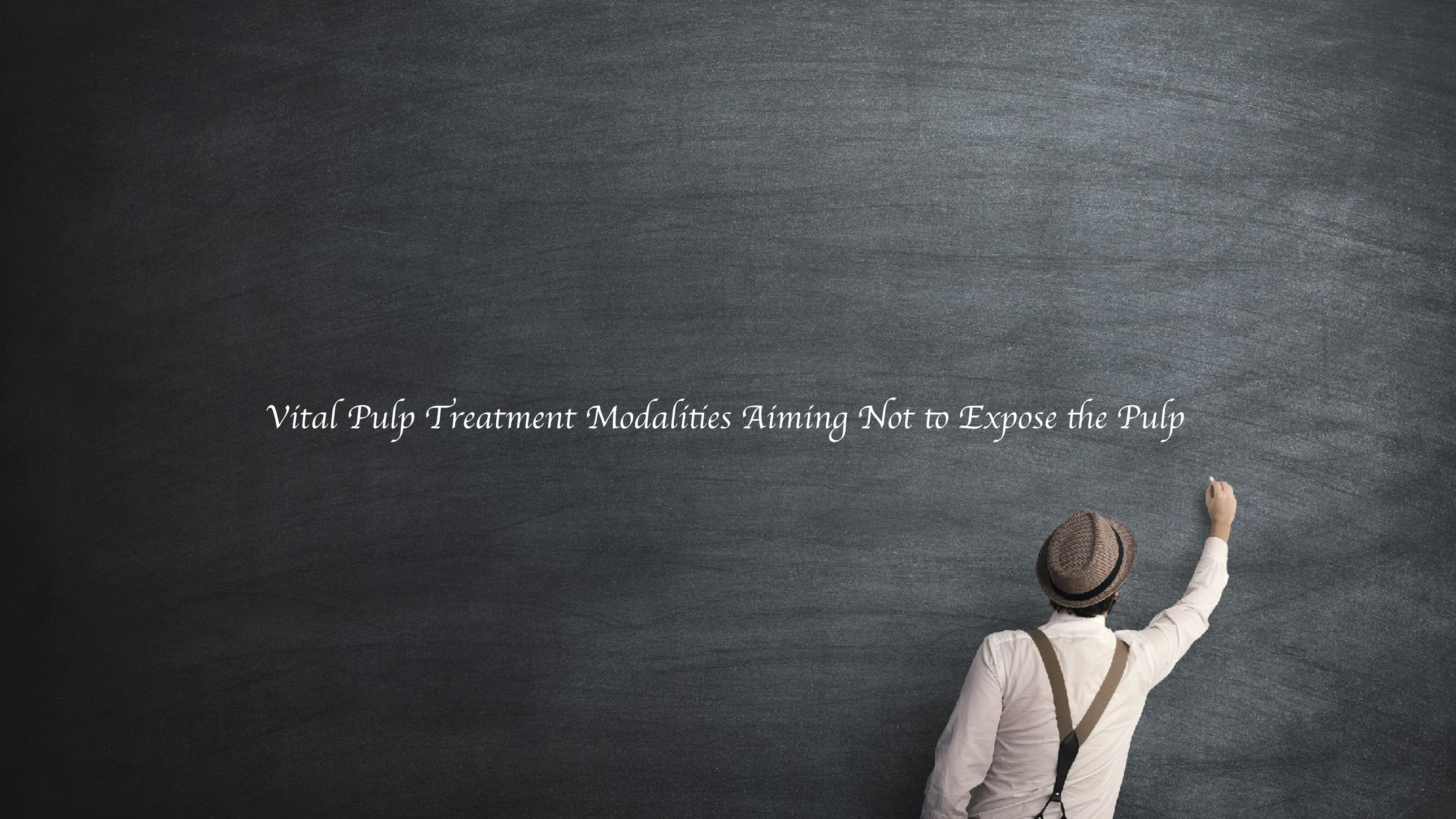
Pain ory

Cha er of pain

Signs & S toms

Dr Mostafa Elkholy, BDS, MSc, Phd

Vital Pulp Treatment Modalities Aiming Not to Expose the Pulp



Vital Pulp Treatment Modalities

Vital Pulp Treatment Modalities Aiming Not to Expose the Pulp

Non-selective caries removal

Complete removal of soft and firm carious dentine from the periphery and central aspects of the cavity until hard dentine is reached.

Selective caries removal

A collective name for several treatments: selective caries removal in one-stage and stepwise excavation

Adapted from the European Society of Endodontology

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Vital Pulp Treatment Modalities

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Selective caries removal

A collective name for several treatments: selective caries removal in one-stage and stepwise excavation

Selective caries removal in one-stage

Application of a biomaterial onto a dentine barrier in an indirect one-stage selective carious-tissue removal technique. Removal of soft or firm dentine. Immediate placement of a permanent restoration

Stepwise excavation

Application of a biomaterial in an indirect two-stage selective carious-tissue removal technique. Temporary restoration placement between visits and re-entry after 6–12 mo. The first stage involves selective carious removal to soft dentine to the extent that it facilitates proper placement of a temporary restoration, and the second stage involves removal to firm dentine – the final placement of a permanent restoration

