

**Current Topic****DENTAL COMPOSITES: PAST, PRESENT AND FUTURE****Amit Patodiya<sup>1</sup>, Mithra N Hegde<sup>2</sup>****Author's Affiliation:** <sup>1</sup>PhD research scholar Nitte University, <sup>2</sup>Head of Dept. of Conservative Dentistry & Endodontics, A.B. Shetty Memorial Institute of Dental Sciences Mangalore**Correspondence:** Dr. Amit Patodiya, Email: dr\_amit@meeradentalhospital.com**ABSTRACT**

Composites have come a long way & have become a main stream material for as many restorative procedures as possible. This paper is an attempt to portrait the developments from past to present & the future needs. Also it is an effort to highlight the properties which desirable to make this material free of any weakness. It can be concluded that composite resin is a promising aesthetic restorative material with universal application provided all its weak points are well taken care of.

**Keywords:** composite, fillers, polymerization shrinkage**INTRODUCTION**

It has been a matter of great interest to restorative dentists to preserve the tooth structure and restore the surface defects by using materials which gives back the lost form and function and also the aesthetics as close to natural as possible. Dental composites have been one such material which fulfills most of these desirable criteria.

With their invention almost 60 years back, these aesthetic materials have come a long way and have witnessed lot of changes both in their development and also in acceptance in minds of general dentists. But as it's said no one is born perfect and same goes with dental composites.

**DISCUSSION****The Past**

The journey started way back in early 1950s with discovery of "Acid Etching" by Michael G. Buonocore<sup>(1)</sup> and then successive developments of resin monomers bisphenol A-glycidyl methacrylate (BisGMA) by Raphael L. Bowen<sup>(2)</sup>. The primitive composites though being crude had been an attempt to have a material which resembles tooth structure. By composition they had resin matrix of BisGMA and UDMA (urethane dimethacrylate) monomers bonded with silica fillers ranging from 50 micron to 0.5 mm using a silane coupling agent.

The major drawbacks of these composites were

**Poor strength** - The strength of the composites is owed to their filler content and the primitive composites lacked in adequate filler loading. Also the filler particles were excessively big as much as 50 micrometers. This limited the filler loading to small quantities as the higher quantity led to high viscosity and poor handling of the material. Thus they were restricted to be used for restoring anterior teeth.

**Dimensional instability-** These composites used to distort under heavy occlusal forces and had high wear rate compared to natural tooth structure. The underlying reason was poor compressive strength of the filler particles and viscous resin matrix.

**Discoloration** - It was observed that there was lot of water sorbtion in these conventional composites which used cause surface discolorations. Also the heavy monomers (BisGMA and UDMA) could not hold the filler particles glued to them for longer time periods hence leading to voids and surface defects.

**Polymerization shrinkage** - During the curing of composites as the monomer used to get converted to polymer there was a high stress buildup within the restoration thereby pulling it from the tooth surface and causing post operative sensitivity, secondary caries and marginal discoloration and often but not the least fracture of the restoration. It was documented to be as high as approximately 10 percent<sup>(3)</sup>

**Leeching of uncured monomers** - No matter what curing methods were deployed, it was found that there was fair amount of monomers being left uncured owing to poor degree of conversion<sup>(4)</sup>. This uncured monomer leached out with time leading to irritation to pulp and surrounding soft tissues.

**Poor surface finish** - Much of this problem was due to dislodgement of large filler particles during finishing and polishing procedure and subsequent brushing actions by patient. The resultant voids lead to dull surface full of ditches and added up to surface discoloration of the composites.

