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Effect of Amount of 3-Methacryloxy Propyl Thrimethoxysilane Coupling Agent and Nano Filling Structure on Physic-Mechanical Properties of Dental Resin Composite

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Quantitative Study

Abstract

Many researchers in the field of dental polymeric base nano composite investigated the effect filling morphology and filling material content on mechanical and physical properties of construction after setting reaction. Our present study concentrated on the effect of Ϋ metacryloxy propyloxt tri metoxy silane (Ϋ MPS) content as coupling agent (orgnic material) on physical and mechanical performance of nano composite material. It was shown that despite of contraction after setting reaction, all this properties improved and efficient silanization can efficiently affect structural integrity of dental filling nano composite.

Keywords: Dental composite, Nano particle, Ϋ MPS, Physical properties, Mechanical properties

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Introduction

In today's society, people are very concerned about their aesthetic appearance. As part of that appearance, their teeth play an integral role. Therefore the color of restoration which used to fill dental cavity play important role to maintenance it's beauty. As a result there has been an abundance of research in resin composite technology and adhesive dentistry.[1-3]

In spite of recent advances in modern dental resin composites: The adhesion between fillers and the organic polymeric matrix in dental resin provided by coupling agents through a filler-matrix interaction

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(FMI). Comparatively, the FMI has the smallest volume in the composite body, but it is a fundamental phase to provide composite resins with sufficient properties.

Nature and amount of the coupling agent and the composition, size and distribution of the fillers affects The effectiveness of treatment with fillers γ-methacryl oxypropyltrimethoxysilane (γ-MPS),. as an Organosilanes, are those most commonly used. In resin composite Systems. The organo-functional polymerizable group forms a covalent-bond with the Polymerizable monomer groups (vinyl groups or –C=C–) during composite polymerization in samples.

Henrique et all evaluate the effect of different percentages of an organofunctionalized

Silane monomer as adhesion promoter between barium borosilicate glass fillers and (co)monomer blend in experimental dental composite resin. Flexural strength and elastic modulus can sometimes be improved with lower concentrations of organo silane coupling agent rather than higher concentrations of the silane (γ-MPS) used as coupling agent on barium borosilicate glassfiller microparticles of the dental composite resin.

Irini et al investigated the effect of Y metacryloxypropyl tri methoxy silane on the structural performance of dental resin composite.relative to the silica surface in low percentage of coupling agent orientation formed. At higher silane amounts silane molecules form a layer around the filler particles which now have to occupy a random, parallel and perpendicularly orientation relative to the silica surface. This parameter affect dynamic properties of dental resin composite.

In the some different study it was shown that effect of filer content on mechanical properties and physical resulted properties is strong. And it affect to the band between tooth and filling material. Increasing resistance against crack propagation and decrease in polymerization shrinkage but our study devoted on effect of different coupling agent content as an organic part on the physico mechanical properties of dental resin restoration composite.

Methods

In this research different dental resin composite with 3, 5,7,10 weight percent of γ-methacryl oxypropyltrimethoxysilane solution was prepared and named 1, 2, 3, 4. Samples consist of 25% silica (SiO_2) as filling material. Bis-GMA, TEGDMA monomer as matrix for structure construction had been used. Camphorquinone as light sensitive initiator of polymerization had been used.(as one percent). All the chemical are analytical grade and prepared of Sigma-Aldrich.

To characterized physic-chemical properties of construction some of analysis performed

Measurement of contraction after setting reaction is operated by grinder retch set up that characterized diameter and volume changes.

To investigated the degree of conversion of composite as function of silanization process Fourier transform infra-red experiment using Perkin Elmer machine operated and surface area under Picks for adsorption diagram for the samples in C=C and C-C bands estimated. That is related to the degree of conversion. Measurements were in deferent time interval

Mechanical characterization of samples operated in compression test using INSTUN device in 10mm/min strain rate. And elastic modulus of them after light polymerization characterized.

Vickers hardness characterization done by loading 200G bar on the samples in 10 second and recording applying force.

Results

Contraction after setting reaction: According to the figure one we can see contraction after setting of dental resin composites.

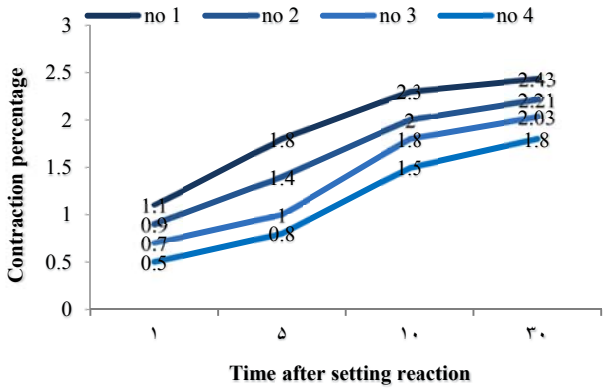

Figure 1. Contraction after setting versus time of reaction

As much as amount of silanized nano silca increases, the amount contraction after setting reaction decreases. It means complete coupling of filling material by matrix would lower the contraction. As time increases the contraction percentage increases by the slope of the curve in lower contain coupling agent which is more than higher content.

