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Literature Review

Is Self-Adhesive Resin Cement a Good Alternative to Conventional and Resin Cements? A Literature Review

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Abstract

Introduction: The clinical success of an indirect restorative procedure depends in part on the cementation technique used to create a link between the restoration and the tooth.

To overcome someone of the shortcomings of both conventional and resin cements, as well as to bring the favorable characteristics of different cements classes into a single product. Self-adhesive cements do not require any pretreatment of the tooth surface. Once the cement is mixed, it's application procedure is extremely simple.

Aim of the Work: To summarize research conducted on Self-adhesive cements and provide information on their properties, based on the results of original scientific full-length papers from peer-reviewed journals listed in PubMed.

Materials and Methods: The search was conducting using the term" Self-adhesive cement OR (trade names of currently available products)".

Conclusion: The majority of available literature data is based on studies that investigated one of the Self-adhesive cements that are currently available to clinicians. According to the *in vitro* results, Self-adhesive cement adhesion to dentine and various restorative materials is satisfactory and comparable to other multistep resin cements, while adhesion to enamel appears to be weak link in their bonding properties. Long-term clinical performance of these materials needs to be assessed prior to making a general recommendation for their use.

Keywords: *Self-Adhesive Cements; Review*

Introduction

Adhesive bonding techniques and modern all-ceramic systems offer a wide range of highly esthetic treatment options. The inherent brittleness of some ceramic materials and certain clinical situations requires resin bonding of the restoration to the tooth for long-term clinical success. A surface pretreatment of the ceramic and the tooth is necessary to obtain a good adhesion. The clinician faces many problems when luting restorations such as the choice of the appropriate agent depending on the restoration material, the technique sensitivity, and the necessity of applying different luting materials.

To overcome some of the disadvantages of the conventional and resin cements, self-adhesive cements were introduced to the market. They do not require any pretreatment of the tooth surface and their application is accomplished in a single clinical step [1].

In the last two decades, the increased demand for esthetics in dentistry has resulted in significant improvements in metal - free restorations, from indirect resin composites to various categories of ceramic materials [5-7].

Nevertheless, the clinical performance of those esthetic restorative materials relies largely on the luting/bonding procedure.

Among the desired features of the luting material for a metal-free restoration are optical characteristics similar to natural dentition, improved mechanical properties to strengthen the final restoration, and ability to bond to multiple substrates.

The customarily used conventional luting cements, such as zinc phosphate and glass-ionomer, do not meet these expectations.

With the introduction of metal-free indirect restorations, there was an imminent need to develop alternative luting materials. The first resin based or conventional resin cements introduced to the market required the use of dental adhesives to promote bonding to enamel and dentin [2].

Several studies demonstrated that the use of conventional resin cements can improve mechanical properties of metal-free indirect restorations when compared with other luting cements [3] and this has been directly related to long term clinical success [4].

However, incompatibility issues between simplified adhesive systems having acidic and hydrophilic characteristics and self- and dual-cured resin cements were reported at the early stage of development of the new resin cements[5-7].

This incompatibility was responsible for directly compromising bond strengths, potentially reducing retention and support for the restorations.

Most clinical procedures involving resin-based luting materials occur under unfavorable circumstances, such as altered and/or deep dentin, subgingival preparations, and sometimes with challenging field isolation.

Combined, all these limiting factors can have a significant impact on the adhesive application and subsequent performance when resin cements requiring prebonding are used.

However, their use is justified if one considers all the benefits offered by a resin luting material, such as improved mechanical properties, lower solubility, and reinforcement of all-ceramic restorations in comparison with the traditional luting cements [8,9].

Commercially available self-adhesive resin cements (Table 1) combine the easy application of conventional luting materials with the improved mechanical properties and bonding capability of the conventional resin cements.

The presence of functional acidic monomers, dual cure setting mechanism, and fillers capable of neutralizing the initial low PH of the cement are essential clinically relevant elements of the material that should be understood when selecting the ideal luting material for each particular clinical situation.

This review addresses the most relevant aspects of self-adhesive resin cements and their potential impact on clinical performance.

The article focuses on self-adhesive resin cements as the “modern” luting material, because extensive information on traditional luting cements and conventional resin cements are covered in several previous publications [8-10].

