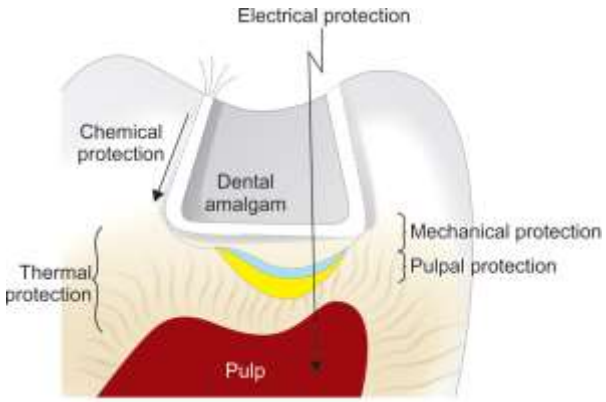
Cavity liner and cement base (part 1)

Liners and bases are materials that act as pulp protection agents with the consideration of chemical protection, electrical protection, thermal protection, pulpal medication, and mechanical protection



Clinical uses of base and lining material

1- Thermal protection from temperature changes and electrical protection from the electrical stimuli under metallic restorations such as amalgam
2- Mechanical protection during various restorative procedures.
3- Act as barriers to microleakage.
4- Cementation of cast or ceramic restorations.
5- Protect the pulp in case of a deep carious lesion as a pulp capping material.
6- Prevent bacteria and toxins from affecting the pulp by the bactericidal or bacteriostatic properties

The ideal lining material should have these properties:

1. Be compatible with restorative materials.
2. It should not irritate the pulp.
3. Prevent injuries to the pulp-dentin from restorative materials.
4. Be insoluble in 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 manipulate and apply.
10. It should be radiopaque in the X-ray

Classification of Pulp Protective Agents

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

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

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

Liners: are materials that are placed as thin coatings or layers.

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) to 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 the tooth structure. eg: Varnish, Ca (OH)2, and resin bond.

Bases:
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 allows adequate thickness for the final restorative material. (Cement bases, typically 1 to 2 mm).

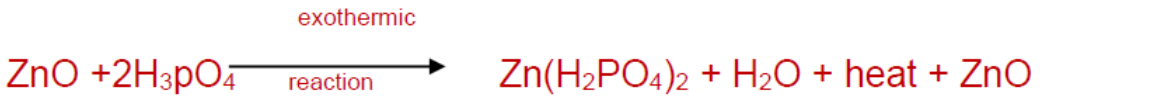
Function:

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

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 a 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.



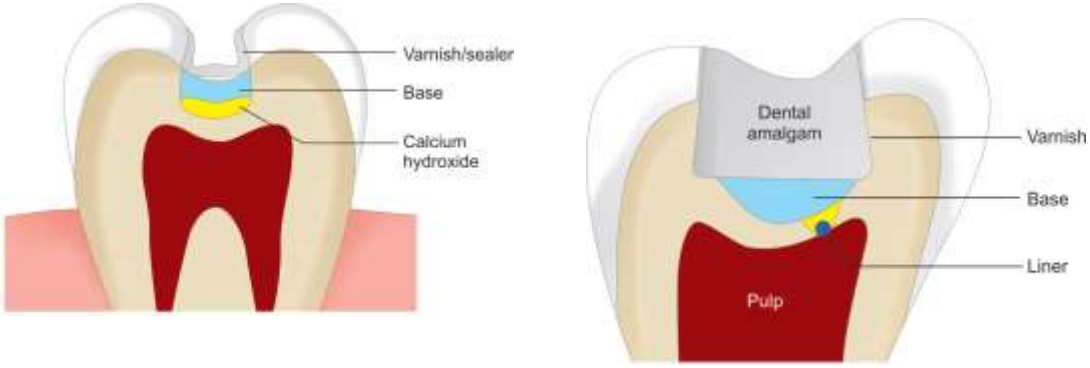
Zinc oxide + Phosphoric acid + heat → Amorphous zinc phosphate + Zinc oxide (unreacted)

Advantages:

1- Easy to manipulate.
2- High 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.



