Cavity Liners and Bases
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Dental pulp is specialized connective tissue that occupies the pulp chamber and root canals. It comprises of nerves, vessels, lymph channels, etc.
Mainly 4 functions

- Formative/ Developmental
- Nutritive
- Sensory
- Defensive/ Reparative

Knowledge of the size and contour of the pulp chamber is essential during cavity preparation.
Caries is a bacterial infection.

All restorative procedures cause pulpal irritation.
Physiologic Considerations for Pulp Protection

- Remaining Dentinal Thickness
  - No material that can be placed in a tooth provides better protection for the pulp than dentin.
  - The RDT from the depth of cavity preparation to the pulp is the single important factor in protecting the pulp.
• A 0.5-mm thickness reduces the effect of toxins by 75%. A 1.0-mm thickness reduces the effect of toxins by 90%.

• A 2.0-mm thickness or more lead to a little pulpal reaction.
Stimuli that induce fluid movements in dentinal tubules distort odontoblast and afferent nerves (arrow), leading to a sensation of pain. Many operative procedures such as cutting or air-drying induce such fluid movement.
Various Types of Pulp Irritants

- Microbial irritation
- Chemical Irritation
- Thermal irritation.
- Radiant irritation
• **Microbial Irritants**

• **Bacteria** that survive *drying* under the filling material remain *viable* for many years. Such dominant bacteria can become active when *moisture reintroduced* as a result of marginal percolation of various filling materials, poor marginal seal, improper condensation, etc.
Mechanical and Thermal Irritants

It depends on

- Speed of rotation
- Type, size and shape of bur
- Coolant system
- Type of filling material
Chemical Irritants

They are

• Various filling materials
• Various medicaments used for desensitization or dehydration of dentin
Radiant Irritants

- X ray radiation
- Laser beam
- Uptake of radium containing water
- Mechanical and Thermal Irritations
Inflammation

It is a complex vascular and lymphatic reaction as well as local tissue destruction. It involves macrophages, plasma cells, and lymphocytes.

Pulpal irritation $\rightarrow$ pulpal inflammation

Invasion of microorganisms into the region of pulp injury is called infection.
Pulp Protection

To protect the pulp against those irritants we give

- Chemical protection
- Thermal protection
- Electrical protection
- Mechanical protection
- Pulp medication
Indications of Cavity Liners & Bases

Schematic view of needs for pulpal protection below metallic restoration.
Chemical protection

Sealing of dentinal tubules against invasion of:

- Bacteria, bacterial toxins, & enzymes
- Corrosive products of amalgam
- Chemical irritants of dental cement & restorative materials
Thermal protection

Cavity bases act as thermal insulator under metallic restorations
Electrical protection

Cavity bases act as insulator against galvanism result from use of dissimilar metallic restorations
Mechanical protection

If the remaining tooth structure is week or can't withstand the occlusal or condensation force

Therefore cavity base can help!!
Dental Pulp Medication

In the case of pulp exposure we give

• Pulp capping

• Pulpotomy
Cavity Liners and Bases

Definition

Materials placed between dentin (and sometimes pulp) and the restoration to provide pulpal protection or pulpal response.
1. Cavity Varnish

Is a solution of one or more resins dissolved in an organic solvent which when applied onto the cavity walls, the solvent evaporates leaving a thin film that serves as a barrier between the restoration and dentinal tubules.
- **Composition**: Natural gum such as copal, rosin, or synthetic resin dissolved in an organic solvent such as alcohol, acetone or ether. Fluoride is added to composition of some products.

- Applied by using a brush or a small pledget of cotton
Commercial products of cavity varnish
The film thickness 2-5 µm.

Varnish should be confined to dentin

Two application have been shown to be more effective than a single coat.

It has been used under amalgam and before cementation of indirect restorations with zinc phosphate cement.
Contraindications

- Direct resin composite restorations
- Glass-ionomer restorations
- Indirect ceramic and resin composite restorations
2. Cavity sealers

- A materials provide sealing as well as bonding at the interface between cavity preparation walls and restoration.

- Examples include: Adhesive bonding systems, resin luting cements and glass-ionomer luting cement.

- The film thickness 20-50 μm.
3. Cavity Liners

A material of minimal thickness (0.2 to 1mm) to provide a barrier against the passage of bacteria and their products and restoration and/or provide a therapeutic effect and applied only to dentin cavity walls that are near to the pulp.

They are usually suspensions of calcium hydroxide in a volatile solvents.
**Composition:** suspensions of calcium hydroxide in an organic liquid such as methyl ethyl ketone or ethyl alcohol.

