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Resin Cements in Dentistry

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Abstract

Even though the GIC has undergone many advances, its chemistry is fundamentally different from that of modern resin based composite direct filling products, which feature a silica or glass particle filled polymer matrix that enhances repair retention. When the restoration is etched or air abraded after the tooth has been conditioned with an adhesive resin and etched, retention becomes "micromechanical," ensuring the resin cement's high tensile strength. Cementation of the extraoral fabricated restoration is very important for the longevity of the restoration. The bond strength of resin cement to ceramic and fibre post is better than conventional cements. This article discusses about the various types of resin cements and there uses for luting indirect restorations such crowns, veneers, inlays, and onlays, etc.

Keywords: Resin cements; Adhesion; Cementation; Strength.

Key Messages: The advent of all-in-one resin cements has been one of the major developments in recent years. The dental team must make decisions and ask questions when selecting the right system and cementation method due to the multitude of available options. In order to assist clinicians in selecting the resin cement type most appropriate for their needs when cementing indirect restorations, this page offers information on resin cements.

INTRODUCTION

The two categories of cementation procedures that could be explored are conventional cementation and adhesive luting. Different types of conventional (such zinc phosphate, glass ionomer) or resin cements can be used to achieve conventional cementation, which mostly relies on mechanical bonding. Resin cements are used to provide adhesive luting, which takes advantage of a variety of mechanical, micromechanical, chemical, and molecular bonding mechanisms (Kameyama *et al.*, 2015; Sakaguchi *et al.*, 2019).[1,2]

Qualities of a Good Cement[3,4]

A strong bond, regardless of prep design

Consistent mix

Easy clean-up

Lack of post-op sensitivity

Self-adhesive resin cements have adhesive components that eliminate the need for separate

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etchants and primers for bonding to tooth, alloy, or ceramic substrates that are required with the use of other cementation alternatives.

Esthetic resin cements are tooth colored or translucent cements based on diacrylate resin that require a bonding agent for adhesion to tooth structure and separate primers for bonding to metal and ceramic substrates. Adhesive resin cements are based on acrylic or diacrylate resin with adhesive monomers that bond well to metal substrates. Adhesive resin cements may require a separate primer for bonding to ceramic, metal, and tooth substrates. Self-adhesive resin cements have adhesive components that eliminate the need for separate etchants and primers for bonding to tooth, alloy, or ceramic substrates, and a number of commercial self-adhesive resin cements are available.[1,5]

Composition and Reaction of Self-adhesive Resin Cements.[6,7]

Self adhesive resin cements are composed of diacrylate resins with acidic and adhesive groups and glass filler. They are usually dual cured resins that can be light activated and can self cure. During setting, self-adhesive resin cements typically undergo a change in pH from acidic (pH 2.1 to 2.3) to less acidic (pH 5.6 to 6.0). The early acidity of the cement allows it to be self-etching. The change with time to a less acidic pH may make the cement more hydrolytically stable, although the clinical implications of the less acidic pH have not been demonstrated as yet.

The similar theory of tooth demineralization and concurrent infiltration by methacrylate monomers underlies the use of self-etch adhesives and self-adhesive cements. Although the self-etch and self-adhesive procedures may also suffer from worse surface conditioning, the bonding mechanism of these adhesive techniques has been related to an extra chemical binding to tooth structures.[2,8]

Use of etch and rinse adhesive light cure composite resin cements should be restricted to porcelain veneers and press able ceramic crowns that permit the curing light to penetrate the porcelain so that photo polymerization of the cement beneath the translucent veneer or crown takes place.

Its multifunctional monomers with phosphoric acid groups simultaneously demineralize and infiltrate enamel and dentin. The dominant setting reaction is the radical polymerization that can be initiated by light exposure or through the self-curing mechanism. This results in extensive crosslinking of cement monomers and the creation of high molecular weight polymers. Additionally, in order to assure neutralization of this initially acidic system, a glass ionomer concept was applied, resulting in a pH increase from 1 to 6 through reactions between phosphoric acid groups and alkaline filler. Phosphoric acid groups also react with the tooth apatite. Water that is formed in these neutralization processes is claimed to contribute to the cement's initial hydrophilicity, which provides improved adaptation to the tooth structure and moisture tolerance. Subsequently, water is expected to be reused by reaction with acidic functional groups and during the cement reaction with ion-releasing basic filler particles. Such a reaction would finally result in an intelligent switch to a hydrophobic matrix. The adhesion obtained is claimed to rely on micromechanical retention and chemical interaction between monomer acidic groups and hydroxyapatite. Self-adhesive resin cements that contain functional phosphate monomers react chemically with ceramic fillers and other inorganic fillers to produce the best possible bond strengths.[9-11]