The clinical performance of self-adhesive resin cements has also been included in this review.

Cement	Manufacturer
BeautiCem SA	Shofu Inc
Bifix SE	Voco
BisCem	Bisca Inc
Breeze	Pentron
Calibra Universal	Dentsply
Clearfil SA	Kuraray Noritake Dental
Embrace WetBond	Pulpdent Corporation
G-Cem	GC Corporation
G-Cem LinkAce	GC Corporation
iCem	Heraeus-Kulzer
Maxcem Elite	Kerr
Monocem	Shafu
Panavia SA	Kuraray Noritake Dental
RelyX Unicem	3M/ESPE
RelyX Unicem 2	3M/ESPE
SeT	SDI
Smart Cem 2	Dentsply
SppedCEM Plus	Ivoclar Vivadent

Table 1: *Self-adhesive resin cements listed by alphabetical order.*

This list is not intended to cover all products available. Any omission is unintentional.

Review

The use of what is known as a resin composite for luting is a prerequisite for the insertion of adhesive inlays.

From June 1992 to November 1993, a total of 93 adhesive restorations were instead in 55 patients (33 female, 22 male) [11].

The chemical composition of luting composite is identical to that of restorative composites.

The main difference is the reduced viscosity as a result of lower filer content.

At that time the introduction of the ultrasonic technique (USI-technique) [12], however offered the possibility of inserting tooth-colored inlays with highly viscous hybrid composites.

The aim of this clinical study was to compare handling, processing properties, and suitability of two different low viscous and one high viscous luting composite.

The diagnosis for each tooth was noted at the beginning of the treatment. Moreover, a sensitivity test (Co_2) was carried out. Slightly divergent inlay cavities were prepared without beveling the margins. Where necessary, areas close to the pulp were covered with a calcium hydroxide preparation. Glass ionomer or phosphate cement was used as base/lining material. All inlays were inserted applying the enamel etch technique with the use of a rubber dam.

After selective etching of the preparation margin with 35% phosphoric acid, the dentin was additionally pretreated with Syntoc.

A retentive etching pattern on ceramic restorative materials (e.g., IPS Empress) was achieved with 4.9% hydrofluoric acid (IPS ceramic etching gel).

Monobond S silane primer was applied to salinize the inner surfaces of the restorations (reaction time at least 5 minutes). Variolink, the hybrid composite, was used as luting composite in three degrees of viscosity variolink high and law are suitable for the conventionals - insertion technique, i.e. without additional ulta-sonic activation. Variolink low was primarily developed for the insertion of bridges, crowns, or veneers. For inlays, onlays, or partial crowns, the manufacturer additionally offers variolink in a thicker consistency (variolink high). Varialink ultra, the two-component material was available for the USI - technique.

Setting of all luting composites mentioned was initiated by 90s light - curing from different positions. Subsequent to insertion, the processing time, flow properties, and possibility of excess removal were registered in a questionnaire. In separate check-ups, all cleaned and finished inlays were checked according to special criteria including surface roughness, shade matching, marginal integrity, complaints, and changes in sensitivity, radiographic check.

In a second step, the clinical results were classified in the following categories:

- Excellent.
- Good (small defects, repair without damage possible).
- Sufficient (small defects, repair without damage impossible).
- In sufficient (large defects, preventive. renewal indicate).
- Poor (failure, immediate renewal mandatory).

Descriptive and statistical evaluation were done.

Variolink low, the low-viscosity material, is comparable to conventional luting composites (e.g. Dual Cement) and was primarily recommended by the manufacturer for the insertion of veneers and crowns.

Furthermore, the study found that inlays with subgingival preparation in cleanly visible areas can also be inserted with the material.

For restorations in molar regions, however, there is always the risk of overlooking excess material.

The law-viscosity, tooth - colored luting material demonstrated a limited optical contrast to the tooth, especially in proximal areas difficult to inspect.

It was also noted that a lot of time had to be spent for the removal of excess material.

Sometimes the clearly cured excess was only detected once the radiographic check was carried out.

Variolink high, recommended to the adhesive insertion of inlays, or partial crowns, proved to be better than the low-viscosity version of the material as for as handling was concerned. The luting material was especially advantageous for restorations that were luted to the tooth by means of micromechanical retention alone.

