

GLASS IONOMER

Dentalelle Tutoring

The Basics

- Glass ionomer cements are tooth-coloured materials that bond chemically to dental hard tissues and release fluoride for a relatively long period.
- In areas with high decay rate, or where additional protection is needed from decay, glass ionomer is best!

Types

- In general, glass ionomer cements are classified into three main categories: *conventional, metal-reinforced and resin-modified*.
- **Conventional glass ionomer** cements are the powder and liquid mixed together, an acid-base reaction occurs. As the metallic polyalkenoate salt begins to precipitate, gelation begins and proceeds until the cement sets hard.

Recently, several faster setting, high-viscosity conventional glass ionomer cements have become available. These materials set faster and are of higher viscosity because of finer glass particles, anhydrous polyacrylic acids of high molecular weight and a high powder-to-liquid mixing ratio. The setting reaction is the same as the acid-base reaction typical of conventional glass ionomer cements.

- **Metal-reinforced glass ionomer cements** were first introduced in 1977. The addition of silver-amalgam alloy powder to conventional materials increased the physical strength of the cement and provided radiopacity.
 - In 1992, resin-modified glass ionomer cements were developed that could be light cured. In these materials, the fundamental acid-base reaction is supplemented by a second resin polymerization usually initiated by a light-curing process. In their simplest form, they are glass ionomer cements that contain a small quantity of a water-soluble, polymerizable resin component.

Advantages

- By bonding a restorative material to tooth structure, the cavity is theoretically sealed, protecting the pulp, eliminating secondary caries and preventing leakage at the margins. This also allows cavity forms to be more conservative and, to some extent, reinforces the remaining tooth by integrating restorative material with the tooth structures.
- The shear bond strength of conventional glass ionomer cements to conditioned enamel and dentin is relatively low. However, this bond strength is more a measure of the tensile strength of the cement itself, since fractures are usually cohesive within the cement, leaving the enriched residue attached to the tooth.
- Comparisons between resin-modified glass ionomer cements and conventional materials reveal that the shear bond strength of the former is generally greater, but that they show very low bond strength to unconditioned dentin compared to conventional materials.
- **Conditioning** therefore plays a greater role in achieving effective bonding with the resin-modified glass ionomer cements. In addition, when the enamel surface is etched with phosphoric acid, the bond strength of the resin-modified materials is close to that of composite-resin bonded to etched enamel. **This suggests, along with the effects of light-curing, that the bonding mechanism of resin-modified glass ionomer cements may be different from that of conventional materials.**

Margins

- The coefficient of thermal expansion of conventional glass ionomer cements is close to that of dental hard tissues and has been cited as a significant reason for the good margin adaptation of glass ionomer restorations.
- Even though the shear bond strength of glass ionomer cements does not approach that of the latest dentin bonding agent, glass ionomer restorations placed in cervical cavities are very durable. **Nevertheless, microleakage still occurs at margins.** *An in vitro study has shown that conventional glass ionomer cements were less reliable in sealing enamel margins than composite-resin.*
- Although resin-modified glass ionomer cements show higher bond strength to dental hard tissues than conventional materials, they exhibit variable results in microleakage tests.
- Not all of them display significantly less leakage against enamel and dentin than their conventional counterparts.
- **Why?** This may be partly because their coefficient of thermal expansion is higher than conventional materials, though still much less than composite-resins.

Fluoride

- **The main advantage****
- Fluoride is released from the glass powder at the time of mixing and lies free within the matrix. It can therefore be released without affecting the physical properties of the cement. Since it can also be taken up into the cement during topical fluoride treatment and released again, the cement may act as a fluoride reservoir over a relatively long period.²⁴ As a result, it has been suggested that glass ionomer cements will be clinically cariostatic.
- The amount of constant fluoride release did not differ much between brands of conventional glass ionomer cements. The fluoride release of some resin-modified materials is at least the same as conventional materials but varies amongst different commercial products. Nevertheless, the critical amount of fluoride released from a restoration that is required to be effective in inhibiting caries has not yet been established.

Esthetics

- Conventional glass ionomer cements are tooth-coloured and available in different shades. Although the addition of resin in the modified materials has further improved their translucency, they are still rather opaque and not as esthetic as composite-resins.
- In addition, surface finish is usually not as good. The colour of resin-modified materials has been reported to vary with the finishing and polishing techniques used. Potential also exists for increased body discolouration and surface staining because of their hydrophilic monomers and incomplete polymerization.
- **If doing an anterior tooth** and esthetics is a concern, resin modified would work a lot better or a composite, veneer..something else along those lines.

Biocompatibility

- The biocompatibility of glass ionomer cements is very important because they need to be in direct contact with enamel and dentin if any chemical adhesion is to occur.
- *Lining is normally not necessary under conventional glass ionomer restorations when there is no pulpal exposure.*
- Concern has been raised regarding the biocompatibility of resin-modified materials since they contain unsaturated groups. A cell culture study revealed poor biocompatibility of a resin-modified liner.
- As a result of this uncertainty, use of resin-modified materials in deep unlined cavities is probably not advisable.

Disadvantages

- The main limitation of the glass ionomer cements is their **relative lack of strength** and low resistance to abrasion and wear. Conventional glass ionomer cements have low flexural strength but high modulus of elasticity, and are therefore very brittle and prone to bulk fracture.
- Some glass cermet cements are arguably stronger than conventional materials but their fracture resistance remains low.
- The resin-modified materials have been shown to have significantly higher flexural and tensile strengths and lower modulus of elasticity than the conventional materials.

Saliva

- Conventional glass ionomer restorations are difficult to manipulate as they are sensitive to moisture imbibition during the early setting reaction and to desiccation as the materials begin to harden.
- Although it was believed that the occurrence of the resin polymerization in the modified materials reduces the early sensitivity to moisture, studies have shown that the properties of the materials changed markedly with exposure to moisture.
- In other words, if moisture is an issue or the patient has a lot of saliva where the rubber dam cannot be used, conventional glass ionomer use is **NOT** a good idea.

Examples



Additional Resources

- Kilpatrick NM, Murray JJ, McCabe JF. The use of a reinforced glass-ionomer cermet for the restoration of primary molars: a clinical trial. *Br Dent J* 1995; 179:175-9.
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- Williams JA, Billington RW, Pearson GJ. The comparative strengths of commercial glass-ionomer cements with and without metal additions. *Br Dent J* 1992; 172:279-82.
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