**Two-paste chemical cure system**

**One-paste light-cure system**
Other types of liners

- Type III GIC
- Type IV ZOE
A material of minimal thickness (1 to 2mm) to replace missing dentin, used for:

1. Bulk buildup and/or,
2. Blocking out undercuts in preparations for indirect restorations and/or,
3. Provide thermal protection and/or,
4. Supplement mechanical support for the restoration.
Examples of Cavity Bases

- Glass ionomer and Resin-modified glass-ionomer cement,
- Zinc phosphate cements
- Zinc polycarboxylate cement
- Zinc-oxide Eugenol Cement
Glass Ionomer Cement

Advantages

• Anti cariogenic effect due to fluoride release
• Chemically bonded to tooth structure
• Good physical properties
• Biocompatible to dentin/pulp complex
Composition

- **Powder**
  Acid soluble calcium fluroalumino silicate glass

- **Liquid**
  1. Polyacrylic acid in the form co-polymer with itaconic acid & malice acid
  2. Tartaric acid: improves handling characteristic
  3. Water: Medium of reaction & hydrates the reaction products
When the powder & liquid are mixed, Surface of glass particles are attacked by acid. then Ca, Al, sodium, & fluoride ions are leached into aqueous medium.
Glass Ionomer Products

Vitrabond Light cure Glass Ionomer Liner/Cement, 3 M ESPE, USA
Self-Cured, Glass Ionomer Lining Cement, GC America
GC Fuji LINING™ LC (Paste Pak) Radiopaque Lining Material
Zinc Phosphate Cement

More than 100 years ago, a French architect proposed the use of zinc oxide as a stopping medium for carious teeth.

Zinc phosphate cement has progressively advanced from the original wall plaster that induced its development over a century ago.
II. Cements based on phosphoric acid

- Zinc-phosphate cement
- Silicate cement
- Phosphoric acid
- Zinc oxide
- Fluoro-alumino-silicate glass
- Silico-phosphate cement
A. ZINC-PHOSPHATE CEMENT

COMPOSITION:

Powder:
- Zinc oxide
- Magnesium oxide
- Other oxides and fluorides may be present

Liquid:
- Phosphoric acid
- 30-40% Water
- ZnO or Al(OH)₃ as buffering agents
ZINC-PHOSPHATE CEMENT

MANIPULATION:
ZINC-PHOSPHATE CEMENT

MANIPULATION:

- Zinc-phosphate material is mixed on a thick, cooled glass slab using stainless steel spatula (*Freeze slab technique*) to \( \uparrow \) W.T. and S.T.
- Powder is added to liquid small increment by small increment to help in buffering the acid and to \( \uparrow \) W.T. and S.T.
MANIPULATION: (Cont.d)

Precautions ......................;

1. Liquid bottle should be tightly closed (Evaporation of water will reduce the reactivity of the cement)
2. Liquid with Cloudy appearance discarded
3. Shake the powder bottle before dispensing the correct ratio and never use powder of other cements (e.g. ZOE...) or of other manufacturer
ZINC-PHOSPHATE CEMENT

SETTING REACTION:

- Exothermic chemical reaction of acid-base type

\[ \text{ZnO} + \text{H}_3\text{PO}_4 \rightarrow \text{Zn}_3\text{(PO}_4)_2 + \text{H}_2\text{O} \]

- Set material is composed of a matrix of zinc phosphate salt infiltrated with non-reacted zinc oxide particles that are responsible for material’s opacity
ZINC-PHOSPHATE CEMENT

SETTING REACTION: (Cont.d)

- Control of setting time
  1. ↑ L/P ratio ↓ ↑ S.T.
  2. ↑ Mixing Rate ↓ ↓ S.T.
  3. ↑ Particle size ↓ ↑ S.T.
  4. ↑ Temperature ↓ ↓ S.T.
  5. ↑ Buffering of the liquid ↓ ↑ S.T.
  6. Presence of moisture ↓ ↓ S.T.
ZINC-PHOSPHATE CEMENT

CHARACTERS:

1. Biological properties:
   - Fresh mix of zinc phosphate cement is highly acidic (pH 1.6-3.6) due to presence of strong phosphoric acid causes pulp irritation
   - In deep cavity, cavity liner should be used beneath
   - Thin mix is more irritant than thick mix
   - Set material becomes neutral within 48 hrs
ZINC-PHOSPHATE CEMENT

CHARACTERS: (Cont.d)

