Cavity liner and cement base (part 2)

3- Zinc polycarboxylate cement:

Zinc polyacrylate cement (or zinc polycarboxylate) is supplied as a powder and a liquid or as a powder that is mixed with water. The liquid is a water solution of polyacrylic acid (32% to 42%). The cement powder is essentially zinc oxide and magnesium oxide. The cement powder that is mixed with water contains zinc oxide particles coated by 15% to 18% polyacrylic acid.

Properties

1- Polycarboxylate cement is one of the dental cement systems which have chemical adhesion to enamel and dentin, by the ability of the carboxylate groups in the cement molecule to chelate to calcium in enamel and dentin.
2- The large sizes of the polyacrylic acid molecule, which can't penetrate through dentinal tubules, make this cement a low irritant to the pulp, so this cement is used as a base or for cementation with sensitive teeth.
3- Short setting time (2-6 minutes).
4- This cement is sensitive to disintegration and solubility more than zinc phosphate cement.
5- Polycarboxylate cement adheres to gold-casting alloy

Uses:-

1- As a luting agent.
2- As a base material.
3- In orthodontics for cementation of bands.

Manipulation:-

1- Powder/liquid ratio for the base consistency is 2-3 parts of powder to 1 part of liquid by weight. The powder/liquid ratio becomes (1.5/1) when using polycarboxylate cement as a luting agent.
2- A dry and cool glass slab is used for mixing, the cooling slows the chemical reaction and thus provides a longer working time.
3- The liquid should not be dispensed until just before the time of mixing, to avoid evaporation of water which cause an increase in the viscosity and will cause a decrease in strength and higher solubility.
4- The mix should be completed within 30-40 seconds.

4- Glass ionomer cement:-

Glass ionomer cement is supplied as a powder and a liquid or may come as capsules. The powder is fluoro-alumino-silicate glass. The liquid typically is a 47.5% solution of 2: 1 polyacrylic acid and itaconic acid copolymer.

Uses:-

1- As a base material.
2- Luting agent.
3- Also can be used as a filling material, especially for the modified types of glass ionomer cement (Cl I, Cl III, Cl V).
4- Fissure sealants.

Properties:

1- The compressive strength is greater than zinc phosphate cement.
2- Glass ionomer cement is very sensitive to contact with water during setting. The field must be isolated completely. If glass ionomer is used as filling material, once the cement has achieved its initial set (about 7 minutes), coat the cement surface with a coating agent such as a varnish, because the complete setting reaction takes place in 24 hours.
3- Glass ionomer cement bonds to tooth structure chemically by ionic interaction with calcium and/or phosphate ions from the surface of the enamel or dentin. In addition, when the enamel surface is conditioned (etched with 37% phosphoric acid), the bond strength

of glass ionomer cement becomes greater, because acid etching of the enamel surface will produce micro porosities on the etched surface that will improve the mechanical retention.

4- Glass ionomer cement release fluoride, so it has an anti-cariogenic effect (bacteriostatic or bactericidal), thus this cement can be used in a patient with a high caries index.

Classification of glass ionomer cement:

The most practical classification of Glass ionomer cements are on their clinical usage into:

- **Type I Glass ionomer cements**: are the luting cements, characterized by low film thickness and rapid set.
- **Type II Glass ionomer cements** are restorative cements, with subtypes into two types.
    - **Type II-1 Glass ionomer cements** are aesthetic cements (available in both conventional and resin-modified presentations) and
    - **Type II-2 Glass ionomer cements** are 'reinforced' cement which are more wear-resistant.
- **Type III Glass ionomer cements** are the lining cements and fissure sealants, characterized by low viscosity and rapid set.

5- Resin cements:-

Are thin versions of restorative resins (e.g. calibra and panavia resin cements), consisting of a resin matrix with inorganic fillers that are bonded to the matrix with monomers. The fillers are silica or glass particles, and the level of the filler varies from 40%-80% by weight. The bonding of the cement to enamel is attained by the acid-etch technique. Then bonding agent is used to provide mechanical adhesion of the cement to the etched surface of the tooth. Polymerization of resin cement is achieved either by chemical reaction (self-cure), light activation (light cure), or both (dual cure). The self-cured composite cement is typically two pastes system (base and catalyst), while the light cure cement is a single-component system.

