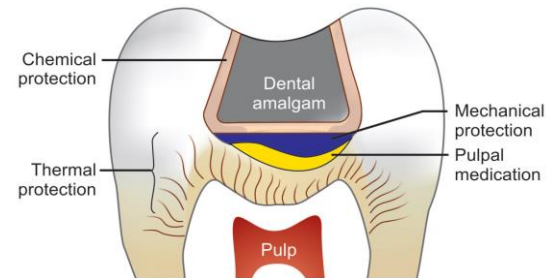


Dental Cements; liner materials

Dental cements have been widely used in various clinical applications since the early twentieth century. They are used as filling materials, protective cavity liners, luting materials for crowns, bridges, inlays and orthodontic appliances, root canal fillings, and pulp capping. Various types of cements are available for different purposes. Dental cements are mainly used to provide protection to the pulp against irritants as the following:

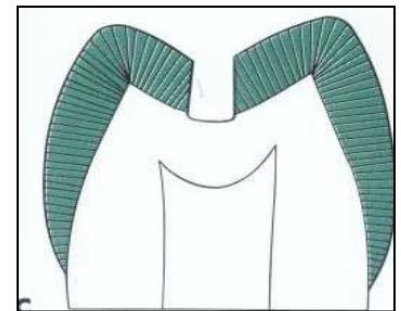
1. Thermal protection against temperature changes.
2. Electrical protection against galvanic currents.
3. Mechanical protection during various restorative procedures.
4. Chemical protection from toxic components.
5. Protection from microleakage interface between tooth and the restoration.



Pulp Protection in Shallow and Moderate Carious Lesions

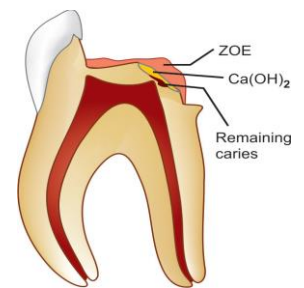
There is no need for pulpal protection, there is a sufficient thickness of dentin. For dental amalgam the cavity is coated with amalgam bond or two thin coats of a varnish and restored. For a composite the cavity is etched, coated with a bonding agent and restored. Both varnish and the bonding system provide chemical protection.

In a moderate carious lesion, caries penetrates the enamel and may involve one half of the dentin, but not to the extent of endangering the pulp. In these cases, to protect the pulp, Varnish is used to coat the floor and walls, then cement base such as zinc phosphate cement, or modified ZOE cement is placed over it. After the base material hardens, permanent restoration is done.



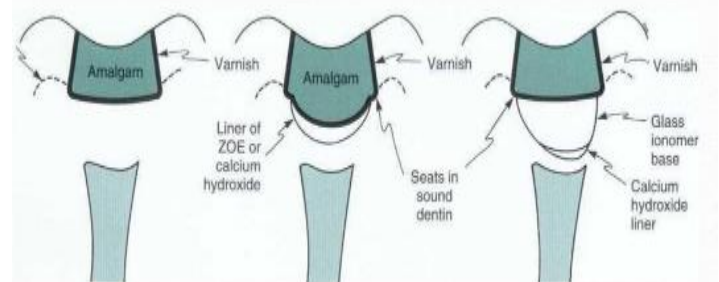
Pulp Protection in Deep Carious Lesions

In deep carious lesion, caries can reach very near or up to the pulp, a liner such as Ca (OH)₂ should be applied on the pulpal and axial walls. On top a cement base is placed such as zinc phosphate cement, or modified zinc oxide euogenol cement or poly carboxylate cement then a varnish is used to coat the walls.



Showing methods of pulp protection under different restorative materials

Types of restoration	Shallow (RDT > 2.0 mm)	Moderately deep (RDT > 0.5–2 mm)	Deep (RDT < 0.5 mm)
Silver amalgam	Varnish	Base, e.g. zinc phosphate, zinc polycarboxylate	Calcium hydroxide as sub-base covered with base
Glass ionomer cement	Not required	Not required	Calcium hydroxide as liner
Composite resins	Dentin bonding agent	Dentin bonding agent	Calcium hydroxide as liner followed by glass ionomer as base
Cast gold restorations		Base	Calcium hydroxide as liner with base over it



Materials Used For Pulp Protection:

Different types of materials are used for pulp protection. These materials help to:

1. Insulate the pulp.
2. Protect the pulp in case of deep carious lesion.
3. Act as barriers to microleakage.
4. Prevent bacteria and toxins from affecting the pulp.

Classification of Pulp Protective Agents:

1. Cavity sealers:
 - a. Varnish.
 - b. Resin bonding agents.
2. Liners.
3. Bases.



1.a. Varnish

Varnish is an organic copal or resin gum suspended in solutions (solvents) of ether or chloroform. When applied on the tooth surface the organic solvent evaporates leaving behind a protective film. Two coats of varnish are applied using a small cotton pellet for sufficient wetting of cavity walls.

Advantages:

1. It is used to reduce microleakage.
2. In case of amalgam restoration, varnish improves the sealing ability of the amalgam
3. Reduces postoperative sensitivity
4. Prevents discoloration of tooth by checking migration of ions into the dentin.

Indications for use of varnish

1. To seal the dentinal tubules
2. To act as barrier to protect the tooth from chemical irritants from cements
3. To reduce microleakage around restorations.



Contraindications:

1. Use of varnish is contraindicated under glass ionomers as it interferes the bonding of tooth to these cements.
2. With restorative resins varnish is not used because the varnish liners dissolve in the monomer of the resin and it also interfere the polymerization of resins.

1.b. Resin Bonding Agents

An adhesive sealer is commonly used under composite restorations. For application, cotton tip applicator is used to apply sealer on all areas of exposed dentin.

