



RESEARCH ARTICLE

RECENT ADVANCEMENT IN RESTORATIVE COMPOSITE MATERIALS

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ABSTRACT

Aim: To determine the various advancement in restorative composite materials

Objective: This review aims towards the understanding of various restorative composite materials available commercially and also the advancement in it.

Background: There is mercury present in the silver filling material, called amalgam, in the past century there has been no evidence showing that silver fillings are harmful to patients. But nowadays dentists doesn't use amalgam filling because of its various disadvantages like it can corrode over time, amalgam filling does not bond (hold together) with your tooth etc. Composite fillings are primarily a resin which has been "filled" with other inorganic materials. This compound makes a composite filling more resistant to wear, colour adjustable, and easier to polish. The various composite fillings used are microfilled composites, hybrid composites, nano filled composites.

Reason: The reason for this study is to determine the various advancements in restorative materials.

INTRODUCTION

The aim of the esthetic and restorative dentistry is to replace the lost or damaged structures with artificial materials that possess biological, physical and functional properties similar to natural teeth (Chu and Ahmad, 2003). Composite resins occupy a paramount position because they offer excellent esthetic potential and acceptable longevity without the need for extensive sound structure preparation (Dietschi *et al.*, 2006). The various modification modifications in composite resin have improved their physical and mechanical properties. Due to the variety of shades, translucencies, effects, opacities and innovative placement technique today composite allow simple reproduction of polychromatic and optical properties of natural dentition.

TYPES OF COMPOSITES

Depending upon the composition the composite resins are classified as macrofilled composite, micro filled composite and hybrid composite.

Microfilled composites

It provides better esthetic and polishability to the surface (Ferracane, 1995). Due to high polishability they are indicated for the restoration of anterior teeth and cervical lesions. The smaller size of silica particles produce smoother surface (Anusavice, 2004).

This fillers particles have larger surface area which requires more resin matrix to wet the surface which results in extremely high viscosity and that limits the percentage filler content possible. Mechanical properties such as strength and stiffness are generally inferior to larger quartz or glass filled composites because of the lower filler content, which often limit their use to non stress bearing areas (Ferracane, 1995).

Macro filled composite

Crystalline Quartz has got a excellent optical properties and chemical inertness which is commonly used as macro filler (Ferracane, 1995), (Anusavice, 2004). The properties of macro fillers are, they are extremely hard, difficult to grind and polish. The chances of wearing soft polymers leads exposing the hard Quartz particle which leads to rough surface (Ferracane, 1995), (Anusavice, 2004).

Hybrid composite

Barium glass is used as the most common filler. To improve the handling characteristics and reduce stickiness a small amount of micro fillers are used (Ferracane, 1995). Most modern hybrid fillers consist of colloidal silica and ground particles of glasses containing heavy metals constituting a filler content of approximately 75% to 80% by weight (Sensi *et al.*, 2007). The smaller microfiller sizes increases the surface area which generally increases the viscosity and requires a decrease in overall filler loading as compared with small particle composites.

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The strength of hybrids allows their use in posterior and anterior regions as a universal composite (Sarrett, 2005)

Bulk fill composite

Bulk fill composite is designed for the use in restoration of the posterior teeth which allow you to fill the prepared tooth and cure the restoration in fewer layer. Time consumption is less when compared to traditional composites when small increments are added to avoid shrinkage. This technique would be faster than placing numerous increments if curing time were identical and it is easier than placing numerous increments. The main advantage of bulk fill composite reduce the procedure time without reducing the confidence, it has fast and easy 4mm placement, flowable viscosity for easy adaptation, high strength and low wear.

Utopian composite

Resin based composite filling materials can arbitrarily be categorised as flowable and universal composite. Flowables have low viscosity offering improved weta bility for better adaptation to cavity flows and the walls. the universal composite offer high viscosity allowing optical sculpt ability and carving for creating correct anatomical morphology. The utopian composite should possess the handling characteristics of a flowable for adaptation as well as having high viscosity for facilitating sculpting.

Artglass

It is an non conventional dental polymer which is used in inlays, onlays and crowns. The resin matrix is composed of Bis-gma/Udma. A moderate amount of colloidal silica is also incorporated for the purpose of enhancing certain handling characteristics. Art-glass is photo cured using a special xenon stroboscopic light. It has an advantage of having considerably more wear resistant than conventional light cured composite, it has also got good marginal adaptation, better esthetics and superior proximal contact.