Properties:

1- Resin cements are insoluble in oral fluids.
2- Higher filler particle loading results in higher mechanical properties (strength and stiffness) and reduced polymerization shrinkage, and a lower coefficient of thermal expansion.
3- In some products, fluoride is added to act as an anti-cariogenic factor, and reduce resin cement sensitivities.

Uses:

1- As a luting material either for cast or for tooth-colored restorations such as esthetic ceramic and laboratory-processed composite restoration.
2- Also resin cement with a high filler range can be used as a base material.

Cavity liners

1- Cavity varnishes:-

They are solutions of natural resins or synthetic resins dissolved in a solvent such as alcohol, chloroform, or acetone. The solvent evaporates, leaving a thin film on the cavity preparation.

Functions:-

1- It is placed on enamel and dentin walls to reduce the penetration of oral fluids around amalgam restoration. The cavity varnish inhibited microleakage during the first few weeks. After that, the varnish will be dissolved by oral fluids and replaced by the corrosion products of the amalgam which form at the amalgam tooth interface.
2- Varnish is applied on dentin surfaces to minimize penetration of the acid from zinc phosphate cements by occluding the orifices of the dentinal tubules.
3- Reduce post-operative sensitivity.

Properties:

1- Varnishes, neither possess mechanical strength nor provide thermal insulation because of thin film thickness.
2- When glass ionomer cement is used as a base material, varnish should not be used as a subbase, because glass ionomer cement

contains fluoride, and varnish prevents fluoride release and reaction with the tooth, also varnish prevents the chemical bonds between tooth and glass ionomer cement.

3- Varnish should not be used when the restoration is composite resin. Because varnish inhibits the polymerization reaction of omposite resin material. So calcium hydroxide can be used under composite resin.

Manipulation: -

Varnish solutions are usually applied by a mean of a small round piece of cotton. A thin layer is applied to the preparation and then gently dried with a steam of air. A minimum of 2 thin layers should be applied, as the initial layer dries it leaves small voids, so the second layer fills in the voids and produce a more continuous coating.

Varnish solutions should be tightly capped immediately after use to minimize loss of solvent. Most varnishes are supplied with a separate bottle of a pure solvent this solvent is used to keep the varnish from becoming too thick, also used for removing varnish from the external tooth surface.

2- Bonding agent:

Generally, bonding agents are unfilled resins that are used for mechanical adhesion of the composite restoration to the conditioned enamel and dentin. The conditioning is achieved by using 37% phosphoric acid for 15-60 seconds then washing and drying the tooth. These bonding agents act as a liner for composite restorations especially for shallow cavities because they occlude the orifices of dentinal tubules and reduce post-operative sensitivities.

Also, special bonding agents are introduced as amalgam bonds which can act as a liner for amalgam restorations by sealing the cavity against fluid flow and microleakage.

3- Calcium hydroxide: Ca(OH)2

Usually referred to as liner, intermediate base, or pulp capping agent; examples: calcipulp, dycal, hydrex. Calcium hydroxide is supplied as a two-paste system one is a base and the other is a catalyst.

Properties:

1- The set material has an alkaline PH (9.2-11.7), which reduces the acidity of zinc phosphate when used as a sub-base material in deep cavities.
2- The antimicrobial action of calcium hydroxide makes this material useful in indirect pulp capping procedures.
3- Calcium hydroxide stimulates the odontoblast cells for the formation of secondary dentin (stimulates the formation of the dentinal bridge) when it is put directly over exposed pulp tissue, so calcium hydroxide is used for direct pulp capping.
4- Water is an important component for the setting reaction of calcium hydroxide-based liner.

Manipulation:-

Equal lengths of the different colored pastes are dispensed on a paper pad and then mixed into a uniform color (homogenous) and then applied by using of dycal applicator. The setting time is short (about 1-2 minutes); therefore, the mix should be done quickly and then applied on a dry dentin so flow freely and easily. Proper setting requires humidity; place a moist cotton pellet at the opening of the cavity, on top of the newly placed cement for 30 seconds. Be sure that the cotton does not contact the cement. After 30 seconds, check the cement gently with the explorer to ensure that it cannot be penetrated.