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 to have a creamy mix which is used for cementation of crown and inlays. While in cement base consistency more powder/liquid ratio is used to have a putty mix of zinc phosphate cement which may be used as a thermal insulator over thin dentin and as high strength base.
2- **Viscosity**: It depends on the 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 the time elapsed between the end of mixing and the beginning of setting. The setting time of zinc phosphate range

from 2 to 8 minutes at 37º 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 the powder/liquid ratio and with proper incorporation of powder with liquid during mixing.
7- **Acidity**: In the early manipulation stage the cement is highly acidic, and this acidity is reduced with time and becomes 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, the glass slab should be thick cool, and clean.



2. **Powder/liquid ratio**: Because an increase in the ratio of powder to liquid generally provides more desirable properties, incorporation of 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. The addition of water causes a more rapid reaction resulting in shorting setting time. While the loss of water from the liquid will lengthen 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, 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.



   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 ºC) or a freeze at (-10 ºC). 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 a shorter setting time. This method has been advocated for the cementation of bridges with multiple retainers, also for preparing base material for multiple cavities at the same visit, or for the cementation of orthodontic bands.
6. **Insertion:**
   A. The tooth structure should be dry; this will insures better adhesion and a harder set.
   B. A small quantity of cement is rolled lightly into a ball between the thumb and the fourth finger then picked up on the point of a probe and carried into the cavity (as in figure 3).
   C. Then the cement is shaped with an appropriate instrument, either (Ash 49) on the pulpal floor of the cavity, or (Ash 6) to adapt the cement on the axial wall in the class II cavity. The instrument is coated with the powder of the cement to prevent the cement from sticking to the instrument. The axiopulpal line angle is prepared to an around angle with the same instrument.
   D. A 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 minutes 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 a flat pulpal floor, because this may cause pulp exposure. In this case, a base material is used in these deep parts to have a flat pulpal floor

2- Zinc oxide-eugenol cement (ZOE):

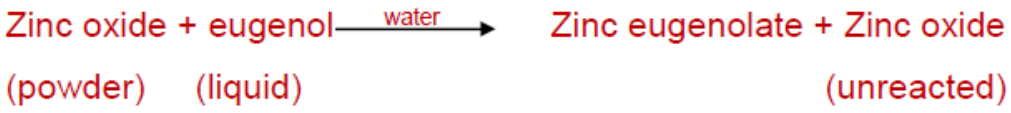
Powder: Zinc oxide with the addition of white rosin to reduce the brittleness of the set cement, and zinc acetate to improve the strength of the cement.

Liquid: eugenol with olive oil as a plasticizer.

Two compositional changes have been used to increase the strength of the cement for luting purposes:

A. 1Methyle methacrylate polymer is added to the powder.
B. Alumina (AL2O3) is added to the powder and ethoxy benzoic acid to the liquid.

Setting reaction:



1. The reaction is not exothermic a cooled mixing slab is not required and the presence of moisture is essential for the setting to occur.
2. There is no need to incorporate the powder in small increments. The bulk of powder is incorporated in the initial step, and then a series of smaller amounts is added until the mix is complete.
3. The average setting time is around 8 minutes.

Properties:

1. Neutral in PH (7) can be safely used in moderately deep cavities without danger to the pulp.
2. Has a sedative effect on the pulp so we use it without any varnish or liner.
3. Radio-opaque.
4. Excellent seal against leakage, so used as a temporary restoration.

Uses:

1. As temporary restorations.
2. The modified type is used as a crown and bridge cementation and as a cement base.
3. As an endodontic sealer.

* Zinc oxide eugenol Cement is unaccepted as base material under composite restorations because it impaired the setting reaction (polymerization) of composite resin.