Operative Dentistry

Lecture (10) Dr. Raghad Noori

Management of Deep-Seated Carious lesions

❖ Introduction

Dental pulp is a highly vascularized tissue of the tooth and has the potential to heal. It performs many functions throughout the life of tooth therefore, every effort should be made to maintain its integrity and vitality. In asymptomatic, vital teeth with deep lesions, strategies for conservative carious tissue removal which reduce tissue loss and pulp exposure risk have to be balanced against removing adequate tissue to maximize restoration longevity. The criterion used to guide carious dentin tissue removal is hardness, judged by tactile feedback during examination.

Also, asymptomatic vital teeth with very deep carious lesion that may lead to a potential pulp exposure, strategies to preserve the vitality of the tooth need to be implemented, these are called vital pulp therapy.

Vital pulp therapy Definition: is a restorative dental procedure that aims to treat teeth with compromised dental pulp without the full removal of all healthy pulp tissue.

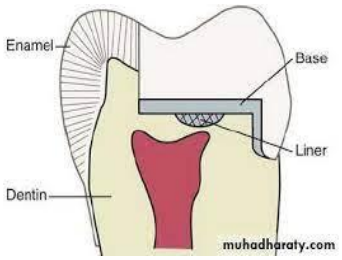
❖ Vital Pulp Therapy for Teeth Diagnosed with a Normal Pulp or Reversible Pulpitis

1. Protective liner:

A protective liner is a material placed on the pulpal surface of a cavity preparation, covering exposed dentin tubules, to act as a protective barrier between the restorative material or cement and the tooth's pulp. Placement of a liner and a protective base such as calcium hydroxide and glass ionomer cement are frequently used.

- ✓ **Indications:** In a tooth with a normal pulp, when dentin is exposed and all caries is removed during the preparation for a restoration, a protective radiopaque liner may be placed between the permanent restoration and the dentin to minimize thermal and chemical pulp injury, promote pulp tissue healing and induce reactionary dentin formation, or minimize postoperative sensitivity.
- ✓ **Objectives:** A protective liner is utilized to preserve the tooth's vitality, promote pulp tissue healing and tertiary dentin formation, and minimize

microleakage. Adverse post-treatment signs or symptoms such as sensitivity, pain, or swelling should not occur.



2. In direct pulp capping

Sir John Tomes stated in 1859 that 'It is better that a layer of discolored dentine be allowed to remain for the protection of the pulp rather than run the risk of sacrificing the tooth.' He had observed that discolored and demineralised dentine could be left behind in deep cavities of the tooth before restoration, often with highly satisfactory results. To achieve indirect pulp protection, carious dentine near the pulp is preserved in order to avoid pulp exposure and is covered with a suitable material. This is especially applicable if exposures of the pulp are suspected in teeth with deep carious lesions, where the carious lesion extending to ¾ of dentin thickness on the radiogragh. The removal of this dentine may lead to exposure of the pulp, thus impairing its prognosis.

It has been shown that demineralised dentine, if it is free of bacteria, will remineralise once the source of the infection has been eliminated. The diagnosis of the presence of demineralised dentin that is bacteria-free can be assisted by using a caries disclosing solution. However, it has been shown that using these disclosing solutions may stain deep dentin layer close to the pulp resulting in over excavation. The placement of a suitable material directly on this demineralised dentin is commonly called indirect pulp capping (IPC) or indirect pulp protection.



➢ Methods of carious tissue removal to perform IPC procedure:

The step of partial removal of carious dentine, leaving bacteria-free demineralized dentine is called selective carious tissue removal. Studies found that the selective removal of the heavily infected dentine biomass while retaining affected dentine, shows favorable results in terms of tooth vitality preservation. Selective carious tissue removal can be performed either by incomplete caries removal with no subsequent re-entry (one visit) or stepwise caries removal with subsequent re-entry (two visits). Both techniques resulted in fewer numbers of pulp exposure. The difference between them is that in the one step incomplete caries removal, there is no subsequent reopening of the cavity after 3-6 months. In stepwise caries removal, there is a second entry to the cavity to remove the remaining soft affected dentine completely.

