



Review Article

Advances in composite resin: A review

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ABSTRACT

The presentation of resin based materials was without a doubt an insurgency in the field of restorative dentistry as the utilization of composites these days has gotten far reaching with increase in aesthetic demands. Broad endeavors are as yet in progress to improve its composition and microstructure so as to upgrade their clinical performance and life span. These materials have been the focal point of focus lately with the target of improving their presentation by changing initiation framework, monomers, and fillers and their coupling agents, and by making novel polymerization strategies. The present article discusses various advances in composite resin materials that have occurred over the years and augmented its importance in the field of restorative dentistry.

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1. Introduction

Composites have been widely used in clinical dentistry for nearly 50 years now. Their development and evolution depend on acrylate, and their first acquaintance into dentistry dates back to the late 1950s and early 1960s. Bowen first reported a monomer named bisphenol-A diglycidyl methacrylate (bis-GMA;(2,2-bis[4-(2-hydroxy-3-methacryloxypropoxy)phenyl] propane)) and the fruitful blend of composite by including inorganic fillers.¹

Composite resins have been effectively utilized in dentistry for a long time now and have supplanted amalgam as a posterior restorative material. These materials represent one of the numerous achievements of present day biomaterials research, since they reinstate biological tissue in both appearance and function.² The benefits of resin based restorative materials include tooth-like appearance, manipulation simplicity, relative insolubility in oral fluids and are pocket friendly.

A lot of elements contribute towards composite failure like poor oral hygiene, inappropriate cavity structure, flawed composite manipulation and composite material

performance to name a few.³ The most impressive weaknesses of composite resins can be said to be microleakage and postoperative sensitivity which cause low protection from tensile pressure and scraped area and discolouration.⁴ Over the years, an urge to improve mechanical properties of composite resin has been on the rise.

1.1. Direct Composite Resin

Created by Dr. Lars Ehrnford in 1995, this composite system includes a resin lattice and an inorganic ceramic part. As an alternative to combining of the filler particles into composite resin matrix, another framework was brought in its place by which the resin is melded to the fibrous ceramic filler arrangement. This essentially consist of aluminum oxide and silicon dioxide glass particles or barium aluminum silicate or strontium glasses. These glass particles are consolidated to shape into a molten glass which is gratified through a die on to frame thin strands of glass fibers.⁵

This idea gives a premise to creating packable or condensable posterior composite resin. Regular light-restored hybrid and half pitch composites can't be mass put on account of over the top polymerization shrinkage

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and the frailty to acceptably light-polymerize the resin past a 2 mm significance. Packable composites should not be viewed as a help as mass position of packable sap composite isn't recommended and may bargain the life span of the restoration.⁶

1.2. Indirect Composite Resin

Indirect inlays and onlays have come into existence due to fundamental clinical issues that were experienced by the dentists with direct posterior composite resins. Reconstruction efforts not made evidently on a tooth on the other hand on a model serves for good modification, shows regular contours and proximal contact.⁴ However, it was seen that the first generation indirect resin composites demonstrated improved properties just in lab concentrates and had disappointments in clinical examinations. The clinical disappointments suffered with the first generation composites and the impediments confronted with ceramic restorations prompted the advancement of improved second generation composites.⁵

The second generation composites have microhybrid filler with a diameter of 0.04-1 μ , which is in contrast to that of the first generation composites. The filler content was additionally twice that of the organic matrix in the latter. By expanding the filler load, the mechanical properties and wear resistance is improved, and by lessening the organic resin matrix, the polymerization shrinkage is diminished.⁵

1.3. Flowable Composites

It is purported because of its low consistency and capacity to be syringed into a depression planning with a needle tip. The material can stream into cavity preparations and has a significant role particularly where deposition of material into a tight space is needed. Most by far of flowable composites accessible contain 56% to 70% filler by weight. In like manner, they have decreased mechanical properties, for example, a higher vulnerability to wear, a higher polymerization shrinkage, and lower flexural quality.⁷

1.4. Nanocomposites

Nanotechnology may give composite resins with a significantly littler filler molecule size that can be broken down in higher concentrations and polymerized into the resin framework. Nanotechnology can improve the coherence between tooth structure and nanosized filler molecule size extending from 0.005 – 0.01 μ m and provide a progressively steady and natural interface between mineralized hard tissues of the tooth and propelled restorative biomaterials.⁸ Studies have shown that nanocomposites show more prominent crack strength and bond to tooth structure.⁹

1.5. Compomers

Compomers were showcased as polyacid-modified composite resins and are resultant of a combination of composites and glass ionomer cements. This material can adhere efficiently to dental hard tissues, gives fluoride articulation and is a biocompatible material. Polyacid-modified composites is an attempt to keep the advantages by limiting the hindrances of composites and glass ionomers. Since its established properties is of chiefly solidifying on exposure of light, the operation is unambiguous and they have gained recognition in a short while.¹⁰ The core of compomers is shaped of methacrylate and polycarboxylate polymers with resins which can undergo polymerisation, glass filling particles, for eg, fluoroaluminosilicate, and also strontium fluorosilicate or it may also contain barium fluorosilicate glass and photograph triggers (camphoroquinone/amine framework) and balancers.¹¹