2. Interfacial properties:
   - Zinc phosphate cement shows no chemical bonding either to tooth structure or restoration surfaces (Mechanical retention and physical adhesion)

3. Chemical properties:
   - Cement shows some degree of solubility, and it is dependant on L/P ratio (thin mix \[ \downarrow \] solubility)
A. ZINC-POLYCARBOXYLATE CEMENT
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COMPOSITION AND PRESENTATION:

1. Powder / liquid system
   Powder:
   - Zinc oxide
   - Magnesium oxide
   - Stannous fluoride in some products

   Liquid:
   - Poly-acrylic acid (30-40%)
   - Water
ZINC-POLYCARBOXYLATE CEMENT

COMPOSITION: (Cont.d)

2. Single bottle system
   - Poly-acrylic acid is supplied as a dry powder blended with cement powder
   - This mixture is mixed with regular water to get a cement mix

3. Capsules
   - Recently available for automatic mixing
ZINC-POLYCARBOXYLATE CEMENT

MANIPULATION:

- Mixing of cement powder and liquid is carried out on a glass slab using a stainless steel spatula.
- PAA is viscous and needs more effort during mixing of material.
- Thin mix \((P/L \text{ ratio} = 1.5:1)\) used for cementing purposes.
- Thick mix \((P/L \text{ ratio} = 2.5:1)\) used as cavity base.
ZINC-POLYCARBOXYLATE CEMENT

MANIPULATION: (Cont.d)

- Polycarboxylate cement adhere to stainless steel instrument, *so any metallic instrument should be cleaned while cement still unset*

- To achieve better bonding to tooth structure;
  1. Tooth surface should be cleaned and dried from saliva
  2. Mixed cement should be applied to tooth structure as fresh as possible
ZINC-POLYCARBOXYLATE CEMENT

SETTING REACTION:

- Chemical reaction of acid-base type

\[ \text{Zinc oxide} + \text{PAA} \rightarrow \text{Zinc-polycarboxylate} \]

- Set material: composed of zinc-polycarboxylate matrix with un-reacted zinc oxide particles dispersed in providing the cement its opacity

- Speed of the reaction is affected by temperature, P/L ratio, powder particle size, and mixing rate.
ZINC-POLYCARBOXYLATE CEMENT

SETTING REACTION:

- Chemical reaction of acid-base type
  
  Zinc oxide + PAA $\rightarrow$ Zinc-polycarboxylate

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CHARACTERS: (Cont.d)

2. Interfacial properties:
   - PAA provides chemical adhesion to tooth structure, base metal alloys, and tin-plated noble alloys

3. Chemical properties:
   - Polycarboxylate cement is more soluble in water than zinc-phosphate cement
ZINC-POLYCARBOXYLATE CEMENT

CHARACTERS: (Cont.d)

4. Thermal properties:
   - Set cement has low thermal diffusivity (can be used as cavity base)

5. Esthetic properties:
   - Set cement is opaque due to presence of unreacted zinc oxide particles → not used to lute ceramic restorations
Zinc Oxide Eugenol (ZOE) cement have been used extensively in dentistry since 1890s

- They are cements of low strength
- They are the least irritating of all dental
- They have an obtudant effect on exposed dentin
Classification

- Type I ZOE: For temporary cementation
- Type II ZOE: Permanent cementation
- Type III ZOE: For temporary filling and cement base
- Type IV ZOE: Cavity liners
ZOE cement is available as

- Powder and liquid System
Composition and setting reaction

**ZOE** is a material created by the combination of **zinc oxide** and **eugenol** contained in **oil of cloves**.

An acid-base reaction takes place with the formation of **zinc eugenolate** chelate.

The reaction is catalyzed by **water** and is accelerated by the presence of **alcohol** and **glacial acetate**.
Two - Past System

Equal lengths of each past are dispersed and mixed until a uniform color is observed.
Modified ZOE Cements

The modified ZOE cements are as follows

- EBA – alumina modified cement
- Polymer reinforced ZOE cement

These were introduced to improve the mechanical properties of ZOE cements.
This cement features a reinforcing polymer incorporated into the powder.
Clinical Considerations of Cavity Liners and Bases

Clinical judgments about the need for specific liners and bases are linked to:

1. Amount of remaining dentin thickness (RDT).

2. Considerations of adhesive materials.

3. The type of restorative material being used.
Pulp medication

Liners are also formulated to provide pulpal medication. Main aspects are

1. Relief of pulpal inflammation

2. Facilitation of reparative dentin formation for physiologic protection
Thank You