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RECENT ADVANCEMENT IN BASE MATERIAL USED IN DENTISTRY- A REVIEW

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ABSTRACT

BASE: An insulating layer of cement placed in the deeper portion of a prepared cavity to insulate the pulp. A material that is used to protect the pulp in a prepared cavity by providing thermal insulation, a base may also serve as a medicament. A building material made by grinding calcined limestone and clay to a fine powder, which can be mixed with water and poured to set as a solid mass or used as an ingredient in making mortar or concrete. A substance used for filling cavities or anchoring crowns, inlays, or other restorations.

KEY WORDS

Dentistry, Base materials

USES OF BASE IN DENTISTRY:

- Prevents micro leakage — Today's base materials offer a stronger bond to the dentin than traditional glass ionomers, resulting in less leakage under the composite. Base products seal the tooth and strongly bond to the restoration to reduce the incidence of micro leakage between the tooth and the restoration.
- Inhibits bacterial growth — If you place a composite restoration and there is leakage underneath the restoration, the base will prevent your tooth from becoming infected by releasing fluoride into the tooth. The uptake of fluoride by the tooth tissue results in a reduction of artificial root surface caries.
- Reduces postoperative sensitivity — bases offer a strong bond to the tooth, sealing the tooth structure to protect against micro leakage. This strong bond to the tooth structure can help reduce postoperative sensitivity. RMGI liner/bases can even be used as a clinically effective way to treat dentin hypersensitivity.
- Releases fluoride in the tooth — While flowable composites do not release fluoride, the base we use actually releases fluoride into the tooth for protection long after the restoration is placed. This fluoride has been shown to reduce the incidence of secondary decay.
- Provides quick and easy placement — base materials are available in different forms and delivery systems. Some manufacturers offer dispensing options that cut down on some of the preparation time. We appreciate the peace of mind knowing that the material is mixed right every time and maintains the same consistency use after use. Because of this consistency and chemical

makeup, Vitrebond Plus liner/base allows for a quick technique and excellent handling, making placement a breeze for the doctor.

Helps reduce the effect of shrinkage — As composite resin material cures, it shrinks. RMGI liner/base materials have shown a greater ability to reduce the effect of polymerization shrinkage than flowable liners.

Versatile protection for every restoration — RMGI liner/bases can be used under both direct and indirect restorations, and offer excellent performance under composite, amalgam, ceramic, and metal, which is why the material lends itself well to nearly every procedure in our practice. They also deliver excellent adhesion without the use of any dental adhesive system.

WHY WE SHOULD USE BASE- RATIONALE:

The rationale for use of a base to gain thermal insulation is not as accepted today. It is believed that sealing dentin is far more effective in controlling post- operative sensitivity. The base should have adequate strength and modulus of elasticity to support the overlying restoration.

TYPES OF BASE:

1. Zinc phosphate
2. Glass Ionomer cement
3. Resin Modified Glass Ionomer Cement
4. Calcium Hydroxide
5. Calcium Sulphate
6. Non- Eugenol cements
7. Poly carboxylate
8. Flowable composite
9. Dual cure composite
10. Compomer
11. Giomers

BASE MATERIAL - CEMENTS:

ZINC PHOSPHATE :

Zinc phosphate (ZOP) has been in clinical use longer than any other type of cement, and in many studies it is used as the control. The powder is composed of zinc oxide (90%) and magnesium oxide (10%). Certain other chemicals may be added, e.g. tannin fluoride may be added as a source of fluoride (Shofu products). The liquid contains phosphoric acid, water,and aluminum phosphate (which acts as buffering agent). The water influences the rate of the acid-base reaction. Loss of water from the reaction can lengthen the setting times; adding water shortens setting times. A change in water content can reduce both compressive and tensile strength. ADA Specification No. 96 (water-based cement) (1).There are instances when a clinician needs to extend the working time. This can be accomplished 4 ways:

1) Reduce the P/L, which will lower the Ph.
2) Add the powder to the liquid a little at a time.
3) Delay mixing the last amount of powder, which will destroy the matrix, requiring it to reform when the last powder is added.
4) Mix on a cold glass slab, thus cooling the exothermic reaction (caused by the surface of the alkaline powder dissolving in the acid liquid).

