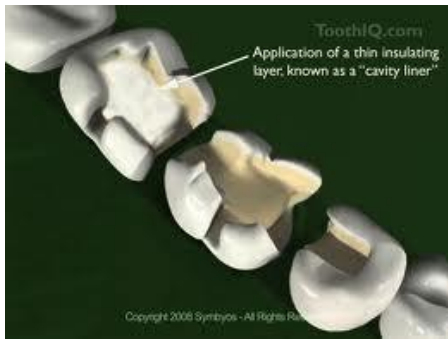




DENTAL CEMENTS

Dr. Sahar T. Taha BDS, MS, ABOD



Uses of dental cements

Cavity lining

Luting agents

Endodontic treatment

Modified to be used as filling materials



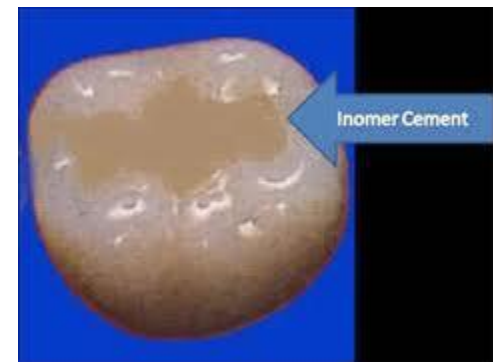
Prepared tooth



Crown placed over prepared tooth



Crown in place



DENTAL CEMENTS

- ◉ A range of materials has been developed to be applied to the dentin prior to the placement of the restorative materials. These include cavity varnishes, bases and liners.



DENTAL CEMENTS

The roles of dental cements:

- ◉ Protective
- ◉ Palliative
- ◉ Therapeutic





- ◉ The use of dental cements as cavity liners depends on:
 - Thickness of the remaining dentin.
 - The type of restorative material used.

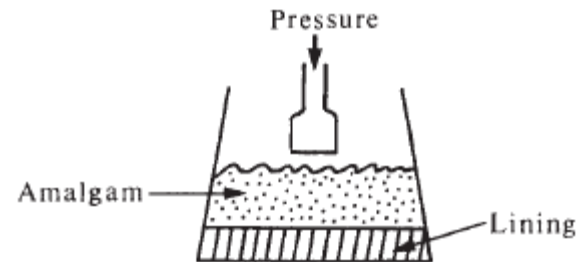
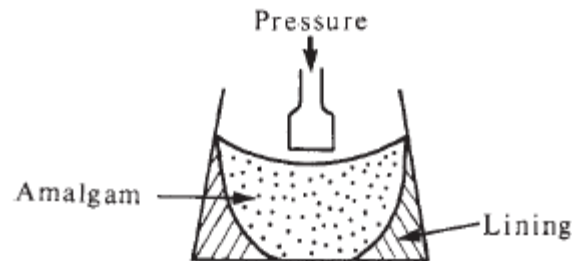
GENERAL STRUCTURE

- ⦿ On mixing the powder and liquid, only a part of the powder reacts with the liquid and the final set materials is composed of:
“A core of unreacted powder, surrounded by a matrix formed by reaction of powder and liquid.”



REQUIREMENTS

- ◉ Should be non-toxic and non-irritant to pulp and tissues.
- ◉ Insoluble in saliva and liquids taken into the mouth.
- ◉ Mechanical properties must meet the requirements for their particular applications, e.g. a cavity lining cement should develop sufficient strength rapidly to enable filling material to be packed on it.



REQUIREMENTS (CONTINUED)

- ⦿ Protection of the pulp from insults such as; thermal insulation, chemical protection and electrical insulation under a metallic restoration to minimize galvanic effects.
- ⦿ Should be bacteriostatic.
- ⦿ Should have a sedative (soothing) effect on the pulp.

REQUIREMENTS (CONTINUED)

- ◉ Cement should ideally adhere to enamel and dentin, and to gold alloys, porcelain and acrylics but not to dental instruments.
- ◉ Radiopaque.



Full porcelain fused to metal



Full porcelain crown



Full cast alloy crown



Dental Cements

```
graph TD; A[Dental Cements] --> B[Calcium Hydroxide cements]; A --> C[Varnishes]; A --> D[Zinc-oxide based cements]; A --> E[Glass ionomer cements]; A --> F[Resin cements]; D --> G[Zinc oxide-Eugenol]; D --> H[Zinc oxide-phosphate]; D --> I[Zinc oxide-polycarboxylate]; G --> J[Modified]; G --> K[Unmodified];
```

Calcium
Hydroxide
cements

Varnishes

Zinc-oxide
based cements

Glass ionomer
cements

Resin cements

Zinc oxide-
Eugenol

Zinc oxide-
phosphate

Zinc oxide-
polycarboxylate

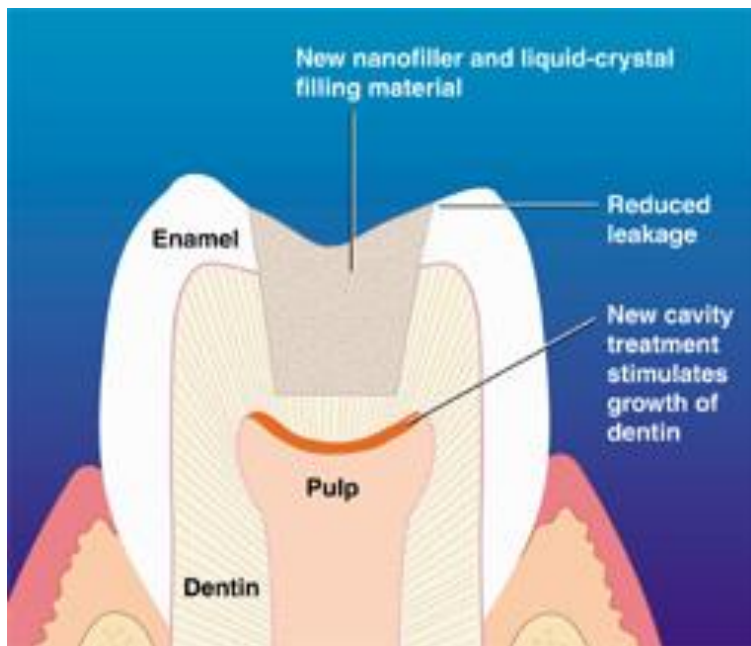
Modified

Unmodified

CAVITY PREPARATION



CALCIUM HYDROXIDE CEMENT



CALCIUM HYDROXIDE CEMENTS

Available as:

- ◉ Chemical cured system; Two paste system of base and catalyst
- ◉ Light cured system. One paste system

Composition:

- ◉ **Base:** 50% Ca(OH)_2
10% Zinc oxide
39.5% Sulfonamide
0.5% Zinc stearate (accelerator)
- ◉ **Catalyst** 40% glyconyl salicylate with varying amounts of titanium dioxide and calcium tungstate or barium sulphate.