Adapted from the European Society of Endodontology

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Indirect pulp capping

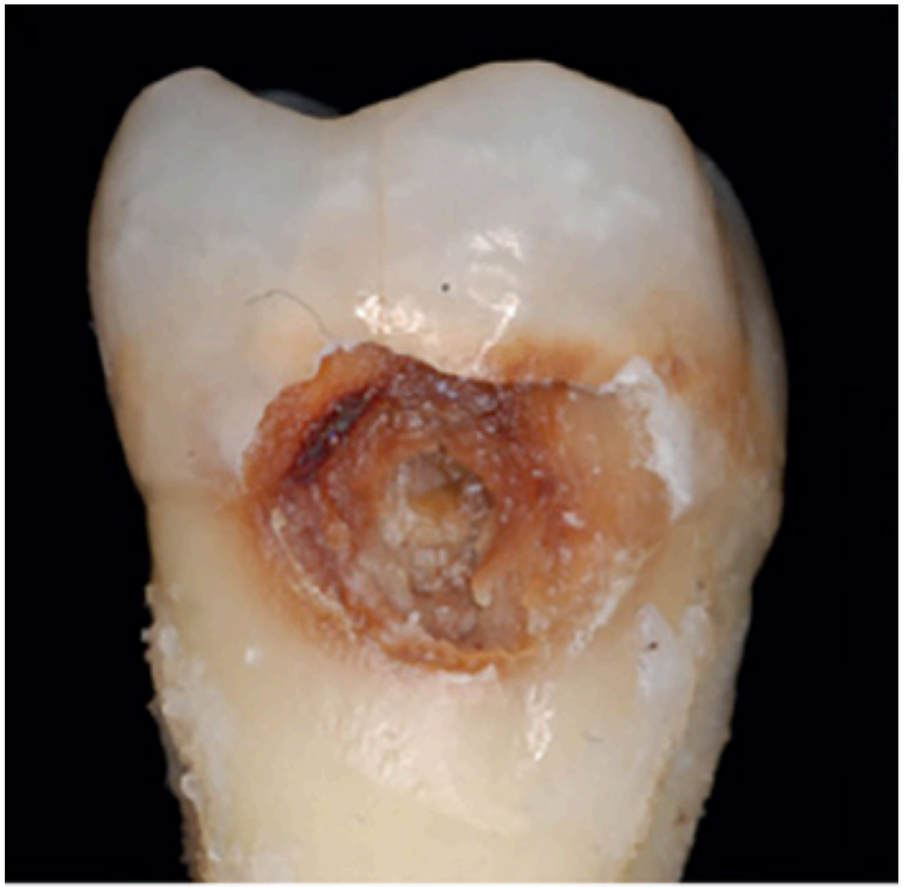
Application of a biomaterial onto a thin dentine barrier in a one-stage carious-tissue removal technique generally to hard dentine. Leaves neither soft nor firm carious dentine behind. Considered more aggressive than selective carious-tissue removal in one-stage and stepwise excavation. However, if the excavation is successful, pulp exposure is avoided. The problem is that the frequency of unintended exposures will be more frequent than for selective caries removal in one-stage or stepwise excavation.

Adapted from the European Society of Endodontology

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Caries Excavation

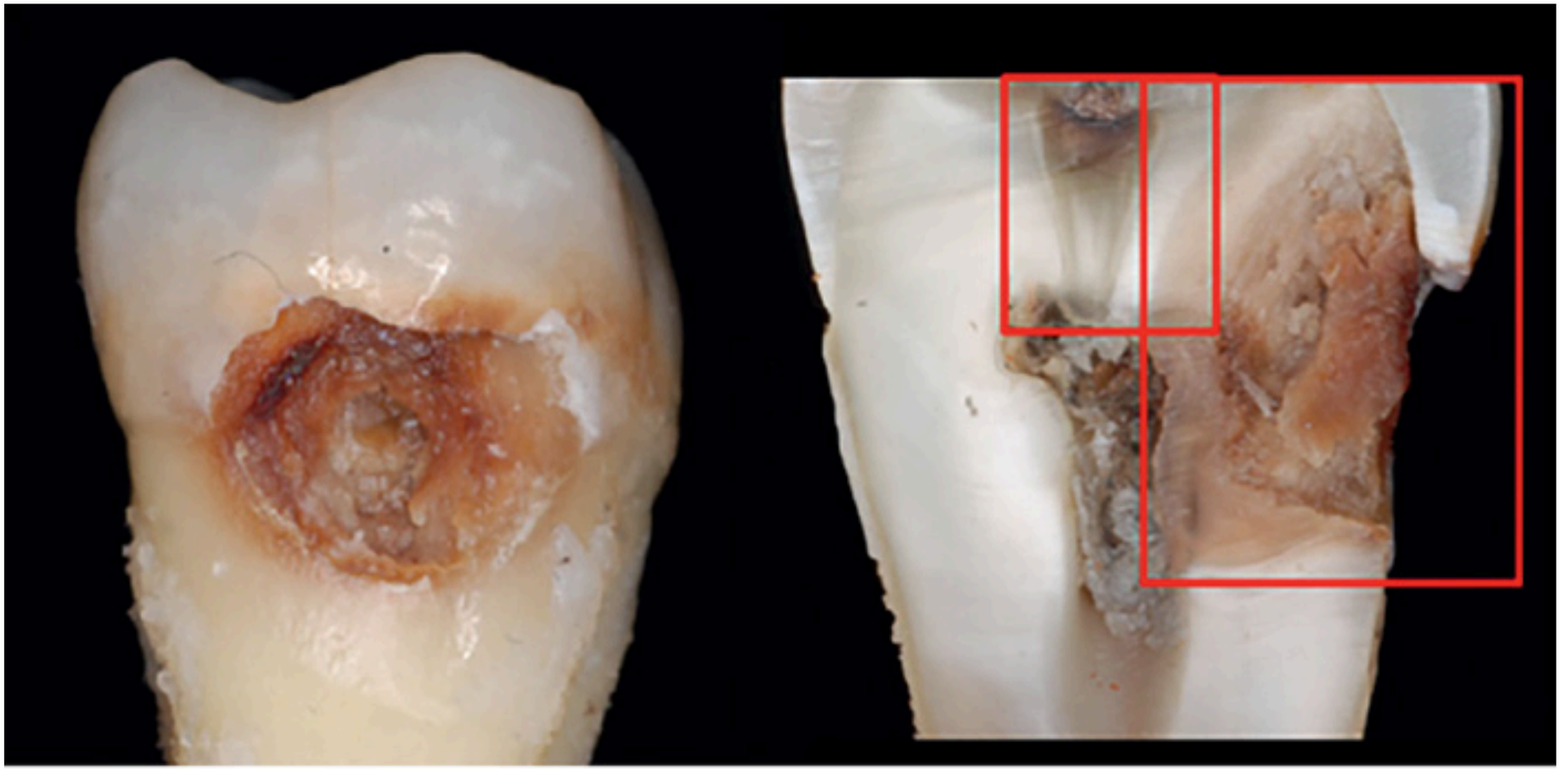


Source: John Wiley & Sons, Inc.

Vital Pulp Treatment Modalities

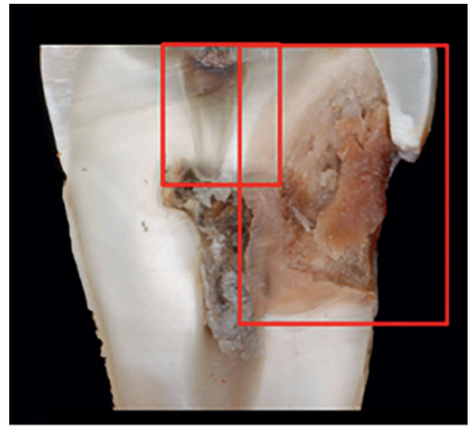
Vital Pulp Treatment Modalities Aiming Not to Expose the Pulp

