The next step in restoratives
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Introduction

During the last few decades, a great deal of research has been carried out aimed at finding alternatives for the well established amalgam. As it turned out, this was no easy task. Especially with regard to the low cost/quality ratio of a direct restorative, there are few materials that can compete with amalgam. In addition to composites and glass ionomer cement, the new filling material Glass Carbomer can signify an important step forwards.

Besides its aesthetic drawbacks, amalgam also has several less positive properties such as: method of preparation, environmental drawbacks, and expansion resulting from corrosion, which can lead to cracks in the tooth.

A great deal of money has been invested over the last 30 years in development of posterior composites. However, the problems associated with composite have not been solved. Composites shrink during the setting process. This can cause leakage and cracks, resulting in pain symptoms. However, the main problem is the bonding of hydrophobic (water repellent) material and hydrophilic (wet) dentin. By using complicated and time-consuming bonding procedures, one can obtain a strong bonding to dentin, but once this bonding has finally been established, it is not stable over time (1, 3). Research has shown that the most simplified types of bonding systems in particular disintegrate within a few years as a result of water take up (2). Due to these properties, now the use of amalgam is slightly increasing after years of decline on a global scale.

In a lot of countries, glass ionomer is used as a posterior filling material. This material is very popular in developing countries in particular (4). As opposed to composites, this material can be easily applied and bonding to dentin and enamel is unsurpassed with regard to sealing properties and durability.

Glass ionomer cement

Glass ionomers has been available for 35 years, but in Western countries its value is still not properly appreciated as an alternative to amalgam and composites. Glass ionomers set chemically and will generate no shrinking forces on the tooth. It has the same coefficient of expansion as tooth tissue and it has an excellent bonding to enamel and dentine and is also biocompatible. However, its most important characteristic is its ability to repair damaged (demineralised) enamel and dentin (5). Also the bond is increased during time due the forming of a Fluorapatite layer (approx. 500 microns width) at the margin of the filling and tooth structure. This layer is insoluble and is no longer sensitive for decay. Once inserted into the fissure, the material is also slowly converted into a fluorapatite type of material (6: fig. 1). In spite of all these excellent properties, glass ionomer also has its disadvantages. The relatively slow setting speed of the material makes it sensitive to fracturing, initial wear, and erosion by
acids. A simple way to speed up the set is to add energy during the setting process, thus skipping over initial sensitive period before exposure to saliva can occur (7). This heat energy can be easily supplied by the use of a high-energy LED or Halogen lamp. Although this technical intervention can result in a fast and reliable method of restoration, there are still a few characteristics that can be improved. The solubility in an acid environment, for example under a contact point, can be a problem. Recent research has shown that 40 % of the GIC’s used in a class II were suffering with this problem. (fig. 2) In addition, polishing of glass ionomer cement and its aesthetic properties can also be improved. In spite of these less favourable properties, glass ionomer cement is closer to being an ideal and biocompatible posterior restoration material than composites.

**Fig. 1. Fissures are remineralised in fluorapatite**

![Image of fluorapatite remineralisation](image)

**Fig. 2 Solubility in percentage at pH=4**

![Bar graph showing solubility at pH=4](image)
Glass Carbomer Filling and Sealant

Glass Carbomer is a glass-based filling and sealing material that sets chemically, but is optimised for heat curing (only 60 seconds!) using an high energy LED (Halogen) lamp. Both have the same glasslike base as glass ionomer cement except that it has a much finer structure, as a result of which less matrix remains between the glass particles, so that the material is stronger (8). In addition, use of this so called nanotechnology greatly increases the reactive surface of the filling material, which in turn leads to a better reaction. Due to its very fine structure, Glass Carbomer has an extremely smooth surface and can be highly polished. But the material must therefore be mixed using a powerful mixer for a longer period of time in order to ensure that all the particles are fully wetted. An organic carbon chain based additive, which is completely biocompatible, is also added to Glass Carbomer to provide the material with greater strength and increased transparency. This transparency optimises the material for the heat-based setting process, so the radiant heat is able to penetrate more deeply. It also improves the aesthetic aspect of the material and gives it a beautiful gloss (fig. 3). As a result of this additive, the material also becomes practically insoluble and therefore less sensitive to the influence of acids.

Fluorapatite is added to the Glass Carbomer Fillings and Sealants in order to accelerate the remineralization process. Fluorapatite is a more stable form of hydroxylapatite, which is normally found in mineralised tissues.

Compared to conventional glass ionomer cement, these particles will accelerate the transformation into fluorapatite. This fluorapatite layer will not stop after 500 microns but will expand over the whole filling. This new layer down is the most solid and hard biological structure that can be formed inside the mouth and is practically impermeable to the process of decay.

In the Glass Carbomer Sealants even more fluorapatite is added (50% vol.) to speed up the forming of this very hard structure more rapidly. The Sealant material has a more fluent consistency than the Filling material.

Conclusions

Both amalgam and composites are not natural restorative materials and have many drawbacks. An alternative should be easy to use and to apply without complex procedures. In all cases, it should provide a reliable seal for the lesion brought by the decay process and by the specialist. The material should be as natural as possible in order to allow a powerful and natural remineralization process to further restore the element and minimise the necessary preparation. Glass Carbomer is a new and important step forward, and it meets the above requirements as closely as possible.

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Fig. 3: Simple setting process using heat from a high-energy LED or halogen lamp

Fig. 4: Glass Carbomer filling
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