IQRA NATIONATL UNIVERSITY PESHWAR

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Q1. Discuss glass ionomer cement briefly?

A glass ionomer cement (GIC) is a dental restorative material used in dentistry as a filling material and luting cement, including for orthodontic bracket attachment. Glass-ionomer cements are based on the reaction of silicate glass-powder (calciumaluminofluorosilicate glass and polyacrylic acid, an ionomer. Occasionally water is used instead of an acid, altering the properties of the material and its uses. This reaction produces a powdered cement of glass particles surrounded by matrix of fluoride elements and is known chemically as glass polyalkenoate. There are other forms of similar reactions which can take place, for example, when using an aqueous solution of acrylic/itaconic copolymer with tartaric acid, this results in a glass-ionomer in liquid form. An aqueous solution of maleic acid polymer or maleic/acrylic copolymer with tartaric acid can also be used to form a glass-ionomer in liquid form. Tartaric acid plays a significant part in controlling the setting characteristics of the material. Glass-ionomer based hybrids incorporate another dental material, for example resin-modified glass ionomer cements (RMGIC) and compomers.

History:

Dental sealants were first introduced as part of the preventative programme, in the late 1960s, in response to increasing cases of pits and fissures on occlusal surfaces due to caries. This led to glass ionomer cements to be introduced in 1972 by Wilson and Kent as derivative of the silicate cements and the polycarboxylate cements. The glass ionomer cements incorporated the fluoride releasing properties of the silicate cements with the adhesive qualities of polycarboxylate cements. This incorporation allowed the material to be stronger, less soluble and more translucent (and therefore more aesthetic) than its predecessors.

Advantages:

Glass ionomer sealants are thought to prevent caries through a steady fluoride release over a prolonged period and the fissures are more resistant to demineralization, even after the visible loss of sealant material. however, a systemic review found no difference in caries development when GICs was used as a fissure sealing material compared to the conventional resin based sealants, in addition, it has less retention to the tooth structure than the resin based sealants.

These sealants have hydrophilic properties, allowing them to be an alternative of the hydrophobic resin in the generally wet oral cavity. Resin-based sealants are easily destroyed by saliva contamination.

Chemically curable glass ionomer cements are considered safe from allergic reactions but a few have been reported with resin-based materials. Nevertheless, allergic reactions are very rarely associated with both sealants.

Disadvantages:

The main disadvantage of glass ionomer sealants or cements has been inadequate retention or simply lack of strength, toughness, and limited wear resistance. For instance, due to its poor retention rate, periodic recalls are necessary, even after 6 months, to eventually replace the lost sealant. Different methods have been used to address the physical shortcomings of the glass ionomer cements such as thermo-light curing(polymerization), or addition of the zirconia, hydroxyapatite, N-vinyl pyrrolidone, N-vinyl caprolactam, and fluoroapatite to reinforce the glass ionomer cements.

Clinical uses:

The different clinical uses of glass ionomer compounds as restorative materials include;

- **Cermets:**

  which are essentially metal reinforced, glass ionomer cements, used to aid in restoring tooth loss as a result of decay or cavities to the tooth surfaces near the gingival margin, or the tooth roots, though cermets can be incorporated at other sites on various teeth, depending on the function required. They maintain adhesion to enamel and dentine and have an identical setting reaction to other glass ionomers. The development of cermets is an attempt to improve the mechanical properties of glass ionomers, particularly brittleness and abrasion resistance by incorporating metals such as silver, tin, gold and titanium. The use of these materials with glass ionomers appears to increase the value of compressive strength and fatigue limit as compared to conventional glass ionomer, however there is no marked difference in the flexural strength and resistance to abrasive wear as compared to glass ionomers.

- **Dentine surface treatment**:

  which can be performed with glass ionomer cements as the cement has adhesive characteristics which may be useful when placed in undercut cavities. The surfaces on which the glass cement ionomers are placed would be adequately prepared by removing the precipitated salivary proteins, present from saliva as this would greatly reduce the receptiveness of the glass ionomer cement and dentine surface, to bond formation. A number of different substances can be used to remove this element, such as citric acid, however the most effective substance seems to be poly(acrylic) acid, which is applied to the tooth surface for 30 seconds before it is washed off. The tooth is then dried to ensure the surface is receptive to bond formation but care is taken to ensure desiccation does not occur.

- **Matrix techniques**:

  with glass ionomers, which are used to aid in proximal cavity restorations of anterior teeth. Between the teeth that are adjacent to the cavity, the matrix is inserted, commonly before any dentine surface conditioning. Once the material is inserted in excess, the matrix is placed around the tooth root and kept in place with the help of firm digital pressure while the material sets. Once set, the matrix can be carefully removed using a sharp probe or excavator.

- **Fissure sealants**:

  which involve the use of glass ionomers as the materials can be mixed to achieve a certain fluid consistency and viscosity that allows the cement to sink into fissures and pits located in posterior teeth and fill these spaces which pose as a site for caries risk, thereby reducing the risk of caries manifesting.

- **Orthodontic brackets**:

  which can involve the use of glass ionomer cements as an adhesive cement that forms strong chemical bonds between the enamel and the many metals which are used in orthodontic brackets such as stainless steel.

  Fluoride varnishes have been combined with sealant application in the prevention of dental caries. It has been proven that the combined usage of both increases the overall effectiveness as compared to using fluoride varnish alone.

Chemistry and setting reaction:

All GICs contain a basic glass and an acidic polymer liquid, which set by an acid-base reaction. The polymer is an ionomer, containing a small proportion – some 5 to 10% – of substituted ionic groups. These allow it to be acid decomposable and clinically set readily.