Caries Excavation



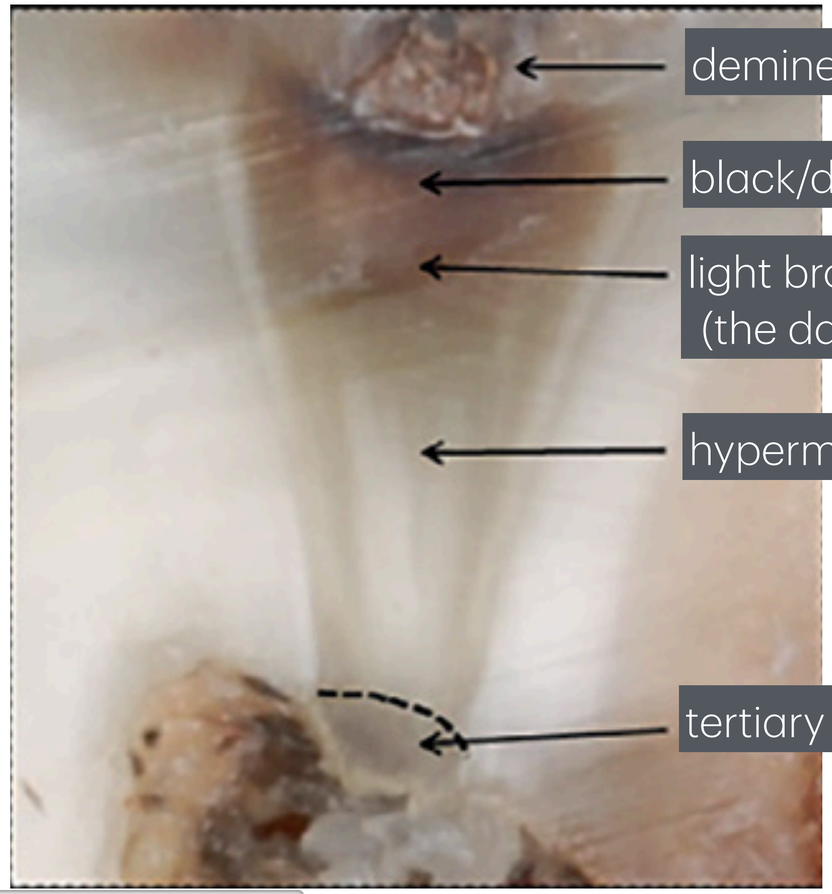
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Vital Pulp Treatment Modalities



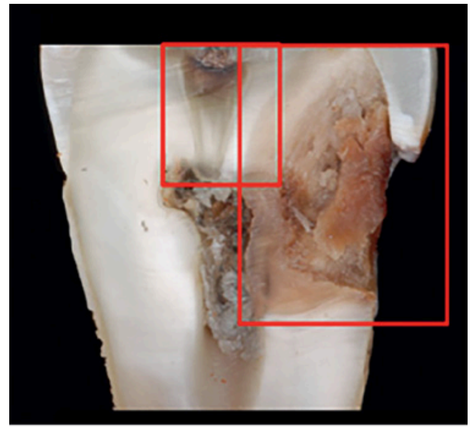
Vital Pulp Treatment Modalities Aiming Not to Expose the Pulp

Caries Excavation



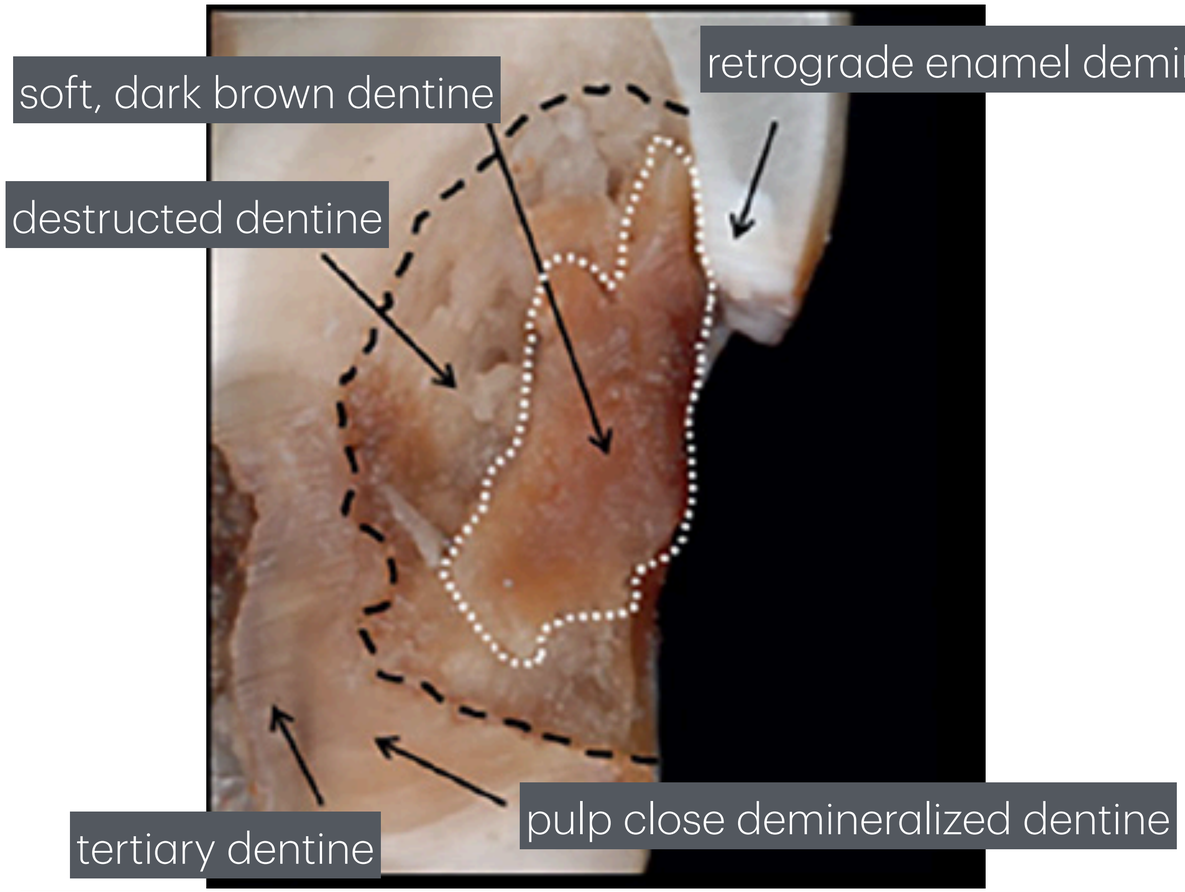
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Caries Excavation



Source: John Wiley & Sons, Inc.

