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Glass Ionomer Cement as a Luting Cement

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I. INTRODUCTION

Cements are used in dental practice primarily for retaining or sealing restorations and prosthetic devices in a fixed position within the mouth. These cements are often referred to as 'luting cements'. The cementation of indirect restoration is one of the most important steps in prosthetic and restorative dentistry. Cementation aims to bond the prosthetic restoration to the prepared enamel or enamel and dentine. (1) Successful cementation protocols prevent biofilm formation at the margin between tooth and restoration and minimize mechanical and biological complications. Nowadays, the most commonly used dental cements are glass-ionomer and resin cement. The type, shade, thickness of resin cement and the shade of the ceramic, all together, have a tangible influence on the final restoration color.(2)

Glass-ionomer cement, introduced in 1969 by Wilson and Kent, was originally Known as ASPA (aluminosilicate polyacrylic acid). It was developed from the desire to have a luting agent with the fluoride release/translucency of dental silicate cement and the adhesion to tooth of polycarboxylate cement.(2) Glass ionomer is the generic name of a group of materials that use silicate glass powder and an aqueous solution of polyacrylic acid. The material acquires its name from its formulation of a glass powder and an ionomeric acid that contains carboxyl groups. It is also referred to as polyalkeonate cement.(3)

Types of Glass Ionomer Cement

There are three types based on their formulations and their potential uses

Type I

- Luting applications
- Powder liquid ratio is generally 1.5 : 1
- Grain size 15 m or less
- High early resistance to water contamination
- Radiopaque

Type II

- Restorative material
- Powder liquid ratio 3:1
- Must protect for 24 hours for best results
- Reduced fluoride content to improve translucency
- For anterior repairs where appearance matters.

Type III

- Liner and base.
- Powder liquid ratio varies according to use
- Lining requires 1.5:1 for easy
- Base requires 3:1 or greater for strength
- Light activated varieties available

Type IV

Metal modified glass ionomer cement

- Miracle mix
- Cermet cement

Light curable versions of GIC are also available. (HEMA added to liquid) Hybrid glass ionomer \ resin modified (4)

Adhesion

Glass ionomer has the property of permanent adhesion to untreated enamel and dentin under moist conditions of the mouth. It reacts with the smear layer on cut dentin (more for a filling material than for a luting agent). Glass ionomer also bonds to other reactive polar substrates such as the base metals.

Bonding is of a chemical rather than a micro mechanical nature. Therefore, no acid etching or surface roughening procedures is deprecated. About 80% of maximum bond strength is developed in 15 minutes but strength slowly increases for several days after that.(3)

Mechanism Of Adhesion To Enamel And Dentine

Chemically, tooth material consists of apatite, which makes up 98% of enamel and 70% of dentin by weight and collagen, which is found in dentin alone. The bond of glass ionomer cements is better to enamel than to dentine, because bonding to apatite is the principal mode of adhesion.

Beech proposed that the interaction between apatite and polyacrylic acid produced polyacrylate ions, which then formed strong ionic bonds with the surface calcium ions of apatite in enamel and dentine.

Wilson suggested that initially, when the

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cement paste is applied to tooth material and is

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fluid, wetting and initial adhesion is by hydrogen bonding provided by free carboxyl groups present in the fresh paste. As the cement ages, the hydrogen bonds are progressively replaced by ionic bonds. The cations coming either from the cement or the hydroxyapatite. Polymeric polar chains of polyacid are essential for the achievement of adhesion. Their role is thought to be one of bridging the interface between the cement and the substrate.

Wilson et al postulated that during absorption polyacrylate entered the molecular surface of hydroxyapatite, displacing and replacing the surface phosphate. Also calcium ions are displaced from hydoxypatite along with phosphate during this ionic exchange. Therefore, an intermediate layer of calcium and aluminium phosphates and polyacrylates would form at the interface between the cement and apatite. Chain length is also an important factor in adhesion. The polymer chains capable of bridging gaps between the cement body and substrate. [5]

Bonding to enamel, which is mostly apatite is due to ionic and polar forces and bonding to dentine is only to the apatite constituent of the dentine. Therefore, the adhesion of glass ionomer to dentine is weaker. Collagen contains both amino and carboxylic acid groups, so adhesion could be due to hydrogen bonding or cationic bridges. However, recent absorption studies show that polyacrylic acid and polyacrylate are not absorbed on collagen. Cements based on polyacrylic acid appear to bond more strongly than those based on copolymers of acrylic acid with itaconic or maleic acids. Evidence is only accumulating that bond strength to tooth substances depends on the nature of the polyacid used. If it were proved, then the molecular configuration of the polyacid would become an important factor in controlling adhesion.