This slows the chemical reaction that occurs between the powder and liquid and is the most effective way to extend the working time. This also allows more powder to be added, which will improve the physical properties. When mixing on a cool slab, one must be certain that the slab is dry, otherwise moisture will dilute the liquid and shorten the set time. (2)

The advantages of ZOP are as follows:

It is easily mixed, is relatively strong, and has a long history of clinical success. ZOP's

disadvantages are questionable pulpal irritation, lack of antibacterial action ,brittleness, lack of adhesion, and solubility in oral fluids. The maximum film thickness for ZOP is 25 µm when used as a luting agent (Type 1). Because the viscosity of the mix increases rapidly, seating of a casting must take place immediately after mixing, otherwise it may be difficult to seat the restoration. Also, the smaller the particle size,the faster the set. Zinc phosphate does not adhere to tooth structure via chemical interaction, but instead by physical interlocking at the interface. When used as a cementing agent, the length, taper, and surface area of the preparation are crucial to its success. (3) The liquid component of ZOP is very acidic, and it was once believed to be the cause of the postoperative sensitivity associated with its use. It has since been shown that this is not true.(4)

GLASS IONOMER CEMENT:

Glass ionomer is a combination of 'Glass' powder and 'ionomer' acid GIC can be defined as a water- based material that hardens following an acid-base reaction between the basic fluoro alumina silicate glass powder and an acidic solution of polyacrylic acid.

GIC AS BASE:

When GIC is placed over the decalcified dentin close to the pulp, it can promote remineralization, even in areas of active caries. For this reason GIC is used as a base in the deep caries before placing the final restorative material.

Functions of components:

Alumina (Al2 O3)Increase opacity, Silica (SiO2)Increase Translucency, Fluoride: Its has 5 functions: Anti-cariogenecity, Increase translucency, Increase working time, Increase strength, Calcium fluoride (Ca F2)Increase opacity, acts as flux, Aluminium phosphates -- Decrease melting to Increase translucency, Cryolite (Na3 Al F6)Increase translucency, acts as flux.

BIOCOMPATABILITY:

The sensitivity encountered on luting full crowns is due to The high initial pH {2.33}.

ANTICARIOGENECITY:

GIC has the unique property of being cariostatic due to the sustained release of fluoride, which confers resistance to caries not only on the restored tooth but also on the adjacent tooth. The influence of fluoride is found in a zone of resistance to demineralization, which is at least 3mm thick around a GIC restoration. Fluoride contributes to carious inhibition in the oral environment by means of both - Physicochemical mechanism- Biologic mechanism.

RADIO-OPACITY:

GIC are fairly R/O due to inclusion of radio opacifies like BaSO4. Most GIC's are slightly more radiopaque than dentin and can be differentiated in radiograph.

Liner and base (TYPE III):

A lining cement is basically used to protect the pulp from temperature change, by sealing dentinal tubules. It needs to be only 0.5mm thick. They have low physical properties and are used to fill voids in cavity preparation. The P: L = 1.5 : 1 A base is used as a dentin substitute. According to Mount, the entire cavity should be filled with GIC and then cut back to make room for amalgam / composite (5)

CALCIUM HYDROXIDE:

Calcium hydroxide (CaOH) is considered a liner because it is suspended in a solvent with a thickening agent. As with a varnish, the solvent evaporates, leaving behind (as a liner) a layer of CaOH. How-ever, Craig and Powers consider CaOH a low-strength base.3 Calcium hydroxide has 2 components: a base and a catalyst. The base portion contains calcium tungstate, tribasic calcium phosphate, and zinc oxide in glycol

salicylate. The catalyst is composed of calcium hydroxide, zinc oxide, and zinc stearate in ethylene toluene sulfonamide. The calcium tungstate, or in some cases barium sulfate, are fillers used to provide radiopacity.(6) The high pH can lead to mild to moderate cytotoxic effects for cells in the pulp as well as bacteria in dentin and spaces between the tooth and restoration. Thus, this material can be antibacterial. In addition, due to its alkaline property it counteracts the acidic by products of bacteria. This property results from the catalyst component(7) According to Ferracane, CaOH continues to have a high pH even after setting, because the material leaches out hydroxyl ions after coming in contact with moisture (dentinal fluid).(8)

ADVANTAGES OF CaOH:

It include easy manipulation, rapid hardening in thin layers, a relatively good seal, and some beneficial effects on carious dentin and the exposed pulp. Its disadvantages include low strength, plastic deformation, and high solubility in water. It is not usually considered a cement, CaOH is an acceptable temporary or short-term cement. This material is strong, is easily cleansed from resin temporary crowns, and is easily removed from the inside of temporary crowns(9) CaOH will dissolve when in contact with saliva, meaning that closed margins are essential when CaOH is used as a temporary cement. Calcium hydroxide does not bond to dentin, allowing easy removal from the preparation. Examples of calcium hydroxide products are Dycal (10).

