Failures in Composite Restoration - A Review

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***Abstract*: In recent years, the demand of tooth colored restorative material and its advantages has led to a rapid increase in the use of resins. The steady growth of interest in 'cosmetic' treatments led to increase in use of composite fillings which are naturally an attractive alternative to silver amalgam restorations, particularly in clinical situations where the restorations would otherwise be visible. This review is based on the failures of composite restoration and problems faced by dentist and patient. Some of the major problems are shrinkage of resins, post operative sensitive, fracture of restoration, wear, inadequate finishing and polishing etc. This review paper will be useful in understanding the problems related to the failures of composite restoration.**

***Keywords*: Composite, Failures, Shrinkage, Wear, Review**

Introduction

As per McLean, the main endeavour to create plastic restorative materials was uncovered in the Allied Field Information Technical Report No. 1185, distributed in 1947. A cold cured acrylic resin for use in restorative dentistry was produced in Germany [1]. The self-cured, unfilled acrylic materials could be put specifically into the prepared tooth. The polymer and monomer were combined and embedded into the pit where it polymerized. In any case, these amine-containing resins were not shading steady and turned dull on introduction to sunlight. They additionally had issues of over the excessive working time to set initially (1.5 minutes), poor compressive quality, low grating protection, low modulus of versatility, high water absorption and a polymerization shrinkage of 7% by volume. Their high coefficient of thermal expansion additionally predis-postured they to miniaturized scale spillage and the issues related with microleakage [2]. In 1958, the main composite resin material, P-Cadwrit, was made accessible in Germany. In 1959, Bowen recorded his first patent in the U.S.A. on the renowned Bis-GMA resin. The upsides of composite resins in light of Bis-GMA resin over an acrylic resin include: bring down polymerization shrinkage, non-volatile, bring down exothermic properties, more prominent compressive quality and less lethal to the pulp [3]. Knight et al built up the urethane dimethacrylates in 1973. A resin was made for use in composite dental materials along these lines which have points of interest of higher molecular weight, lower viscosity and less in vivo stain-in with use than Bis-GMA [l] resins.

According to Lutz et al [4], filled remedial resin consists of three-dimensional mixes of at least two synthetically extraordinary materials with a surface interfacial stage. The 3 stages are: the matrix stage, the surface interfacial stage, and the dispersed stage. Every resin "should likewise incorporate a quickening agent initiator framework to start and finish polymerization. The artificially cured composites by and large utilize an amine-peroxide framework, though the light-cured resin utilizes a diketone-amine framework which is actuated by the extraordinary blue light. What's more, pigments and opaquers are added to control translucency and shade. The resin framework is a dimethacrylate oligomer such Bis-GMA or urethane-diacrylate. The surface interfacial stage comprises of either a bipolar coupling specialist to tie the natural resin grid to the inorganic fillers, or copolymeric of homopolymeric bond between the natural Fine-Particle measure Composite Resins network and fractional organic filler. The level of interfacial bond and compound solidness is basic for fruitful clinical utilization of any composite resin [5]. Lutz et al [4] grouped the dispersed stage in view of the three noteworthy classes of filler particles utilized. Conventional macrofillers comprise of quartz, glass, borosilicate, and ground or smashed ceramic. The measurement of macrofillers particles go from 0.1 to 100A.055/lm. Microfillers are normally pyrogenic silica which is indistinct, finely light cured. Contrasted with the large particle composite dispersed particles of around 0.04A.05.5/lm in estimate. The resins, they furnish a smoother restorative surface with micro filler-based complexes are generally one of three less surface degeneration, better shading solidness and higher writes: [1] fragmented prepolymerized particles of I to 200A.05 5/lm in estimate, [2] circular prepolymerized particles of 20 to 30A.055/lm in width, and [3] agglomerated microfiller complexes of I to 25A.055/lm in diameter. Self-cured resins are favourable where compos-degeneration at the filler-matrix interface would in any case composite resin should be put in regions of the mouth where light can't reach adequately [2] Be that as it may, the visible light-cured resins have numerous preferences, including: control over the working time, quick completing of resins and cases of rebuilding and control over the profundity of cure. Since no mixing is required, it implies simpler dealing with and insignificant porosity, the real advantage is that the rebuilding will be significantly more shading stable contrasted with self cured resins. Subsequently, most of the composite resins now accessible are light-cured resins [2, 6].