✓ Material used for IPC

1) This can be achieved with the placement of an antibacterial liner such as calcium hydroxide, MTA, Biodentine, or zinc oxide–eugenol cement, which is aimed at stimulating secondary dentine formation.

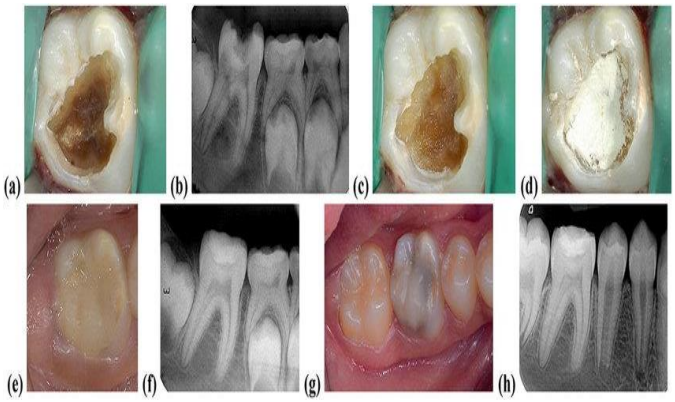
2) With the advent of adhesive dental materials, another possible restorative option is the placement of calcium hydroxide, MTA, Biodentine followed by an adhesive base such as glass–ionomer or resin modified glass–ionomer cement. The aim is to provide a combination of an antibacterial barrier and an adhesive seal against the further ingress of bacteria.

✓ Indication of IPC:

1) When there is a radiographically evident deep carious lesion encroaching on the pulp.
2) Tooth has no history of spontaneous pain.
3) Tooth responds normally to vitality test.

✓ Procedure of stepwise carious tissue excavation and IPC:

1. Field must be isolated with rubber dam isolation to minimize bacterial contamination of the treatment site.
2. All peripheral carious dentin is removed with large round bur or spoon excavator.
3. Area adjacent to the pulp is debrided off only the soft carious dentin.
4. CaOH2 and ZOE — type liners Placed.
5. Base or adhesive cement applied over the lining for complete sealing
6. After 3-6 months or more Cement removed.
7. Internal surface of the cavity inspected for remineralization and hard dentin formation.
8. Remove any residual soft dentin.
9. Permanent restoration applied.



3- Direct Pulp Capping

Direct pulp capping can be described as the dressing of an exposed pulp with the objective of maintaining pulp vitality.

✓ **Indications for pulp capping include:**

1. Teeth with recent (24 h) traumatic exposures or mechanical non-carious exposures during cavity preparation.
2. Pulp capping should be considered only for immature permanent teeth, or for mature permanent teeth with simple restorative needs.
3. Mature teeth with inflamed pulps, as with carious pulp exposures, should not be pulp capped.
4. Pre-operative tooth sensitivity frequently has been mentioned as a contraindication to Pulp capping.

✓ **Requirements for a successful direct pulp therapy**

Direct pulp therapy has a high success rate if the following conditions are met:

(1) The pulp is not inflamed; i.e. signs and symptoms not of irreversible pulpitis.

(2) Hemorrhage is properly controlled; Various methods have been proposed to achieve pulpal hemostasis, including mechanical pressure with a sterile dry cotton pellet, or with one soaked in saline, hydrogen peroxide, sodium hypochlorite, in concentrations of 2.5%, 3%, or 5.25%, is a biocompatible and effective solution for achieving hemostasis before pulp capping and the disinfectant chlorhexidine also has been described as an effective hemostatic for pulp capping

(3) A non-toxic capping material is applied; traditionally, calcium hydroxide has been the most common direct pulp-capping agent. Calcium hydroxide is antibacterial and disinfects the superficial pulp. MTA and Biodentine can be used for direct pup capping.