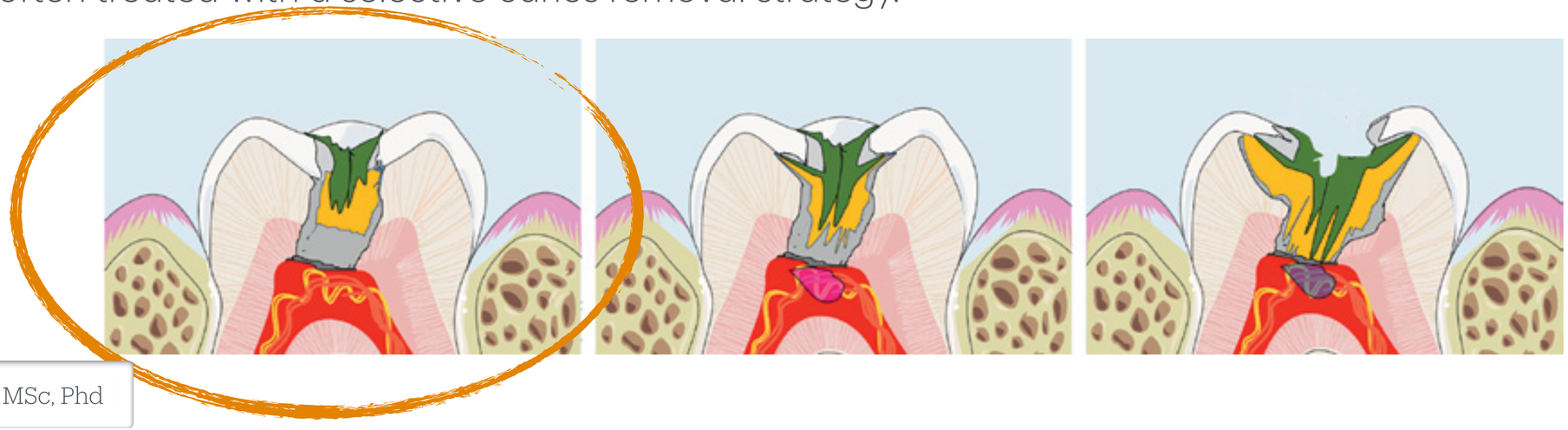
Vital Pulp Treatment Modalities

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Radiographic features: This stage is defined as a lesion penetrating 2/3–3/4 of the dentine, with a radiopaque zone separating the advancing front of the lesion and the pulp.

Histologic features: Microorganisms are located in the carious dentine. Evidence of chronic pulp inflammation, but not associated with invasion of microorganisms into the pulp cavity

Recommended treatment: Selective carious removal in one step to either soft or firm dentine. This particular lesion class is most often treated with a selective caries removal strategy.



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Radiographic features: This stage, described as deep caries, is defined as a lesion penetrating 3/4 or more of the dentine, but still with a radiopaque zone separating the advancing front of the lesion and the pulp.

Histologic features: Microorganisms are located in the carious dentine. Evidence of chronic pulp inflammation with a low probability of the presence of invading microorganisms in the pulp cavity.

Recommended treatment: Stepwise excavation . Evidence for selective carious removal in one step to either soft or firm dentine is available but mainly based on children and adolescent patients.



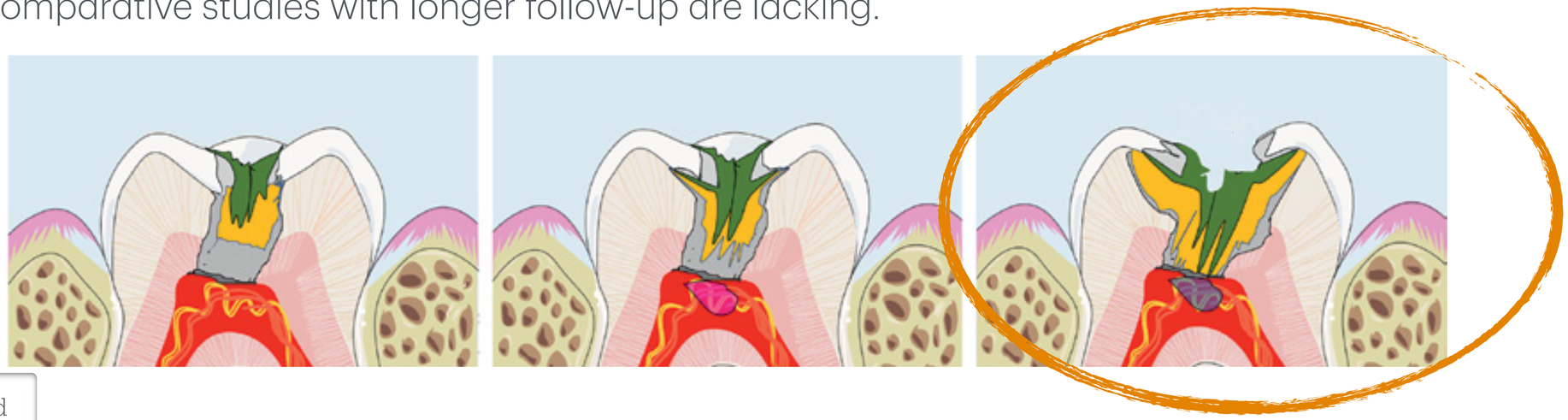
Vital Pulp Treatment Modalities

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Radiographic features: This stage, described as extremely deep caries, is defined as a lesion penetrating the entire thickness of the dentine without a radiopaque zone separating the advancing front of the lesion and the pulp.

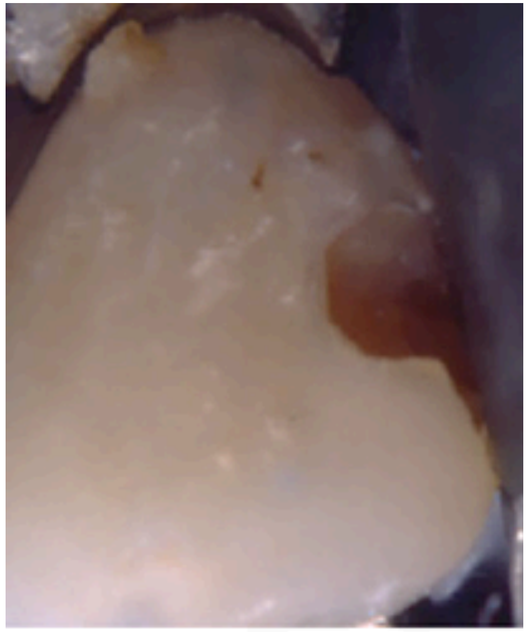
Histologic features: Microorganisms are located in the carious dentine, tertiary dentine and within the pulp cavity. The pulpal status includes severe inflammation associated with partial or full necrosis in the pulp cavity.

