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ORIGINAL RESEARCH

ASSESSMENT OF COMPRESSIVE AND DIAMETRIC TENSILE STRENGTH OF NANO AND HYBRID COMPOSITES

Paritosh Sharma[1], Palak Malhi[2]

[1,2]Senior Lecturer, Department of Conservative and and Endodontics
Himachal Dental College, Sundernagar,H.P.

Corresponding author
Dr. Palak Malhi
[3]Senior Lecturer, Department of Conservative and and Endodontics
Himachal Dental College, Sundernagar,H.P.

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Abstract

Background: To assess the comprehensive and diametric tensile strength of nano and hybrid composites.
Materials & methods: 10 samples in each group were included. The compressive strength test was performed using a Universal Testing Machine at a crosshead speed of 1 mm/min. Data was collected. The results were analysed using SPSS software. P-value was 0.05 was significant.
Results: Samples of 10 in each group were included. The compressive strength was evaluated. The mean value for hybrid and nano composites was 250.54 and 262.5MPa. The mean value for nexcomp was 272.5 MPa. The P-value was not significant.
Conclusion: Compressive strengths of different types of composites are about same.
Keywords: hybrid, composites, compressive strength.

Introduction

The ultimate goal of dental restorative material is to replace the biological, functional and esthetic properties of healthy tooth structure. Dental amalgam and gold alloys, which have a long record of clinical success, have been used as dental restorative materials for more than 100 years, especially in posterior teeth, because their mechanical properties match those of natural teeth; however, these metallic materials are not esthetic. Since their introduction into the dental market 40 years ago, dental resin composites have proven to be successful. It is expected that the usage of resin composites in posterior teeth will continue to grow. Although considerable improvements have been made in the properties of dental resin composite over the years, no fundamental change in monomer systems has occurred since Bowen introduced dimethacryltaes the form of bis - GMA in 1962. Major developments come from improvements in filler systems. Resin composites have gone through generations of traditional macrofilled composites, microfilled, hybrid, microhybrid and nanocomposites. [1]

A core build- up is a restoration placed in a badly broken down tooth to restore the bulk of the coronal portion so as to facilitate the subsequent restoration by means of an indirect extra coronal restoration. A core restoration should provide satisfactory strength and resistance during crown preparation and impression procedures and therefore contribute to the retention and support of the temporary crown and in long term the definitive restoration. The core material should have compressive strength to resist intraoral forces and flexural strength to prevent core dislodgement during function. Materials used for core restoration after

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endodontic treatment include amalgam, glass ionomer, hybrid glass ionomer, and resin composites. [2-4] Each of these core materials have their own advantages and disadvantages, a thorough knowledge of which helps in selection of the appropriate material for a particular clinical situation. With the advent of composite resin many of the desirable properties were combined into one material. They have adequate strength, ease of handling and they can be bonded to the tooth structure. Hence, they are one of the commonly used materials for core build up. Their compressive strength is comparable to amalgam cores. Fluoride releasing composites are also available. Also, improvement in composites and enamel and dentin bonding systems has stimulated trends toward more conservative techniques. Apart from esthetics, resin composite cores have a number of advantages over amalgam. [3,5] Hence, this study was conducted to assess the comprehensive and diametric tensile strength of nano and hybrid composites.

Materials & methods

10 samples in each group were included. The compressive strength test was performed using a Universal Testing Machine at a crosshead speed of 1 mm/min. For diametric tensile strength test, a nickel-chromium split mold with 3 mm in depth and 6 mm in diameter was used to prepare the cylindrical specimens. Other parts of the procedure were the same as compressive testing method except for the orientation of the samples in the instron testing machine. Data was collected. The results were analysed using SPSS software. P-value was 0.05 was significant.

Results

Samples of 10 in each group were included. The compressive strength was evaluated. The mean value for hybrid and nano composites was 250.54 and 262.5MPa. The mean value for nexcomp was 272.5 MPa. The P-value was not significant.

Table 1: Compressive strength values (MPa) of composite types

Types of composites	Mean	P- value
Spectrum	244.3	0.5
Hybrid	250.54	0.5
Nano	262.5	
Nexcomp	272.5	0.2

Table 2: Diametric tensile strength values (MPa) of composite types

Types of composites	Mean	P- value
Spectrum	30.14	0.2
Nexcomp	25.42	0.006
Synergy nano	32.52	0.02
Hybrid	32.16	

The mean diametric tensile strength (DTS) for nexcomp was 25.42MPa. In hybrid composites, the mean tensile strength was 32.16 MPa. The p-value shows 0.02. The nexcomp depicted the p- value with significance of 0.006. Nanofilled composites may have lower DTS than the other composite resins.

