Glass ionomer cement

Glass ionomer cement (GIC) is an adhesive cement widely used in dentistry. Glass ionomer is created by combining glass powder with ionomer.

Composition

- The powder is finely ground silica glass with a high content of aluminium, calcium and fluorine.
- The liquid is polyalkenoic acids – polyacrylic, itaconic, maleic, tartaric acid.

Preparation

After mixing the powder and liquid, calcium and aluminum cations Ca^{2+}, Al^{3+} are released in the initial phase of solidification. The concentration of Ca^{2+} grows faster than the concentration of Al^{3+}, so the cement solidifies within a few minutes with the help of calcium bridges between polyacrylic acid molecules. The resulting gel reacts to moisture, water serves as a reaction component and after hardening stabilizes the cement structure by hydration and the gel turns into a water-insoluble Ca-Al-polycarboxyl gel. The structure of fully cured GIC is a mixture of glass particles surrounded by silica gel in a matrix of polyanions, connected by transverse ionic bonds. The final cement maturation processes can take up to several months.

Properties

- Long-term release of fluorides, chemical bond to dental tissues, bioactivity, aesthetics
- Movement of fluorine ions:
  - Glass ionomer cements contain a high content of fluorides. Thanks to this, a large part of the fluorides is released immediately after the filling is made. The amount of fluoride released decreases over time. The amount that is released is more dependent on the composition of the glass ionomer than on the content of fluorides in the glass ionomer.
- Glass ionomers can also act as a fluoride reservoir. When the environment is rich in fluorides, the glass ionomers absorb them in increased amounts and release them back when the fluoride level in their environment drops. Clinically, the glass ionomer is saturated with fluorine, e.g. during tooth cleaning with fluoride toothpaste. This can prolong the release time of fluoride ions and promote the remineralization effects of the glass ionomer cement.
- Bonding of glass ionomer to enamel and dentin:
  - A unique feature of glass ionomers is the diffusion bond that forms with both dentin and enamel. Polyacrylic acid displaces phosphate and calcium ions from the tooth tissue and these are taken up by the adjacent cementum. At the same time, fluoride ions and strontium released from the cement penetrate into the dental tissue to maintain the electrolyte balance.

Bioactivity of glass ionomers

In dental practice, there is a need for materials that can be used to replace damaged and lost dental tissues. Until now, almost all filling materials have been biologically inert. Today's glass ionomer cements have been proven to release ions. This also gives their anticariogenicity.

Working with GIC

The use of GIC does not have specific requirements for the shape of the cavity. Macro or micro retention is not necessary. The walls of the cavity should be smooth and clean so that the material fits as tightly as possible and ion exchange can take place to the greatest extent possible. As a result of ion exchange, the material adheres firmly to the surface of the cavity. After a gentle approach to cavity, only decaying dentin is removed. The walls of the cavity are cooled and a conditioner is applied (weak acid, dissolving the smear layer). The acid must be washed off after 10 seconds. After this preparation, the surface of the cavity becomes wettable, the glass ionomer flows freely over it. The glass ionomer must be protected from excessive moisture. The material hardens in a few minutes and can be processed. The processed filling is covered with a layer of light-curing varnish.

Links

References

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