

## *Operative dentistry*

### **Zinc oxide eugenol (ZOE):**

There are 2 types:

- 1) Unreinforced ZOE (ordinary type): supplied as  
**powder:** (zinc oxide + some additives like zinc acetate, white resin to increase strength of the material).  
**Liquid:** eugenol. Such ZOE formulations for temporary cements are popular and perform adequately.
- 2) Reinforced ZOE products are stronger and less soluble than the first one. Additives include either alumina, or polymethyl methacrylate resin is added to the powder. And the liquid contains in addition to eugenol ethoxybenzoic acid (EBA) used as intermediate bases.



### ***Properties and uses:***

- 1) ZOE has a sedative effect on dental pulp, so that is used as temporary restoration (ordinary type) before a permanent one is used. (modified type) create an insulating base under permanent restorations .
- 2) Eugenol inhibits free radical polymerization of composite materials, so ZOE is contra-indicated under composite.
- 3) Neutral in PH so, can be safely used in moderately deep cavities.
- 4) Radioopaque.
- 5) It adapts very closely to dentin, thus providing a good marginal seal.
- 6) Its antibacterial properties inhibit bacterial growth on the cavity walls.
- 7) To cement a temporary crown.

### ***Mixing:***

The powder is measured and dispensed with a scoop. The liquid is dispensed as drops. A glass slab is used for mixing P/L ZOE products. The powder is forced into the liquid using a cement spatula. The mixing process first incorporates large increments of powder then smaller increments. Spatulate the powder and liquid in quick motion with the flat side of the spatula, using a small portion of the mixing surface. Continue the procedure until the mix become thick, putty-like and it can be rolled into a ball with fingers without sticking to the skin for temporary restoration or as a cement base. For cementation we use the same way just with a different consistency (creamy).

### ***Insertion:***

As a temporary restoration carried with any suitable flat-bladed instrument to the cavity, packing is best affected by the use of a ball shaped piece of cotton damped with water or a plastic instrument may be used after dipping them in dry ZOE powder. The patient is requested

to close his mouth, bringing his teeth together in occlusion function, the proximal and cervical areas are contoured as carefully as if this was a permanent restoration.

As a base inserted in the same manner described for ZPC. Mastication on ZOE dressing should be limited. M.T 1½ min.

### **Polycarboxylate cement:-**

Was the first adhesive material developed for use in dentistry supplied as:

1) Powder: is zinc oxide and magnesium oxide. (Stainless steel fibers + alumina to increase the strength).

Liquid: is a weak solution of polyacrylic acid (30-50%) which is very viscous.

2) Water hardening cements or water setting:

P: zinc oxide or glass powder is mixed with the powdered anhydrous, freeze, dried, polyacrylic acid.

L: water.

### **Properties:-**

1- Polycarboxylate cement is not as acidic as ZPC because of

i) The PH of polycarboxylate rises more rapidly than that of ZPC.

ii) The large size of the polyacrylic acid molecules compared with phosphoric acid may limit its diffusion through the dental tubules and is very biocompatible.

2- The carboxylate groups of polyacrylic acid bond to calcium in tooth structure, and the bond to the enamel is stronger than dentin.

3- Polycarboxylate cement adheres to gold casting alloy.

### **Uses:-**

1) Intermediate base.

2) Luting cements

3) Used for direct bonding of orthodontic brackets to teeth.

### **Mixing:**

The powder and liquid are dispensed and mixed on a paper pad with a cement spatula. The liquid should not be dispensed until one is ready to mix, as water can evaporate and cause increase in viscosity with decrease in strength and higher solubility. The powder is rapidly incorporated to the liquid in large quantities; we should complete mixing within 30 -45sec. in order to provide sufficient working time (2.5-6 min.).

The mixed material must be placed while the cement is still glossy which indicate that the liquid still available to bond to the tooth "adhesion depends on unreacted carboxylic acid groups".

For placing the material as a base the procedure is similar to that of ZPC.

### **Glass ionomer cement (GIC):-**

Powder: is an acid soluble, calcium fluoro-alumino silicate glass.

Liquid: an aqueous solution of polyacrylic acid that contain carboxyl group (viscous liquid).