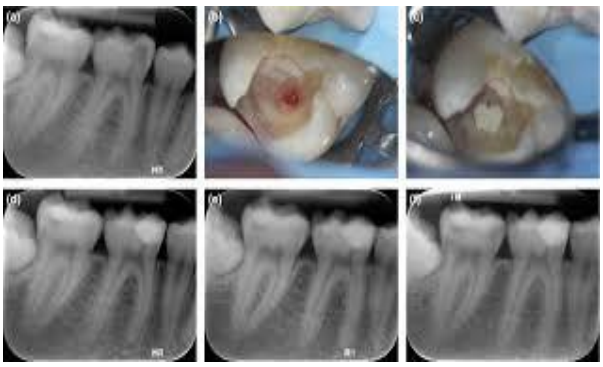
➢ **A major disadvantage of calcium hydroxide materials**

1. They do not seal the exposed pulp from the external environment. Therefore, an additional base material, such as a resin-modified glass ionomer, can be placed to help seal the pulp against bacterial ingress during the healing phase.
2. Dentin bridges beneath calcium hydroxide pulp caps contain 'tunnel defects' that leave the pulp open to recurring bacterial infection via microleakage. In comparison to MTA, which help to form dentin bridge that is free of tunnel defects.
3. Calcium hydroxide materials tend to soften, disintegrate, and dissolve over time, leaving voids and other potential pathways for bacterial infiltration.

☒ **MTA** is a dimensionally stable material that don't dissolve and can provide good barrier against ingress of fluids and bacteria. However, various other materials, including zinc oxide eugenol, glass ionomers, resin adhesives have been proposed as capping agents for vital pulp therapy, but MTA is an alkaline material that stimulates dentinal bridging and appears to have particular promise as a pulp-capping material.

✓ **Technique:**

1. After adequate anesthesia has been obtained, place a rubber dam and disinfect the tooth with a chlorhexidine solution and gently rinse with anesthetic or sterile saline. If any hemorrhage occurs, dab with a sterile cotton pellet until hemorrhage ceases. As noted previously, a sodium hypochlorite or chlorhexidine solution may be used to aid in hemostasis.
2. Mix pure calcium hydroxide with sterile water, saline, or anesthetic solution, and apply directly to the exposure site. A hard-setting calcium hydroxide liner also can be used, and is preferable if the pulp is small.
3. Next, apply and light-cure a resin modified glass ionomer base/liner material such as to protect the calcium hydroxide dressing and to provide a better seal.
4. Finally, use a good temporary and wait for 4 - 6 weeks for final restoration.



✓ **Recall**

The tooth should be evaluated using electrical pulp testing (EPT), thermal testing, and palpation and percussion tests at 3–4 weeks, 3 months, 6 months, 12 months, and every year thereafter. Periodic radiographs are needed to detect the presence of periapical radiolucencies, and for immature teeth, continued development of the root. Hard tissue barriers sometimes can be seen at the treated exposure site as early as 6 weeks after treatment.

✓ **Prognosis**

The success of the pulp-capping procedure relies on the ability of calcium hydroxide to disinfect the superficial pulp and dentin and to initiate necrosis of the superficial inflamed pulp. The quality of the bacteria-tight seal provided by the base, bonding system, and restoration is also of critical importance. The reported prognosis for direct pulp capping is in the range of 80% when performed under ideal conditions, that is, on an uninflamed pulp and with a good coronal seal.

4. Partial pulpotomy

The phrase 'partial pulpotomy' or 'Cvek pulpotomy' describes removal of inflamed pulp tissue to the level of healthy coronal pulp. A sterile diamond rotating at high speed under copious water spray is used to surgically excise inflamed pulp tissue. The excision is considered complete when the pulp stump no longer bleeds excessively. The rationale for the Cvek pulpotomy is this: if the inflamed tissue is removed, the healthy underlying tissue is more likely to remain healthy and to seal the exposure with hard tissue bridging of the exposure site. Of course, the other requirements for successful pulp capping, such as hemostasis and a bacteria-tight seal, are met. Pulpotomies have been used routinely in treatment of primary and young permanent teeth after traumatic pulp exposures, but their use in mature permanent teeth is a relatively new concept, and is considered unproven for carious exposures.

✓ **Indications**

Indications for a partial pulpotomy are similar to those for direct pulp capping. As with simple direct pulp capping, an immature permanent tooth or a mature permanent tooth with uncomplicated restorative needs is preferable. The partial pulpotomy should be selected as an alternative to direct pulp capping when the extent of pulpal inflammation is expected to be greater than normal.