Classification[12,13]

The wide range of chemical compositions of resin cements, including phosphoric acid esters, 10-MDP, HEMA, glycerol phosphate dimethacrylate (GPDM), 4-META, bis-GMA, and triethylene glycol dimethacry late (TEGDMA), made it difficult to classify them. They were divided into three categories: self-adhesive, cement with 10-MDP, and Bis-GMA cement (10-MDP free or non self-adhesive).

Resin cements may be classified according to their polymerization mechanisms or according by their adhesive scheme.[5]

According to Polymerization

- Light cured
- Chemical cured
- Dual cured

According to Adhesive scheme

- Total etch
- Self-etching
- Self-adhesive (all in one cement or universal cement)

Curing method photo initiation, activated by light

Characteristics

Increased working time

Decreased finishing time

Color stability

In comparison to other cementation options, self-adhesive resin cements do not require separate etchants and primers for bonding to dental, metal, or ceramic surfaces because they contain adhesive components. There are many commercial self-adhesive resin cements on the market today.[14,15]

Composition of resin cements[8]

Material	Type	Composition	Curing Time	Manufacturer
Cement-It	Composite resin cement	bis-GMA, UDMA, HDDMA, PEGDMA, barium-boro-silicate glass (65 wt%)	20	Jeneric Pentron (Wallingford, CT, USA)
NX3	Composite resin cement	TEGDMA, bis-GMA, fluoro-aluminosilicate glass (67.5 wt %/47 vol %), activators, stabilizers, radiopaque agent	20	Kerr (Orange, CA, USA)
Variolink Esthetic DC	Composite resin cement	UMDA and further methacrylate monomers, ytterbium trifluoride, spheroid mixed oxide (67 wt %/38 vol %), initiators, stabilizers and pigments	10	Ivoclar Vivadent (Ellwangen, Germany)
Estecem	Adhesive resin cement	bis-GMA, TEGDMA, bis-MPEPP, silica-zirconia filler (74 wt %), camphorquinone		Tokuyama Dental (Taitou, Japan)
Multilink Automix	Adhesive resin cement	dimethacrylate and HEMA, barium glass and silica filler, ytterbium trifluoride (68 wt %), catalysts, stabilizers, pigments	10	Ivoclar Vivadent (Ellwangen, Germany)
Panavia 2.0	Adhesive resin cement	10-MDP, BPEDMA, hydrophobic aliphatic metahrylates, hydrophilic aliphatic metahrylate, silanated silica filler, silanated barium glass filler, sodium fluoride (70.8 wt %)	20	Kuraray (Osaka, Japan)
Breeze	Self-adhesive resin cement	bis-GMA, UDMA, TEGDMA, HEMA, 4-MET, silane treated barium glass, silica, BiOCl, Ca-Al-F-silicate, curing system	20	Jeneric Pentron (Wallingford, CT, USA)
Calibra Universal	Self-adhesive resin cement	UDMA, trimethylolpropane trimethacrylate TMPTMA, bis-EMA—Bisphenol A ethoxylate dimethacrylate, TEGDMA, HEMA, 3-(acryloyloxy)-2-hydroxypropyl methacrylate, urethane modified bis-GMA, PENTA, silanated barium glass, fumed silica (48 vol %)	10	Dentsply Sirona (York, PA, USA)
Max Cem Elite Chroma	Self-adhesive resin cement	HEMA, GDM, UDMA, 1,1,3,3-tetramethylbutyl hydroperoxide TEGDMA, fluoroaluminosilicate glass, GPDM, barium glass filler, fumed silica (69 wt %)	10	Kerr (Orange, CA, USA)
Panavia SA Cement Plus	Self-adhesive resin cement	bis-GMA, TEGDMA, HEMA, 10-MDP, hydrophobic aromatic dimethacrylate, hydrophobic aliphatic dimethacrylate, sodium fluoride, silanated barium glass filler, silanated colloidal silica (70 wt %/40 vol %)	10	Kuraray (Osaka, Japan)
RelyX U200	Self-adhesive resin cement	methacrylate monomers containing phosphoric acid groups, methacrylate monomers, silanated fillers (70 wt %/43 vol %), initiator components, stabilizers, rheological additives, alkaline (basic) initiator components, stabilizers, pigments	20	3M ESPE (St. Paul, MN, USA)
Smart Cem 2	Self-adhesive resin cement	UDMA, urethane modified bis-GMA, TEGDMA, PENTA, dimethacrylate resins, barium boron fluoroaluminosilicate glass amorphous silica (69 wt %/46 vol %)	10	Dentsply Sirona (York, PA, USA)
Speed CEM Plus	Self-adhesive resin cement	UDMA, TEGDMA, PEGDMA, methacrylated phosphoric acid ester, 1,10-decandiol dimethacrylate, copolymers, dibenzoyl peroxide, ytterbium trifluoride, barium glass, silicon dioxide (75 wt %/45 vol %)	20	Ivoclar Vivadent (Ellwangen, Germany)