Recommended treatment: Pulpectomy or root canal treatment. Pulpotomy including partial pulpotomy may also be considered, but comparative studies with longer follow-up are lacking.



Vital Pulp Treatment Modalities

Vital Pulp Treatment Modalities Aiming Not to Expose the Pulp

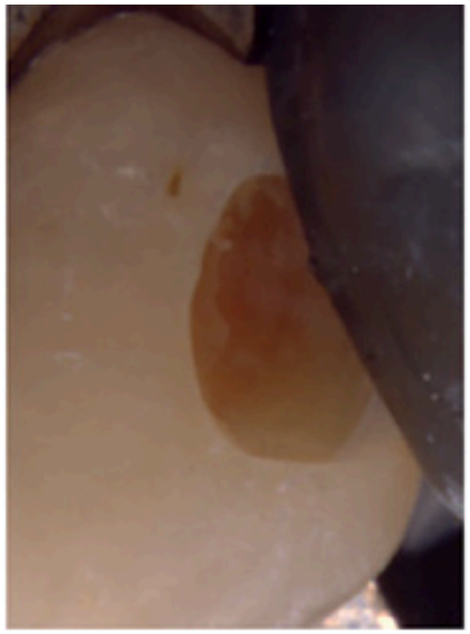


Approximal carious lesion in a maxillary canine planned for stepwise excavation

Lim ZE, Duncan HF, Moorthy A, McReynolds D. Br Dent J. 2023;234(4):233–40.

Vital Pulp Treatment Modalities

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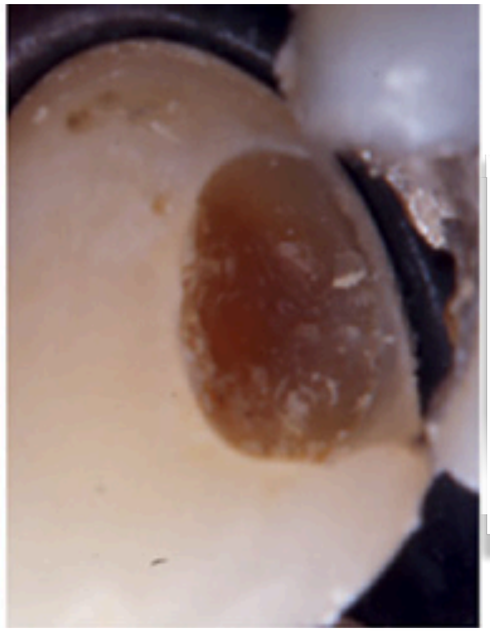


After the first stage selective carious removal to soft dentine to an extent that facilitates proper placement of a temporary restoration

Lim ZE, Duncan HF, Moorthy A, McReynolds D. Br Dent J. 2023;234(4):233–40.

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Vital Pulp Treatment Modalities Aiming Not to Expose the Pulp



following a treatment interval and removal of temporary restoration the retained dentine is darker reflecting lesion arrestment.

The periphery of the cavity should be excavated to hard dentine in order to facilitate the proper placement of a temporary restoration

Lim ZE, Duncan HF, Moorthy A, McReynolds D. Br Dent J. 2023;234(4):233–40.

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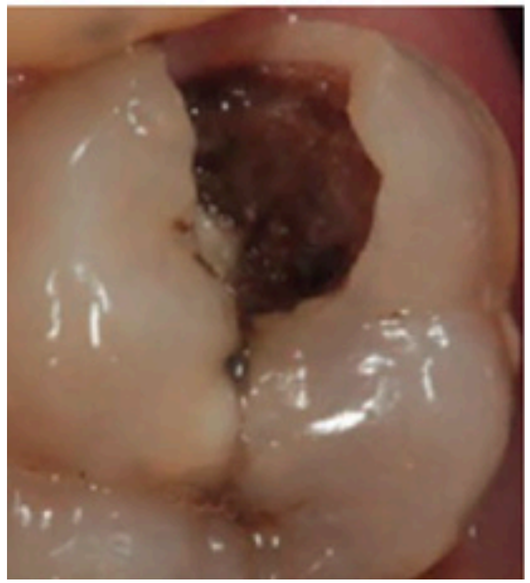


The carious lesion before treatment is categorized as a radiographically well-defined deep carious lesion penetrating to the pulpal quarter but with a radiopaque zone separating the carious lesion to the pulp

Lim ZE, Duncan HF, Moorthy A, McReynolds D. Br Dent J. 2023;234(4):233–40.

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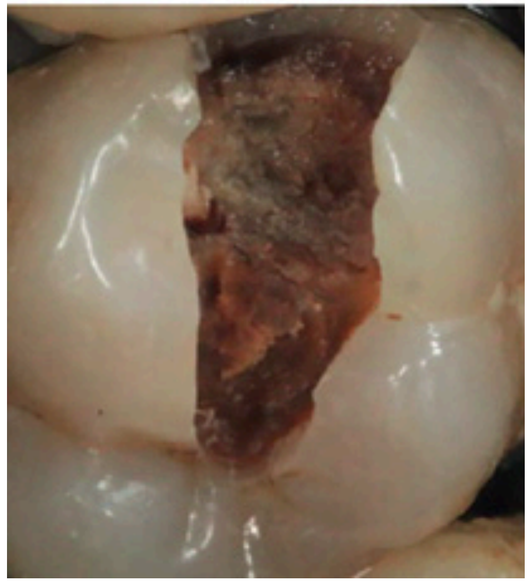


Maxillary molar with an open lesion environment planned for selective caries removal in one stage

Lim ZE, Duncan HF, Moorthy A, McReynolds D. Br Dent J. 2023;234(4):233–40.

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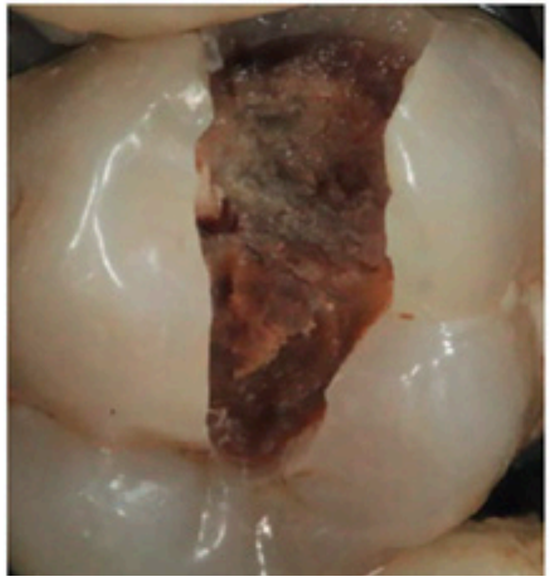