RECENT ADVANCES IN BASE MATERIAL :

COMPOMER:

compomers (also known as polyacid-modified resin composites) are fluoride-containing resin composites.(11)

PROPERTIES OF COMPOMER:

MECHANICAL PROPERTIES:

One mechanical property of composers that does differ significantly from those of conventional composite resin however is fracture toughness.(12)

FLOURIDE RELEASE:

Compomer are designed to release fluoride in clinically beneficial amounts. Fluoride is present in the reactive glass filler and becomes available for release, following reaction of this glass with the acid functional groups, triggered moisture uptake.(13)

Fluoride release occurs to enhanced extends in acidic conditions.

CLINICAL APPLICATION :

Compomers are designed for the same sort of clinical applications as conventional composites. These include class- II and class-V cavities, as fissure sealant and as bonding agents for the retention of orthodontic bands.

Their fluoride release, however is seen as a useful feature for use in peodotontics and certain brands have been produced that are specifically aimed at children.(14)

INDICATIONS FOR COMPOMERS:

1) A carious lesion where esthetics is a concern.
2) A carious lesion where esthetics is not a concern.
3) A non carious (e.g., abrasion, erosion, abfraction) lesion where esthetics is a concern.
4) A non carious (e.g., abrasion, erosion, abfraction) lesion where esthetics is not a concern.(15)

GIOMER:

Giomer are a relatively new type of restorative material. The name "giomer" is a hybrid of the

words "glass ionomer" and "composite", which pretty well describes what a giomer is claimed to be.

ADVANTAGE OF GIOMER:

Giomer has a very important properties, such as fluoride release, fluoride recharge ability, and chemical bonding to tooth structure.

DISADVANTAGE OF GIOMER:

Their esthetics, for example, are less than ideal and make them a poor second choice to resin composites for restoring esthetically-demanding areas. Also, they are sensitive to moisture contamination and desiccation, which can present the clinician with challenges during their placement.(16)

SMART COMPOSITE:

Calcium and phosphate particles have been used as fillers in dental resins, and the resulting composite released calcium (Ca) and phosphate (P04) ions, which can form hydroxyapatite. Such low strengths were insufficient to make these composites acceptable as bulk restoratives. Recently, nano particles of calcium phosphates were synthesized and incorporated into dental resins. The high surface area of the nano particles, along with fillers, resulted in composites with stress-bearing and Ca and P04 releasing capabilities. Tetracalcium phosphate is another important compound used in bone cements, and dental composite, hence, is promising in buffering harmful acids and inhibiting tooth caries.

pH of around 5.5—4 is considered to be cariogenic . Therefore, it is desirable for Ca—P04 composite to be “smart”, to increase the release of caries-inhibiting ions when ph drops.

RESIN MODIFIED GLASS IONOMER:

The resin modified glass ionomers have been defined as glass ionomers that are modified by the inclusion of a resin monomer and sets through acid/base reaction and through photo chemical polymerization. The resin modified glass Ionomer materials are hybrid materials of traditional glass Ionomer cement with a small addition of light, curing resin and hence exhibit properties intermediate to the two, with some characteristics superior to conventional glass Ionomer materials. They have the advantages of adhesion to the tooth surface, esthetics, fluoride release and rapid hardening by visible light.

CONCLUSION:

Base plays important role in restorations such as reducing the post operative sensitivity in composite restorations and preventing from galvanic shock and corrosion in metallic restorations thus it prevents pulp from mechanical and thermal insults. Zinc po4 and GIC are widely used as a base material but recently various other materials such as compomers, giomers, and resin modified glass ionomer where showed better results. So the purpose of the review is to reveal the properties and use of recently introduced base material and they can be used as a better alternate for the conventional base materials.

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