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Discussion

A core build-up is a restoration placed to provide the foundation for a restoration that will endure the masticatory stress that occurs in the oral cavity for prolonged periods and to provide satisfactory strength and resistance to fracture before and after crown preparation. [2] The selection of materials is based primarily on ease of handling with due consideration being given for mechanical properties and manipulative variables. Among mechanical properties compressive strength of core materials is important because cores usually replace a large bulk of tooth structure and they should provide sufficient strength to resist intraoral compressive and tensile forces that are produced in function and parafunction. [6] Hence, this study was conducted to assess the comprehensive and diametric tensile strength of nano and hybrid composites.

In the present study, samples of 10 in each group were included. The compressive strength was evaluated. The mean value for hybrid and nano composites was 250.54 and 262.5MPa. The mean value for nexcomp was 272.5 MPa. The P-value was not significant. A study by Davari A et al, studied the latest innovations are the development of dental composites based on nanotechnology. So they evaluated the physical properties Diametral Tensile Strength (DTS) and Compressive Strenghth (CS) of such new materials. Four different light-activated resin composite materials of A2 shades (10 samples in each group) were used. The compressive strength test was performed using a Universal Testing Machine at a crosshead speed of 1 mm/min. Specimens were positioned vertically on the testing machine base and subjected to compressive load until failure. For diametric tensile strength test, a nickel-chromium split mold with 3 mm in depth and 6 mm in diameter was used to prepare the cylindrical specimens. Other parts of the procedure were the same as compressive testing method except for the orientation of the samples in the instron testing machine. Data was subjected to the parametric statistical analysis (ANOVA, t test) at significant level of P = 0.05. No significant differences were found between the compressive strengths of the resin composites. [7]

In the present study, the mean diametric tensile strength (DTS) for nexcomp was 25.42MPa. In hybrid composites, the mean tensile strength was 32.16 MPa. The p-value shows 0.02. The nexcomp depicted the p- value with significance of 0.006. Nanofilled composites may have lower DTS than the other composite resins. Another study by Hegde MN et al, assess and compare compressive strength of newer nanocomposites (FiltekZ350, Ceram X Mono, Ceram X Duo) with microhybrid (Tetric Ceram) and to compare difference in compressive strength of newer nanocomposites. Forty eight specimens of composite were fabricated using customized biparpite brass mold measuring 5mm x 5mm and were grouped with twelve specimens in each Group I : Tetric Ceram, Group II: Filtek Z 350, Group III : Ceram X Mono, Group IV : Ceram X Duo. Composite resins are placed in cylindrical recesses and covered with mylar strip and are cured using QHL light curing unit. Compressive strength is evaluated using Instron machine. Results were statistically analyzed using One way Anova and Student t test. Analysis demonstrated that nanocomposites have better compressive strength than micro hybrid ($P<0.001$). It can be concluded that nanocomposites have better compressive strength than microhybrid composite and nanocomposite showed optimal compressive strength of 312 - 417 Mpa. [8] Nano filled materials are believed to offer excellent wear resistance, strength and ultimate esthetics due to their excellent polishability, polish retention and lustrous appearance. Nano filled resin composites show mechanical properties at least as good as those of universal hybrids and could thus be used for the same clinical indications along with anterior restorations due to their high esthetic properties. Mechanical properties of a material describe its response to loading. Although most clinical situations involve complicated three-dimensional loading situations, it is common to simply describe the external load in terms of a simple dimension as compression. Compressive strength is

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particularly important because of chewing forces. It is one of the measures of strength of material in different force conditions, increased value represents increased strength of the material. [9]

Mechanical behavior depends upon the concentration and particle size of the inorganic filler. [10,11] Owing to the reduced dimension of the particles and to a wide size distribution, an increased filler load can be achieved in nano composites (Filtek Z 350, Ceram X), with out increasing their viscosity and increasing the mechanical properties such as tensile strength, compressive strength and other mechanical properties. [12] Factor that influences DTS is filler particle size. Light-scattering within the composite is increased as the particle size of the fillers approaches the wavelength of the activating light. The light scattering will reduce the amount of light transmitted through the composite. [13] Therefore, the hybrid composites (Diafill, Spectrum) and Synergy Nano composite showed the greatest DTS values, since they were less affected by light-scattering. [14]

Conclusion

Compressive strengths of various composites are about the same, but DTS of some nanofilled composites may be lower than the other nanofilled or hybrid composites.

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