Since the correct position of inlays is not automatically defined during the insertion, the risk of fixing the restoration inappropriately was always present. With Variolink high, however, restorations could be put in the same position as during try-in, with subsequent removal of excess and polymerization.

Since the introduction of the ultrasonic insertion technique the use of high-viscosity, abrasion-resistant fine particle hybrids as luting material is possible.

The highly-viscous variolink ultra offered enough time for carful insertion and removal of excess. In clinical use, excess material was never present as thin press flash, but always as stable, clearly-visible excess.

Compared with earlier studies, hypersensitivity could be reduced by more than 70% by consistently using syntac, the dentin adhesive.

Only 5% of the cases reported short-term complaints after insertion. No inlays had to be replaced. The excellent radiopacity of the material was very helpful during postoperative check-ups [13].

Variolink was clearly visible in marginal areas of the restoration. Excess flash previously overlooked could thus be detected and subsequently removed.

Nevertheless, the examinations of inlays, onlays, and partial crowns clearly confirmed that the recommendations regarding range of indication must be followed.

Finally, they concluded clinically that ratings with regard to handling, processing, and clinical suitability confirm that highly-viscous luting composites (variolink Ultra) were most appropriate for the insertion of inlays and partial crowns by means of ultrasonic activation.

Exact removal of excess material was supported by narrow marginal gaps. Variolink high was an alternative for adhesive luting without ultrasound.

Good results could be achieved in clearly visible area with Variolink low.

Chemistry and curing mechanism

In general terms, a self-adhesive resin is, by nature, a self-etching material during the initial stages of its chemical reaction. Its low PH and high hydrophilicity at early stages after mixing yields good wetting of tooth structure and promotes surface demineralization, similar to what occurs with self-etching adhesives [14]. As the reaction progresses, the acidity of the cement is gradually neutralized because of the reaction with the apatite from dental substrates [15,16] and with the metal oxides present in the basic, acid-soluble inorganic fillers [14,17,18].

In parallel, as the hydrophilic and acidic monomers are consumed by the chemical reactions *in-situ*, the cement becomes more hydrophobic, which is highly desirable in a fully set resin cement to minimize water sorption, hygroscopic expansion, and hydrolytic degradation [19].

Self-adhesive resin cements demonstrate different levels of PH neutralization during their setting reaction. In general, the least PH-neutralization has been observed with the mostly hydrophilic cements. Additionally, un-consumed, residual acidic monomers can have an impact on the polymerization reaction of the cement, especially by inhibiting the action of the amine accelerator required for the camphor quinine-amino photo initiator system present in essentially all current cement systems [20].

Self-adhesive resin cements must be presented as two-part materials, usually in separate, individual syringes or in the more popular dual-barrel syringe dispensers. In either case, the components must be separated because of the possibility of pre-mature acid-base interaction between acidic monomers and the ion-leachable glass fillers, the need to separate the self-curing chemical components, and the need to isolate the tertiary amine used in the photo curing mechanism from the acidic monomers [14].

The main constituents of any self-adhesive resin cement are the predominant functional acidic monomers, conventional di-methacrylate monomers (eg, bis- GMA, UDMA, and TEGDMA), filler particles, and activator- initiator systems.

Monomer Abbreviation	Complete Monomer Name
BMP	bis(2-methacrylaxyethyI) acid phosphate
MDP	10-methacrylayloxydecyI dihydrogen phosphate
Penta-P	Dipentaerythritol penta-acrylate monophosphate
Phenyl-P	2-methacryl-oxyethyl phenyl hydrogen phosphate
PMGDM	Pyromellitic glycerol dimethacrylate
4-META	4-methacryloxyethyl trimellitic anhydride

Table 2: *Function acidic monomers commonly used in self-adhesive resin cements.*

Current self-adhesive resin cements are dual-cure resin materials that rely on light-cure and chemical-cure activation to convert monomers into polymers. However, the two curing mechanisms are not necessarily integrated and do not always follow the assumption that light- curing supplements self-curing or vice versa [21].

It has been suggested that the early vitrification (polymer network formation) induced by light activation could interfere with the self-polymerization, thus compromising the overall degree of conversion of dual-cure resin cements [22].

