

Liners and bases material act as pulp protection agents require consideration of: chemical protection, electrical protection, thermal protection, pulpal medication, and mechanical protection (as in figure 1).

Reasons for use of base and lining materials:

1. Insulation against temperature changes and electrical stimuli under metallic restorations such as amalgam.
2. Mechanical protection provides by distributing local stresses from restoration across the underlying dentin surface.
3. To reduce the risk of microleakage.
4. Cementation of cast or ceramic restorations.
5. As a pulp capping.
6. Some have bactericidal or bacteriostatic properties.
7. Prevention of the risk of along-term damage to the pulp-dentin organ from operative treatment.
8. Cementation of orthodontic bands.

The ideal lining material should have these properties:

1. Be compatible with the restorative materials.
2. It should not irritant to the pulp.
3. Prevent injuries of the pulp-dentin from restorative materials.
4. Be insoluble in the oral fluids.
5. Possess sufficient physical strength during insertion of the restoration.
6. Prevent heat/cold conduction from metallic restorations.
7. It should have a bacteriostatic effect eg: zinc oxide eugenol.
8. It should improve the marginal seal and have sealing ability eg: zinc oxide eugenol, so we use it as a temporary restorative material.

9. It should be easy to manipulation and apply.

10. It should be radiopaque in the X-ray.

- **Two groups of pulp protection materials are available:**

- Varnishes and liners
- Cement bases.

The materials may be used alone or in combination, depend on:

- The extent and location of the preparation.
- The restoration material to be used.

Liners: are materials that are placed as thin coating or layer.

Function:-

1. To provide a barrier against chemical irritation. (They do not function as thermal isolators).
2. Reduce marginal leakage around most filling materials (amalgam) so reduce the inflammatory reaction and post-operative sensitivity caused by marginal leakage.
3. Electrical insulation (treatment of galvanic shock).

The need for liners is greatest with metallic restorations that are not well bonded to tooth structure. eg: Varnish, Ca (OH)₂, and resin bond.

Bases:

(Cement bases, typically 1 to 2 mm). Deep parts in the dentin should be covered by a base or a subbase/base combination. The thickness of the base depends on its physical properties, but always allowing adequate thickness for the final restorative material.

Function:

1. Provide thermal insulation.
2. Mechanical protection by resist forces applied during condensation of the restorative materials.
3. A barrier against chemical irritation

The cement materials include:

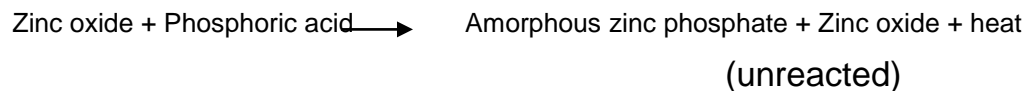
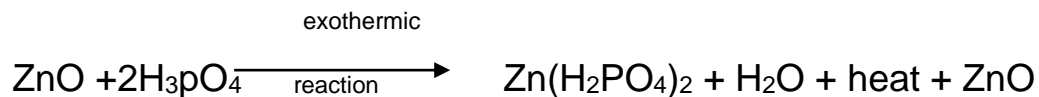
1- Zinc phosphate cement:

It is hard and strong but irritating to the pulp, it is a powder-liquid system. The powder consists mainly of zinc oxide with the addition of magnesium oxide and silicon dioxide.

The liquid consist of ortho-phosphoric acid (40%) with metallic salts that serve to slow down the setting reaction, and water.

Setting reaction:

When the powder is brought into contact with the liquid to begin the cement mix, wetting occurs and chemical reaction is initiated. The surface of the powder is dissolved by the liquid resulting in an exothermic reaction. The initial mixture is highly acidic.



Advantages:

1. Easy to manipulate.
2. High strength necessary for a base.
3. Withstand mechanical trauma.
4. Provide good protection against thermal shock.

Uses:

1. As a base material when high compressive strength is required.
2. To lute cast restorations to the teeth.
3. Cementation of orthodontic bands.
4. Rarely may be used as a temporary cement dressing.