* A resin has been added to calcium hydroxide to improve its properties (improve thermal and mechanical properties, reduce solubility) and the setting is performed by light curing.

General Clinical Consideration: -

After cavity preparation, certain factors should be taken into consideration during lining placement in the cavity:

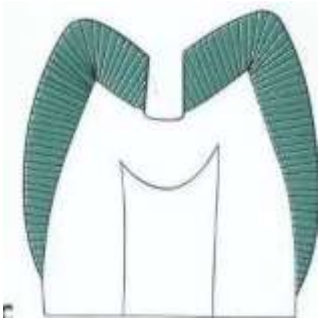
1- The prepared cavity should be clean and dry before the application of the lining material. The quadrant of the prepared tooth should be isolated completely from saliva because the entire lining and base material is sensitive to water during their application and setting.
2- All liners and base materials undergo dissolution and disintegration in saliva with time; therefore, they should not reach the margins of the cavity (except varnishes and bonding agents). So lining is placed

on: the pulpal floor in Cl I, the pulpal floor and axial wall in Cl II, axial wall in Cl III, IV, and V.

3- In cavities prepared for amalgam restorations, the base material should not be extended on the walls of the cavity because this material will block the undercuts (convergence of the buccal and lingual walls) which are important for amalgam retention. Also, all the retentive holes, grooves, and pins should be free from lining before amalgam placement.

Cavities can be classified according to their proximity from the pulp into:

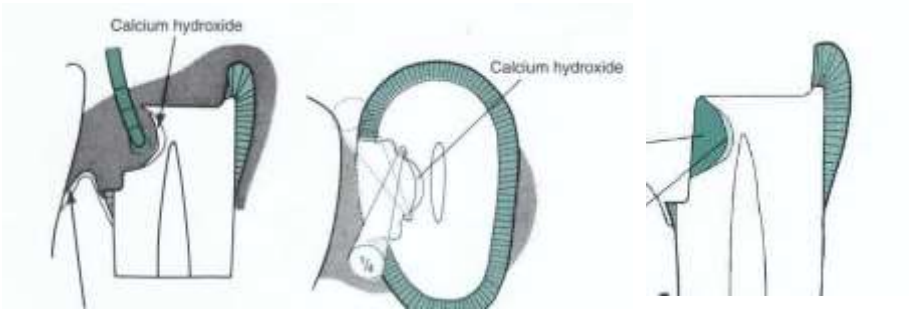
1- **Shallow cavity preparation**: - there is no need for pulpal protection, and there is a sufficient thickness of dentin so that no protective base is required. For dental amalgam, the cavity is coated with two thin coats of a varnish or amalgam bond and restored. For a composite, the cavity is etched, coated with a single coat of a bonding agent, and restored. Both varnish and the bonding system provide chemical protection



2- **Moderately deep cavity**: a prepared cavity that extends into dentin beyond the minimal depth necessary to attain retention and strength for the restorative material. Varnish is used to coat the floor and walls, then a cement base such as zinc phosphate cement, or modified ZOE cement may be contoured to replace the missing dentine.



3- **Deep cavity**: - that includes some extension toward the pulp, a liner such as Ca (OH) 2 should be applied on the pulpal and axial walls. On top a cement base is placed such as zinc phosphate cement, modified zinc oxide eugenol cement, or polycarboxylate cement then a varnish is used to coat the walls. Recently, a new protocol prefers the use of dycal with a glass ionomer base, because of the presence of chemical bonding between the tooth and the glass ionomer cement that will reduce microleakage and the sensitivity postoperatively.



4- **Deep cavity with exposure of the pulp**: - exposure of a small area of the pulp with no sign or symptoms of degenerating pulp, the choice of conservation pulp capping is recommended. In an isolated clean field, calcium hydroxide is carefully placed over the pulp and the border of dentin that surround the exposure site. A base material is placed on the top (such as zinc phosphate or reinforced zinc oxide eugenol), and also glass ionomer cement base is preferred. The restoration of the tooth should be completed as soon as possible. A secondary dentin barrier is likely to be formed within a few weeks.