Acta Scientific Dental Sciences (ISSN: 2581-4893)

Volume 5 Issue 6 June 2021

Review Article

Compomers: A Review of Literature

Neelam Mittal[1] and Supriya Gupta[2]*

[1]*Professor, Department of Conservative Dentistry and Endodontics, Faculty of Dental Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh, India*

[2]*Junior Resident, Conservative Dentistry and Endodontics, Faculty of Dental Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh, India*

***Corresponding Author:** Supriya Gupta, Junior Resident, Conservative Dentistry and Endodontics, Faculty of Dental Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh, India.

Received: March 15, 2021

Published: May 17, 2021

© All rights are reserved by **Neelam Mittal and Supriya Gupta.**

Abstract

Polyacid-modified composite resins are a class of composite material used in dental repair. Similar to conventional composite materials, compomers also have two distinct phases. These phases are different in form and chemical composition and are mutually insoluble in each other. They are combined to form a mixture that has superior mechanical properties to those of the individual phases. This term is derived from the words composite ('comp-') and glass-ionomer ('-omer'). Compomers have bifunctional monomer, which reacts with the pendant methacrylate groups of other monomers. These also react with the cations liberated by the glass particles. Different kinds of products are available for compomers. The purpose of this paper is to describe their specificities and to compare their different properties like mechanical property, water uptake and fluoride release.

Keywords: Bifunctional Monomer; Compomers; Fluoride Release; Glass-Ionomer Cements; Mechanical Strength

Abbreviations

GIC: Glass-Ionomer Cements; UDMA: Urethane Dimethacrylate; Bis-GMA: Bisphenol A-Glycidyl Methacrylate

Introduction

Compomers are also referred to as polyacid-modified composite resins and were introduced into dentistry in the mid-1990s. The term polyacid-modified composite resin was proposed in 1994. Polyacid-modified composites were introduced into clinical use in about 1992. These are aesthetic materials which are used for the restoring teeth damaged by dental caries [1]. Compomer is regarded as an alternative for GICs and composites which are aesthetic dental filling materials. The compomers are formed from composites and GICs hence these materials possess many properties and characteristics of both materials. To incorporate the properties like adherence of compomers to tooth structure and fluoride release to decrease the incidence of caries compomers combine the polymers of composite with the characteristics of glass ionomers [2]. They consist mainly of dimethacrylate macromonomers blended with diluents and filled with inert filler, bonded in with silane coupling agent. In addition, they also contain some extra components like an acid-functional monomer.

Composition and setting

Compomers are composed of calcium-aluminium-fluorosilicate glass, immersed in a polymeric matrix. They consist mainly of dimethacrylate macromonomers blended with diluents and filled with inert filler, bonded in with silane coupling agent. Its matrix phase is composed of monomers which consists of essentially modified methacrylates, (UDMA, BisGMA, etc.) and bifunctional monomers. One of the main features of compomer is that it doesn't contain any water and the majority of its components are same as composite resins [3].

Compomers contain bifunctional monomer is able to react concomitantly by radical polymerization with the methacrylates and, by an acid-base neutralization reaction with the release of cations from the glass particles by the action of water [2]. However, without the presence of water in the composition of the compomers the neutralization reaction is inhibited. Hence, these materials do not set in the absence of light.

A limited neutralization reaction could eventually take place, once water penetrates through the polymeric covalent network, then forming ionic bonds [2]. Due to this reaction fluoride is released from the glass filler to the matrix, from where it is released into the mouth, and reduces the incidence of caries (anticariogenic agent) [4]. Compomers are designed in such a way that they absorb water in the order of 2 - 3.5% by mass of water on soaking [3].

It differs from GIC in at least two respects; firstly, the glass particles are partially silanized to provide direct bond with the resin matrix and secondly the matrix is formed mainly by light-activation and radical polymerization reaction of monomers.

Compomers and traditional composite resins have a similar setting reaction. The setting reaction is mainly an addition polymerization process. Setting is mostly light-initiated and the initiator used is camphorquinone along with amine accelerator which is sensitive to blue light at 470 nm [2]. With the compomers at high depths light penetration can be low due to a combination of absorption by the initiators higher up in the specimen and scattering, leading to few free radicals [5].

Polymerization continued at a slower rate even after the light was switched off and it will proceed up to 60 hours post-irradiation [6]. Despite this it is found that increase in strength does not occur beyond 24 hours even when stored under completely dry conditions.

On the other hand, a study using diametral tensile strength to determine changes in mechanical properties showed that strength of compomers rose from 25 MPa at 1 hour to 43 MPa at 24 hours, a change that is consistent with the continuation of polymerization well after irradiation has been completed [4].