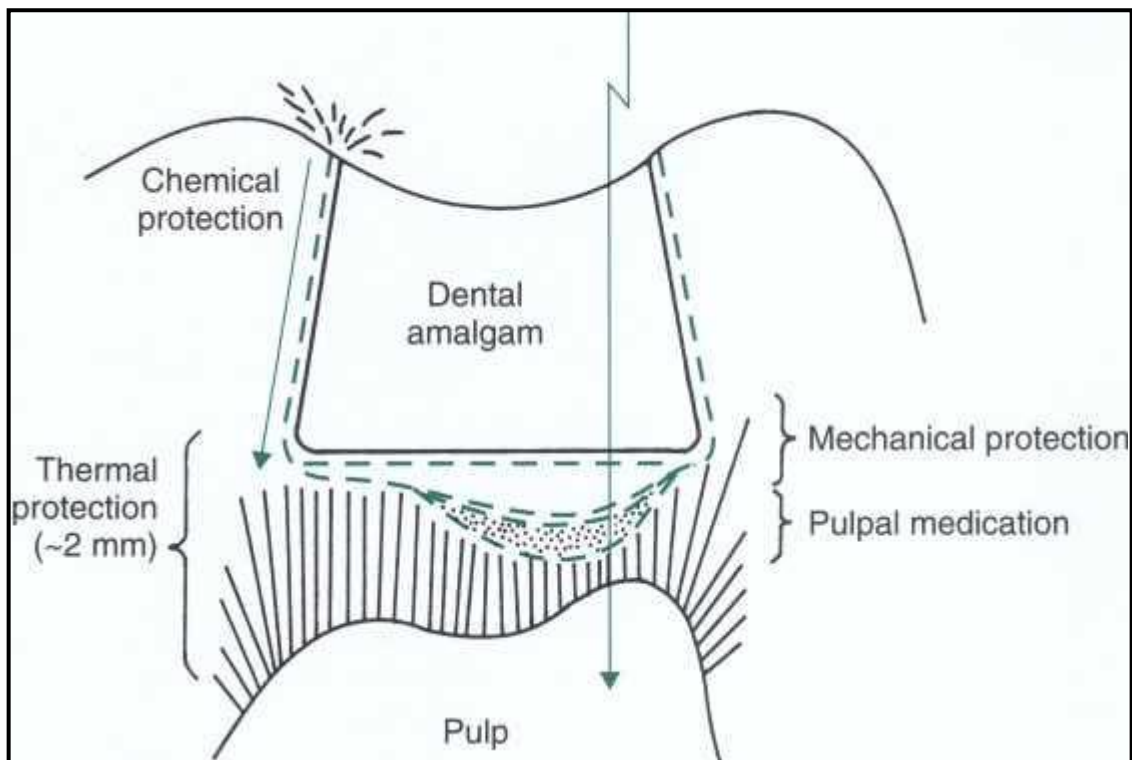


FIG . 1 Schematic view of needs for pulpal protection below metallic restoration. Varnishes, liners, and/or bases may be added to tooth preparation under amalgam for purposes of chemical, electrical, thermal, or mechanical protection, and/or pulpal medication.

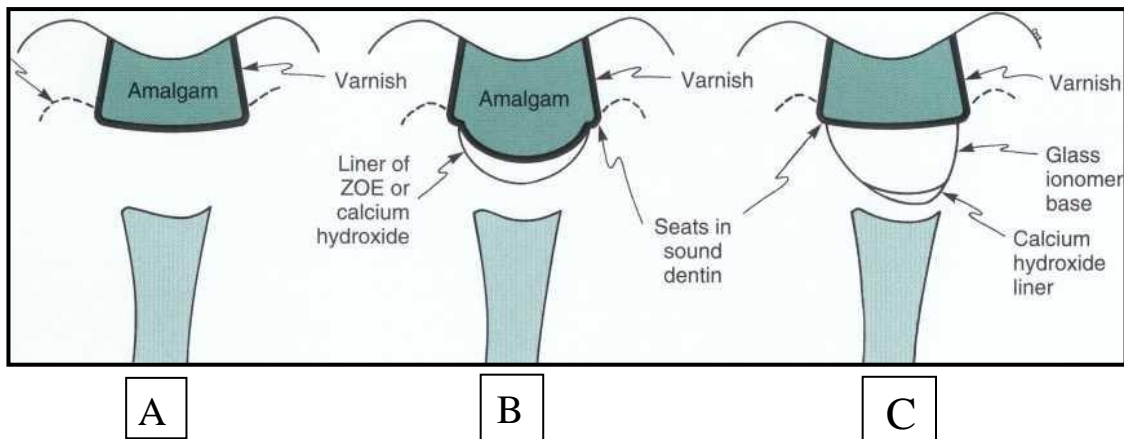


Fig. 2 Schematic examples of use of liners and bases for amalgam restorations. A, For shallow amalgam tooth preparations, varnish or sealer is applied to walls of preparation before insertion of restoration. B, For moderate depth tooth preparations, liners may be placed for thermal protection and pulpal medication. (Note seats in sound dentin for amalgam restoration.) C, In very deep preparation, calcium hydroxide is placed in deepest region in which infected dentin was excavated, and then base of glass ionomer is inserted. Amalgam bonding systems are being advocated as a substitute for liner and varnish, except for calcium hydroxide liner in the deepest region (judged to be within 0.5 mm of pulp).