More recently, it has been confirmed that insufficient light exposure to self-adhesive resin cement could result in incomplete polymerization, to a level even lower than that of self-curing alone [23].

Self-adhesive resin cements usually present a significant delayed initial polymerization rate because of the presence of acidic functional monomers, which can deactivate free radicals and compromise the curing reaction. This delayed polymerization can last from 24 hours to 7 days, depending on the product [24].

It is important, however, to highlight that the ability of a self-adhesive resin cement to cure under clinical conditions depends on a multitude of factors.

For instance, if the cementing substrate is mostly comprised of resin build-up material or amalgam or a metal casting, or any material other than dentin or enamel, the necessary neutralization of the acidic monomers can be significantly affected and, therefore, the amount of residual acidity may unbalance the setting reaction, likely reducing the curing rate, delaying final setting, and ultimately compromising the overall polymerization of the cement.

Another aspect that directly affects the chemistry and curing of resin cements is storage temperature. Excessive (prolonged) heat during storage (> 30°C) can have detrimental effects on the acidic monomers, and the components responsible for the self-curing reaction, and significantly alter working and setting time, either extending or reducing them depending on which component is more affected by heat [25].

It is recommended to store self-adhesive resin cements in a cool place (4°C - 18°C) and the bring them to room temperature before using.

Mechanical properties

Improved properties are one of the reasons why clinicians have been shifting from conventional luting materials (Zinc phosphate, Zinc poly carboy late, and glass-ionomer cements) to resin-based luting materials.

Studies have demonstrated that self-adhesive resin cements are mechanically stronger than conventional, no resin-based materials [26] and some present flexural strength similar to conventional resin cements [27]. However, it has been observed that flexural properties and wear resistance can vary widely among commercial self-adhesive resin cements, and in general, self-adhesive cements have lower mechanical properties than conventional resin cements [29].

Nevertheless, self-adhesive rein cements are available clinical alternative concerning their mechanical properties, especially in cases when the benefits of a self-adhesive luting procedure surpass the need for maximum mechanical properties, such as cementation of fiber posts, monolithic zirconia crowns, and PFM crowns when moisture control is challenging for adhesive application.

Bonding to relevant substrates

Self-adhesive resin cements do not require that a bonding agent or dental adhesive be placed before cementation. However, many self-adhesive resin cements can benefit from additional surface treatments before cementation to improve performance [29-31].

Natural dental substrates: Enamel and Dentin Self-adhesive resin cements are expected to simultaneously demineralize and infiltrate enamel and dentin. Even though micromechanical retention and chemical interaction between acidic groups and hydroxyapatite are expected, self-adhesive resin cements interact only superficially with dental hard tissues [16,18,32].

Enamel bonding with self-adhesive resin cements can be compared with self-etching adhesive systems.

The acidic monomers present in the composition of self-adhesive cements provide lower interprismatic hybridization and, consequently, weaker bond strengths compared with conventional hybridization techniques. with the separate etching and bonding approach. The functional acidic monomers are generally weaker when compared with traditional phosphoric acid etching and thus have reduced capacity to demineralize enamel. Bond strengths to enamel are usually low and make self-adhesive resin cements unsuitable for cementing veneers. For example, selective enamel etching is considered an alternative approach for creating increased bond strengths, producing results comparable with conventional resin cements [31-33].

Clinically, the selective enamel etch process has been proven to significantly increase retention and survival rate of partial ceramic crowns, particularly in complex restorations with extensive caries, build-ups or cavity linings, and reduced amount of exposed dentin and enamel available for bonding [34].

Dentin bonding, conversely, does not benefit from phosphoric acid etching before self-adhesive resin cement application. Pre-etching has been shown to diminish the effectiveness of the bond, probably because of inadequate resin cement infiltration into the exposed collagen fibril network [32,33].

Some studies have demonstrated that the use of polyacrylic acid instead of phosphoric acid can have a positive impact on the bonding performance of self-adhesive resin cements to dentin, but there are conflicting results [30,35].

The optimal concentration of polyacrylic acid is not clearly established but may vary from 10% up to 25%. It is assumed that there is a potential influence of the concentration of the polyacrylic acid and the respective acidity (PH). For instance, 20% polyacrylic acid has a reported PH of around 1.0 [36,37] whereas 10% polyacrylic acid is around 2.0 [38].