✓ **Technique**

1. Accomplish anesthesia, isolation, and surface disinfection is described in the section on direct pulp capping.
2. At the exposure site, remove 1–2mm of the superficial pulp tissue using a sharp, sterile diamond rotary instrument. The diamond should be running at very high speed with copious water spray.
3. If excessive bleeding continues, extend the preparation apically. Remove any excess blood by rinsing with sterile saline or anesthetic solution and

dry with a sterile cotton pellet. If the pulp tissue show optimal condition (vascular non bleeding tissue), then stop cutting of pulp tissue.

4. As described previously, sodium hypochlorite or chlorhexidine can be used to facilitate hemostasis. Take care to avoid formation of a blood clot, which compromises the prognosis.
5. Mix and apply a thin layer of pure calcium hydroxide. If the pulp is not large enough to accommodate any further loss of tissue, mix and apply a hard-setting calcium hydroxide liner such as Dycal.
6. As in teeth with conventional direct pulp caps, place an appropriate resin-modified glass-ionomer liner or base, a dentin/ enamel adhesive, and restorative material.

✓ **Recall**

Schedule follow-up examinations, using the time intervals and procedures described for pulp capping.

✓ **Prognosis**

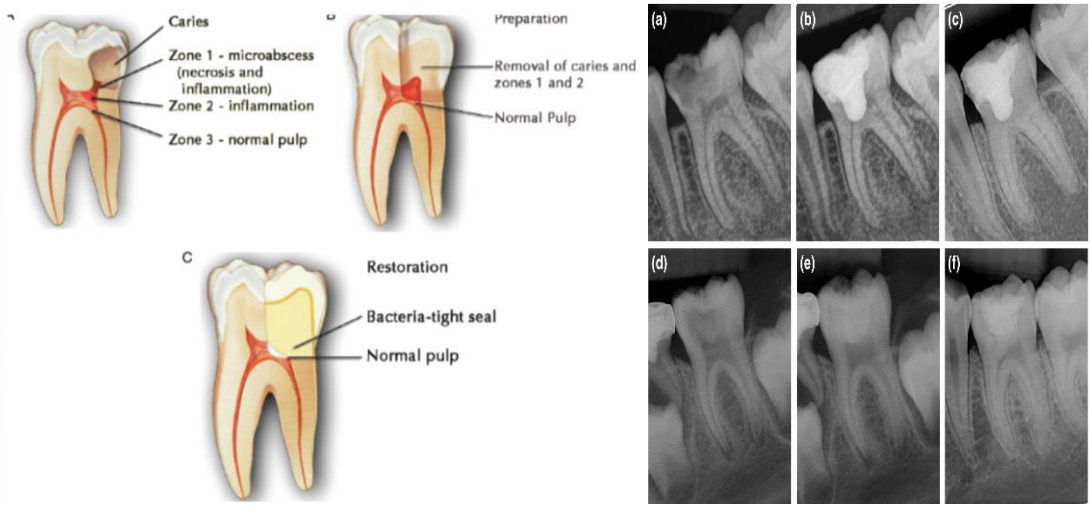
The partial pulpotomy offers several advantages over direct pulp capping.

a) Superficial inflamed pulp tissue is removed during preparation of the pulpal cavity.

b) Calcium hydroxide disinfects the pulp and dentin and removes additional inflamed pulp tissue.

c) In addition, the pulpotomy provides space for the materials required to provide the requisite bacteria-tight seal.

The prognosis for success of partial pulpotomies is in the range of 95%. However, this success rate is for traumatized teeth where the level of pulpal inflammation is very predictable. The success rate for treatment of carious exposures is unknown currently.



5. Full pulpotomy

A ‘full pulpotomy’ involves removal of the entire coronal pulp to the level of the root canal orifice(s).

✓ Indications

The indications for a full pulpotomy are similar to those for a partial pulpotomy, except that the pulp in question is likely to have more extensive inflammation, if the coronal pulp is rather small in size.

✓ Technique

a) The technique for a full pulpotomy is similar to that of the partial pulpotomy, except that the entire mass of coronal pulp tissue is removed, normally to the canal orifices.
b) The tissue is capped with calcium hydroxide in a manner similar to partial pulpotomy.

✓ Recall

Recall evaluations are performed at the same intervals recommended for a tooth treated with a direct pulp cap or partial pulpotomy.

