DENTAL CEMENTS

PART 2  Glass ionomer cements
        Resin cements

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I-PRESENTATION:

1-powder and liquid
2-preproportioned capsules
3-water settable cement: L freeze dried, added to P→ L is distilled H₂O or diluted soln. of tartaric acid.
II-COMPOSITION:

A) Powder
- calciumfluoro-aluminosilicate glass
  - calcium fluoride and sodium fluoride act as flux to lower the firing temperature of glass powder.
  - barium to give radiopacity

B) Liquid
aqueous solution of polyacrylic itaconic acid copolymer
III-MANIPULATION
- P&L → mix on special paperpad with plastic spatula
- Preproportioned capsules → mechanical mixer

IV-Setting reaction

Acid-base reaction

3 stages occur on mixing P&L:
1) dissolution of glass particles
2) migration of surface ions
3) reaction and precipitation
1) dissolution of glass particles by acid: $H^+$ attacks glass to release cations ($Ca^{++}$, $Al^{+++}$ and $F^-$) → 20-30% of glass is decomposed

2) migration of surface ions ($Ca^{++}$, $Al^{+++}$ and $F^-$) into the liquid - divalent $Ca^{++}$ migrate first, followed by trivalent $Al^{+++}$ - sodium ions form silica gel around unreacted particles.

3) reaction and precipitation

- **initial set**: first $Ca^{++}$ react with carboxylic gp of acid → crosslinked carboxylic salt gel
- **final set**: then slowly migrated $Al^{+++}$ react → stronger crosslinked cement (longer time)

 دقيقة carboxylic gel salts is a continuous process (24hrs) - the set material should be protected against premature exposure to saliva (affects setting & surface hardness)
Role of water in the setting process:

- Water in the liquid is a reaction medium and is loosely bound to structure
- then it hydrates crosslinked matrix and becomes tightly bound → stable gel (increasing strength)
- **dryness during initial set**: incomplete reaction & surface will crack
- **moisture contamination during initial set**: matrix dissolution
- Thus, GI cement must be protected against water changes in the structure during setting process.
V-MICROSTRUCTURE

**Cored structure:** unreacted glass surrounded by silica gel embedded in matrix of cross-linked polysalt-hydrogel of calcium & aluminum - *Aluminumfluoro-carboxylate salts* constitutes the main bulk of the matrix and provides final strength.
Cross-linked polyacid

Glass core

Silica gel

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VI-PROPERTIES

1-biological prop.:
Effect on the pulp
a- mild irritant effect on pulp, so in deep cavities sub-base of Ca(OH)₂ is placed under glass ionomer to prevent pulpal irritation
b- anticariogenic effet due to release of fluoride

2-consistency and film thickness
Film thickness determines:
degree of seating of cast restoration,
24 μm

3-solubility and disintegration
-Solubility and disintegration is 1.5%wt after 24 hrs immersion in H₂O.
- H₂O attacks GI cement during setting
-coating the restoration immediately by varnish to protect cement from premature exposure to saliva

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4-strength

-strength of a cement depends on:
  a-composition of P&L
  b-P/L ratio

High mechanical properties
-Has higher compressive strength but lower tensile strength (brittle)
5-bonding to enamel and dentin

!! main advantage!! chemical bonding to enamel and dentin

-bond strength of GI cement is lower than polycarboxylate cements due to sensitivity of GI to moisture during setting.

6-optical properties

!!Translucent!! so it is used under composite and porcelain
USES

Type I luting applications
Type II restorative material
Type III liner or base
(light cured also available)
MODIFICATIONS OF GLASS IONOMER CEMENT:

1) Metal modified GI (miracle mix)
- Amalgam alloy powder added to glass to ↑wear resistance & flexure.
- but proved unsuccessful.

2) Cermet GI (ketac-silver)
- Silver, gold, palladium were sintered to GI-powder, Ag adheres intimately to glass particles:
- Advantage: ↑Strength & wear resistance.
- Disadvantage: -opaque due to metal content, lower fluoride release.
- Uses: - core material, class I & II (deciduous teeth).
3) Light cured GI "resin modified GI or hybrid ionomer"

a-dual cure: P&L

i-acid-base reaction

ii-polymerization reaction of resin component: by light activated free radical reaction

-L: modified polyacid with methacrylate end group:
   HEMA: hydroxy-ethyl-methacrylate

b-triple cure:

i-acid-base reaction

ii-light cure polymerization

iii-chemical cure polymerization

-to ensure effective polymerization of resin part in deep cavities
Application of resin modified glass ionomer:

- Lining material under composite resin, then used in cervical class 5 restorations in adults
- They are recommended for high caries risk patients
4. **Compomer (polyacid modified resin composite materials):**