### **Uses:**

1- As a base material in deep cavity

2- As a luting agent for permanently cement crown and orthodontic band

3- As a restorative material (esthetic).

4- Pit and fissure sealants.

5- Core build up material.

### **Types:-**

1) Type I\_ Luting.

2) Type II\_ Restorative (esthetic)

3) Type III\_ Base/Liner

- 4) Type IV\_ Pit and fissure sealants.
- 5) Type V\_ Luting for orthodontic purposes.
- 6) Type VI\_Core build up material.
- 7) Type VII\_High Fluoride releasing command set.
- 8) Type VII\_(ART) Atraumatic restorative treatment.
- 9) Type IX\_Pediatric GIC.

***Properties:-***

- GIC materials are strongest and least soluble dental cements. They are also adhesive and release fluorides. They have a good biocompatibility.
- GIC materials bond to tooth structure; in addition they bond to stainless steel and alloys ceramometal crown.
- Dehydration causes crazing and cracking and produces an opaque restoration. Water absorption can cause swelling and surface disruption and protection is required for 10- 30 min. after placement.

Various improvements in the original material have been made and incorporated into a number of formulations:

1- Conventional GIC: this is composed of powder, which is Ca, fluoro alumino-silicate glass, and the liquid is polyacrylic acid.

Used as liner, base, cement.

2- Metal- modified glass ionomers: (used as filling material for class V(permanent teeth), class I and II (primary teeth), bases under composite and amalgam, cores).

i- Miracle mixture (amalgam alloy particle admixed with cement powder).

ii- Cermet particle reinforcement (Ag-Pd). Much stronger than unmodified, but had poor esthetic.

3- Light cured glass ionomers: (liners, bases) hydroxyethyl methacrylate (HEMA) added to liquid component and light cure accelerator. Other powder particles mixed with alumino-silicate glass. Is more desirable under composite materials because this type is acid resistance.

4- Hybrid (resin-modified) glass ionomers (cements, restorative filling material, cores).

-HEMA and other polymers added to the liquid component.

-Polymers added to powder component.

-Silicate glass of composites substituted for some powder.

They are light cured, less technique sensitive, stronger.

***Mixing:-***

It's critical that GIC is properly mixed and handled. If it is not, non-adhesive materials result. The powder is dispensed with a scoop, and the liquid is dispensed as drops. A cement spatula and paper pad are typically used "special mixing pad will keep all the liquid available for the reaction and facilitate spatulation". The powder incorporated into the liquid in one or two portions and the mixing process is much quicker than for ZOE, ZPC, if the mixing procedure is too slow, the resulting mix becomes too thick. Mixing time 30-45 sec. S.T. 7 min. W.T.2min.

The best results have been obtained when the material is applied to clean cavity walls that are well isolated in a dry field. The mixed cement should be used only as long as it still appears glossy on the surface.

GIC may be dispensed in disposable capsules that mixed in an amalgamator. Specific directions for mixing are provided by the manufacturer. The capsule has a "spout" where the mixed material is expressed from the capsule with a gun or dispenser.

The use of GIC as intermediate layer between dentin and resin composite is often referred to as (sandwich technique).

GIC use most often in conjunction with class II resin composite restorations is sometimes called the bonded-base techniques.



### **Clinical consideration of lining materials according to the depth of cavity:**

- **In shallow cavity** (1-2 or more of remaining dentin) for amalgam restoration: the cavity is coated with 2 thin coats of a varnish and restored. For composite restoration, the cavity is etched, primed coated with single coat of a bonding agent and then restored.
- **Moderately deep cavity**, varnish is used first then cement base such as ZPC or modified ZOE cement may be contoured to replace the missing dentin, then amalgam restoration.
- If we want to use adhesive base cement (GIC, polycarboxylate cement) varnish or bonding agent is not indicated at first because the coating will eliminate the potential for adhesion.
- **In deep cavity**, a liner such as  $\text{Ca}(\text{OH})_2$  on the pulpal and axial wall, overlaid with a base then restorative materials.

If there is a pulp exposure, calcium hydroxide is used to stimulate reparative dentin.

The best possible base for any restoration is sound tooth structure. So you must remember that: Don't remove sound tooth structure to provide space for a base. Maintaining sound dentin will enhance restoration support and provide maximum dentin thickness for pulpal protection.

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