The setting process:

- ◉ Equal volumes $\xrightarrow{\text{mixed}}$ set in 2 minutes, calcium hydroxide reacts with the salicylate ester to form a chelate of amorphous calcium disalicylate.



CALCIUM HYDROXIDE CEMENTS



PROPERTIES:

- ⦿ **Low compressive strength** (10-27) Mpa \Rightarrow but sufficient to withstand the condensation of amalgam.
- ⦿ Freshly mixed cement has a **highly basic pH of 11-12**, as such calcium hydroxide helps in the **formation of 2ry dentin**.
- ⦿ When the mixed paste is placed in contact with pulp, possibly in the presence of microscopic pulp exposure, it will cause a three-layer necrosis of some 1.5 mm thickness which eventually develops into a calcified layer, forming a bridge of dentin-like material that isolates the pulp.

PROPERTIES:

- ◉ Does not provide any significant thermal insulation.
- ◉ Water soluble; therefore, should not be applied at the margins of restorations.
- ◉ Antibacterial.

CAVITY VARNISHES



CAVITY VARNISHES

- ⦿ Varnish consists of a clear or yellowish liquid, containing either: Natural resin (e.g. copal, rosin and gum) or Synthetic resin dissolved in an organic solvent like alcohol, acetone or ether.
- ⦿ Varnish is a solution of one or more resins, when applied onto the cavity walls, it evaporates leaving a thin resin film that serves as a barrier between the amalgam restoration and the dentinal tubules.

FUNCTIONS

- ◉ It reduces microleakage around the margins of newly placed amalgam restoration, thereby reducing postoperative sensitivity.
- ◉ In amalgam restorations, they also prevent penetration of corrosion products into the dentinal tubules; thus minimizing tooth discoloration.
- ◉ May be used as a temporary protection in cases of galvanic shock.

Properties:

- ◉ Vanishes neither possess mechanical strength nor provide thermal insulation because of the thin film thickness (2-40 μm).
- ◉ As their solubility is low, they are insoluble in distilled water.

Manipulation:

- ◉ Since the solvent may evaporate, cavity varnish should be applied 3 times to ensure uniformly coating resin using either a brush or a small cotton pellet.



ZINC OXIDE-BASED CEMENTS



Prepared tooth



Crown placed over prepared tooth



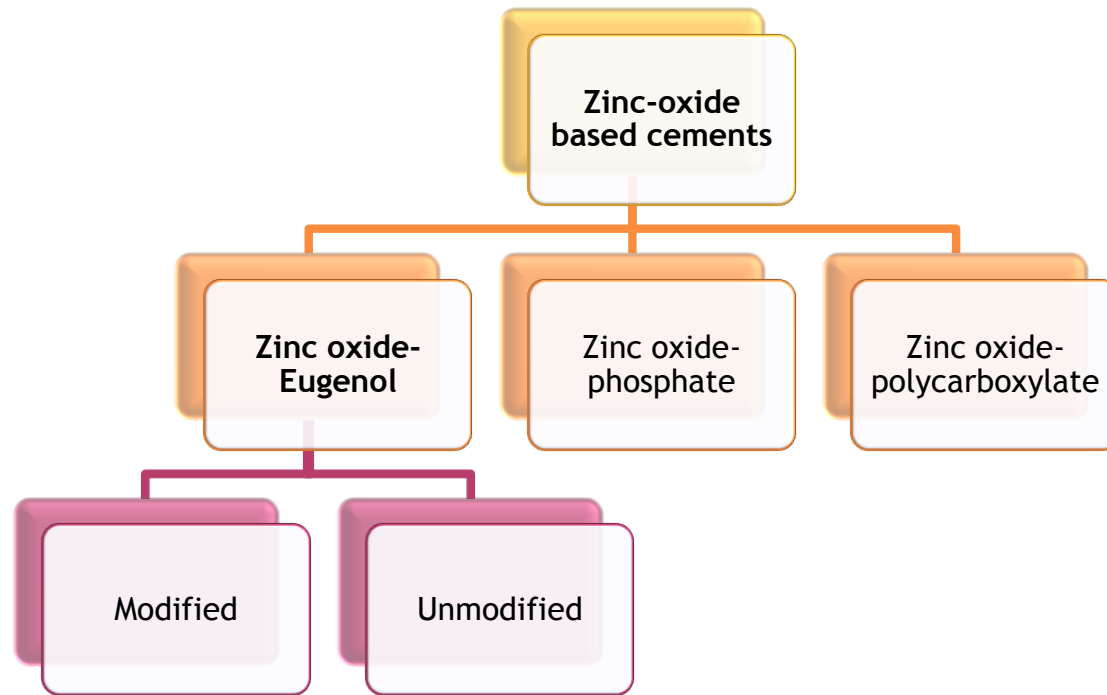
Crown in place

ZINC OXIDE-BASED CEMENTS

- Used as powder and liquid systems, these cements undergo a general acid-base reaction:



- They are available as powder and liquid or two-paste systems.



General Properties of Zinc oxide-eugenol:

- ◉ They come in a wide variety of different formulations and applications.
- ◉ In general, they are cements of **low strength**.
- ◉ The **least irritating** of all dental cements and known to have a **sedative effect** on exposed dentin.

UNMODIFIED ZINC OXIDE-EUGENOL

Components:

Powder:

Zinc oxide	69% - principal ingredient
White rosin	29.3% - to reduce brittleness of set cement
Zinc stearate	1.0% - accelerator, plasticizer
Zinc acetate	0.7% - accelerator, improves strength

Magnesium oxide is added in some powders in a ratio of 10%, acts with eugenol in a similar manner as zinc oxide.

Liquid:

Eugenol	85 % - reacts with zinc oxide
Olive oil	15 %- plasticizer

(Oil is present to make the taste of the eugenol acceptable and modify the viscosity. Olive oil may be substituted with cotton-seed oil).