These differences might account for rendering dentin surfaces more or less suitable for self-adhesive resin cements. More directed studies are required before the application of polyacrylic acid is routinely recommended before self-adhesive resin cements, and one should consider the benefit of the procedure against adding another step to the process.

In the clinical scenario, the presence of remnants of provisional cements can adversely affect the performance of the self-adhesive resin cements. Application of different clearing treatments to dentin before bonding can have effects ranging from simple removal of contaminants to total or partial removal of the smear layer [39].

A study found that the ideal cleaning treatment before bonding with Relyx Unicem was achieved by sand basting the dentin surface. The same study demonstrated that either 0.12% chlorhexidine Di gluconate or 40% polyacrylic acid were not able to significantly increase shear bond strength when compared with a hand instrumentation cleaning protocol [29].

It is valid to highlight that the viscosity of some self-adhesive resin cements can also be partially responsible for a limited diffusion into the exposed dentinal tubules treated by the polyacrylic acid [40].

Cleaning the substrate before bonding with self-adhesive resin cement seems a logical, required clinical procedure. When additional retention is desirable, it seems that the hand instrument cleaning followed by mild polyacrylic acid or brief sandblasting are safe to use, but one should avoid strong acids or other cleaning solutions with unknown interactions with the chemistry of self-adhesive resin cements.

Cementation of posts to radicular dentin is another clinical scenario that faces numerous challenges, especially when resinous materials are to be used. The main reason for failure of fiber posts is depending of the resin cement from the radicular dentin [41].

Several aspects create challenges when using an adhesive system followed by conventional resin cements for luting posts, such as moisture control, proper adhesive application, and subsequent light curing of the cement [42]. In this particular scenario, the use of self-adhesive resin cements seems to be a suitable and perhaps less technique-sensitive option than other luting strategies that may involve pretreating the difficult-to- access canals with adhesives.

A recent systematic review with meta-analysis of *in vitro* studies suggested that the use of self-adhesive resin cement could improve the retention of fiber posts into root canals [43].

Authors attributed the result to the bonding properties of self-adhesive resin cements, which create micromechanical retention and chemical bonding, greater moisture tolerance [44] and lower polymerization stress compared with conventional resin cements [45]. Perhaps even more relevant clinically is the elimination of the technique sensitivity associated with intracanal bonding when conventional resin cements are used with separate adhesives.

Ceramic substrates

Today, numerous ceramic products are available and a thorough understanding of the ideal luting material and surface treatment for each ceramic is crucial. More recently, new resin-matrix ceramic materials have been introduced, creating a new category of esthetic indirect restorative materials to which clinicians need to bond [46].

Even though dental ceramics are regarded as strong materials, it is well known that the using a luting agent with bonding capability and enhanced mechanical properties is necessary for their durability because it significantly increase fracture resistance [47].

In general, resin cements meet those requirements are the preferred choice as luting materials for all ceramic restorations.

Glass matrix ceramics are essentially nonmetallic inorganic ceramics containing a glass phase.

They are represented by the traditional feldspathic ceramics; the synthetic ceramics, such as leucite, lithium disilicate, and the glass infiltrated ceramics, such as alumina (In-Ceram, Vit/Sirona Bensheim, Germany). These ceramics allow for chemical treatment of the internal surface to improve retention, usually with hydrofluoric acid gel followed by salinization [48].

Recommended for all glass matrix ceramics, salinization has been shown to reduce the contact angle and increase the wettability of the ceramic surface [49] making it a suitable substrate for resin cements. The combination of hydrofluoric acid etching and salinization is currently the standard, recommended procedure for bonding resin cements, including self adhesive, to glass matrix ceramics [50].

Self adhesive resin cements are not the best choice for cementing veneers. Although a good bond is accomplished to the veneer of the hydrofluoric acid etching, salinization, and adhesive bonding, the bonding to the dental substrate (usually enamel) is weak and may result in early clinical dislodgment of the veneer. Light- cured- only cements remain the best option for cementing veneers. These cements do not contain certain amine 5 required for the self-curing reaction that have been shown to all discolor, and thus the light-cure- only cements are the most color stable.

It is known that the cement choice is less important to the clinical success when cementing zirconia prosthesis [51-54].