Characteristic properties of zinc phosphate:

- 1. Consistency:** Two arbitrary consistencies: either luting consistency, or cement base consistency. In luting consistency less powder/liquid ratio is used in order to have creamy mix which is used for cementation of crown and inlays. While in cement base consistency more powder/liquid ratio is used to have putty mix of zinc phosphate cement which may be used as thermal insulator over a thin dentin and as high strength base.
- 2. Viscosity:** It depends on time and temperature of mixing. So mixing should be made on a cool glass slab to reduce the viscosity of mixing.
- 3. Setting time:** It is time elapsed between the end of mixing and the beginning of setting. Setting time of zinc phosphate range from 2 to 8 minutes at 37° C (depending on the product and the mixing consistency).
- 4. Strength:** Influenced by the initial powder and liquid composition, powder/liquid ratio and the manner of mixing, and the handling of the cement during its placement.
- 5. Solubility:** Greater resistance to solubility is obtained by increasing the powder/liquid ratio.
- 6. Dimensional stability:** Zinc phosphate exhibits shrinkage on hardening. This shrinkage can be reduced by increasing powder/liquid ratio and with proper incorporating of powder with liquid during mixing.
- 7. Acidity:** In early manipulation stage the cement is highly acidic, and this acidity reduced with time and become nearly neutral at 48 hours.
- 8. Thermal and electrical conductivity:** Zinc phosphate is desirable to protect against thermal and electrical trauma to the pulp.

Manipulation of zinc phosphate:

The proper amount of powder should be slowly incorporated into the liquid on a cool slab (approximately 21°C) to attain the desired consistency of cement.

- 1) Mixing slab:** Because the reaction between zinc oxide and phosphoric acid is exothermic reaction, the glass slab should be thick cool and clean.
- 2) Powder/liquid ratio:** Because an increase in the ratio of powder to liquid generally provide more desirable properties, incorporation as much powder as possible to obtain a particular consistency.
- 3) Care of the liquid:** When zinc phosphate cement liquid is exposed to a humid atmosphere, it will absorb water, whereas exposed to dry air will lose water. Addition of water cause more rapid reaction result in shorting setting time. While loss of water from liquid will lengthened the setting time. So the cement liquid bottle should be kept tightly closed when not dispensing the material.
- 4) Mixing procedure:**
 - a) The powder should be divided into several small amounts as in figure (1), so that each may be separately drawn into the liquid and spatulated. The liquid is dispensed to another area on the slab.
 - b) Mixing over a large area: The heat of the reaction is most effectively dissipated when the cement is mixed over a large area of the cooled slab. A long, narrow-bladed stainless steel spatula may be used to spread the cement across this large area (as in figure 2).
 - c) The zinc phosphate should be mixed to a thinner consistency for setting inlays or cementation of crowns. A thick mix or thick consistency (a putty-like mixture) is used when basing material is required. This will cause lowered initial acidity of the base material, less post operative pain, and ease of placement.

d) Mixing time not more than 60-90 Sec. 15 for each increment.

5. Frozen slab method: In this method a glass slab is cooled in a refrigerator at (6 °C) or a freeze at (-10 °C). A mix of cement is made on the cold slab by adding the powder until the correct consistency is reached. The advantages of the frozen slab method are an increase in the working time and shorter the setting time. This method has been advocated for cementation of bridges with multiple retainers, also for preparing base material for multiple cavities at the same visit, or for cementation of orthodontic bands.

6. Insertion:

- a) The tooth structure should be dry; this will insures better adhesion and a harder set.
- b) Small quantity of cement is rolled lightly into a ball between the thumb and the forth finger then picked up on the point of a probe and carried into the cavity (as in figure 3).
- c) Then the cement shaped with appropriate instrument, either (Ash 49) on the pulpal floor of the cavity, or (Ash 6) to adapt the cement on the axial wall in class II cavity. The instrument coated with the powder of the cement to prevent the cement from sticking to the instrument. The axiopulpal line angle is molded to around angle with the same instrument.
- d) Small excavator is used to remove any excess from the retention grooves or pits and from the cavity walls. Any trimming by burs should be delayed for at least 10 minute after insertion to avoid dislodgment. If need to do that (do it with sharp burs operated at low speed and minimum pressure). Adequate space should be left for the restoration, otherwise it becomes weak and fracture will occur due to thin restoration. No cement should be extending over any margins of the cavity and in the undercuts.

* When there are one or two spots of caries on the pulpal floor they should be removed by round bur, but without removing the sound dentin around these spots to gain flat pulpal floor, because this may cause pulp exposure. In this case a base material is used in these deep parts to have flat pulpal floor.



Figure (1). Cement powder divided into small increments on a thick glass slab.



Figure (2). Mixing of zinc phosphate is done on a wide area on a glass slab.



Figure (3). A mixed Cement ball is carried by the tip of the prob into the cavit