Dental composites consist of a polymerizable resin matrix, particle fillers, reinforcing glass and silane coupling agents [7]. These glass particle/resin matrix composites have good aesthetic properties and strength, making them the most widely used materials for restorations of anterior teeth [8]. Development of modern dental composite restorative materials started in the late 1950s and early 1960s, when Bowen [9] began experiments to reinforce epoxy resins with filler particles.

Since 1990, numerous classifications of resins composites have been presented. Composite Resins have been utilized for almost 50 years and quite a long time upgrades have been made with respect to their composition and their properties. The majority of them contrasted chiefly in the specific filler matrix utilized, e.g. conventional/customary, little molecule composites, matrix (smaller scale hybrid, monohybrid, submicron cross breed and monohybrid) [10]. The consolidation of the filler in the composite material has improved the mechanical properties of the composite, for example, compressive and rigidity, surface hardness or resistance to surface space[11].On the other hand, posterior composite restorations have been shown to produce higher failure rates due to secondary caries [12,13].

Light Curing

Every composite requires a specific measure of energy (joules) for finish curing. This may differ by the manufacturer, by the sort of composite material, and the shade of the composite. It is a component of the energy of the curing light (mW/cm2) and the measure of time that the light is conveyed. Tragically, the measure of delivered energy can fluctuate because of the improper position of the light tip, movement of the light tip amid curing, separation of the light tip from the resin, shade and type of the resin material, state of the light curing unit, or thickness of the resin. Indeed, even the most capable curing light won't cure a composite on the off chance that it isn't legitimately set. Because the best layer of the composite is hard, that does not imply that the composite is cured at the base [14].

All in all, insufficient consideration is given to legitimate position of the curing light or the state of the light. The best possible measure of irradiance is controlled by the manufacturer and the shade of the composite. Deficient or inadequate curing unfavorably influences the resin physical properties, lessens the bond quality to the tooth, diminishes the biocompatibility of the restoration, increments negligible wear and breakdown, and increments bacterial colonization of the restoration [15] A few reviews have demonstrated that numerous QTH (quartz-tungsten-halogen) curing lights in dental workplaces don't convey enough light energy to totally cure composites[16].

Size and Location of Restoration

The position of the tooth in the curve and the size of the cavity have been appeared to be a factor in the accomplishment of a restoration. One investigation found the risk of failure in the molar region to be twice as high with respect to premolars, [17] while another examination put the failure rate in bring down molars as three times that of the upper premolars [18]. Multi-surfaced restoration efforts are additionally more inclined to failure than single surface restoration. An investigation figured that for each surface added to the restoration, a 40% expansion in the failure rate resulted [17].

Polymerisation shrinkage

Every single composite resin contract amid polymerization, such withdrawal is named polymerization shrinkage. Polymerization shrinkage of composite resin is critical as a result of its impact on cavosurface edges. It causes partition between a composite resin mass and the adjacent tooth structure. Negligible adjustment of a composite resin rebuilding is reliant on a few variables including: polymerization shrinkage, hygroscopic properties, holding between restorative material and the cavity walls. Coefficient of thermal expansion of the material, and the Finishing methods [19-22].

It has been exhibited that regardless of acid etching of enamel walls, hygroscopic expansion of composite resin, cautious completing strategies, and utilization of material with warm expanxivity like that of enamel, marginal gaps will in any case result from polymerization recoil age. Such shrinkage may cause minor gap development, or when the finish - resin bond stays in place, it might bring about damage inside the composite resins as micro cracks which may cause untimely disappointment of the restoration [23]. The shrinkage properties of composite resins are subject to both the physical components of the materials and how the materials are cured and dealt with clinically. Different composite materials have been appeared to display polymerization shrinkage from around 1.5 - 5.5% by volume [19]. Late investigations report shrinkage of around 1-2% volume for posterior composite resins contrasted with around 4-5% volume for early ordinary composites [24]. Joining of a high division of filler particles alongside a fitting creation of the monomer matrix hypothetically would give a composite resin the most minimal conceivable polymerization shrinkage. The measure of volumetric change in back composite resins when cured has been expressed as one of the principle determinants of the life span of the composite resin reclamation.

When matrix monomer convert to polymer Composite shrinks immediately upon setting (2-3% by volume) stresses are invariably generated within the material at the margins on shrinking [25]. Larger the increment of compo- site, greater the total shrinkage, this will again increases the potent- tail for stress formation [26].