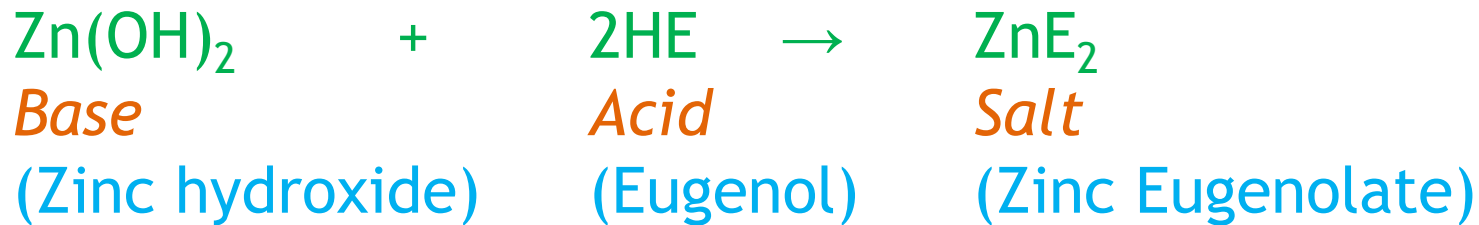
SETTING PROCESS

- ⊙ Adding powder in small increments to the liquid → thick consistency within 1 minute.
- ⊙ P/L ratio of 4:1 or more.
- ⊙ In the first reaction, hydrolysis of zinc oxide to its hydroxide takes place. Water is essential for the reaction:



SETTING PROCESS (CONTINUED)

- ◉ The reaction proceeds as a typical acid-base reaction:



- ◉ Thus the set cement consists of particles of Zinc-oxide embedded in a matrix of Zinc eugenolate.
- ◉ ZOE material set faster in the mouth than out of the mouth, making it quite useful and popular.

SETTING TIME

The complete reaction takes up to 24 hours which is too slow for clinical purposes.

Setting time is affected by a number of factors:

- ◉ ***Particle size***: Smaller zinc oxide particle set faster.
- ◉ ***Accelerators***: Alcohol, glacial acetic acid and water will accelerate the setting reaction.
- ◉ ***Heat***: Cooling the glass slab slows the reaction.
- ◉ ***Retarders***: The set can be retarded with glycol and glycerin.
- ◉ ***Powder to liquid ratio***: the higher the ratio, faster the set.

MANIPULATION

- ◉ The bottles should be shaken gently.
- ◉ Measured quantities dispensed onto a cool glass slab, and the P/L ratio of 4:1 to 6:1 by weight.
- ◉ The **bulk** of the powder is incorporated on to the liquid and spatulated thoroughly in **a circular** motion with a stiff stainless steel spatula.
- ◉ Smaller increments are then added until the mix is complete.

PROPERTIES

- ◉ **Compressive strength:** they are relatively weak cements (3 to 4Mpa up to 50-55 Mpa).
- ◉ **Tensile strength:** ranges from 0.32 to 5.3 Mpa.
- ◉ **Modulus of elasticity:** 0.22 to 5.4 Gpa.
- ◉ **pH:** 6.6 - 8
- ◉ **Has little or no effect on pulp in deep cavities.**
Free eugenol has a sedative effect on the pulp and reduces pain and as such it is associated with **antibacterial** property.
- ◉ It has a **mild irritant** property so it is not recommend to be placed directly on exposed pulp.
- ◉ **Thermal properties:** they are excellent thermal insulators and have the same conductivity as human dentin.

MODIFIED ZINC OXIDE-EUGENOL

- ⦿ These were introduced to improve the mechanical properties of ZnOE cement.
- ⦿ This is by adding either **alumina** (EBA-alumina modified cement) or **resin** (polymer reinforced zinc oxide eugenol cement) to the powder and/or liquid.

EBA-ALUMINA MODIFIED CEMENT

- ◉ White powder and a pinkish colored liquid:

Powder: **70% zinc oxide + 30% fused quartz or alumina**

Liquid: **37% eugenol + 63% ethoxy benzoic acid**

- ◉ EBA encourages the formation of a crystalline structure which imparts greater strength.

Properties and Application:

- ◉ Because of addition and modification:

Compressive strength: 45Mpa

Tensile strength: 4.1 Mpa

Modulus of elasticity: 2.5 Gpa.

Reduction in solubility

- ◉ Used as liners and temporary filling materials.

Manipulation:

- ◉ Similar to ZnOE cement.

POLYMER REINFORCED ZNOE CEMENT

Composition:

- ◉ Powder: 70% Zinc oxide + finely divided natural or synthetic resins.
- ◉ Liquid: Eugenol + acetic acid-accelerator + thymol - antimicrobial.

Uses:

- ◉ Luting agent.
- ◉ As base.
- ◉ As temporary filling material.
- ◉ As cavity liner.

Setting Reaction:

- ◉ Similar to ZnOE cement.

Setting time:

- ◉ 6 to 10 minutes.



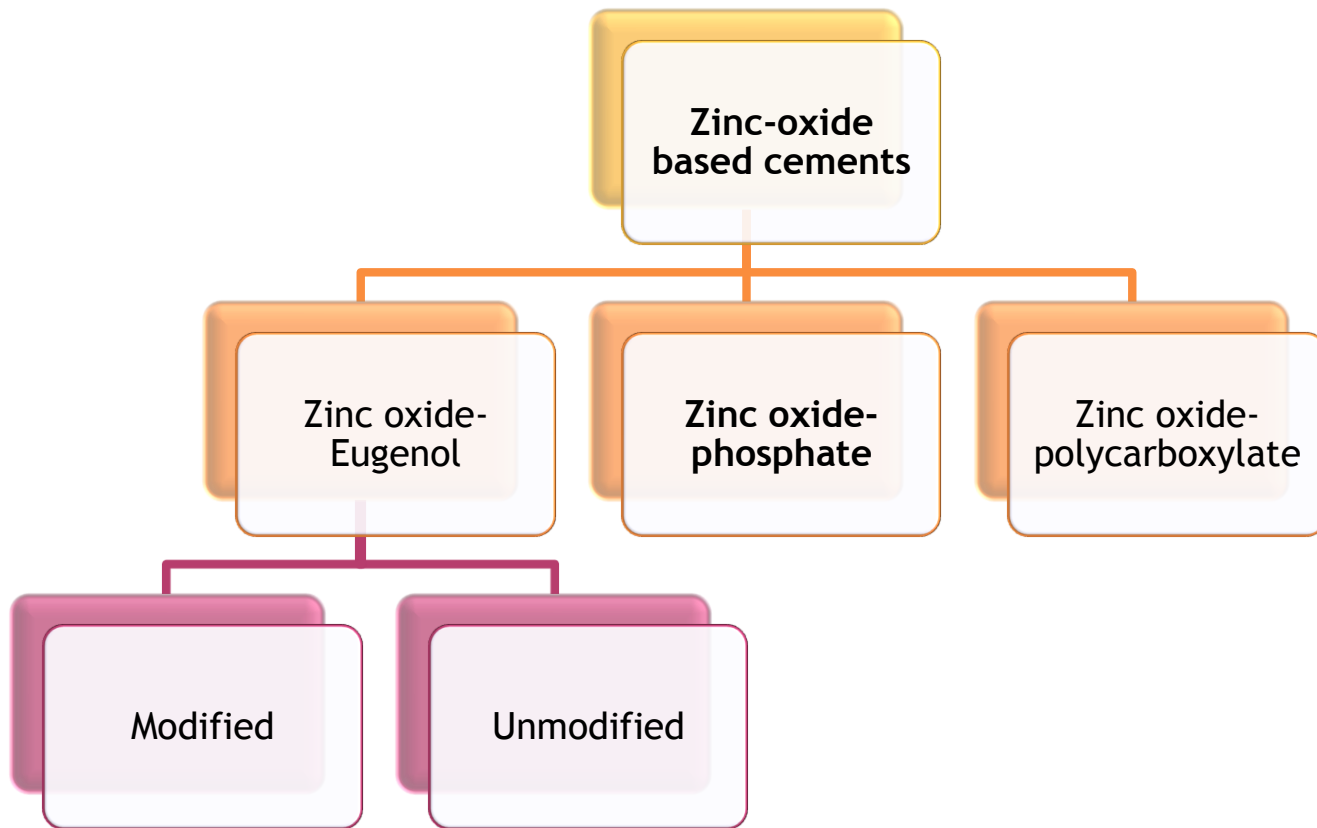
POLYMER-ENFORCED ZOE (CONTINUED)