Mechanical properties of structure: In figure 2 the mechanical properties of samples as young modulus versus coupling agent was shown.

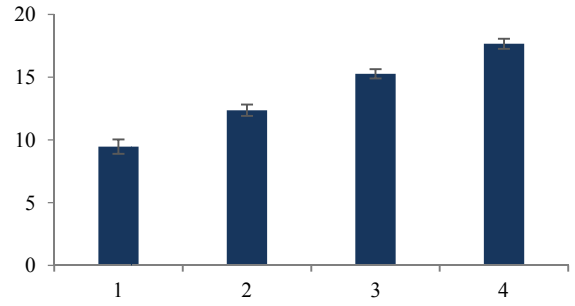

Figure 2. Young modulus of sample function of coupling agent percentage

As it was shown higher level of coupling agent of structure interact by Nano particle may enhances structure strenght. Because higher level of Nano particle-matrix integration would affect strongly load bearing of samples.

Conversion degree of structure: Figure 3 show the degree of conversion of samples as the amount of silanized Nano particles increases.

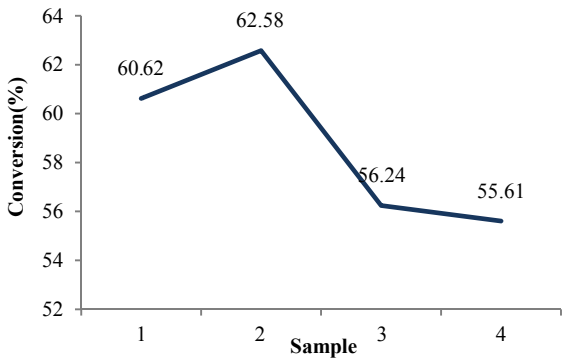

Figure 3. Degree of conversion of sample with different ϒ MPS

As observed above amount of silanization can different conversion behavior of samples. For example increasing from 3 to 5 percent in silanized particles would increase conversion ratio of samples but more than this specific amount reduces polymerization reaction. First mechanism may related to the more homogenous distribution of filed silanized particles and second one may related to the decreasing degree of chain propagation through Nano particles reaction.

Hardness evaluation: Figure 4 showed hardness profile of samples in 2 cm depth of their structure.

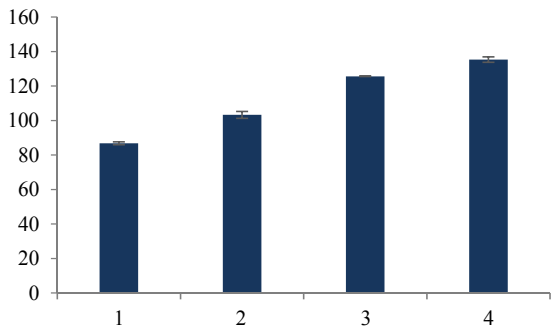

Figure 4. Vickers Hardness of different samples

Silanization by influencing the Nano particle-matrix reaction lead to the more increasing the hardness. Low level of matrix-nano particle reaction couldn't strength against indenter coin compared with integrated structure and more silanized sample boost this properties according to the figure.

As was shown despite of contraction after setting reaction samples show better physic mechanical properties as silanization reaction increases but more silanization reaction may limited flexural strength and provide brittleness of them.

Microstructure of Nano composites: In figure 5 scanning electron microscopy of silanized nano particle which interact to the matrix was shown.

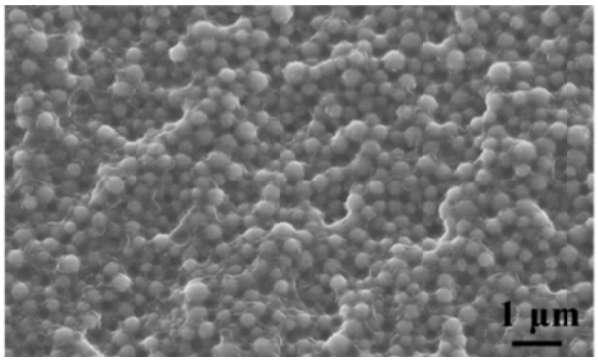

Figure 5. SEM image of silanized sample

Discussion

Our research is devoted on characterization of effect of silanized nano particle in dental polymeric nano composite filling material in the performance of physical and mechanical properties. Our reasrch shown that despite of setting contraction improvement of mechanical and pyysical properties of samples achieved by efficient silanization process.

Conflict of Interests

Authors have no conflict of interests.

Acknowledgments

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