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Comparison of Flexural and Compressive Strength of Nano-Hybrid versusConventional Hybrid Composites

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ABSTRACT

Objective: To compare the flexural and compressive strength of Nano hybrid versus conventional hybrid composite material.

Material & Methods:A total of 64 specimens were made (half from conventional hybrid composite and half from Nano hybrid).Thirty-twowere tested for compressive strength and 32 for flexural strength using universal testing machine. Two samples independent t test was used for comparison.

Results: The mean compressive strength of conventional hybrid composite was 260.1±36.6 MPa while for Nano hybrid composite it was 186.4±37.0 MPa and the difference was very highly statistically significant ($p<0.001$). Similarly, the mean flexural strength of conventional hybrid composite was 121.5±20.0MPa and for Nano hybrid was 91.6±11.6 Mpa with very highly statistical difference ($p<0.001$).

Conclusion: Conventional hybrid composite have better mechanical properties than Nano hybrid composite restorative material.

Keywords:Conventional Hybrid Composite;Non-Hybrid; Flexural Strength; Compressive Strength

INTRODUCTION

Dental composite resin is widely used as a tooth colored restorative material because of its aesthetic superiority as fillings, strong bonding ability and mechanical reinforcement in restorative procedures.(1)Compressive strength is the ability of a material to resist vertical stresses, under compression. This property is very useful for comparing materials as these materials are generally brittle and weak in tension.(2)The highest maximum compressive strength is needed to resist masticatory forces, although the specific value is unknown.(3) Flexural strength is another important property of composite which is the fracture under tensile as well as compressive load.(4)Flexural strength is also extensively used for comparison for various composites. The three-point bending test is widely used for material characterization because of having advantages like the economy, easiness in sample preparation and testing, and is appropriate for cyclic loading, fatigue testing, and fracture toughness studies.(5)

The Nano hybrid composite is the new innovation in composite filling material. The incorporation of very much scattered inorganic particles into a resin matrix has been appeared to be to a great success for enhancing the performance of polymer composites.(6) The fillers utilized as a part of composite resin straightforwardly influence their radiopacity, properties, resistance to wear and modulus of elasticity. Therefore, composites have as a role been characterized by filler characteristics, for example, type, distribution or average particle size(7, 8) Unlike conventional micro-hybrid and micro-filled materials, nano-filled and nano-hybrid composites were more newly introduced in an

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effort to create highly polishing surface along with gloss retention. All things considered,while nano-filled composites utilize nanosized particles all through the resin framework, nano-hybrids adopt the strategy of consolidating nanometric and regular fillers, and this trademark is like micro hybrid composites.(9)

There is very less literature available on comparison of mechanical property of nanohybrid with conventional hybrid composite material.So, the aim of this study was to compare the flexural and compressive strength of nanohybrid versus conventional hybrid composite material in local commercially available materials.

MATERIAL AND METHODS

This in-vitro experimental study involved total 64 specimens of composite restorative materials. Of these 32 specimens were made from conventional hybrid composite (… US incorp) and 32 from nanocomposite (Brilliant NG). Sixteen specimens from each group were used for compressive strength testing and 16 for flexural strength. Thirty-two specimens (16 from conventional and 16 from nano) for compressive strength testing were made in glass container having dimension of 2 mm thickness and 5mm diameter. In similar way 32 specimen of cylindrical shape with dimensions of 25x2x2 mm were made in putty mold for flexural testing. The prepared specimen was stored at 37^0C for 24 hours. Universal testing machine was used for evaluation of compressive and flexural strength.