Fibre reinforced composite

They have numerous industrial and aerospace application because they are light, strong and non inflammable. Over the years this material have evolved to the extent which can be used for direct and indirect restoration. This material is combination of fibres and resinous matrix. It has a high flexural strength, desirable aesthetics results, easy in use, adaptability to various shapes and capability for direct bonding to tooth structure. The primary function are to reduce cost, improve workability and impart desired properties

Nano hybrid composite

The size of the nanoparticles is approximately 40 micro meter. It has got an outstanding aesthetics, easy to polish and it possess greater wear resistance (Manhart *et al.*, 2000). Various studies has shown that nanocomposite show greater fracture toughness and adhesion to the tooth structure (Mitra *et al.*, 2003). Therefore they can be used for both anterior and posterior restorations. They have been fabricated by a different method from the pyrolytic precipitation process used for colloidal silica.

This allows the primary particle to be surface coated prior to becoming incorporated into 3 dimensional macromolecules chains.

Belle glass HP

The resin matrix contains Bis-gma and fillers. Polymerisation of belle glass is done under a pressure of 29 psi at elevated temperature of 138 degree Celsius and in the presence of nitrogen, an inert gas. The polymerisation rate is increased by the elevation in temperature. Due to the increase in atmospheric pressure the vaporisation potential of the monomer at elevated temperature is reduced. Nitrogen gas usage during polymerisation process relates to an increase in the wear resistance i.e nitrogen will provide an oxygen free environment which results in high level of polymerisation, more translucency of cured mass. If oxygen is entrapped in the composite, it will interfere in the polymerisation and reduces translucency. It is aesthetically appealing and highly wear resistant.

Flowable composite

Flowable composites were developed in response to requests for special handling properties for composite resin. It had limitations in the physical properties. The filler content of traditional hybrid composite were reduced and retained the same filler size and adding increased resin to reduce viscosity of the mixture. As the filler content is reduced these composites lack sufficient strength to withstand high stress because of increased resin content these composites show more polymerisation shrinkage and have lower elastic moduli and high fracture toughness. They are difficult to manipulate because of stickiness and they cannot be used in high stress bearing area (Bayne *et al.*, 1998). They are used as stress breaker under composite restorations so as to compensate for polymerisation shrinkage stress of overlying composite resin, repair composite resin restoration, porcelain and amalgam restoration , as restorative material in low stress areas and in tunnel preparation, as pit and fissure sealant (Bayne *et al.*, 1998).

Compomer

Recent developments in dental materials offers a new category of light cured resinous restoratives , the polyacid-modified resin composite which is known as the compomer. They are resin composite containing acid - modified monomers and basic glass filler particles (Lutz, 1996). In aqueous environment they absorb water and undergo slow rate diffusion-driven acid base reaction leading to self formation gradient at the uppermost material surface (Eliades *et al.*, 1998). Compomers show improved physical, mechanical and chemical properties and better wear resistance than traditional reinforced and resin modified glass ionomer (Blackwell and Kase, 1996; Kunzelmann, 1996). They set via a free radical polymerisation reaction, they do not have the ability to bond to hard tooth tissues (Martin *et al.*, 1994). They have lower levels of fluoride release than GIC (Forsten, 1994).

Ormocer

In order to overcome various limitations and concerns associated with the traditional composites a new packable restorative material was introduced which is called ormocer which is an acronym for organically modified ceramic technology (Cunha *et al.*, 2003).

They contain inorganic-organic-copolymer in addition to the inorganic silanated filler particles (Fraunhofer Institute for Silicate Research, ?). Ormocer matrix is a polymer even prior to light curing. It consist of ceramic polymerisation which has low shrinkage as against the organic dimethacrylate monomer matrix seen in composite. It has a capacity to double the conversion of monomer improving the physical properties of the material.

Giomer

Glass ionomers are easy to place, fast-setting, have high fluoride release, low polymerisation shrinkage, hydrophilicity and bonding ability to enamel and dentin. Light activated glass ionomer in particular have the added benefits of reduction in microleakage and immediate finishing and polishing (Graham, ?). They are new type of restorative material that demonstrate same characteristics as glass ionomers but clinically demonstrated esthetics and polishing (Gordon *et al.*, ?).

Conclusion

Recent advances in the field of dentistry has given a wide variety of composites available today in the market. But the right material for each clinical situations should be selected based on the requirement of individual case. Every method has its merits and demerits, these should be considered while they are selected for clinical purposes.

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