Properties of compomers

1. **Fluoride release**: Most of researches have shown that bacterial plaque formation is inhibited by a fluoride concentration of 2 mg/L. This leads to inhibition of carious lesions formation as increased fluoride concentration helps the formation of hydroxyfluoroapatite which is resistant to acid attack. Compomers also have fluoride releasing capacity which might be slower and lower than the self-curing GIC. This can be due to encapsulated fluoride ions by the matrix which decelerate the fluoride release rate [9]. With the help of topical fluoride agent fluoride-releasing ability of compomers can be regenerated. High-release compomers appear to have greater recharge capacity than low-release ones [3].
2. **Fracture toughness**: Fracture toughness is one of the mechanical properties of compomers that differs significantly from conventional composite resins. The mean fracture toughness ranged from 0.97 to 1.23 MPam 1/2 for compomers and 1.75 to 1.92 MPam 1/2 for composites. Counterpart composites have significantly higher fracture toughness than compomers [10].
3. **Mechanical properties**: Flexural and compressive strengths and microhardness of the compomers were higher than GIC but lesser than Composite. Surface roughness of compomer and composite was not significantly different.

   Addition of 3% hydroxyapatite and 4% bio-active glass into compomer improved the demineralization resistance properties of enamel as they increase the microhardness value of marginal enamel [11].
4. **Buffering**: Studies have shown that compomers used to change the pH in the direction of neutral of lactic acid storage solutions. The result was found to be repeatable when samples were exposed to fresh lactic acid at weekly intervals over a period of 6 weeks. This proper is present in glass ionomer cements but absent in composite. This can reduce the incidence of caries hence it is a desirable property [12].
5. **Bond strength**: To produce gap-free restoration margins bond strengths of 17 to 20 MPa may be required to withstand contraction forces sufficiently. Despite the advance-

ment of compomer materials, the dentin bond strength of composites was found to be superior to these materials [13].

6. **Adhesion**: One of the key features of polyacid-modified composite resins is their lack of adhesion to tooth tissues. This is a feature that they share with conventional dental composite resins, and the contrasts with the behaviour of the glass-ionomer cement [14]. Hence it is necessary to use bonding agents to help adhesion of the compomer to tooth together with the appropriate preparation of the freshly cut tooth surface [15].

Advantages

- It is biocompatible in nature.
- Due to release of fluoride and buffering capacity it decreases the incidence of secondary caries, therefore has anti-cariogenic effect.
- It is aesthetically pleasing than GIC as it allows for the shade selection.
- Various mechanical properties of compomers are found to be superior to that of glass ionomers but inferior to conventional composite.

Disadvantages

- Fluoride releasing capacity of compomer is much less than self-curing GIC [3].
- In few studies colour stability has been found to be somewhat a problem with compomers. This is not completely surprising as they are designed to consume water, which is likely to alter appearance through a change in refractive index. This also used to carry with it coloured chemical species (stains) from certain foodstuffs such as coffee and red wine [16].
- These materials have poor wear resistance. Newer formulations have better wear resistance but it is still less when compared to composite.
- Compomers lack adhesion to the tooth surface same as composite.

Clinical applications

These have same clinical applications as conventional composites. These include class I, Class II [17] and Class V [16] restorations. These are preferred in region where forces of occlusion are less. Compomers are most commonly used in Class V restorations. In certain studies colour of compomer has been shown to change significantly over a period of 3 years in adults therefore colour stability has not always been scored so highly. This has been established in a 5-year study of the compomer [14].

A fairly successful result has been seen with the use of compomer in 'open-sandwich' restorations, with an annual failure rate of only 1.1%. Conventional composites are used for the bulk of the restoration. On comparing them with either compomer or conventional composite advocated that the compomer were inferior as they showed greater occlusal wear and inferior marginal integrity compared with the composite resin [14].

Compomers have been assessed for other clinical applications, for example, compomers are used as pits and fissures sealants over a period of 2-years.

Finally, these have been used to bond orthodontic brackets to the tooth to secure bands. Conventional bonded composite resins are used for same application, and compomer have been found to give satisfactory clinical outcomes.

These materials can also be used as root end filling materials. An apicoectomy technique using a compomer with a suitable bonding system covering the whole surface of the denuded root could reduce apical leakage and enhance the possibility of healing. Significant healing was also present for retrograde root filled teeth with inadequate as well as adequate root fillings.

These can also be used as luting cements (available in two-paste system) [17-19] therefore these are also used for cementation of cast alloy and ceramic-metal restorations.