### The Present

From 1970s to present date there have been rapid development in the material science and many changes have been introduced so as to improvise on composites. Efforts were made to address each of the previous deficiencies and either remove them completely or restrict them to small percentage. Talking of each component one by one-

**Fillers** - In chronological developments the filler particle size was reduced from macro filler to micro fillers where the size of particles was just few micro meters and then came the hybrids a combination of micro and mini fillers<sup>(5)</sup>; thus improvising the strength and handling properties<sup>(6)</sup>. Initially to increase the filler ratio fumed silica was being added in different forms like prepolymerized or agglomerated and sintered agglomerated particles<sup>(7)</sup>. With the advent of nano era the filler particle size went down to as low as few nanometers thereby enabling us to have very high filler loading for use in both anterior and posterior region.<sup>(8)</sup> Thus it got easy to develop exclusive posterior composites having very high compressive strength and low wear rate. Also addition of ceramic whiskers have been tried to reinforce the material further but that has been possible with mainly heat cured resin composites<sup>(9)</sup>.

**Monomers** - Similarly there was a shift in monomer molecules; the heavy molecules of Bis-GMA and UDMA were diluted by low density monomers like TEGDMA (Triethyleneglycol-di-methacrylate). This helped in reducing the density and by regulating the filler quantity, low viscosity flowable composites were introduced. But there was still the issue of polymerization shrinkage. There was introduction of epoxy-

based silorane system<sup>(10)</sup> which claimed to reduce the shrinkage stress by opening of an oxirane ring during the epoxide curing reaction but that was not found significantly less than other nano composites<sup>(11)</sup>. There have been exploration of this problem using other monomers like tetraoxaspiroundecane (TOSU) but there was also associated reduction in mechanical properties<sup>(12)</sup>

**Photo initiators**- Previously camphoroquinone was the sole agent being used for light activation of composites but being of yellow color it caused color instability. There have been development of other less yellow photo initiators like PPD (1-phenyle-1, 2-propanedione)<sup>(13)</sup> Irgacure 819 (bisacylephosphine oxide)<sup>(14)</sup> which are more color stable.

### Current disadvantages:

Despite of the continuous developments going on in field of composites still there are few issues which need to be addressed and eliminated. They are mainly-

**Secondary caries**- Seen mostly under the old composite restorations and often is the cause for caries infiltration in pulp chamber. The basic underlying cause is polymerization stress in the resin monomer which pulls the composite from the tooth interface. This results in failure of bond and continuous seepage of the oral fluids into the prepared cavity. Ultimately marginal breakdown occurs and the bacterial contamination leads to caries under the restoration.<sup>(15)</sup>

**Post operative sensitivity** - Dentin hypersensitivity has been very well explained by Brannstrom's theory of dentin hypersensitivity<sup>(16)</sup>. When the margins of the restoration get open either due to shrinkage or due to poor handling and adaptation of composite then patient often complains of cold sensitivity post restoration. Also there can be persistent sensitivity leading to sharp pulpal pain due to leeching of residual monomers to the pulp. This can be minimized to great extent if after acid etching priming of dentin with primer is done and followed by incremental restorative buildup.<sup>(17)</sup>

**Marginal discoloration** - It's a very common observation to see dark lines demarcating the tooth from composite restorations. They are more pronounced in old restorations and in

posterior teeth. Most common reason behind is the open margins either due to shrinkage or due to marginal breakdown of the material. This discoloration often demands re-restoration.

**Fracture of the restoration** – Due to poor cavity design or high stress on the restoration there is often marginal breakdown. This leads to opening of margin and occurrence of secondary caries. The continuous undermining of restoration leads to weakening of tooth structure and leads to fracture of tooth/ restoration thus demanding replacement of the restoration<sup>(18)</sup>.

### Future

Composite resin is a promising aesthetic restorative material provided all its weak points are well taken care of. Lot of research is being done on development of stronger and better filler particles and resin monomers which have minimum shrinkage. But it is important to understand that primary causes of weakness of present day composites are polymerization shrinkage and the irritation caused by residual monomers. If there won't be any shrinkage then there will be no distortion or open margins and post operative sensitivity. Likewise there won't be any secondary caries or pulpal irritation and what we will have is a long lasting defect free restoration.

### CONCLUSION

It is emphasized here that methods be developed to completely cure the resin monomer and at same time to have closer sintering of filler particles thus increasing the strength of the material and ensuring its longevity in the oral cavity of the patient.

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