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CRITICAL EVALUATION OF RESIN CEMENTS AS A LUTING AGENT

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ABSTRACT

Restorative dentistry has modified in several aspects due to the myriad of options available for fabricating indirect restorations which have come up over the past few decades, especially pertaining to ceramics and resin cements. The resin cements are the newest type of cements for indirect restorations, and they have the ability to bond to the tooth structure and the internal surface of the restoration. To maximize the properties of resin cements, a clear understanding of the factors that affect its clinical performance is of paramount importance. This article presents a comprehensive review over the resin cements with their clinical performance.

KEYWORDS: Resin Cement, Restorative Dentistry, Indirect Restoration.

INTRODUCTION

Luting cements are joining medium which provides adhesion or micro-mechanical attachment to the surfaces to be joined, like indirect restorations and tooth surface. They are very relevant in clinical dentistry since any restoration fabricated in the dental lab (metallic and non-metallic crowns and bridges) must be cemented with 'luting cement'.[1]

The most important functions of the luting cements in fixed prosthodontics are; to be esthetic, provide an effective marginal seal, provide thermal insulation and mechanically lute the fabricated restoration in its desired place, so as to avoid any displacement while in function.[2]

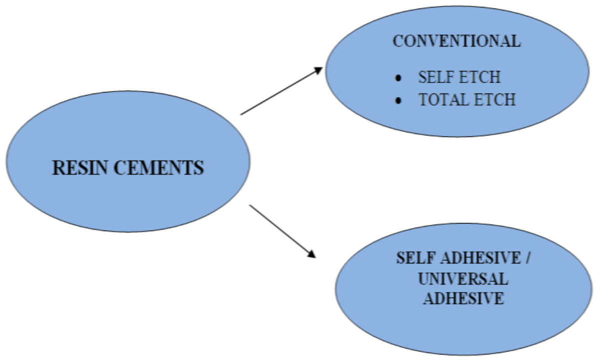
Clinicians should know the characteristics of dental cements, along with the surface qualities of the material for indirect restoration. Like in all-ceramic restoration the material may range from glass ceramic to polycrystalline ceramic which may require different kinds of luting agents for better results. Thus, for adequate luting, cements selection and manipulation are very critical.[3]

Luting cements are those that achieve retention (micro-mechanical locking) by flowing and setting in the space between the two surfaces to be luted. Bonding refers to physical and chemical interaction between the two approximating surfaces. Bonding cements are stronger, so for a given level of "gap filling" they will offer greater retention and superior support for restoration.

Classification: Resin cements are based on bisphenol-a-glycidyl methacrylate (Bis- GMA) resin and other methacrylates, which are modified from the composite resin (restorative material).

Based on their curing mechanism they can be classified as; light-cured, self-cured, and dual-cured. This classification also makes their indication of use easy to understand. Since, those indirect restorations which are thin (veneers) or are made up of primarily glass ceramic, allow the passage of light from the curing unit to initiate polymerization, should be cemented with light cured resin cements. Whereas the restorations fabricated of highly crystalline glass or polycrystalline ceramic must be cemented by self-cured or dual-cured resin cements.[4]

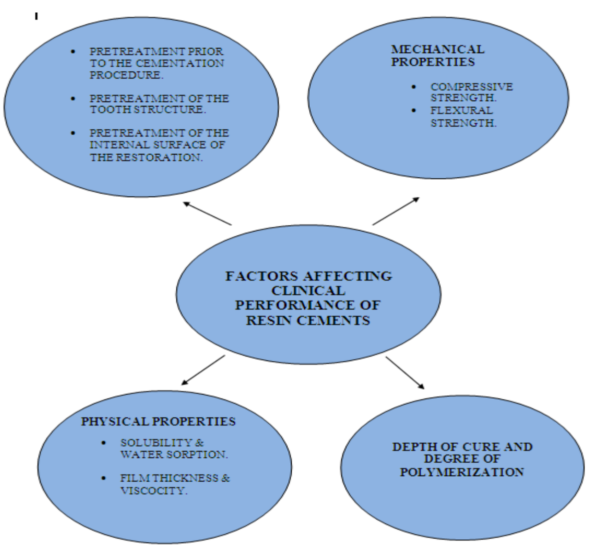
These cements may also be classified into 3 categories depending upon the way they bond with the tooth structure - total-etch, self etching primer, and self-adhesive systems.[3]



Self Etch System: In self-etching technique, the first two components of total - etch technique, etching and bonding components are clubbed together in the form of a self-etching bonding agent, which serves the purpose of conditioner along with adhesive. Both total-etch along with self-etch resin cements come under the category of conventional resin cement.[2]

Total Etch System: The total-etch technique consists of acid etching, bonding and resin cement application and curing. The bonding in total-etch adhesive system is due to the resin which fills up the voids created by demineralization of enamel or dentin. The hybrid layer formed by collagen matrix with resin infiltrated dentinal tubules is important for an effective adhesion when using with resin cements.

Self Adhesive/Universal Adhesive Resin System (SARC): In an attempt to simplify the use of the technique for resin cements, self-adhesive resin cement (SARC) was developed with acidic monomers. With the advent of SARC it became easier for the operator since the surface modifications of the tooth surface prior to curing were not required,[5] owing to their acidic functional monomer,[6] which get copolymerized with adhesive monomers. SARC cements exhibit easy handling, high aesthetics, and good mechanical properties.[7]



Pretreatments Prior to the Cementation Procedure

Pretreatment of the tooth and the internal surface of the restoration should be done prior to the cementation procedure to form a bond between the dentin and the cement (tooth-cement interface) and between the cement and the internal surface of the restoration (cement-restoration interface).[8]

Pretreatment of Tooth Structure

Micromechanical retention is the most important properties of resin cements by which it adheres to the tooth structure and to achieve this goal three usual adhesive steps of etching, priming, and bonding should be performed on the enamel and dentin which form a stable hybrid layer. Thus increase the retention.[9]

Pretreatment of the Internal Surface of the Restoration: Adhesion to the internal surface of the restoration is depend upon following factors, roughening of the internal surface of the restoration is done through air abrasion, sandblasting, or etching with a hydrofluoric acid (for ceramic and composite restorations) or application of an alloy primer (for restorations with a metal subsurface) to increase the surface area for bonding.