Properties:

- ⦿ *Compressive strength* 48 Mpa
- ⦿ *Tensile strength* 4.1 Mpa
- ⦿ *Modulus of elasticity* 2.5 Gpa
- ⦿ *Film thickness* 32 μm
- ⦿ *Solubility and disintegration* 0.03% wt
- ⦿ *Improved abrasion resistance and toughness.*

Manipulation:

- ⦿ The proper P/L is dispensed on a dry glass slab. The powder is mixed into the liquid in small portions with vigorous spatulation.



ZINC PHOSPHATE CEMENTS



ZINC PHOSPHATE CEMENTS

It is the oldest of the luting cements and thus it serves as a standard with which newer cements can be compared.

Applications:

- ◉ Luting for Cr&Br.
- ◉ High strength bases.
- ◉ Temporary restoration.
- ◉ Luting of ortho bands and brackets.



Prepared tooth



Crown placed over prepared tooth



Crown in place

Classification:

ADA Sp. No. 3 designates them as:

- ◉ Type I: Fine grained for luting (film thickness 25 μ m or less).
- ◉ Type II: Medium grain for luting and filling (more than 40 μ m).

Available as:

- ◉ Powder and liquid system.
- ◉ Capsules of proportioned powder and liquid.

COMPOSITION

Powder:

ZnO	90.2%	principal ingredient
Magnesium	8.2%	aids in sintering of cement
Silica	1.4%	aids in sintering of cement
Other oxides	0.2%	improve smoothness of mix (e.g. calcium and barium)

Liquid:

Phosphoric acid	38.2%	reacts with ZnO
Water	36%	controls rate of reaction
Aluminum phosphate	16.2%	buffers
Aluminum	2.5%	
Zinc	7.1%	

SETTING REACTION

- First reaction



- Further reaction



- ◉ Hopeite, virtually insoluble, crystallizes to form phosphate matrix which binds together with unreacted parts of zinc oxide powder.
- ◉ The reaction is exothermic and some shrinkage takes place.
- ◉ Final structure ➡ particles of unreacted zinc oxide in a matrix consisting of phosphates of zinc, magnesium and aluminum.

Properties:

- ◉ Have provided excellent clinical service due to ease of use, and wide range of applications.
- ◉ Well defined working time and a rapid setting time.

MANIPULATION

- ⦿ P/L ratio 3 gm : 1 ml.
- ⦿ For luting agent, working time 3-6 min., and setting time 5-14 min., (depending upon the mixing procedure).
- ⦿ The consistency is either thick (as for cavity bases or liners) or thin (as for luting agent).
- ⦿ Place known amounts of powder and liquid on the polished glass slab, and divide the powder into six separate portions.

MANIPULATION (CONTINUED)

- ◉ Using a linear (not rotary) motion of the spatula, with the edge sweeping approximately half the mixing area of the slab on each stroke, incorporate and mix the power and liquid.
- ◉ The total mixing time should be 90s and there should be no particles of powder and no unused liquid remaining on the slab when mixing is completed.
- ◉ Rapid mixing leads to shortening of working and setting times.
- ◉ Using cooled glass slab will increase the working time without setting time, thus allowing more powder to be added and raising the strength of final cement and reducing its solubility.
- ◉ Water contamination must be avoided.

MANIPULATION (CONTINUED)

- ◉ The combination of the cool glass and the incremental process ensures that an adequate working time is maintained (mixing time 60-90 sec.).
- ◉ The liquid is kept in a stoppered bottle otherwise loss of water and low pH will occur. Such liquid appears cloudy and then it must be discarded. This cloudy acid or liquid slows down the setting reaction of final cement.
- ◉ For luting agent ➡ dispense the P and L at the time you need them.
- ◉ Use the cement soon after mixing.

MIXING OF ZINC PHOSPHATE CEMENT



DESIRED CONSISTENCY OF CEMENT



BIOCOMPATIBILITY

- ◉ Freshly mixed ➡ pH 1.3-3.6 ➡ persisting up to 24h ➡ then returns to near neutral pH.
- ◉ Pulpal sensitivity may be due to high acidity, when freshly mixed.
- ◉ Some pain following cementation due to low pH and osmotic pressure which subsides within few hours. Persistent pulp irritation may have been caused by using too thin mix of the cement.
- ◉ Has no antibacterial effect, small shrinkage and does not provide ideal barrier to the ingress of bacteria.
- ◉ The hardening process of cement takes time and during the 24h, there is a significant release of magnesium with lower amount of zinc.



Mechanical properties:

- ⦿ In general mechanical properties are very much dependent upon the powder to liquid ratio of final cement (linear relationship)
- ⦿ Compressive strength varies from as low as 40 and up to 140 Mpa.
- ⦿ Initial strength occurs within the first 10 minutes and the final strength after 24h.

Thermal properties:

- ⦿ Zinc phosphate cements are good thermal insulators and may be effective in reducing galvanic effects.

SOLUBILITY

- ◉ Is important especially when it is used as luting agent as it may lead to loosening of restoration + caries.
- ◉ The cement is highly soluble in water for first 24h, and loss of material can range from 0.04-0.33% (an acceptable limit is 0.2%).
- ◉ Solubility is highly dependent upon P/L ratio.
- ◉ Fully set cement is slightly soluble in water (release of zinc and phosphates) but is still susceptible to acid attack in the presence of lactic acid.