The major reason for failures in porcelain-veneered zirconia crowns is chipping and fracture of veneering ceramic. As monolithic zirconia crowns became available and increasingly acceptable because of improvements in their optical appearance chipping of the veneering ceramic may no longer be a clinical problem and, therefore, the clinical success of zirconia crowns will likely be more dependent on the retention capacity provided by the surface treatment and cement choice, leaving the clinician the responsibility of choosing the most appropriate, and evidence- based, cementation protocol.

Few studies had investigated the best resin cement and bonding protocol for the novel category of materials. The manufacturer's recommendations for each of these materials vary. Another study found varied results for vita enamic (Vita Zahnfabrik, Langen, Germany) and Lava Ultimate (3 M ESPE) resin-matrix ceramic blocks regarding optimal surface treatment and resin cement choice [55].

Regarding the resin cement, the self-adhesive material presented significantly higher bond strengths to Lava Ultimate than the conventional resin cement [55]. Lava ultimate is still indicated for inlays, onlays, and veneers; however, the manufacturer had removed the crown indication since June 2015 because of higher rates of premature depending. In contrast, surface treatment had little impact when bonding to vita Enamic, which is essentially a ceramic structure infiltrated with a resin. However, the self-adhesive resin cement used presented overall lower bond strengths than the conventional resin cement [55].

Clinical performance of self-adhesive resin cements

Relyx Unicom is by far the most investigated product in clinical studies; however, long-term studies are still lacking [56].

Clinical studies have demonstrated that selective enamel etching before self-adhesive luting procedure with lithium disilicate inlays had no significant influence on marginal integrity when compared with the nonetched controls [57].

A 12-month clinical evaluation of indirect resin composites luted with self-adhesive or conventional resin cements observed that both luting materials performed similarly, but this is not surprising because little or no difference between materials is what is usually expected at the early 1-year clinical evaluation [58].

Of clinical relevance was the finding that plaque accumulation and bleeding score were higher around prostheses cemented with the resin cement.

Factors that possible accounted for this finding were the content of the resins and the resulting bacterial colorization on their surfaces; the bonding of the resin cement, which is not so easily removed from the sulcus; and the high solubility of zinc phosphate cement (i.e. release of potentially antimicrobial zinc ions), which may be on advantage to repel microorganisms from the margins in the long term [59].

Conversely, other authors found less gingival inflammation around restorations cemented with self-adhesive resin cements [60].

A review presented the cement status of clinical studies on self-adhesive resin cements [56]. The review found only three studies comparing self-adhesive resin cements with traditional cements, none of them identifying retention loss either for self-adhesive resin cements or other traditional luting agents. Comparable clinical results were also found between conventional resin cements and self-adhesive resin cements as luting agent for inlays and onlays up to 4 years follow-up [57,61].

It is clear that more sophisticated clinical investigations of these types of cements are required. However, there is a good amount of sound laboratory investigations that can support clinicians in their decision.

Self- Adhesive Cements are considered alternative luting cements with multiple applications in modern dentistry. However, one must consider the material's chemistry, bonding, and mechanical requirements for each particular clinical scenario, and the limitations that are intrinsic to the nature of the material. Clinical studies are still insufficient to completely understand the material clinical performance.

To fulfill patients expectations, dental biomaterials must have a highly aesthetic appearance comparable to that of natural teeth as well as good mechanical properties [62]. This explains the professionals' growing interest for all-ceramic restorations [62,63].

On the other hand, successful bonding of the luting material and the tooth structure is imperative for the retention and longevity of the restoration.

Obtaining adhesion between a luting agent and a ceramic surface requires surface pretreatment 65-66 such as etching, priming, and bonding 67-70.

Until recently, resin cements were divided into two subgroups according to the adhesive system used to prepare the tooth prior to cementation. One group utilized etch- and - rinse adhesive systems example Relyx.TM The second group uses self-etch primer example: Panavia.TM [71,72] Multi step luting materials make the procedure technique, Sensitive [72].

In-vitro studies on the shear bond, the micro tensile bond and the long-term durability of the resin cement on the tooth substrate and the ceramic restoration demonstrated the bond strength was impaired when the surface treatment was insufficient [73].