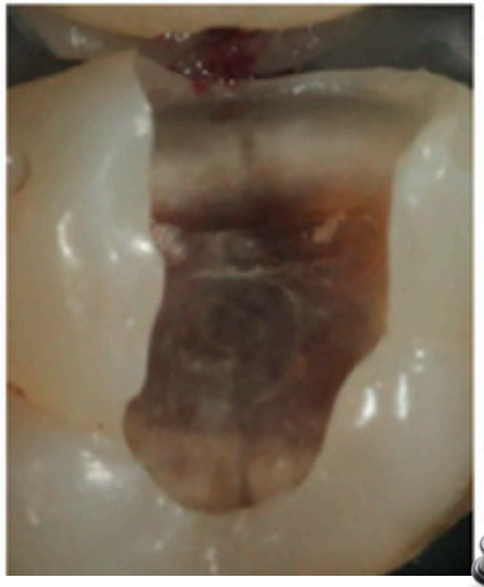
Parts of the overlaying enamel have been removed.
Note the outermost disintegrated carious dentine with a dark brown, dry and soft appearance.

Lim ZE, Duncan HF, Moorthy A, McReynolds D. Br Dent J. 2023;234(4):233–40.

Vital Pulp Treatment Modalities

Vital Pulp Treatment Modalities Aiming Not to Expose the Pulp





Completion of selective removal using burs and hand excavator to firm dentine.
The periphery of the cavity should be excavated to hard dentine in order to facilitate the proper placement of a temporary restoration

Lim ZE, Duncan HF, Moorthy A, McReynolds D. Br Dent J. 2023;234(4):233–40.

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The carious lesion before treatment is categorized as a radiographically well-defined carious lesion penetrating to the middle third of the dentine

Lim ZE, Duncan HF, Moorthy A, McReynolds D. Br Dent J. 2023;234(4):233–40.

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INTERNATIONAL ENDODONTIC JOURNAL

doi:10.1111/iej.13080

European Society of Endodontology position statement: Management of deep caries and the exposed pulp

European Society of Endodontology

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american association of endodontists

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AAE members may reprint this position statement for distribution to patients or referring dentists.

AAE Position Statement on Vital Pulp Therapy

About This Document
The following statement was prepared by the AAE Special Committee on Vital Pulp Therapy.

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Introduction

The American Association of Endodontists is dedicated to excellence in the art and science of endodontics and to the highest standards of patient care. The basis for endodontic treatment utilizes the best available evidence from scientific and clinical studies in concert with the accumulated clinical knowledge and judgment of the practitioner.

Dr Mostafa Elkholy, BDS, MSc, Phd

Vital Pulp Treatment Modalities

Vital Pulp Treatment Modalities Aiming Not to Expose the Pulp

How should we manage deep caries to avoid pulp exposure?

One-stage selective carious-tissue removal to soft or firm dentine (Maltz *et al.* 2012) and two-stage stepwise excavation (Bjørndal *et al.* 2017) are indicated in deep carious lesions when the tooth is asymptomatic or has signs and symptoms indicative of reversible pulpitis. Non-selective (complete) caries removal is no longer regarded the treatment of choice in deep carious lesions, with recent consensus considering it to represent overtreatment (Schwendicke *et al.* 2016).

These selective removal VPT approaches have demonstrated a 3-year success, defined as the absence of clinical symptoms and maintenance of pulp health, of 90% for one-stage selective removal and 70% for stepwise excavation (Maltz *et al.* 2012); however, within this study, many of the stepwise cases did not return for the second visit, making comparison

Caries Management

Complete caries removal is essential to eliminate infected tissues and visualize pulp tissue conditions under magnification when pulpal exposures occur.[19,20] Residual caries compromises necessary observations of pulpal inflammation levels and areas of potential necrosis. Accordingly, predictable management of vital pulp tissue should not be performed without complete removal of both demineralized enamel and infected dentin.

Hard or firm dentin and dentin below white spot enamel lesions is infected by bacteria in both active and arrested lesions. Specifically, histobacteriological studies have consistently shown the presence of chronic inflammatory cell infiltrates and subclinical pulp inflammation where carious tissues are retained, thus potentially compromising pulp vitality.[21,22] Additionally, adhesion of bonding resins to sound dentin

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Journal of Dental Research 91, 1026–31.