The monomer methacrylate, functional monomeric acids, and filler are some of its constituents. As a resin basis, this initially is utilized. The useful monomeric acids demineralize and promote adherence to the surface of the tooth.[14,15] These acids are necessary for the creation of an aqueous insoluble complex between calcium and MPD, whereas 4-META and phenyl-p create a calcium complex that is more resistant to dissolution. Finally, there is the filling, which is made up of glass fillers such Iterbio fluoride, quartz, colloidal silica, barium fluoroaluminosilicate, and calcium aluminosilicate strontium. Its partial dissolution balances the resin's acidity and releases sodium, calcium, silicate, and fluorine ions that contribute to the setting.[16,17] Currently, the accepted and advised method for bonding resin cements, including self-adhesive, to glass matrix ceramics entails silanization and hydrofluoric acid etching.[18,19]

Resin cement and color stability

The color shift of resin cements is better concealed by ceramic that is 0.5 mm thick. According to Kurklu *et al.* 4, 0.5–1 mm ceramic thickness exhibits a color shift that is clinically acceptable when utilized with clear shade cements. The color durability of resin cements was examined by Paula *et al.*[3], who came to the conclusion that the ceramic thickness is a significant factor determining the visibility of cement deterioration over time.[20,21]

Improving the Bonding Performance of Adhesive Resin cements

1. Leave sclerotic dentin in place when preparing the abutment. Dentin permeability is decreased by mineral deposits in the tubules of the dentin.[5,22]
2. Freshly prepared dentin loses some of its permeability when a dentin adhesive is applied. For appropriate long-term bonding effectiveness, only highly filled etch and rinse dentin adhesive (Optibond FL, Kerr) is available. Dentin permeability is reduced when a dentin adhesive is applied to freshly prepared dentin.
3. Avoid using temporary cements that contain eugenol, and clean the surface completely before bonding.[3,23]
4. Apply local anesthetic with vasoconstrictors prior to cementation. The transdentinal flow is reduced by local anesthetic by 70%.
5. For etch and rinse dentin adhesives, chlorhexidine may be used following acid etching. Chlorhexidine, an antibacterial substance that also inhibits matrix metalloproteinases, protects the collagen integrity of the hybrid layer made by etch and rinse adhesives, reducing the degradation of it.[7,24]
6. The bond strength of self-etch adhesives is increased by coating them with a hydrophobic resin.
7. Increase the seating pressure. This technique inhibits water absorption and globule production, which reduces water infiltration from the subordinate dentin into the bonded interface and improves the adhesive interface's quality.[9,25]
8. Apply ultrasonic vibration. It alters the luting agents' thixotropic characteristics, reduces viscosity, raises temperature, and accelerates sitting.[26]

CONCLUSION

Resin cements are polymer based cements made to stick to tooth structure. The advent resin cements for cementation of extra oral fabricated restorations is very advantageous with regard to its strength and longevity. It has better physical properties compare to conventional cements, resin cement is not water soluble, and so the restorations with resin cements will last longer.

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