For compressive strength (CS) in MPa, a cross head speed of 1mm per minute was applied andcalculated by the formula ($CS=P/\pi r^2$)andflexural strength was calculated by formula ($FS=3 PL/2bd^2$). Where P is the applied load,L is the length of the specimen between the attachments, b is the thickness and d is the depth in mm.(10, 11)Statistical analysis was performed in R Package 4.1.2. Mean and SD were calculated for compressive and flexural strength. Independent t test was used for comparison of strengths between Nano hybrid and conventional hybrid composite. The level of significant was $p\leq0.05$

RESULTS

Themean flexural strength of conventional hybrid composite was 121.5±20.0MPa and for Nano hybrid it was 91.6±11.6 Mpa with very highly statistical difference ($p<0.001$). Similarly, the mean compressive strength of conventional hybrid composite was 260.1±36.6 MPa while for Nano hybrid composite it was 186.4±37.0 MPa and the difference was very highly statistically significant ($p<0.001$)**(Table 1).**

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Fig 1 and 2 visually show that there is difference in mechanical properties (Flexural and Compressive strengths) of Nano Hybrid and Conventional Hybrid Composite

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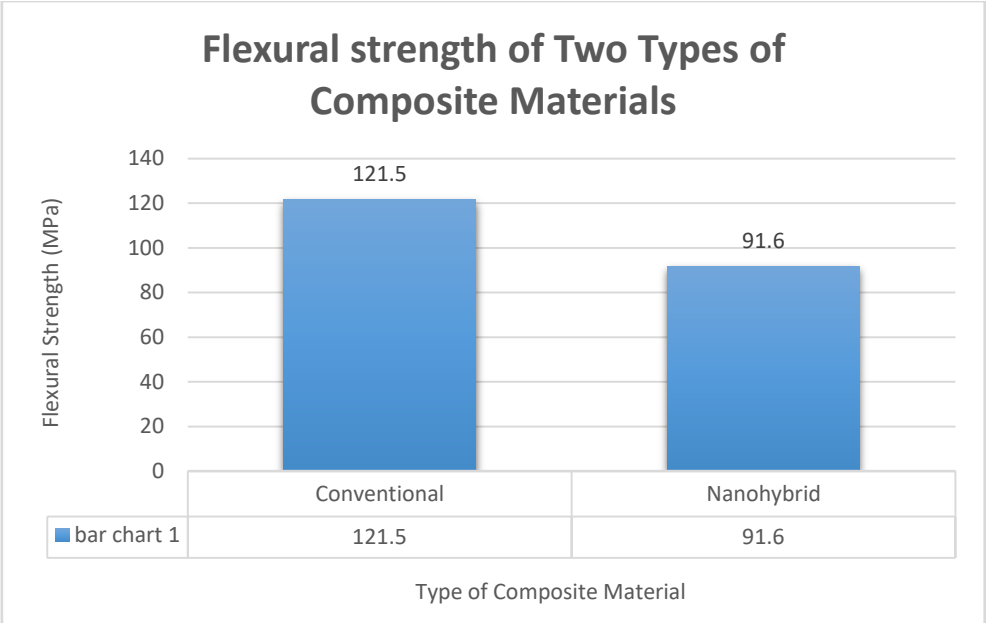

