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Fluoride - Releasing Materials

For all tooth surfaces, there is a continuous cycle of demineralization and re-mineralization of tooth enamel. Tooth decay is an infectious, transmissible disease caused by bacteria colonizing on the teeth and producing acid that dissolves enamel, resulting in greater demineralization. All fluorides act to slow demineralization and boost re-mineralization. If unchecked, bacteria continue destroying tooth structure, eventually infecting the soft pulp tissue and causing pain. Fluorides work in at least four different ways to protect teeth from tooth decay:

1. Fluoride is incorporated in tooth structure when small amounts are swallowed daily while the teeth are forming.
2. Fluoride becomes concentrated in the outer enamel surfaces when applied after teeth erupt into the mouth.
3. Dental plaque and saliva act as fluoride reservoirs enhance the remineralization process.
4. In addition, fluorides interfere with the decay-causing bacteria colonizing on teeth and reduce their acid production, thus slowing demineralization.

Fluoride Varnish:

Fluoride varnish has been found to be effective in preventing caries on permanent teeth. Fluoride varnish also has recently been *shown to prevent or reduce caries in the primary teeth of young* children.

How is the varnish applied?

Application is quick and easy: small droplets of varnish are applied directly to the tooth surface.

Glass ionomer cements:

Glass ionomer cements are materials consisting of ion- cross linked polymer matrices surrounding glass- reinforcing filler particles. Glass ionomer cements for restorations were based on a solution of polyacrylic acid liquid that was mixed with a complex alumino- silicate powder containing calcium and fluoride. The acidic liquid solution (PH ≤ 1.0) dissolved portions of the periphery of the silicate glass particle releasing calcium, aluminum, fluoride, silicon, and other ions.

This process generates true chemical bonds at all internal and external interfaces (tooth surface - filling) when the reaction conditions are correct. Set materials have modest properties compared with composite but have relatively good adhesion and the ability to release fluoride ions from the matrix for incorporation into neighboring tooth structure to suppress dental caries.

Their main characteristics are:

1. An ability to chemically bond to enamel and dentine with insignificant heat formation or shrinkage.
2. Biocompatibility with the pulp and periodontal tissues.
3. Fluoride release producing a cariostatic and antimicrobial action.
4. Less volumetric setting contraction; and a similar coefficient of thermal expansion to tooth structure.

These advantages have made them successful as luting cements and lining materials. However, as a restorative material, their sensitivity to moisture and low mechanical strength and wear resistance make them the least durable. This may be adequate for primary teeth because they will exofoliate in a number of years.

Resin-modified glass ionomer cements:

The simplest forms of resin-modified glass ionomer cements contain the addition of a small quantity of resin component such as hydroxyethyl methacrylate (HEMA) in the liquid of the conventional glass ionomers. More complex materials have been developed by modifications of the polyacid with side chains that can be polymerized by a light-curing mechanism.

Their main characteristics are:

1. Glass ionomer cements bond chemically to enamel and dentine with insignificant heat formation or shrinkage of material during the hardening reaction. So that the cement can firmly adhere to both enamel and dentine without signs of marginal leakage.

2. Shear bond strength of the resin-modified cement to dentine is significantly higher than that of conventional glass ionomer cement and the bond is a stable one.

3. Resin-modified glass ionomers have the advantage of being able to directly bond to resin composite, making them useful in glass ionomer/composite laminate restorations.

4. The resin modified glass ionomers are also highly biocompatible to the pulp and it has better adaptation and seal to the cavity preparation than conventional glass ionomer materials.

5. The final set structure shows dramatic increase in compressive strength but is rather brittle and comparatively low in tensile strength and has low abrasion resistance making it unsuitable for high stress - bearing areas such as posterior teeth.

6. The fluoride release from and uptake by the resin-modified products was higher than or the same as that of conventional glass ioromers and has no adverse effect on the bond strength.

7. resin-modified glass ionomers have greater curing shrinkage than the conventional chemically-cured cements. Incremental placement techniques should always be used to ensure complete curing at depth and to minimize polymerization shrinkage.

Clinical use

Usually came as two-paste system, can harden without light curing. It has a longer working time. It sets sharply once the polymerization reaction is initiated by light. Most manufacturers state that immediate polishing can be carried out after light-curing. However, the setting reaction will continue slowly for at least 24 hours and the best result can be obtained if finishing is delayed. When immediate polishing is required, care must be taken not to overheat the restoration as this may cause excessive drying and cracking and may prevent setting of the ionomeric component. Highly desirable, alternative to amalgam for restoring primary teeth, and as a liner/base material.

It is now apparent that calcium hydroxide lining does not have a therapeutic effect on pulp tissue. It only serves to isolate the pulp from bacterial insult and is conducive to healing. Glass ionomer cement can achieve the same purpose by its ability to closely adhere to tooth structure without minimum microleakage and thus essentially isolate the lesion. The presence of a sub-lining would in fact decrease the surface area for adhesion with the inherent risk of encouraging leakage.

Polyacid-modified resin composites (compomers)

Recently, other resin-ionomer hybrid restoratives have been marketed as multipurpose materials or are resins that may release fluoride but have only limited glass ionomer properties. One such new material is the 'compomer' which contains the major ingredients of both composites (resin component) and glass ionomer cements (polyalkenoate acid and glass fillers component) except for water.

Their main characteristics are:

1. It have two different mechanisms are responsible for the formation of adhesive bonds to the cavity wall. One of these is the self-adhesive property of the restorative can bond to both enamel and dentine without acid etching by carboxyl (COOH) groups, the functional carboxyl groups can form ionic bonds with the calcium ions of the tooth surface. The

second mechanism is adhesion to the tooth surface through the primer/adhesive system.

2. Can only be hardened through light-curing.
3. It has a significantly less bond strength to dentine than other resin-modified glass ionomer cements and chemically cured glass ionomer.
4. Often one component with an adhesive system.
5. Little is known about the clinical wear performance on the recently marketed compomer restorative materials.
6. Recently, studies have found that the release of fluoride by compomers was significantly less than resin modified glass ionomer cement or other fluoride releasing resin composite. However, the antibacterial action decreased significantly over time. In addition, the caries Inhibition effect of compomer restorative material was higher than the conventional type of resin composite.
7. Radiopacity of compomers is differ from that of dentine and it slightly higher than that of enamel. This value is considered to be desirable for radiographic detection of recurrent caries and offers an easy method for documentation of dental work.

Clinical use:

Ease of manipulation is another advantage of the compomer restoratives. Similar to resin composites, since the adhesive can provide sufficient bond strength for retention, no acid etching procedure is required prior to placement of the restorative. The consistency makes it easy to apply and contour without stickiness and, therefore, less time will be required for final finishing. These properties are especially beneficial in treating children because restorations usually can be completed much faster and within the tolerance of the child patient. A recent study has shown that curing shrinkage is similar to that of the conventional hybrid resin composites. Therefore, placement in increments of 3 mm or less is recommended for Dyract AP, 2 mm or less for other newer compomers; and then each to be cured for at least 40 seconds. Finishing can be undertaken immediately after curing using fluted tungsten carbide finishing burs or polishing discs.

They may or may not have the typical features of true glass ionomers such as chemical adhesion to tooth structures and longterm fluoride release. Therefore, they should be used carefully, closely following the instructions of the manufacturers because different handling methods may influence their clinical behavior. It is used as liner/base, restoration, fissure sealant.