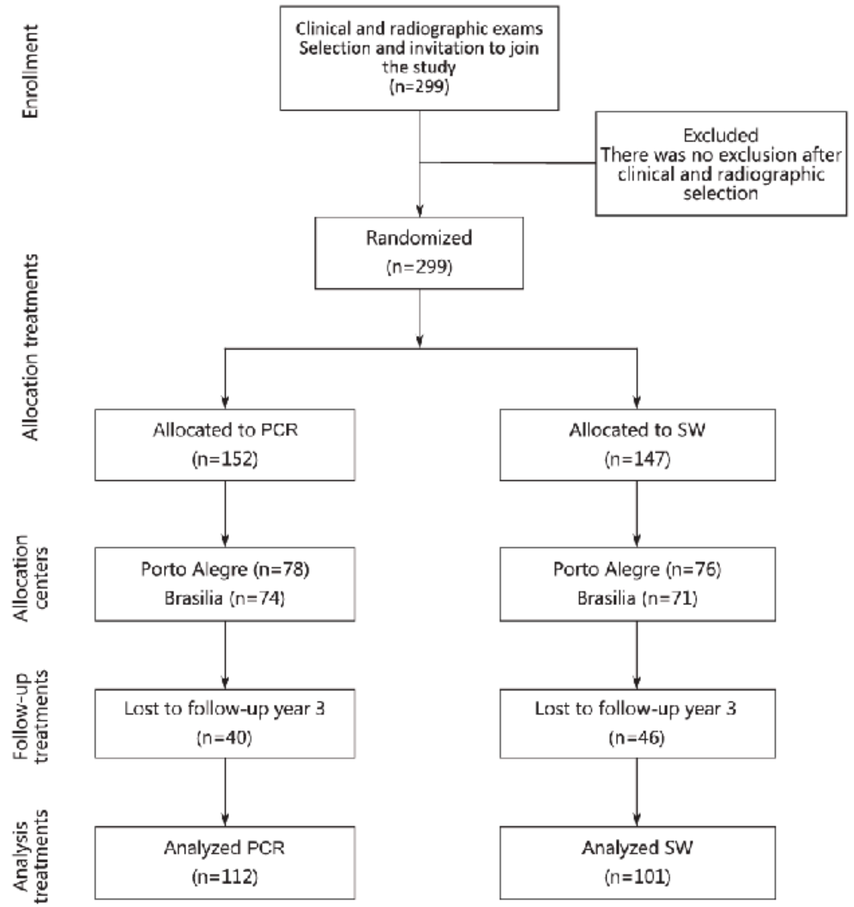
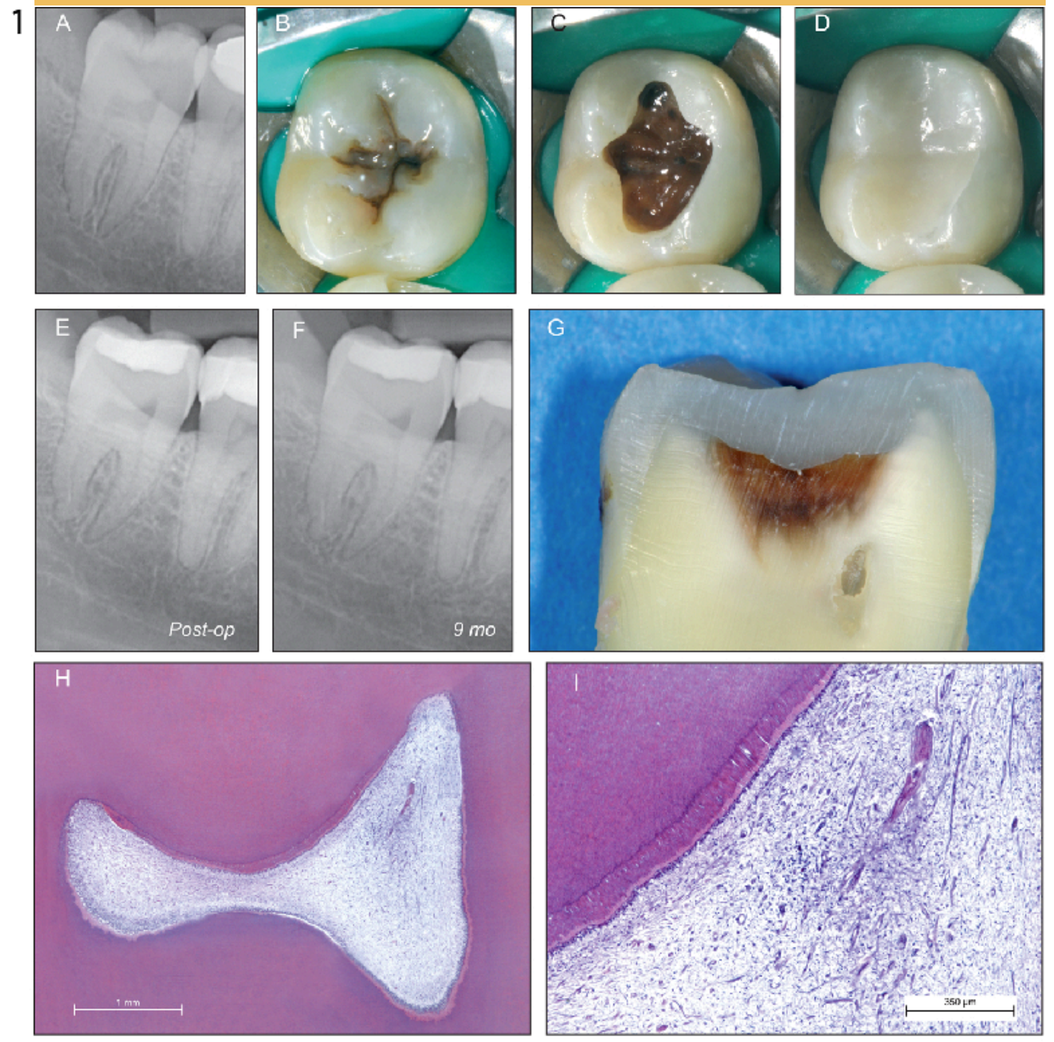


Figure 1. Participant flow and follow-up.

J Dent 2020 Sep:100:103430.



Vital Pulp Treatment M

Vital Pulp Treatment Modalities Aiming Not to Exp

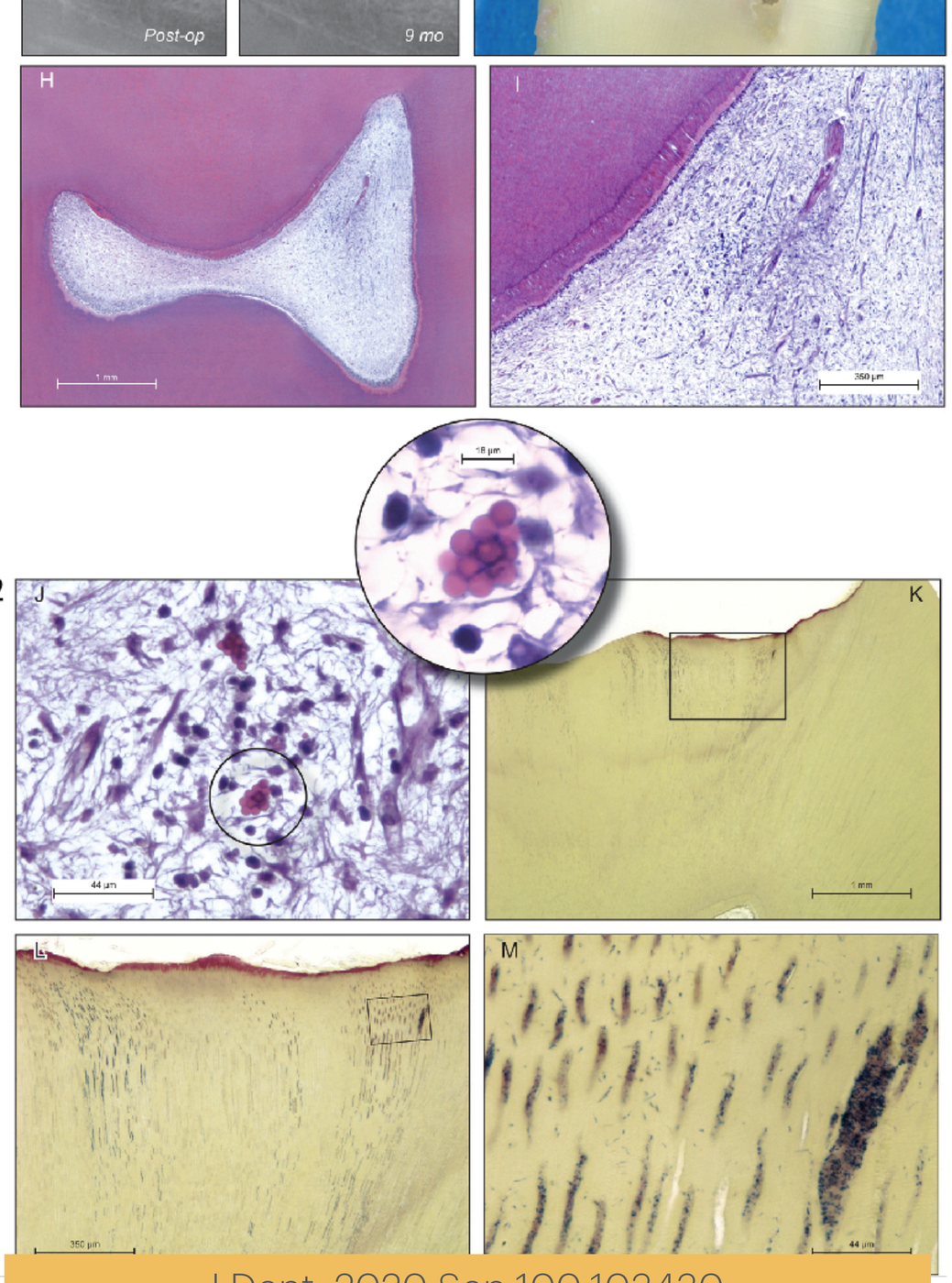
l SW
1)

