The Effect of incorporation of UHMWPE fiber and Silica nanoparticles on mechanical properties of dental Composite resin

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Abstract

Background and Aim: Fiber reinforced composite (FRC) has become a considerable material in restorative dentistry. In this work the effect of different UHMWPE fiber content and fumed silica nanoparticle incorporation on the flexural properties and fracture toughness of UHMWPE fiber-reinforced dental composite was studied.

Materials and Methods:: FRC used in this experimental study, was made of BisGMA/TEGDMA (70/30) resin and silanized corona treated UHMWPE fibers. The flexural strength and flexural modulus of the FRCs were determined on 2 mm×2 mm×25 mm specimens. The fracture toughness (the critical stress intensity factor, KIC) of the composites was also evaluated using a three-point single edge notch beam (SENB) bending technique. To investigate the effect of fiber content on mechanical properties, three different fiber volume fraction (41%, 33% and 25%) were used. Treated nanosilica filler with different weight percentage (0wt%, 10 wt% and 15 wt%) were added to composite samples to evaluate the effect of nanoparticle incorporation on mechanical properties. The nanoparticles distribution was studied by transmission electron microscopy (TEM). The results were submitted to statistical analysis through ANOVA complemented by Tukey's test at a significance level of 5%.

Result: The results show that flexural strength, flexural modulus and fracture toughness of the samples increases with increase in the fiber percentage and this increasing in FRC is significant ($P<0.05$), (flexural strength (225.7±22.2 MPa), flexural modulus (45.225±5.1 GPa), fracture toughness (6.832±1.3 MPa.m1/2). Nanoparticles incorporation (10%wt, 15%wt) show significant reduction ($P<0.05$) in flexural strength of the composites.

Conclusion: Fracture toughness and flexural properties of FRC increase with increasing fiber content. Also nanoparticles distribution and dispersion are two important factors to determine mechanical properties of hybrid composites.

Keywords: dental composites, Bis-GMA, UHMWPE, fiber, nanoparticles

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