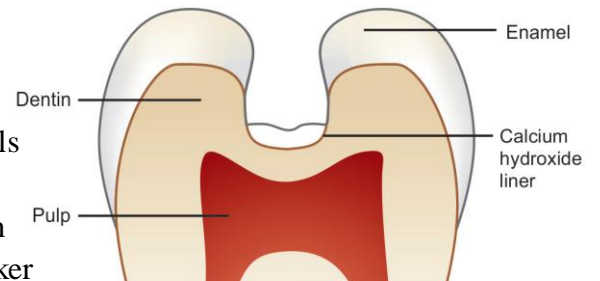


Indications:

1. To seal dentinal tubules
2. To treat dentin hypersensitivity.

2. Liners

Linners are materials that, because of their rheology, can adapt more readily to all aspects of a tooth preparation. They can be used to create a uniform, even surface that aids in adaptation of more viscous filling materials such as amalgams or composites. Liners usually do not have sufficient thickness, hardness and strength to be used alone in the deep preparation. Liners should not be used in layers thicker than 0.5 mm.



Indications of use of liners

1. To protect pulp from chemical irritants by sealing ability.
2. To work as electrical insulation.
3. To stimulate formation of reparative dentin.

Materials used as Liners:

1. Zinc oxide eugenol liners:

Zinc oxide eugenol liners are composed of:

- 1. Powder:** Zinc oxide with the addition of white rosin to reduce the brittleness of the set cement, and zinc acetate to improve the strength of the cement.
- 2. Liquid:** eugenol with olive oil as a plasticizer.



In order to improve the strength the cement, the following materials are added:

- 1- Methyl methacrylate polymer is added to the powder.
- 2- Alumina (AL₂O₃) is added to the powder.
- 3- Ethoxy benzoic acid to the liquid.

Properties:

1. Eugenol is used to alleviate pain from mild-to-moderate inflammation of pulp.
2. Neutral in PH (7) can be safely used in moderately deep cavities.
3. In high concentration, it acts as chemical irritant.
4. It should not be used under composite restorations as it inhibits polymerization of bonding agent and composite.
5. The average setting time is around 8 minutes.
6. Radio-opaque.

Uses:

1. Used as temporary restoration.
2. Used as an endodontic sealer.

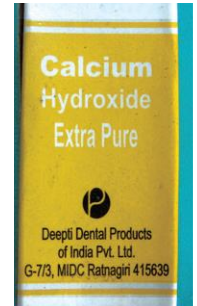
3. Used as a crown and bridge cementation and as cement base materials.

2. Calcium hydroxide:

It is a most common used liner material, it found in markets under different industrial names, such as: calcipulp, dycal, hydrox.

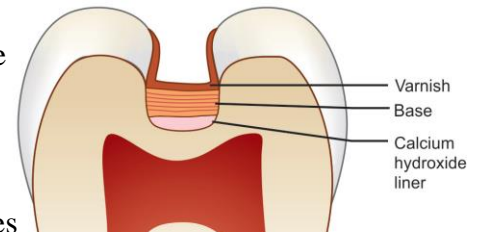
Calcium hydroxide is available in:

1. Powder form.
2. Quick setting paste form (Dycal).



Properties:

1. It stimulates reparative dentin formation (stimulate the formation of dentinal bridge).
2. It forms a mechanical barrier, when applied to dentin.
3. Because of high Alkaline pH (11-13), it neutralizes acidity of silicate and zinc phosphate cements.
4. Biocompatible in nature
5. Bactericidal in nature.
6. A resin has been added to calcium hydroxide to improve its properties (improve thermal and mechanical properties, reduce solubility) and the setting is performed by light curing.
7. The average setting time is short and about 1-2 minutes.



Uses:

1. Used as a liner.
2. Used in indirect pulp capping.
3. Used in direct pulp capping.
4. Used in root fractures, root resorption and open apices.
5. Used to treat perforations (bifurcation or apex perforations).

Limitations:

1. Low strength.
2. High solubility.

Mixing calcium hydroxide cement:

1. Before placement of calcium hydroxide, check the dentin surface (it should be moist). Dispense 1 mm of base and 1 mm of catalyzer onto the mixing pad.
2. For mixing the two pastes, use either the calcium hydroxide applicator or spoon excavator. Mixing should be done for 10 to 15 seconds until a uniform color is achieved. Take a small amount of the calcium hydroxide, place it in the deepest portion of the tooth preparation.
3. Check the setting of calcium hydroxide using the tip of an explorer with minimal pressure. There should be no indentation.

3. Flowable composites:

They are primarily used under composite restorations and in crown and bridge preparations to block out undercuts prior to impression taking.

Advantages

1. Adaptation to preparation walls because of their flow.
2. Placement ease.
3. Esthetic.
4. Consistency.

Disadvantages

1. Technique sensitive.
2. Requires maintenance of contamination free field.
3. Polymerization shrinkage can result in gap formation at resin-tooth interface.



4. Glass ionomer cements (GIC):

Advantages

- Bond to tooth structure
- Anticariogenic
- Act as a thermal barrier
- Easy to use.

Uses:

1. Used as liner materials.
2. Used as base materials.
3. Used as pit and fissure sealant.
4. Used as filling (especially in primary teeth).
5. Used as bonding agent for orthodontic brackets.



5. Light-cured resin-modified glass ionomers (RMGIs):

RMGI materials have a dual-setting reaction—a light-activated, methacrylate crosslinking reaction and a slower, delayed, acid-base reaction that gives RMGIs an additional period of maximum flexibility to absorb stress from the adjacent shrinking composite.

Reference:

Textbook of operative dentistry. Nisha Garg and Amit Garg. (2015).