Consequences of polymerisation shrinkage

i. Weak bonds can occur due to polymerisation shrinkage this causes failure of composite in bonding with the tooth structure
ii. Post-operative sensitivity [26]
iii. Marginal gap formation
iv. Ingress of bacteria and secondary caries [26]
v. The contraction forces transmitted to enamel and dentin, causing cusp flexure, fracture or crazing of enamel and fracture in composite material [27].

Appropriate Placement Technique

Numerous specialists suggest incremental arrangement of the composite in light of the abatement in the "C" factor and the resultant reduction in the shrinkage stress [28]. This has been the prescribed strategy; in any case, with the presentation of the low shrinkage stretch composite materials, mass filling has turned out to be better known. Due to their low stresses and great profundity of cure, these composites might be what have to come. Regardless of which procedure that is utilized, legitimate matrix placement is critical for the restoration achievement. A restoration that has an open contact or a gingival overhanging isn’t a worthy rebuilding. Nourishment impaction from an open contact does not prompt great gingival wellbeing and an open or rough edge may prompt bacterial development and possible intermittent decay. Sectional matrix frameworks and isolating rings may lead better shapes, contacts, and marginal seal.

Proximal Box Placement

Bonding failures have been usually credited to the gingival margins of Class II composite restorations [29]. In the proximal box of most Class II restoration, there is practically zero polish at the edge for bonding. Holes at the gingival edges have been ascribed to the potential for poor bonding at this margin [30]. The disparity between etching depth and adhesive invasion prompts a substantial region of exposed collagen at the gingival margin [31] .Another variable that may meddle with the bonding in the gingival region is water content. Expanded water content prompts lessened adhesive invasion and lower monomer/polymer transformation of the adhesive at the gingival edge when contrasted with the proximal wall. [32] Sometimes, the situation of a glass ionomer as the principal layer for these deep margins might be considered due to a portion of the great characteristics of this material [33].

Water Absorption

The specialized properties of composite resin are influenced by ingestion of water, which goes about as plasticizer and pressure consumption operator, debilitating the molecule network interfaces. Confined swelling happens at the filler-lattice between confront causing deboning, which may prompt hydrolytic breakdown. Separate on the surface of composite pitches may likewise be encouraged by temperature changes and dissolvable impacts. The higher the temperature, the more fast the water absorption [34]. The measure of water ingestion in posterior composite resins utilized today is around 0.2 - 0.6% by weight. Water retention will prompt breakdown of the composite resin with utilize.

Wear

Wear might be characterized as the undesirable expulsion of strong material from surface because of mechanical action [35]. The customary vast molecule measure composite resin contains expansive filler particles which are impressively harder than the resin network. Amid rumination, stresses are transmitted onto the rebuilding surface and especially the particles anticipating from the occlusal surface. Since the particles are harder than the resin network in which they are implanted, a great part of the pressure is transmitted through the molecule into the resin itself. Stress will think and turn out to be too much high where the submerged portion of the molecule is angulated or irregular shape as a fiddle. Such a condition has a tendency to create little breaks around the molecule, along these lines debilitating the lattice locally [36]. Another age of composite resin has hence been produced which contain filler particles of decreased sizes yet expanded filler stacking. The measure of stress around every molecule is diminished which result in a huge lessening in loss of anatomical form. In some composite resin, softer filler particles have been incorporated keeping in mind the end goal to diminish the distinction in hardness between the filler and the network. At the point when softer filler particles are utilized, the masticator stresses are in part consumed by the molecule, instead of being completely transmitted into the encompassing matrix [23] the utilization of softer filler particles in this way diminish the likely hood of creating little splits around the filler and debilitating the framework locally.

Shade Matching

Correct shading coordinating of the restoration and the tooth is an imperative part of the aesthetic restoration. Numerous things can confound making the right shade choice, for example, the lighting framework in the operatory, the way that teeth lighten when got dried out, the shade of the operatory or the patient's dress, and the experience of the individual doing the shade determination. Shade choice requires learning of material science and the physiology of shading; subsequently, it is both an art and a science requiring top to bottom knowledge, precise clinical judgment, and discernment with respect to the dentist. [37] Unfortunately, the confinements of shade guides are critical variables that compromise shade matching methodology in dentistry and add to the dissatisfaction of clinicians, specialists, and patients [38].