To increase the wet ability of the cement to the restoration and forming chemical bonds between the ceramic, the fillers, and the cement a silanating agent should be applied on the etched porcelain and composites. The procedure helps the ceramic chemically adhere to the resin cement through covalent and hydrogen bonds.[10]

MECHANICAL PROPERTIES

Compressive Strength

As resin cements are bonded to both the tooth structure and the restoration, a high compressive strength of the cement also increases the fracture resistance of the restoration, particularly brittle materials such as ceramics. This is particularly true for the first-generation silica-based feldspathic ceramics, which have very low flexural strength (65–120 MPa).[11]

Flexural Strength

In a tooth-cement-restoration assembly, the cement should have adequate flexural strength to be able to transmit the stresses between the tooth and restoration without breaking. This will protect the brittle restorative material. Moreover, the closer the elastic modulus of the cement to that of the dentin, the less will be the stress concentrations at the cement tooth interface and will result to a more durable bond. Resin cements are approximately 20× stronger and 130× tougher in fl exure than conventional cements, which make them the material of choice in the cementation of all-ceramic restorations.[12]

Physical Properties

Film Thickness and Viscosity: Luting cements should exhibit low film thickness. A low cement film thickness improves seating of the restoration and decreases marginal discrepancies which in turn will help reduce plaque accumulation, periodontal disease, cement dissolution, and eventual secondary caries formation. Resin cements have been shown to exhibit a somewhat higher film thickness than conventional cements.[13]

Although resin cements are less soluble in oral fluids, which will compensate for this higher film thickness, a high film thickness can prevent proper seating of the restoration. It was stated that increased film thickness can decrease the tensile strength of cast restorations.[14]

According to the **American Dental Association (ADA)** Specification for luting agents, a film thickness of 25 µm is required for Type I luting cements which include a hydroxyapatite cement, glass ionomer cements, zinc phosphate cements, and polycarboxylate cements and 40 µm for Type II cements which include glass ionomer cement, a resinous cement, a zinc phosphate cement, and glass ionomer-resinous hybrids. Type I cements because of their low film thickness are recommended for precision restorations such as inlays, while Type II cements are commonly used for fixed partial prostheses. When using cements that fall within the Type II category, a thicker die relief is recommended to compensate for the higher film thickness of the cement.[15]

Solubility and Water Sorption

Although resin cements are insoluble to oral fluids, being resins, they absorb water. When resin cements absorb water, their flexural strength is decreased.[16]

The thicker the cement, the greater will be the decrease in flexural strength (plasticizing effect) which makes the cement unable to dissipate stresses from masticatory function between tooth and restoration. This may result to eventual fracture of the ceramic. It is thus important that resin cement layers be kept to a thin layer to minimize the plasticizing phenomenon or resin cements.[17]

Depth of Cure and Degree of Polymerization

Self-Curing Resin Cements: These cements set through chemical reaction and are especially useful in areas that are difficult to reach with light. Examples are metal restorations, porcelain fused to metals, and thick ceramic restorations. These cements contain the tertiary amine benzoyl peroxide that initiates polymerization. The peroxide molecules are the ones responsible for color shift during aging.[18]

Dual-Cured Resin Cements: These cements cure by both light curing and chemical curing, hence the name "dual." These types of cements contain both a self-cured initiator (benzoyl peroxide) and a light-cured initiator (camphoroquinone). The initial set is usually achieved with light curing to quickly seal the gingival margins.[19]

Properties of Conventional resin cement v/s Self adhesive resin cement.[20]

Table. 1: Physical/ Mechanical properties of resin cement.

Properties	Conventional Self Etch/Total Etch	Self Adhesive
Working time (min)	3-10	0.5-5
Setting time (min)	3-7	1-15
Setting reaction	Light and /or chemical	Light and chemical
Compressive strength(Mpa)	194-200	179-255
Tensile strength (Mpa)	34-37	37-41
Elastic modulous (Gpa)	17	4.5-9.8
Bond strength to dentin	18-30	5-12
Solubility in water (wt%)	0.07-0.4	0.13

Table. 2: Advantage/ Disadvantage of resin cement.

Resin Cements	Advantage	Disadvantage	Precaution
Self Etch	Fewer steps than total-etch cements; no etch and rinse steps required	Requires primer placement and drying steps	Unground enamel and sclerotic dentin etching with phosphoric acid
Total Etch	Low solubility, bond to feldspathic porcelain and pressable ceramics.	Film thickness, number of steps, contamination sensitive	Requires bonding resin, moisture control, multiple steps;over etching of dentin possible
Self Adhesive	No bonding agent or bonding steps required; reduced postoperative cold sensitivity	Lower bond strengths than total and self-etch resin cements	Requires enamel etch for optimal bond to enamel

CONCLUSION

The options with the clinician have tremendously increased in designing the indirect restorations due to the variety of ceramic material available today in the market providing satisfactory esthetic value along with high mechanical strength for longevity ceramics. Further, there has been a tremendous growth in the types of luting agents specially resin cements which are more user friendly and provide good bonding with the tooth structure. Proper selection of a luting agent is a last important decision in a series of steps that require meticulous execution and will determine the long-term success of fixed restorations.

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