1.6. Ormocers

This group is formed with a alteration to the resin matrix.¹² Diverse to conventional composites, they are made from inorganic and organic copolymers with silane filler particles. In ormocers, which are structurally composed of three essential segments, while the organic polymer structure is most importantly responsible for obstruction, the optical characteristics and the cross-connect capacity, the inorganic structure is accountable for thermal expansion and substance stability and polysilicones don't control the versatility and interface properties.¹³

The process of solution and gelation in ormocers is trailed by water and alcohol polycondensation, and subsequent polymerisation of titer oligo methacrylate alcoxycsilane incited with multi-utilitarian urethane. In ormocers with filling molecule size varying from 1 μ m – 1.5 μ m, the relatively large size of monomer particles can expand protection from wear by decreasing polymerisation shrinkage and spillage.⁴ In spite of these characteristics, the protection from wear of ormocers, which have biocompatibility and extremely flourishing anticipation of decay, is higher than compared to that of traditional composites and with regards to shear bond force they are comparable to customary composites that mainly incorporate Bis-GMA network. Another advantage in favor of these composites is that properties such as the heat expansion coefficient are similar to that of the natural tooth.¹⁴

1.7. Antimicrobial Composite

Silver and titanium particles were brought into dental composites, respectively, to present antimicrobial properties and upgrade the biocompatibility of composites.¹⁵ Microorganisms are subsequently executed on contact with the materials or through leaching of the antimicrobial agents

into the body environment. A few reports have portrayed the consolidation of a methacryloyloxydodecylpyridinium bromide (MDPB) monomer in composite resins that demonstrated no release of the joined monomer yet at the same time displayed antibacterial properties.¹⁶ Alkylated ammonium chloride subsidiaries and chlorhexidine diacetate have likewise been brought as an antimicrobial agent into dental composites.

1.8. Fiber Reinforced Composite

Fiber-reinforced composites (FRC) have various mechanical and aviation applications since they are light, solid and non-combustible. However, with respect to clinical dentistry, they are relative newcomers into the range of prosthodontic treatment options.¹⁷ Throughout the years, these materials have advanced to the degree that they can be utilized for both direct and indirect restorations. FRC materials present high firmness and quality per weight when contrasted with other basic materials alongside satisfactory durability. From clinical point of view, FRC have been explored for various clinical applications in prosthodontics, for example, substitution of missing teeth by resin-bonded adhesive fixed dental prostheses of different sorts, reinforcement components of false teeth or pontics and coordinate development of posts and cores. FRC have been proposed for active and passive orthodontic applications and post-orthodontic tooth maintenance and in periodontology for supporting mobile teeth trying to delay tooth extraction.¹⁸

1.9. Self-Healing Composite

Materials as a rule have a constrained lifetime and debase because of various physical, synthetic, and biological stimuli. One of the principal self-fixing or self-mending engineered materials detailed strangely shows some similarity to resin based dental materials, mainly because it is resin based. This is primarily an epoxy framework which contains resin filled microcapsules. In an event of a split happening in the epoxy composite material, microcapsules are decimated close to the break and it causes the discharge of the resin. The resin in this way fills the break in the material and responds with a Grubbs catalyst scattered in the epoxy composite, bringing about polymerization of the resin thereby leading to fix of the split. Comparative frameworks were shown to have a basically longer obligation cycle under mechanical stress in situ contrasted with comparative frameworks with oneself fix.¹⁹

1.10. Siloranes

Silorane-based composite resins have been mainly produced to cause an expansion to the clinical presentations of composite resin materials and have been delivered demonstrating a cationic ring opening framed for the reason

that of the siloxane and oxyrane compound structures response. The purpose of oxyrane configuration is to lessen polymerisation shrinkage that usually occurs and the siloxane works in development of a hydrophobic structure. In addition to lessening polymerisation shrinkage, these resins have a few points of interest, for example, diminishing negligible discoloration to a base, not being mutagenic, expanding protection from debilitating and giving protection from fluids. Past investigations have discovered the shrinkage pace of silorane-based composites to be <1%.^{20,21}

1.11. Ominchroma

OMNICHROMA (Tokuyama, Japan) is a recently propelled material that shows a definitive wide-go shading coordinating capacity, covering every old style conceal with only one shade of composite. These materials basically use auxiliary shading with its 260nm round fillers particles. Fillers of essentially specific size and shape are anticipated to cause production of red-to-yellow shading as encircling light goes through the composite material, without the requirement of adding any other extra pigment or dyes. This red-to-yellow shading is often formed by the round fillers that consolidates with the reflected shade of the patient's encompassing dentition, making the ideal match from A1 to D4 and beyond.²²

2. Conclusion

The utilization of composites is expanding a result of its advantages from adhesive bonding to tooth structure, aesthetic characteristics and widespread clinical use. Composite resins have shown advancement in various aspects over the years. There still exists a lot of space for the improvement and further advancement of resin based materials. The future vows to be energizing as it is felt that high quality dental composites will be created in the years to come.

3. Source of Funding

None.

4. Conflict of Interest

None.

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