Dental Cements

```
graph TD; A[Dental Cements] --> B[Calcium Hydroxide cements]; A --> C[Varnishes]; A --> D[Zinc-oxide based cements]; A --> E[Glass ionomer cements]; A --> F[Resin cements]; D --> G[Zinc oxide-Eugenol]; D --> H[Zinc oxide-phosphate]; D --> I[Zinc oxide-polycarboxylate]; G --> J[Modified]; G --> K[Unmodified];
```

Calcium
Hydroxide
cements

Varnishes

Zinc-oxide
based cements

Glass ionomer
cements

Resin cements

Zinc oxide-
Eugenol

Zinc oxide-
phosphate

Zinc oxide-
polycarboxylate

Modified

Unmodified

ZINC POLYCARBOXYLATE CEMENTS



ZINC POLYCARBOXYLATE CEMENTS

- ⦿ It was the first cement system developed with potential for adhesion to tooth structure.

Applications:

- ⦿ Primarily for luting permanent restorations.
- ⦿ As bases and liners.
- ⦿ Used in orthodontics for cementation of bands.

Available as:

- ⦿ Powder and liquid in bottles.
- ⦿ Capsules of proportioned powder and liquid.
- ⦿ ***Water Settable Polycarboxylate Cements***

COMPOSITION

Powder:

- ⦿ Zinc oxide; **basic ingredient**
- ⦿ Magnesium oxide; principle modifier and also aids in sintering
- ⦿ Stannous fluoride; increase strength, modifies setting time and imparts anti-cariogenic properties.
- ⦿ Oxides of bismuth and aluminum in small amounts

Liquid:

- ⦿ Aqueous solution of **polyacrylic acid**.

Water Settable Polycarboxylate Cements

- ⦿ In these cements, the polyacid is freeze dried and its powder is then mixed with the cement powder. Water is used as the liquid.
- ⦿ When the powder is mixed with water, the polyacrylic acid goes into the solution and the reaction proceeds as described for the conventional cements.

Setting Reaction

When the powder and liquid are mixed, the surface of powder particles are attacked by the acid, releasing zinc, magnesium and tin ions. These ions bind to the polymer chain via the carboxyl groups. They also react with carboxyl groups of adjacent polyacid chains to form cross linked salts.

PROPERTIES:

- ◉ Setting reaction is shorter compared with zinc-phosphate cements and are less viscous in general, despite the higher initial viscosity (pseudoplastic property.)
- ◉ P/L for luting cement is 1.5:1 by weight. (P/L ratio 3 gm : 1 ml)
- ◉ The higher the P/L ratio or higher M.W. of copolymer, the shorter working time.
- ◉ Extended W.T. by using cooled glass slab or by refrigerating the powder.
- ◉ Refrigeration of the liquid is not recommended ➡ gelation of the polymer due to hydrogen bonding.
- ◉ Shorter working time is a potential problem that can be overcome by optimizing the amount of tartaric acid in the material (without affecting the setting time).

Biocompatibility:

- ⊙ To soft and hard tissues ➡ less irritant than zinc phosphate cement because:
 - The liquid is rapidly neutralized by the powder. The pH of cement rises more rapidly than zinc phosphate.
 - Penetration of polyacrylic acid in dentinal tubules is less.
- ⊙ Low pH 3-4 (fresh mixed cement), pH of the cement is 5.0-6.0 after 24h.

Mechanical Properties:

- ⊙ Compressive strength of 55-85 Mpa depending on P/L ratio if prepared for luting (lower than zinc phosphate)
- ⊙ The material sets quickly and reaches 80% of its strength after 1h.

Solubility:

- ⦿ Solubility in water 0.1-0.6% by weight and is slightly more soluble than zinc phosphate cement.
- ⦿ It is more soluble in organic acids like lactic acid.
- ⦿ Low P/L ratio results in significantly higher solubility and disintegration in the oral cavity.

Adhesion:

- ⦿ The only cement that has ability to adhere to enamel and dentin and can be good enough to exceed the cohesive strength of cements.
- ⦿ Does not adhere to gold or porcelain.
- ⦿ Adhesion to stainless steel bands is excellent. Thus it is used in orthodontics for cementation of fixed appliances.

Thermal Properties:

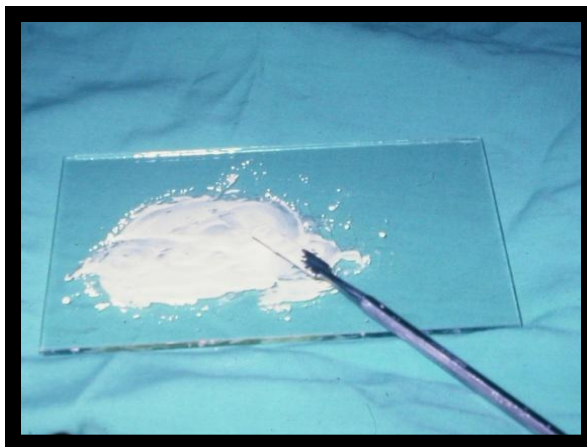
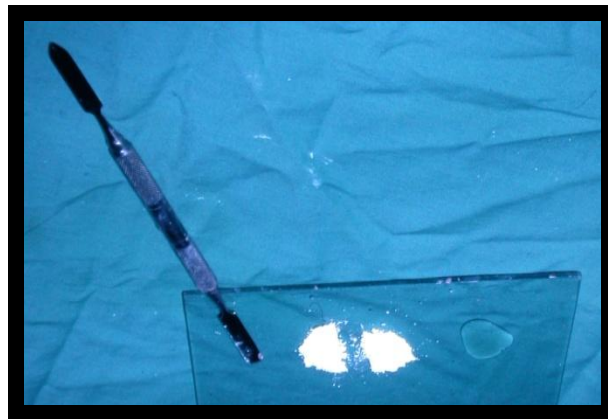
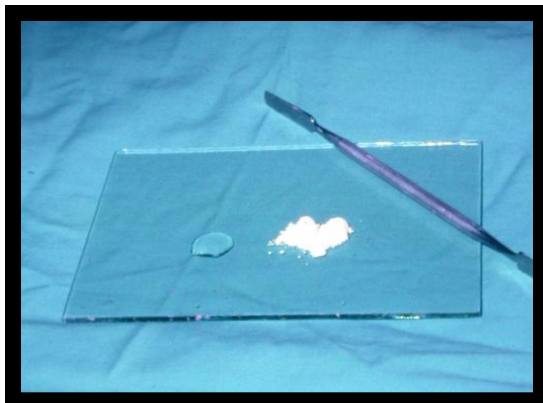
- ⊙ They are good thermal insulators.