The glass filler is generally a calcium alumino fluorosilicate powder, which upon reaction with a polyalkenoic acid gives a glass polyalkenoate-glass residue set in an ionised, polycarboxylate matrix.

The acid base setting reaction begins with the mixing of the components. The first phase of the reaction involves dissolution. The acid begins to attach the surface of the glass particles, as well as the adjacent tooth substrate, thus precipitating their outer layers but also neutralising itself. As the pH of the aqueous solution rises, the polyacrylic acid begins to ionise, and becoming negatively charged it sets up a diffusion gradient and helps draw cations out of the glass and dentine. The alkalinity also induces the polymers to dissociate, increasing the viscosity of the aqueous solution.

Q2. Differentiate permanent cement, luting agent and temporary cement.

Permanent cement:

In light of the new advances in dental materials technology, the decision-making in the selection of the suitable dental cement has become more difficult than ever before. The focus of this article is to provide the practitioner with a brief understanding of the properties and classifications of permanent cements.[1] This will enhance the clinician’s overall ability to make the best selection of cement to enhance the success and longevity of an indirect restorat.

luting agent:

A luting agent is an application of a dental cement connecting the underlying tooth structure to a fixed prosthesis. To lute means to glue two different structures together. There are two major purposes of luting agents in dentistry – to secure a cast restoration in fixed prosthodontics (e.g.

for use of retaining of an inlay, crowns, or bridges), and to keep orthodontic bands and appliances

In a complex restoration procedure, the selection of an appropriate luting agent is crucial to its long-term success.[1] In addition to preventing the fixed prosthesis from dislodging, it is also a seal, preventing bacteria from penetrating the tooth-restoration interface.[2]

Zinc phosphate is the oldest material available and has been used in dentistry for more than a century. The introduction of adhesive resin systems made a wide range of dental materials available as luting agents. The choice of luting agent is dependent on clinical factors including dental occlusion, tooth preparation, adequate moisture control, core material, supporting tooth structure, tooth location, etc.[3] Research has determined that no single luting agent is ideal for all applications.

Temporary cement:

In dentistry, temporary cements are used to temporarily bond provisional restorations, which include inlays, onlays, crowns, bridges, and implants. While there are numerous types of temporary cements, the most common types are eugenol-based, non-eugenol based, and resin based.

Q3. Write a detail note on manipulation, advantages and disadvantages of Zinc Oxide Eugenol cement.

Zinc Oxide Eugenol cement:

Zinc oxide eugenol (ZOE) cement have been used extensively in dentistry since 1890s. They are cements of low strength. Also they are the least irritating of all dental cements and are known to have an obtundant effect on exposed dentin.

Classification:

- **Type I ZOE: For temporary cementation**
- **Type II ZOE: Permanent Cementation**
- **Type III ZOE: Temporary filling and thermal base**
- **Type IV ZOE: Cavity Liners**

ZOE cement is available as

- **Powder and liquid or**
- **Two – paste system**

Manipulation:

Power – Liquid System

Powder/liquid ratio: 4:1-6:1 wt%

After shaking the bottles gently, measured quantity of powder and liquid are dispensed onto a cool glass slab. The bulk of the powder is incorporated into the liquid and saturated thoroughly in a circular motion with a stiff bladed stainless steel spatula. Smaller increments are then added until the mix is complete.

Advantages:

- It exhibit good esthetic qualities .
- Anticariogenic property.
- Analogues to topical applied fluoride solution.

Disadvantages:

- It lacks stability in oral fluids with loss of esthetic qualities
- Rubber dam is essential for successful silicate restoration.
- Irritant to pulp.

Q4. Briefly explain polycarboxylate cement.

Polycarboxylate Cement:

When zinc polycarboxylate cement is used, the bond occurs between the carboxylic acid groups in the liquid polyacrylic acid and the calcium in the tooth structure. The powder of the cement is essentially zinc oxide. This cement continues to maintain some presence in the marketplace because it offers good biocompatibility with pulp tissue.

Because the ultimate properties are affected by changes in the water content of the liquid, the cement liquid should not be dispensed until just before the mix is to occur. Increases in the powder/liquid ratio make the cement less adherent to the tooth; decreases in the ratio result in increased solubility. The powder is quickly added to the liquid and the mix completed within 30 seconds. If the surface of the cement is not glossy in appearance, the mix should be discarded and a new one prepared. The gloss is an indicator of the presence of the carboxylic acid groups required for cement-tooth bonding.

Q5. Distinguish liquid powder ratio of Zinc phosphate cement, also write its uses and advantages.

Powder and liquid system:

POWDER:

Zinc Oxide- 90.2%.

- Principal constituent.

Magnesium Oxide- 8.2%.

- Aids in sintering.

Other Oxide- 0.2%.

- Improve smoothness of mix.

Silica- 1.4%.

- Filler.

Liquid:

Phosphoric Acid- 38.2%.

- React with zinc oxide.

Water- 36.0%.

- Control rate of reaction.

Aluminium Phosphate- 16.2%.

- Buffer.

Aluminium- 2.5%.

Zinc- 7.1%.

Uses:

It is commonly used for luting permanent metal and zirconium dioxide restorations and as a base for dental restorations. Zinc phosphate cement is used for cementation of inlays, crowns, bridges, and orthodontic appliances and occasionally as a temporary restoration.

Advantages:

- Good compressive strength.
- Good thermal insulation ability.
- Dose not dissolve in oral fluids