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Advances in Nanotechnology for the Improvement in Restorative Dentistry

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One of the most challenging problems in restorative dentistry is polymerization shrinkage and low strength due to their inferior mechanical properties. The introduction of resin material Bisphenol A glycidyl methacrylate, or Bis-GMA, has changed its chemical structure dramatically, to overcome the problem of shrinkage, thermal expansion, and low strength to some extent. The introduction of nanotechnology led to the discovery of nano-filler particles. Hybrid composites were developed by combining inorganic glass fillers of various sizes to provide better strength and smooth finish. Nanocomposites are composed of two or more materials that include a matrix material and nanoscale particles. The properties are improved drastically by reducing the size of fillers based on nanotechnology. The properties of nanocomposites (good translucency, contouring and surface finish) are excellent and can restore lost or damaged dental tissues. In addition, such materials should have bioactive and biocompatible properties at the interface between the material and tissue to prevent micro-leakage and ingress of bacteria. The composite resins consist of three basic phases - the organic phase (matrix), the dispersed phase (filler) and the interfacial phase (coupling agent). The resin matrix is a mixture of methacrylate/acrylate monomers. During the application the monomers of resin matrix are polymerized to crosslinked polymer structure by free radical nonlinear polymerization process. In order to achieve a strong covalent interaction in between the organic matrix and inorganic fillers, coupling agents are used. The coupling agents tend to promote bonding or adhesion between the filler particles and matrix and helping in the transfer of load and stresses. A commonly used coupling agent is gamma methacryloxy propyl trimethoxysilane (MTPS). One side of the coupling agent tends to bond with hydroxyl groups of silica particles and other is copolymerized with polymer matrix.

A study of the modification of dental nanocomposites with nanosized fillers is presented. TiO_2 has good antibacterial properties that depend on the surface of the material and decrease in size of the nanoparticles. It is not toxic so it was selected as an additive to the dental nanocomposite material. The principal aim of this study was to synthesize dental nanocomposites with different sizes, treated, nano-TiO_2 fillers in resin matrix for potential application in posterior restoration and to evaluate their mechanical properties. The incorporation of TiO_2 (titania) nanoparticles, via a silane chemical bond, to the dental acrylic resin matrix shows an increase in the wear resistance, flexural strength and surface hardness properties of the dental nanocomposites. For comparison, a commercially available dental resin was reinforced with untreated and treated nano-TiO_2 particles with various sizes.

Biography:

Dr. Ramesh Chaughule has completed his PhD from Tata Institute of Fundamental Research, Mumbai, India, and a pioneer institute in India. Also he graduated in Electronics and Telecommunication Engineering. Presently he is an Adjunct Professor at Ramnarain Ruia College, Mumbai, India. Dr. Chaughule has pioneered in the field of NMR and MRI. He was deputed to Indonesia by IAEA several times as an IAEA expert in the field of NMR. He is an awardee of many international Fellowships to carry out research programs in different countries. Besides number of research publications and book chapters to his credit, Dr. Chaughule has edited several books on MRI and Nanotechnology published by American Scientific Publishers, USA. He has organized several international conferences in India.