Numbers Analyzed and Outcomes

In total, 213 teeth (112 that underwent PCR and 101 that underwent SW) were followed up at year 3. Results from the survival analysis for the Weibull regression are presented in Fig. 2A. At year 3, after adjustment for the other potential predictors, the success rates for each group were 91% and 69% for PCR and SW, respectively ($p = 0.004$). The causes of failure in the PCR group were pulpitis (4) and pulp necrosis (1). In the SW group, the causes of failure included pulpitis (11), necrosis (5), pulp exposure followed by endodontic treatment (2), osteitis (1), tooth extraction (1), and tooth fracture (1). The comparison of survival rates between teeth that had completed (84) and uncompleted SW (17) indicated 88% and 13% success rates, respectively ($p < 0.001$) (Fig. 2B).

Journal of Dental Research 91, 1026–31.

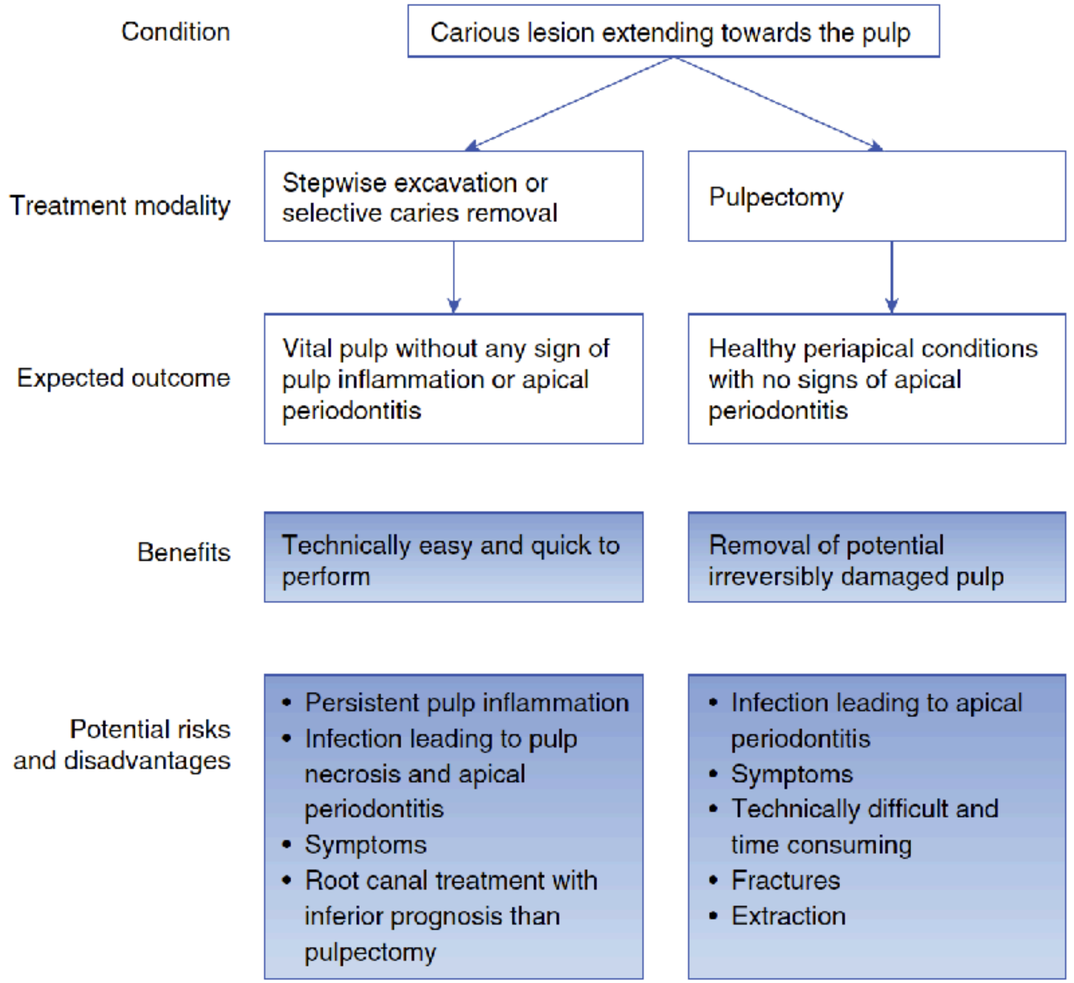
The Weibull regression model with individual level frailty was



J Dent 2020 Sep:100:103430.

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Outcome	Checked by
Pulp exposure during treatment	Visual inspection
Symptoms	Anamnesis
Pulp vitality	Sensate reaction to electrical and/or cold pulp test
Normal periapical conditions	Periapical radiograph
Restorative failure	Visual inspection, probing and bitewing radiograph

Vital Pulp Treatment Modalities

Vital Pulp Treatment Modalities Aiming Not to Expose the Pulp

- Non-selective caries removal
- Selective caries removal
  - Selective caries removal in one-stage
  - Stepwise excavation


[Audible Confusion]

Vital Pulp Treatment Modalities

Vital Pulp Treatment Modalities Aiming Not to Expose the Pulp

- Managing deep carious lesions is challenging because infected dentine cannot be objectively measured.
- It is not possible to monitor pulpal inflammation at the chairside based on patient symptoms or clinical findings.
- The term "deep carious lesion" lacks a clear definition.
- Traditional terms like "complete" and "partial" removal of carious tissue are imprecise and ambiguous.
- It is unclear whether "partial caries removal" refers to the removal of microorganisms or demineralized dentine.