Improving Adhesion

When the cement tooth bonds fractures, it is by cohesive failure within the cement rather than adhesive failure at the interface. Therefore, the strength of the bond is limited by the cohesive strength of the cement used. The smear layer is considered to be beneficial. However, salivary contamination of a freshly prepared dentine surface reduces bond strength, but whether this was because of its water contact or contamination of the dentin surface is uncertain. [6]

Surface Conditioning

A number of research workers have sought to improve adhesion of glass ionomer cements. One way that is common to nearly all adhesive technologies is by pretreatment of the surface. Mclean and Wilson first used the term surface conditioning for this treatment in order to differentiate it from acid etching. Surface conditioning is needed in order to eliminate the wide variation found in the structures of the tooth surfaces following cutting. Rough tooth surfaces are contraindicated. In general, the smoother the surface, the stronger is the bond. Good interfacial contact is important for adhesion. Smoothening is necessary to prevent air entrapment and to minimize sites where stress concentration could occur.[3]

INDICATIONS

1. As a restorative material
2. Fast setting lining cements & bases
3. Luting cements (FINE GRAIN VERSION OF GIC)

a. Useful in patients with rampant caries as well as multiple carious lesions.
b. In exposed porcelain margins used for cosmetic reasons, because of the increased translucency.
c. Crown & other prosthesis cementation, because:
i. its ability to release fluoride, as there is a risk of secondary caries in crown cementation.
ii. Chemical bonding

CONTRAINDICATIONS

- Class IV carious lesions or fractured incisors.
- Lesions involving large areas of labial enamel where esthetics is of utmost importance.
- Class II carious lesions where conventional cavities are prepared, & replacement of previous amalgam.
- Lost cuspal area.[7]

RESIN – MODIFIED GLASS IONOMER CEMENT

Low early strength and moisture sensitivity of the traditional glass ionomer was the result of slow acid-base reactions. Hence to overcome these two inherent drawbacks, some polymerizable resin functional groups have been added to GIC to impart additional curing process and allow the bulk of the material to mature through the acid-base reaction

Resin modified glass ionomers were introduced in 1988 by ANTONUCCI, MC KINNEY and MITRA with an objective to combine some of the desirable properties of glass-ionomer (fluoride release and chemical adhesion) with high strength and low solubility of resins. Antonucci et al. Originally used the term resin-modified glass- ionomer as the trivial name and

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resin-modified glass polyalkenoate as the systematic name.[8,9]

Definition
RMGIC Can be defined as a hybrid cement that sets by an acid base reaction and partly by photo – chemical polymerisation reaction.

Available as
- ✓ Powder/liquid
- ✓ Pre proportioned encapsulated form
- ✓ Paste/Paste systems

Classification
Self cured and light cured ionomers (or resin modified glass ionomers) are available for cementation

1. Chemically activated :
The setting reaction comprises an acid–base reaction of the glass ionomer components occurring without light and chemical polymerization by a redox catalyst, without the necessity of light.Therefore, chemically-activated polymerization of the resin-modified glass-ionomer cement is referred to as ‘‘dark cure’’, because the reaction occurs in absence of light.

2. Dual cure :
The setting reaction comprises an acid–base reaction of the glass ionomer and a light-activated free radical polymerization initiated by visible light.

3.Tri cure systems :
Firstly, an acid/base reaction identical to that of conventional glass ionomer cements.

Secondly, a light-activated free radical polymerization of methacrylate groups of the polymer and HEMA initiated by visible light and occurs only where the light penetrates.

However, as depth of cure through irradiation will be limited by the depth of penetration of the light there is a third setting reaction included so that any remaining monomer that has not set photo-chemically will undergo a chemical polymerization.[10,11,12]

Applications
Self cured hybrid ionomer cement are indicated for permanent cementation of porcelain fuse to metal crowns, bridges, metal inlays, on lays, and crowns, post cementation and luting of orthodontic appliances. Additional uses include adhesive liners for amalgam, bases, provisional restorations and cementation of specific ceramic restorations. [13]

II. CONCLUSION

Luting agents possess varied, complex chemistries that affect their physical properties, longevity and suitability in clinical situations. It appears a single adhesive will not suffice in modern day practice.Though cements are used in small quantities in oral cavity, it should be used with at most care, as it is very important. There are innumerable cements present with different properties, one should know all the properties to use it in order to give a successful restoration to the patient.

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