Fig 1: Flexural Strength of Two Types of Composites

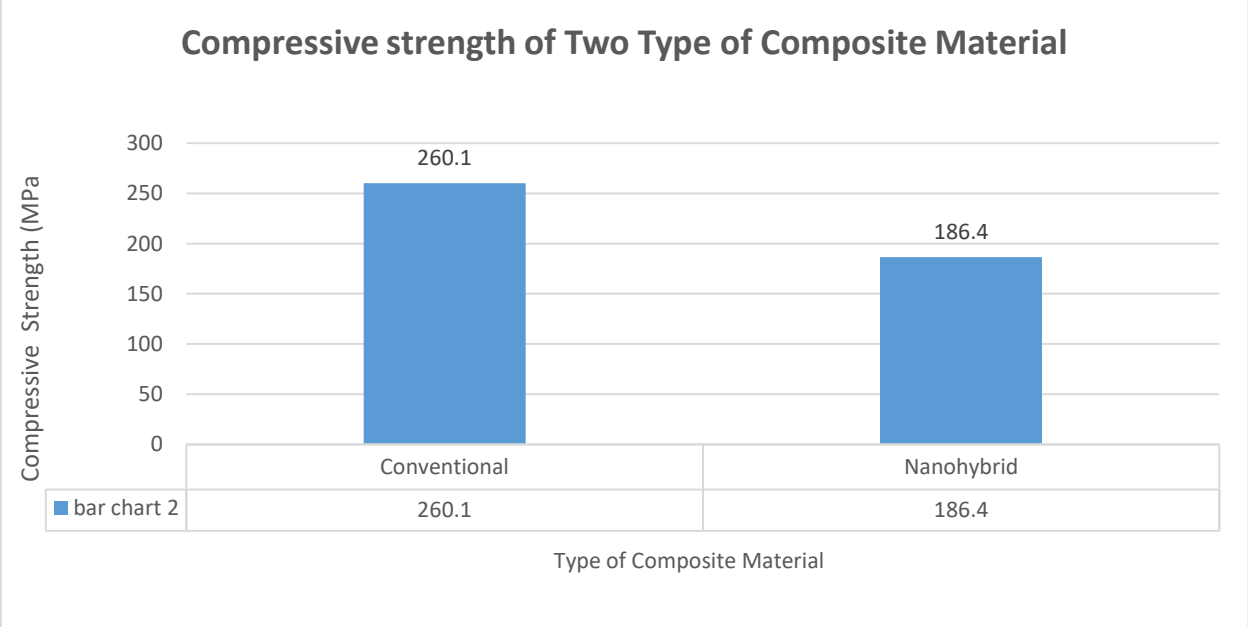

Fig 2: Compressive Strength of Two Type of Composites

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Characteristics	Conventional hybrid Mean(SD)	Nano hybrid Mean(SD)	p-value*
compressive strength (MPa)	260.1 (36.6)	186.4 (37.0)	<0.001
Flexural strength (MPa)	121.5 (20.0)	91.6 (11.6)	<0.001

***Independent t test**

Table 2: Comparison of Flexural and Compressive Strengths of Conventional Hybrid and Nano Hybrid Composite Material

DISCUSSION

This in-vitro experimental study was carried out to compare the flexural and compressive strength of conventional hybrid and nanohybrid composite materials. The findings in this study showed that conventional hybrid have superior mechanical properties as compare to nanohybrid composite.In recent time the most significant change in composite composition is the change of filler content and size of filler. The size of filler in resin matrix has continuously decreased, resulting in nanohybrid and nano filled materials with improved material properties.(12)

Sideridou et al.(13)showed that nano-hybrid had the smallest polymer matrix content primarily of Bis-GMA among the studied composites. It has very less shrinkage during polymerization and absorption of water and the good flexural strength and modulus after placement in water or artificial saliva for one month. Nanohybrid composite materials although have many advantages but it has some limitations as well. Moraesetal. (14) reported that the nano-hybrid composite usually have low-grade properties as compared to conventional hybrid composite but better than the micro-hybrid composite.Under clinical circumstances, nano-hybrid composite may not be similar to conventional materials in performance. These resins materials are more prone to chemical degradation than ceramics or metal due to organic matrix composition.(15)

Our findings showed that conventional hybrid have superior properties than nano-hybrid. The high flexural and compressive strength of conventional hybrid composite can be due to their high filler content and smooth spherical shaped fillers which help in improved packing of filler and increase their strength.(16) Ramdas et al. conducted a study to compare conventional hybrid with nanohybrid composite using 13 specimens in each group. Their results showed that compressive and flexural strength of conventional hybrid was significantly higher than nanohybrid. These results are in the favor of the study findings.

CONCLUSION

Within the limitation of this in-vitro study it can be concluded that conventional hybrid has better mechanical properties than nanohybrid composite restorative material.

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