Improper manipulation

i) Acid etching

Etching time is 15-20 sec on permanent tooth whereas its 60 sec on primary tooth, as it is more amorphous & does not form the deep resin tags. Enamel require more etching time as fluoride content is more & it is impervious to etch, The end results of etching that it appears as irregular surface and frosty white owing to light refraction [25]..

ii) Acid Strength

Buonocore utilized 85% phosphoric acid first. However, later examinations said higher concentration are less effective & are more likely to denude surface, so research suggest 37% phosphoric acid is the ideal concentration [39].Care ought be taken that acid should replenish before use as it evaporates during storage.

iii) Under etching

Inability to accomplish a cold surface could come about because of under etching /hypo calcified enamel [39].

iv) Over etching

Can cause an insoluble reaction product monocalcium phosphate that gets dried out which avoids additionally etching and causes feeble bonding [39].

Average time for an adult permanent is 20 sec while for newly erupted Permanent teeth is 15 secs and for deciduous teeth it's 60 – 120 sec. Washing time is about 10 sec, Insufficient washing leaves debris that interferes with the flow of resin. 60 sec washing with heavy water spray actually weak resin- enamel bond as enamel rod crushed [25,39]

Drying

Electric hot air dryers are the most ideal approach to dry an etched enamel surface. They have appeared to enhance enamel bond quality by around 29%. The least desirable is three way syringe / liquid drying [25, 39]

Type of etching material

For pits & tissues, liquid is recommended. For smooth surface etching, liquids & gels results in similar etch patterns [39].

Oil sullying of hand pieces or/Air water syringes

The oil originates from air compressors, a large portion of which are not kept up well in dental workplaces. Any of the present dentin bonding agent combined with oil defilement gives an eccentric clinical outcome and potential clinical disappointment. Expelling all oil ought to be a prompt goal. Air filters should be placed on the air lines [40].

Isolation and placement of rubber damn

Composite can be easily contaminated by moisture Isolation is necessary during adhesion and bonding of composite resin to tooth structure. Improper isolation causes decreased bond strength & ultimately physical & mechanical properties of compo- site restoration also decreases [26]. Isolation can be done with rubber dam, gingival retraction cords etc. But the placement of rubber dam is most important procedure. For success & longevity of composite restoration Appropriate contour and contacts are important. This can be achieved by proper placement of rubber dam [41, 42]. Although dentin is a wet substance, the constituents of saliva and blood create an environment that can destroy dentin bonding. Use of rubber dam or other dry field aids are necessary to avoid salivary or blood contamination during placement of tooth adhesion materials [40].

Selection criteria

Composites are indicated in class III, IV & V lesion in anterior teeth & small to moderate class I & II cavities [11]. Failure in case selection occurs, in case with poor oral hygiene as composite resin get easily attached to a higher level of pathogenic bacteria than other restoration, which may lead to recurrent caries due to microleakage [26]

Post-operative sensitivity

Post-operative sensitivity can arise if we fail to avoid the cause of shrinkage and placement of restoration [43]. It is caused when a Gap is created between restoration & tooth surfaces [44]. Pressure changes in dentinal fluids as flexural strength of composite restoration and tooth differs which transmitted to the pulp.

Marginal failure and fracture of restoration

Poor marginal strength is the characteristic feature of composite [45]. So margins of restoration should be away from the occlusal contact points. If margins left open there may be chances of microleakage resulting in formation of secondary caries [44]. Marginal fracture is more common than bulk fracture [10].

Microleakage

Microleakage can cause postoperative sensitivity and bacterial invasion e.g. Streptococcus mutans. Microleakage results in subsequence inflammatory changes, secondary caries & discoloration of restoration [40]. Marginal gaps are primarily results from polymerization shrinkage on setting of resins [46]. After setting, dimensional changes occurs by masticatory forces, thermal changes & water sorption of composite restoration [45].

Inadequate finishing & polishing

A proper finishing & polishing is to be done, as all rough surfaces acts as an entry for microorganisms. Sharp projections irritate & inflame gingiva so interporximal areas should be given importance. Dentinal margins can be open at dentin-restoration when dry polishing & finishing is done using the burs having number of flutes, lesser will be the damage [42].

Conclusion

Composite material has a high rate success of longevity when used in posterior restoration. This review has highlighted the major causes for failures of composite restoration. To enhance the accomplishment of these restorations, factors related to the patient and operator is of great importance, which indicates the need for a conservative approach toward restoration replacement and its prevention.

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