Manipulation:

- ⊙ *Conditioning:* The tooth structure should be clean for proper bonding. To clean the surface, 10% polyacrylic acid solution followed by rinsing with water, or 1 to 3% H_2O_2 may be used. Then dry and isolate.

MANIPULATION:

- ◉ *Proportioning:* 1.5 parts of powder to 1 part of liquid by wt.
- ◉ *Procedure:* The powder and liquid are taken on a cooled glass slab.
- ◉ The liquid is dispensed just prior to the mixing otherwise viscosity increases. The powder is incorporated into the liquid in bulk (90%) with a cement spatula and remaining powder is added to adjust consistency. The mix appears quite thick but this cement will flow readily into a thin film when seated under pressure.
- ◉ *Mixing time:* 30 to 40 seconds.



POLYCARBOXYLATE CEMENT

Advantages

- ❑ Adhesion to tooth structure
- ❑ Pulpal biocompatibility. Large molecules do not penetrate dentinal tubules
- ❑ Lack of postoperative sensitivity
- ❑ Antibacterial
- ❑ History of success

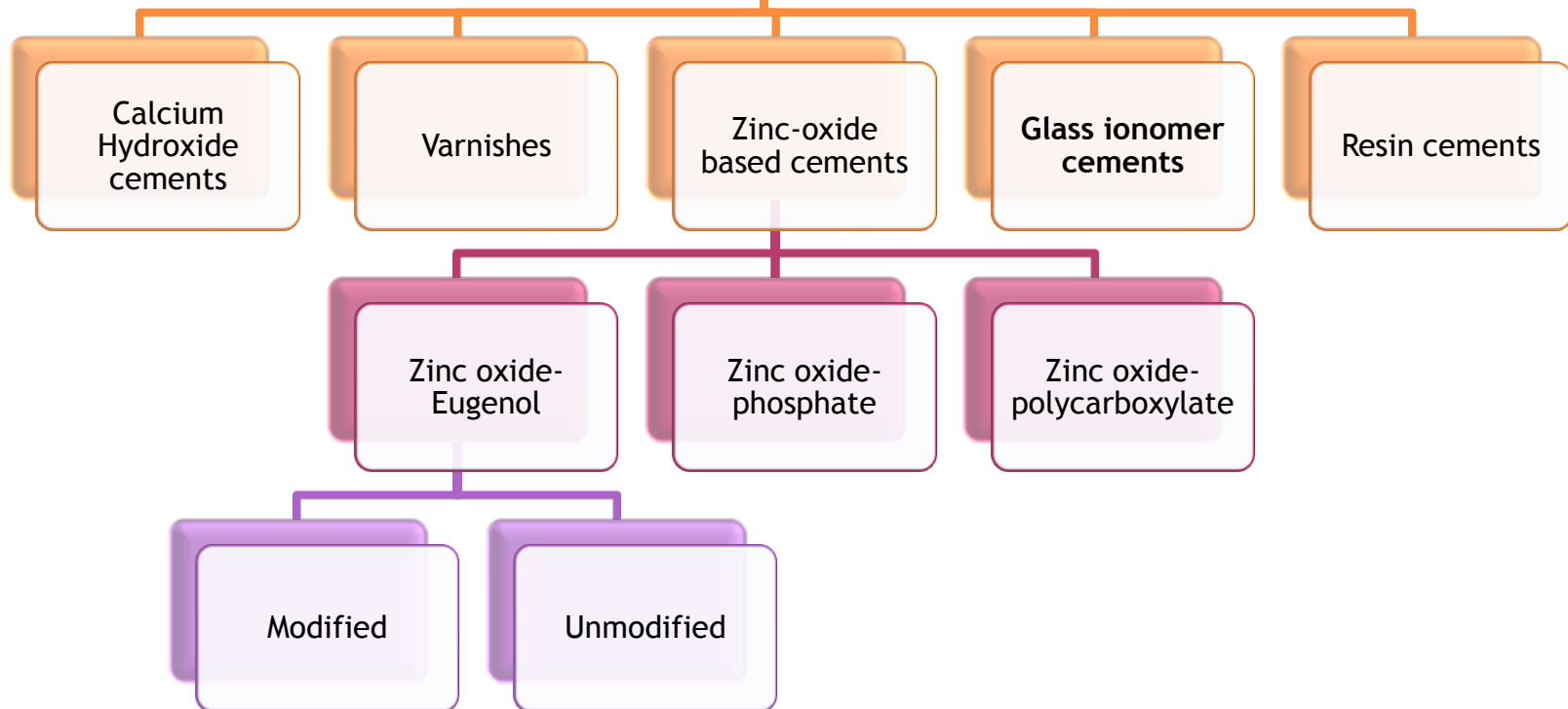
Disadvantages

- ❑ Rapid set causes sudden increase in viscosity- may impede complete seating
- ❑ Plastic deformation under occlusal forces- not suited for use in regions of high stress
- ❑ High solubility-leakage
- ❑ Low compressive strength

GLASS IONOMER CEMENTS



Dental Cements



GLASS IONOMER CEMENTS

- ⦿ This is a group of dental cements based on powders of alumina-silicate glass and liquids consisting of polyacrylic acid.

Composition:

- ⦿ **Powder:** Calcium fluoro-alumino silicate glass

Silica	<u>41.9%</u>
Alumina	<u>28.6%</u>
Alumina fluoride	1.6%
Calcium fluoride	<u>15.7%</u>
Sodium fluoride	9.3%
Aluminum phosphate	3.8%

- ◉ The mixture of this powder (which contains silica, alumina, sodium and aluminum fluorides ...ect.) is fused at high temperature and the molten mass is then shock-cooled and firmly ground to a powder.
- ◉ Particle size 50 μ m for filling and 20 μ m for luting and lining materials.
- ◉ The release of ions from glass (important for setting characteristics, the solubility, and the released of F) is a function of the type of glass employed.
- ◉ The esthetics of these restorations depend on the refractive index and presence of pigment in glass of powder.

POLYACID

- ◉ Wide range of polyacrylic acids are used with a large variety of formulations.
- ◉ Polyacids used mostly are copolymers of acrylic and itaconic acid or acrylic and maleic acid plus tartaric acid and water.
- ◉ The viscosity of liquid depends both upon the polyacid concentration and its MW.
- ◉ Tartaric acid controls pH during setting process which in turn controls the rate of dissolution of the glass.
- ◉ Tartaric acid improves the handling characteristics, increases working time and shortens setting time.
- ◉ Water is the most important constituent of the cement liquid, as it hydrates the reaction products. The amount of water in the liquid is critical. Too much water results in a weak cement. Too little water impairs the reaction and subsequent hydration.

