Minimal Intervention in Cariology – Glass Ionomer Cement

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This article describes how Minimum Intervention Dentistry has developed. Its techniques are less invasive than those of traditional dentistry. The glass ionomer cements have undergone numerous changes and their clinical properties have improved. These high viscosity materials now constitute an excellent alternative to traditional restorative materials. Where the treatment of caries requires a biological approach and where the biocompatibility requires greater attention, the use of these materials is indicated.

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The need to perform atraumatic restorative treatment (ART) in third-world countries has led the World Health Organisation to develop a glass-ionomer that can be used in occlusal areas – involving minimal superficial damage in comparison to treatments that have existed up to now. High-viscosity glass ionomer cements (GIC) have been developed in response to this issue, as their properties are superior to those of conventional low-viscosity GICs in terms of their wear and tear charachteristics, compressive resistance and flexibility, surface hardness and minimal solubility, which guarantees their durability and integrity.

At present, the use of pre-measured capsules and traditional amalgamators represents a step forward in terms of their successful clinical use on a daily basis. They allow accurate mixtures to be measured for use in restorations and thus enhancing their properties.

At the outset, these cements were proposed as an alternative type of filling to composite resins, although they also had a number of other uses. However, their real value lies in their non-competitive and complementary approach to adhesive compounds, offering unique and distinctive properties.

Glass ionomers possess the characteristics listed below:

Biocompatibility

GICs cause no major pulp reactions. Glass ionomer cement is biocompatible with the dentine-pulp complex, so it is well tolerated by the pulp tissue for the following reasons:

- Polyacrylic acids are much weaker and less toxic than phosphoric acid;
- The molecular weight of polyacrylic acid is much heavier, which limits its diffusion inside the dentinal tubules.

Active

GICs maintain a permanent exchange of fluoride with the tooth and minimise the likelihood of microleakage and secondary tooth decay. The release of fluoride into the immediate surroundings has been well documented. It occurs when the material is attacked by acid and has a long-term effect. The intermediate layer between the cement and the dentine, which is formed by fluorinated carbonate apatite, with high resistance and low solubility, has been described as providing a barrier that prevents the dentine or enamel from being dissolved by lactic acid - a phenomenon that can be explained by the cariostatic action of the material. This is now the preferred material for patients with a high risk of tooth decay.

Physical/chemical adhesion to the tooth

An irreversible bond is created between the polyacrylate ions and the hydroxyapatite surface.

One element specifically associated with these materials and their adhesive capacity is the preparation of the surface to which they will be adhered. The preparation involves using polyacrylic acid on the surface where the adhesion is to occur, before placing the galss-ionomer cement into the cavity. This causes a slight demineralisation (micro-retention occurs on the surface) and removes contaminants from the surface in order to stimulate ionic exchanges between the cement and the dental structure.

Adhesion without the use of any mechanical retention or an adhesive agent simplifies the working technique, which means that the use of GICs is very versatile.

Thermal expansion coefficient

Similar to that of the dental structure, the thermal expansion coefficient of a material is defined by the increase in length of the material (1 cm) when the temperature is increased by 1 degree centigrade. If a material that does not have the same thermal expansion coefficient as the tooth is used in a restoration, in the presence of hot or cold items the tooth and the material used for the filling will expand or contract; each in accordance with its respective properties. This results in separation of the material when in contact with cold items or its compression against the cavity wall in the presence of heat.

Technically easy to use

GICs are not sticky and do not come unstuck during the preparation or stick to the instruments. The time involved makes it possible to mould it and remove any excess material before coating.

Limitations of glass ionomers

During the initial phases, a glass ionomer should not be allowed to dry out or be moistened. The effect is not the same if it becomes excessively dry (it cracks very easily) or it becomes wet (and dissolves). Excessive cracking can be explained by the internal contraction stress that occurs within the material, as it needs to set and adhere to rigid walls (of the cavity), which does not allow it to contract. The use of a rubber dam is not recommended as it may cause excessive dryness, meaning that oral fluids will not come into contact with the material during this phase. A good option is to coat the restored surface, to ensure that during the initial phases it is not subjected to excessive moisture.

In patients requiring extensive filling work such as, for example, the treatment for bruxism, restorative work on occlusive and proximal/occlusal cavities of the permanent back teeth, the surface can be coated with a material having a greater resistance. This can be carried out at a subsequent date, during any of the follow-up visits, if damage to the material is observed (reparative dentistry), as some clinicians experience considerable wear and tear while others experience less damage.

Indications

- Class I and II tooth restorations;
- Cervical and proximal restorations of front teeth;
- Temporary restorations of occlusal and proximal/occlusal cavities of the permanent back teeth;
- Restorations in patients at high risk of tooth decay;
- Restorations in all types of temporary teeth;
- Restorations in elderly patients;
- Minimally invasive techniques: ART restorations, Restorations using the Sandwich-technique and Tunnel restorations.

Conclusion

Minimally invasive dentistry has given a tremendous boost to glass ionomers and they are now the preferred materials for use on a daily basis in clinical practice, especially in teeth at high risk of decay, as they are easy to manage and are well-tolerated. Extremely versatile, GICs are an excellent alternative to traditional amalgam in clinical dentistry - an area where many complex situations arise which can now be resolved in a more straightforward and effective manner than previously possible.