- These are supplied as one paste system and not as powder and liquid.
- They are considered as intermediate restoratives between glass ionomer and composite resin materials.
- They are a mechanical mixture of glass ionomer particles and composite materials.
- The light curing reaction plays a significant part of reaction over the acid-base reaction. The later being minimal.
- They are used as anterior restorative materials.
Properties:

- Bonding to the tooth structure is increased due to chemical bond of the glass ionomer part and micromechanical interlocking obtained from the resin part.
- Good optical properties
- Less sensitivity to moisture after setting

Used as anterior restorative material
Light curing glass ionomers have the following advantages over conventional types:

1. Better optical properties.
2. Less sensitivity to moisture after setting.
3. Superior mechanical properties.

N.B. Polyacid modified resin composite materials are more related to composite resin rather than glass ionomer materials.
Resin Cements

Types of resin cements

Unfilled acrylic resin cements

Composite resin cements

Conventional composite resin cements

Self cured type

Light cured type

Adhesive resin cements

Dual cured type
CLASSIFICATION OF RESIN CEMENTS:

There are two major groups of resin cements:
Unfilled acrylic resin cement. (Historical)
Composite resin cements.

1. Unfilled acrylic resin cement:
These are monomer-polymer formulations based on methylmethacrylate and co-monomers.
2. *Composite resin cements:*
These types of filled resin cements replaced the unfilled resin types due to their superior properties. Composite resin cements may be classified according to bonding mechanism to tooth structure into:

**Conventional cements:** gain their retention to tooth structure through acid etching in conjunction with enamel and dentin bonding agents.

**Adhesive resin cements:** these are resin cement systems formulated with an adhesive promoter such as 4-methacryloxy ethyl trimellitic anhydride (4-META).
Composite resin cements could also be classified according to their mode of activation into:

1. **Self (chemical) cure.**
2. **Light cure.**
3. **Dual cure.**
4. 
**PROPERTIES:**

1. **Biological properties:**
   They are irritating to the pulp. Thus, pulp protection via calcium hydroxide or glass ionomer liner is important when cementing an indirect restoration that involves bonding to dentin.

2. **Bonding:**
   Bonding of conventional types occurs to enamel by acid etching, while bonding to dentine occurs by dentine bonding agent. On the other hand, bonding of adhesive type occurs chemically by the help of 4-META.

3. **Film thickness:**
   They may be supplied with different viscosities according to their application.

3. **Optical properties:**
   They are transluscent. Radiopaque types are available to be used in the posterior region to facilitate protection under inlays.
CAVITY VARNISHES AND LINERS

- Varnishes and liners are used for coating the freshly cut tooth structure of the prepared cavity.
- The cavity varnish is natural gum such as copal, rosin or a synthetic resin dissolved in an organic solvent such as acetone, chloroform or ether.
- The cavity varnish is applied to the cavity preparation with a brush or cotton pledget, the solvent is allowed to evaporate leaving a thin coating resin film on the surface. This process may be repeated two to three times to give a uniform resin layer.
- The cavity liner is a liquid in which calcium hydroxide and some zinc oxide are suspended in a solution of natural or synthetic resins.
Applications:

1. To act as a temporary protection against the loss of constituents from the surface of a filling material. Cavity varnishes are used as a surface coat over glass ionomer restoration.

2. To seal the dentinal tubules under amalgam restorations and prevent penetration of metallic ions into enamel and dentin thus reducing discoloration of the tooth around amalgam restorations. A film of varnish under a metallic restoration is not an effective thermal insulator.

3. To seal dentinal tubules and prevent penetration of chemicals into the pulp
CALCIUM HYDROXIDE CEMENTS: 
(AS LINER AND PULP CAPPING MATERIAL)

This material is supplied as two pastes in two collapsible tubes. One paste consists of a mixture of calcium hydroxide, zinc oxide and sulphonamide.

The other paste consists of glycol salicylate, titanium dioxide and calcium sulphate.

Light activated calcium hydroxide cements have become available.
Properties:

1. Biological properties:
   - The freshly mixed cement is *alkaline* with a pH of 11-12.
   - It has the ability to stimulate the pulp to lay down secondary dentin. This characteristic is utilized in very deep carious lesions where calcium hydroxide cement is used as a pulp capping agent. i.e. it can be placed adjacent to the pulp and it is capable of destroying micro-organisms found in carious lesions.

2. Solubility and disintegration:
   The calcium hydroxide is highly soluble since it is dissolved if left at the cavity wall and margin this will lead to increase marginal leakage (applied only on the pulpal floor).

3. Compressive strength: The compressive strength of calcium hydroxide liner is very low (about 5MPa). Therefore in deep cavities, a thin sublining of calcium hydroxide cement and then a base of zinc phosphate cement should be placed before condensation of amalgam.
Thank You