Conclusion

Compomers have been developed as distinctive materials for use as repair materials in clinical dentistry. The presence of minor amounts of both acid-functional monomer and basic ionomer-type glass in compomers present with new properties to them like the ability to draw in moisture to trigger an acid-base reaction which leads to the capacity to release fluoride and buffer acidic environment. However, these clinically desirable features come at a price, since water uptake has been shown in several studies to be associated with reductions in strength over periods of only a few weeks of up to 40% in some instances. Due to water uptake, the reduction in strength does not seem to be important clinically and these materials are convenient for use *in vivo*. Overall, the main conclusion from these clinical results is that compomers perform well and are convenient for their recommended uses in dental restoration.

Conflict of Interest

There is no conflict of interest between the authors.

Bibliography

1. McLean JW., *et al*. "Proposed nomenclature for glass-ionomer dental cements and related materials". *Quintessence International* 25.9 (1994): 587-589.
2. Meyer JM., *et al*. "Compomers: between glass-ionomer cements and composites". *Biomaterials* 19.6 (1998): 529-539.
3. Nicholson John W. "Polyacid-modified composite resins ("compomers") and their use in clinical dentistry". *Dental Materials: Official Publication of the Academy of Dental Materials* 23.5 (2007): 615-622.
4. Cefaly DF., *et al*. "Effect of time on the diametral tensile strength of resin-modified restorative glass ionomer cements and compomer". *Brazilian Dental Journal* 12.3 (2001): 201-204.
5. Krämer N., *et al*. "Adhesive luting of indirect restorations". *American Journal of Dentistry* 13 (2000): 60D-76D.
6. Young AM., *et al*. "FTIR investigation of monomer polymerisation and polyacid neutralisation kinetics and mechanisms in various aesthetic dental restorative materials". *Biomaterials* 25.5 (2004): 823-833.
7. Millar BJ., *et al*. "In vitro caries inhibition by polyacid-modified composite resins ('compomers')". *Journal of Dentistry* 26.2 (1998): 133-116.
8. Vermeersch G., *et al*. "Antibacterial activity of glass-ionomer cements, compomers and resin composites: relationship between acidity and material setting phase". *Journal of Oral Rehabilitation* 32.5 (2005): 368-374.
9. Attar Nuray and Melek D Turgut. "Fluoride release and uptake capacities of fluoride-releasing restorative materials". *Operative Dentistry* 28.4 (2003): 395-402.
10. Yap AU., *et al*. "Fracture resistance of compomer and composite restoratives". *Operative Dentistry* 29.1 (2004): 29-34.
11. Bansal D and Mahajan M. "Comparative evaluation of different periods of enamel microabrasion on the microleakage of class V resin-modified glass ionomer and compomer restorations: An In vitro study". *Indian Journal of Dental Research* 28.6 (2017): 675-680.
12. Nicholson JW., *et al*. "Storage of polyacid-modified resin composites ("compomers") in lactic acid solution". *Dental Materials Journal* 15.6 (1999): 413-416.
13. Tunç ES., *et al*. "The evaluation of bond strength of a composite and a compomer to white mineral trioxide aggregate with two different bonding systems". *The Journal of Endodontics* 5 (2008): 603-605.
14. John Nicholson, Beata Czarnecka, 4 - Polyacid-modified composite resins (compomers), Materials for the Direct Restoration of Teeth (2016): 69-85.
15. Shruthi AS., *et al*. "Comparative evaluation of microleakage of conventional and modifications of glass ionomer cement in primary teeth: An in vitro study". *Journal of Indian Society of Pedodontics and Preventive Dentistry* 33.4 (2015): 279-284.
16. Demirci M., *et al*. "Clinical evaluation of a polyacid-modified resin composite in class V carious lesions: 3-year results". *Dental Materials Journal* 24.3 (2005): 321-327.
17. Qvist V., *et al*. "Class II restorations in primary teeth: 7-year study on three resin-modified glass ionomer cements and a compomer". *European Journal of Oral Sciences* 112.2 (2004): 188-196.
18. Güngör HC., *et al*. "Clinical evaluation of a polyacid-modified resin composite-based fissure sealant: two-year results". *Operative Dentistry* 29.3 (2004): 254-260.
19. Nicholson J W and M A McKenzie. "The properties of polymerizable luting cements". *Journal of Oral Rehabilitation* 26.10 (1999): 767-774.

Volume 5 Issue 6 June 2021

© All rights are reserved by Neelam Mittal and Supriya Gupta.