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Dentistry

Commentary

Inspiration for the Future Development of Dental Restorative Composites

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DESCRIPTION

Despite the stability and toughness of dental resin composites, the complicated oral environment remains the biggest problem for dental materials. Materials used in dental restorations are also sensitive to a number of stresses that are created during mastication activities. These strains either directly or indirectly affect dental restoration materials, causing reactions that eventually result in failure or jeopardise the materials' long-term stability. Despite the huge advancements made in resin composites recently, tooth decay and early restorative replacement remain clinical problems brought on by eating and brushing teeth. A major problem with restorative composites that are aesthetically pleasing is their higher failure rate. This is due to a variety of factors, including stresses created during chewing processes, fracture over time, polymerization shrinkage, loss of retention, recurrent caries under restorations, etc.

The primary cause of marginal leakage and post-operative sensitivity in composite restorations is polymerization shrinkage. There is still need for the development of restoratives due to the intrinsic inadequacy of dental composites resulting from polymerization shrinkage. During the numerous oral activities, such as chewing, swallowing, and other similar actions, human teeth are subjected to a combination of tensile and shear stresses. Due to these stress circumstances, the phenomenon of fracture initiation begins and spreads over time, which may cause tooth restorative composites to fail catastrophically. When cracks spread quickly, the materials utilised for the indirect repair should be able to withstand the fracture loads operating on the tooth structure.

Dental restorations made of dimethacrylate have the drawback of having a quicker rate of fracture propagation, which not only causes clinical failure of such materials but also causes the issue of microchipping in the occlusal contact area. Optimizing the chemical compositions of the restorative materials could lead to the development of dental materials with acceptable fracture toughness. The inclusion of fillers in the matrix, which slows the rate of crack propagation in composites and contributes to additional toughening mechanisms, such as crack deflection, the crack pinning effect, and good adhesion bonding between filler and matrix material, is one of the frequently advocated methods for achieving enhanced fracture toughness. Dental restorations are also subjected to various temperature ranges that range from 15°C-75°C in the complex oral environment.

The human masticatory process, a complex process that involves cyclic mastication loading at various temperatures, is clinically applied to dental restorative materials. To counteract the stress concentration effect on the tooth-restoration interface, a dental restorative material used in the stress-bearing region must tolerate the vigorous masticatory forces. If possible, dental materials' storage moduli should be comparable to the type of dental tissue they were intended to replace.

Glass temperature, on the other hand, is regarded as a fingerprint for polymer-based composites since it denotes abrupt changes in the mechanical properties of materials as well as the beginning of thermal deterioration once the dental restoratives have absorbed enough heat energy. To preserve the physical and mechanical qualities of materials, the glass temperature value of restorative material for dental applications should be higher than the highest temperature that exists throughout oral activities. The wear resistance of dental materials and tooth enamel under various dynamic loading circumstances, unique formulations, and working mediums like dry, artificial saliva, citric acid medium, etc. has also been the subject of much investigation. The abrasion phenomena brought on by brushing and mastication has persisted despite the more important development of resin-based composites in recent decades.

The presence of abrasive particles in toothpaste can speed up the abrasion process during brushing, and the resulting wear is caused by mutual action of contact from sliding and three-body abrasion. The oral environment exposes resin composites to a variety of physical and chemical elements found in foods, beverages, saliva, and other oral hygiene practices. Because the interaction of these agents may cause restorative composites to degrade, these composites should be robust to various oral environments and display the least amount of diversity possible inside the mouth. The masticatory loading conditions on posterior restorations, together with the oral media, are key factors in the tribological interactions between artificial restorations and natural dentine.

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It therefore hastens the gradual loss of material in that area and frequently results in cracks in the enamel or restorations, which results in the loss of the anatomical contours of the restorations or teeth. A great deal of research has focused on comparing various dental materials by replicating oral circumstances using wear test machines. However, only a few research have concentrated on the alarming *in vitro* wear mechanism that occurs when dental materials are being worn down. This restriction has been taken into account when doing subsequent *in vitro* wear tests in order to understand the related wear mechanism, which led to the careful examination of *in vivo* failure pattern of dental restorative composites.