AVAILABLE AS:

1. Powder / liquid

Problems:

- ⦿ Excessive solubility of cement in saliva coupled with slow setting reactions.
- ⦿ Obtaining correct or incorrect P/L ratio.
- ⦿ Reduced powder ➡ smooth creamy paste ➡ slower setting, weaker cement and more susceptible to dissolution.

2. Anhydrous cement ➡ water hardening type

3. Capsules ➡ pre-proportioned, powder / liquid in capsules.



SETTING REACTION

When the powder/liquid are mixed together, the acid liquid attacks the glass particles. Thus Ca, Al, Na and F ions are leached into the aqueous medium probably in the form of complexes.

- ◉ Calcium polysalts form first and later aluminum polysalts.
- ◉ The set cement consists of agglomerates of unreacted powder particles surrounded by silica gel and embedded in an amorphous matrix of hydrate Ca and AL polysalts.

SETTING REACTION

- ◉ Even after the cement has apparently set, precipitation of the polysalts for the initial set continues to occur. However, formation of calcium salt is probably responsible for the initial set. With time, the slower forming aluminum polysalts becomes the dominant phase in the matrix.
- ◉ Exposure of the cement to water before the hardening reaction is complete, leads to loss of cations and anions which leach out from the matrix as they can be dissolved.

PROPERTIES

Mechanical properties:

- ⦿ Compressive strength 150 Mpa
- ⦿ Tensile strength 6.6 Mpa
- ⦿ Hardness 49 KHN

Solubility and Disintegration:

- ⦿ The initial solubility is high (0.4%) due to leaching of intermediate products. The complete setting reaction takes place in 24h therefore the cement should be protected from saliva in mouth during this period. GIC are more resistant to attacks by organic acids.

ADHESION

- ◉ It provides good chemical adhesion to enamel and dentine. The exact mechanism has not been fully understood.
- ◉ The bonding is due to the reaction between the carboxyl groups of the polyacrylic acid and the calcium in the enamel and dentine.
- ◉ The bond to enamel is always higher than that to dentine, probably due to the greater inorganic content of enamel and its greater homogeneity.

Esthetics:

- ⦿ They are inferior to composites. They lack translucency and have a rough surface texture.

Biocompatibility:

- ⦿ Pulp response - mild.
- ⦿ The pulp reaction is greater than ZnOE cement but less than Zinc phosphate cement.
- ⦿ In deep cavities, the pulp should be protected by a layer of Ca(OH)_2 .

Anticariogenic Properties:

- ⦿ Fluoride release.
- ⦿ Adhesion-may reduce infiltration of oral fluids.

Manipulation

- ◉ Conditioning of tooth surface.
- ◉ Proper manipulation.
- ◉ Protections of cement during setting.
- ◉ Finishing.

Powder / Liquid ratio: Generally 3:1 by wt.

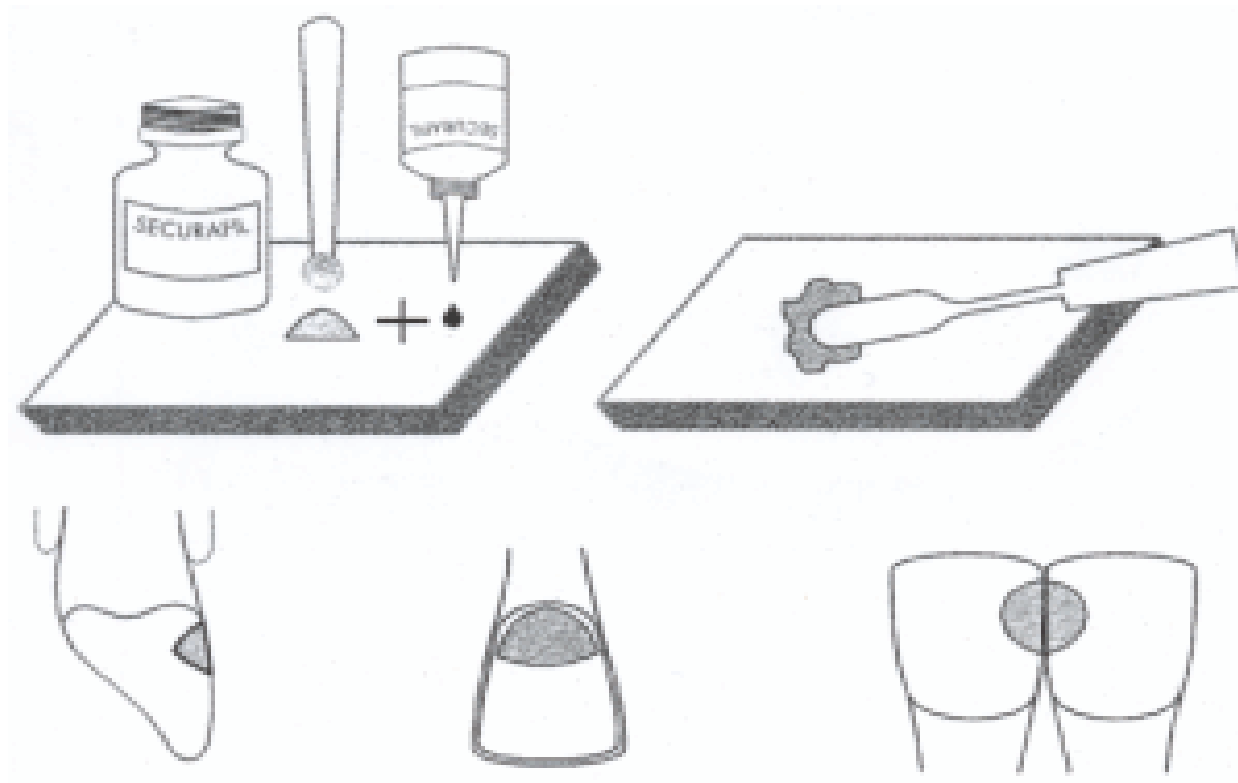
- ◉ Hand mixing:

The powder and liquid is dispensed just prior to mixing. A cool and dry glass slab is preferred as it allows all the powder to be incorporated into the mix and yet maintain its plasticity.

The powder is divided into 2 equal increments. The first increment is incorporated into the liquid rapidly with the stiff spatula to produce a homogenous milky consistency. The remainder of the powder is then added. The mixing is done in a folding method in order to preserve the gel structure.

- ◉ Mixing Time: 45 seconds.

MANIPULATION OF GIC



Mixing by Machine (mechanical):

- ◉ GIC supplied in capsule form containing proportioned powder and liquid and is mixed in an amalgamator which is operated at a very high speed. The capsule has a nozzle and so the mix can be injected directly into the cavity.