An ideal dental adhesive must be biocompatible and resistant to micro leakage [63,73]. The cement should also provide a durable bond between dissimilar materials, possess favorable compressive and tensile strengths, have sufficient fracture toughness to prevent dislodgment as a result of interfacial or cohesive failures [74,75], be able to wet the tooth and the restoration surfaces, exhibit adequate film thickness and viscosity to ensure complete seating [73,76], exhibit minimal solubility in the oral cavity [74,75,77] and demonstrate adequate working and setting time [73,76].

The dental adhesive should also enhance the fracture resistance of the full-ceramic crowns [63,74,78] and ensure adequate marginal adaptation [79].

Resin cements are composites that consist of a resin matrix, eg bis-GMA or urethane dimethacrylate, and a filler of fine inorganic particles. Bonding of resin-based composite materials to tooth hand tissues has been simplified [72].

Even though enamel and dentin bonding has progressed from the first to the seventh-generation adhesives, bonding to dentin remains less predictable than bonding to enamel 80,82.

All luting agents required the application of one of these adhesive systems to prepare the tooth prior to cementation 67,80,83,84. This multistep procedure and the performance of the etch-and-rinse or self-etch adhesive itself can influence the bonding effectiveness 72,85.

To overcome some of the shortcomings of both conventional and resin cements, resin-based self- adhesive cements were introduced in 2002 as a new subgroups resin cement. The goal was present the favorable characteristics of different classes (total etch, self-etch) in a single product. This new category of cements does not require any surface treatment of the teeth or restorations and provides effective bond strength [64,69,74,87,88].

Self-adhesive cements aim to combine the favorable properties of conventional (Zinc phosphate, glass ionomers and poly carboxylate cements and resin luting agents [71,77].

In fact, it is reported that self-adhesive resin cements provide the equivalent bond strength of conventional resin cements to dentin, 80,84 gold alloy and glass ceramics [96] and zirconia [96,97].

Attar., *et al*. [99] demonstrated that resin-based cements that rely on the application of etch-and-rinse adhesive systems have greater flexural strength than conventional resin cements; different studies found lower bond strengths 72,84. Due to its simplified application technique, the first self-adhesive cement introduced to the market (RelyX TM Unicem; 3 M EPSE, St Paul Minn) rapidly gained popularity among clinicians [72].

Thus, several brands developed self-adhesive cements (Rely XTM unicem; Rely X TM Uioo; 3 M ESPE, St. Paul, Minn; Smatcem® 2 Dentsply Caulk, Milford; G-Gem TM, GC America, Inc, Alsip; Maxcem Elite TM (Kerr Crop, Orange. Calif); SeT(SDI Ltd, Bays water, Australia); SAC-H, SAC-A (Kuraray Medical Tokyo).

Regarding their composition, self-adhesive cements are based on phosphoric acid methacrylate that demineralize and infiltrate the tooth substrate, resulting in micromechanical retention. Secondary reactions have been suggested to provide chemical adhesion to hydroxyapatite [71,93].

The basic inorganic fillers are able to undergo a cement reaction with the phosphoric-acid methacrylates. The dominant setting reaction starts with free radical polymerization, which can be initiated either by light or by a redox system (dual-curing composite materials) 64,93.

The purpose of this literature review is to evaluate the reliability of self-adhesive luting agents and compare them to the conventional etch-and-rinse and self-etching luting agents.

Based on the published articles RelyX TM unicem- the most investigated self-adhesive cement. proved to be satisfactory and comparable to other multistep resin cements. However, Rely X TM Unicem bonding performance was found to be better on dentin than on enamel. On the other hand, this product can bond to the silica-based ceramics, aluminum oxide ceramics, zirconium oxide ceramics regardless of the ceramic treatment.

Product	Delivery System	Working/setting time	Shades	Composition
BisCem® (Bisco Schaumbug. IL, USA	Paste/paste dual syringe; Direct dispensing through a mixing tip	1min/6min at 22°C	Translucent Opaque	Bis (hydroxyethyl methacrylate phosphate (base), tetraethylene glycol dimethacrylate, dental glass
Breeze™ (Pentron Clinical Technologies, Waillingford, CT, USA)	Paste/paste dual syringe. Direct dispensing through a mixing tip	1min/4min at 22°C	A2 tralucent Opaceous White	Mixture Bis-GMA, UDMA, TEGDMA, HEMA, and 4- MET resins, silane-treated barium borosilicate glasses, silica with initiators, Stabilizers and UV absorber, organic and/or inorganic pigments, opacifiers
Clearfil SA (Kuraray, Tokyo, Japan; SL)	Dual barrel syringes	1 min/ 5 min	A2 White	Bis-GMA, TEGDMA, MDP, barium glass, silica, sodium fluoride
Embrace WetBond resin cement (Pulpdent; Watertown, MA, USA)	Automix or standard syringe packaging	Completely autocures in 7min	One shade	Di; tri-, and multi-functional acrylate monomers into a hydrophilic, resin acid-integrating network (RAIN)
G-Cam™ (GC; Tokyo, Japan)	Capsules	2min/rmin	A2, A03, Translucent, B01	Powder: fluoroaluminosilicate glass, initiator, pigment. Liquid: 4-Met, Phosphoric acid ester monomer, water, UDMA, dimethacrylate, silica powder, initiator, stabilizer
iCEM® (Heraeas Kuizer)	Double syringe			No information available
Maxcam Elite™ Kerr; Orange CA, USA)	Paste/paste dual syringe direct dispensing through a mixing tip	2min/ 3min	Clear White Opaque Yellow Brown	GPDM (glycerol dimethacrylate dihydrogen phosphate), comonomers (mono, di, and tri-functional methacrylate monomers), proprietary self-curing redox activator, photo-initiator (camphorquinone), stabilizer, barium glass fillers, fluoroaluminosilicate glass filler, fumed silica (filler load 67% wt. particle size 3.6 um
Monocem™ (shofu Dental, San Marcos, CA, USA)	Paste/ paste dual syringe. Direct dispensing through a mixing tip	Ultimate working time (7 min in anaerobic conditions)	Translucent Bleach white	No Information available

RelyX™ Unicem (3M ESPE, St Paul, MN, USA)	Capsules (Aplicap: 0.001 ml; Maxicap: 0.36 ml)	2min/5min at 22°C	AL A2 Universal Translucent White opaque A3 Opaque	Powder glass fillers, silica calcium hydroxide, self-curing initiators, pigments, light-curing initiators. Liquid: methacrylated phosphoric esters, dimethacrylates, acetate, stabilizers, self-curing initiators, light-curing initiators
SeT (SDl Australia, SE)	Capsules	5 min	Translucent, A1, A2, OA3 White opaque	UDMA, phosphate, fluoroalumino-silicate glass, silica
Smart Cam® (Dentsply-caulk- Germany)	Dual-barreled syringe	2min/6min	Translucent Light Medium Dark opaque	Urethane dimethacrylate; di-and tri-methacrylate resins; phosphoric acid modified arylate resin, barium boron fluoroaluminosilicate glass; organic peroxide initiator, camphorquinone photoinitiator; phosphene oxide photoinitiator accelerators; butylated hydroxy toluene; UV stabilizer; titanium dioxide, iron oxide; hydrophobic amorphous silicon dioxide
SpeedCEM™ (lvoclar, Vivadent)	Double syringe	Working time; self 100-140S. dual 100-140s setting time; (37°C) Self 150-220s, Dual 150-220S	Transparent opaque yellow	Dimethacrylates, ytterbium trifluoride, co-polymer, glass filler, silicon dioxide, adhesive monomer initiators, stabilizers and pigments.

Table 3: *Characteristics of self-adhesive cements of different brands.*

Self-adhesive cements seem to be promising in indirect restorative procedures because they offer a simplified technique, reduce the occurrence of postoperative sensitivity and are suitable for a wide range of applications.

Prospective, Long-term studies are necessary to evaluate self-adhesives introduced in the market prior to making any general recommendation regarding their use [79-99].

Conclusion

The majority of available literature data is based on studies that investigated one of the Self-adhesive cements that are currently available to clinicians. According to the *in vitro* results, Self-adhesive cement adhesion to dentine and various restorative materials is satisfactory and comparable to other multistep resin cements, while adhesion to enamel appears to be weak link in their bonding properties. Long-term clinical performance of these materials needs to be assessed prior to marking a general recommendation for their use.

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