Advantages of Mechanical mixing:

- ◉ Better properties due to controlled P/L ratio.
- ◉ Less mixing time required.
- ◉ Convenient delivery system.

Disadvantages:

- ◉ Cement quantity limited by the manufacturer.
- ◉ Shade selection is limited.



Protection of Cement during Setting:

GIC is extremely sensitive to air and water during setting. Thus immediately before placement into the cavity, a pre-shaped matrix is applied to:

1. Protect the cement from the environment during initial set.
2. Provide maximum contour so that minimal finishing is required.

The matrix is removed after five minutes. Immediately after removal, the cement surface is again protected with:

1. A special varnish supplied by manufacturer, or
2. An unfilled light cured resin bonding agent.

GLASS IONOMER CEMENTS

Advantages

- Chemical adhesion to tooth
- Fluoride release
- High compressive strength
- Easy to mix
- Adhere to base metals

Disadvantages

- Sensitive to moisture contamination before setting-increases solubility
- Postoperative sensitivity
- Slow initial set

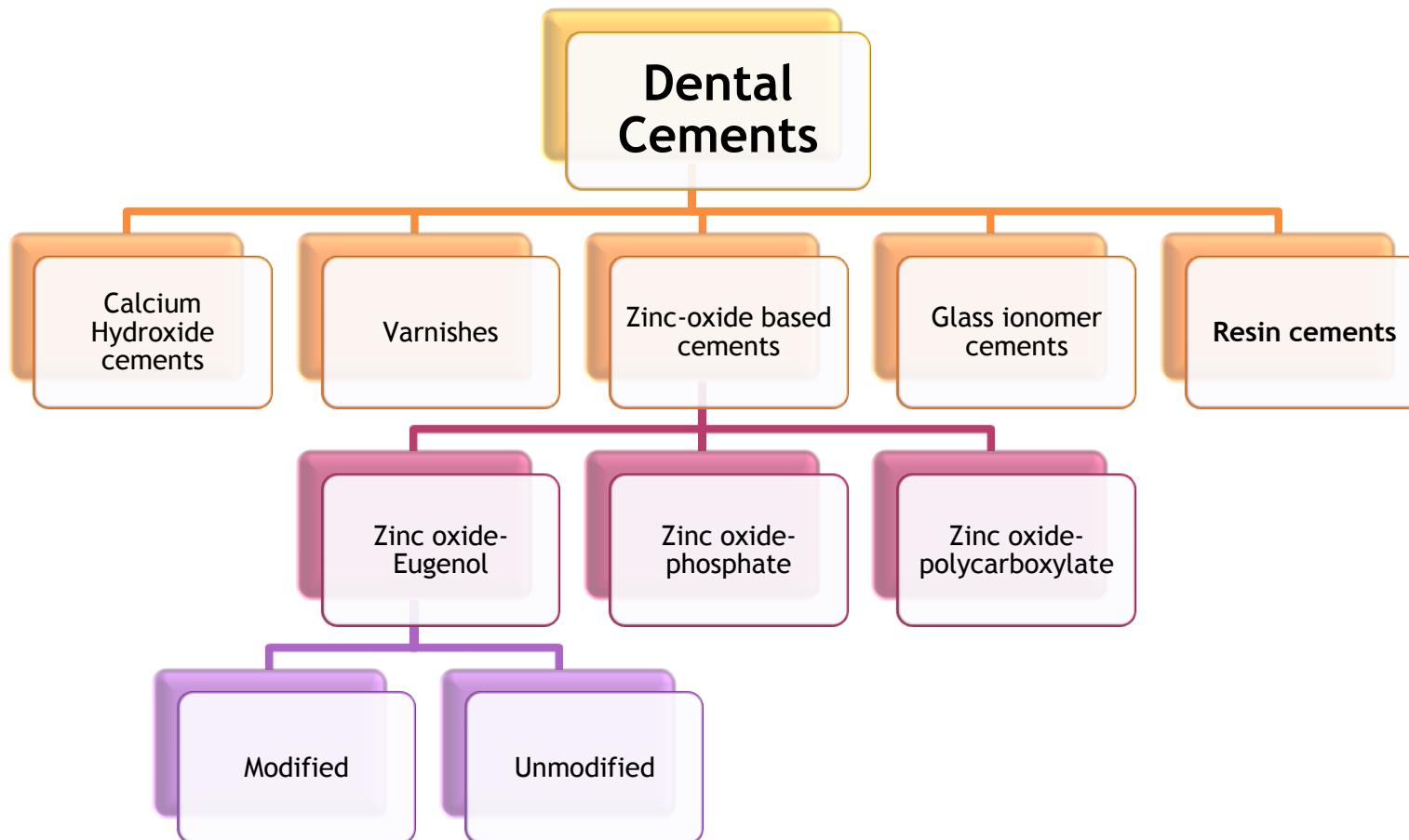
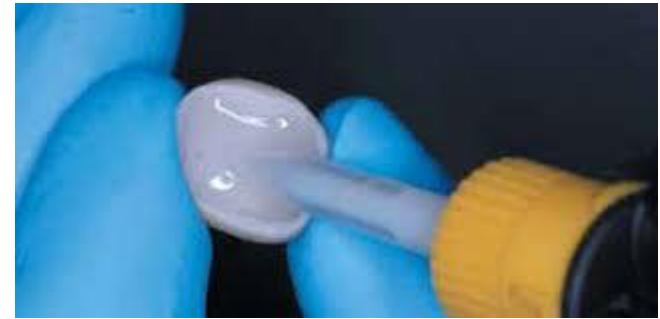
RESIN-MODIFIED GLASS IONOMER CEMENTS

Composition

- ⦿ Consists of fluoroaluminasilicate glass powder and an aqueous solution of polyalkenoic acid with methacrylate groups.
- ⦿ Supplied as powder-liquid or paste-paste.

- An improvement over the conventional GIC (improved mechanical properties with the same advantages of the conventional GIC)
- Disadvantages:
 - ⦿ Increased water sorption
 - ⦿ cost

RESIN CEMENTS



RESIN CEMENTS

Composition



- ◉ Consists of silane-treated boro-silicate glass in a resin matrix of BIS-GMA co-polymerized with ethylene glycol dimethacrylate as a viscosity diluent.
- ◉ Supplied as powder-liquid or paste-paste.
- ◉ Chemical (auto)-cure, light-cure or dual-cure cements.

Advantages

- **High strength**
- Insoluble
- Excellent bond to tooth
- Can be used with metals, laboratory composites or all-ceramic restorations

Disadvantages

- Multiple steps
- Moisture-sensitive technique
- Possible post-cementation sensitivity
- More expensive
- Little to no fluoride release

HAVE A GREAT DAY!

