



Comparative Evaluation of Flexural Strength of Two Newer Composite Resin Materials: An in Vitro Study

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ABSTRACT

Objective: To evaluate in vitro the flexural strength of two newer composite resin materials. **Material and Methods:** Twenty-four samples were equally divided into two groups: G1 - Brilliant EverGlow and G2: Brilliant NG. The rectangular blocks of 25 mm in length, 2 mm in width and thickness were prepared from two composite materials. Blocks were created by applying composites to a customized split mold and formed between two parallel glass plates. Before light-curing, blocks were covered with Mylar strips and rinsed for 10 seconds in water. Subsequently, they were stored in distilled water for 24 hours at 37°C and 100% humidity before testing. Each sample was placed within a suitable framework of aluminum. The length of gap between the support was 21 mm and the speed of crosshead at 1 mm/minute. The data were subjected to an independent t-test. The level of significance was set at $p < 0.05$. **Results:** A less flexural strength was observed in G1 (77.43 Mpa) compared to G2 (118.70 Mpa) ($p < 0.001$). **Conclusion:** Universal nanohybrid composite resin material was found to have greater flexural strength than universal submicron hybrid composite material.

Keywords: Dental Materials; Composite Resins; Flexural Strength.

Introduction

Esthetic restorative resins are the most favored materials for restoration because of modifications in their physical, mechanical and optical properties. Various fillers and resin systems have recently been upgraded or applied to restorative materials for better restorations' clinical performance. Previous studies have documented improvements in elastic modulus, flexural strength, compressive strength, diametric tensile strength, stiffness, fracture strength and wear resistance of these newer composite resins [1-3]. In contrast to traditional resins, nanocomposites thus react much better to the functional stresses. Composite resins for stress-bearing surfaces need to be checked since they are still the key concern for the clinical success of composite materials. Nanohybrid composites contain a lower organic matrix percentage and a higher percentage of fillers and exhibit lower polymerization shrinkage than nanofilled composites [4,5]. The structure and viscosity of recent composite materials differ and need to be checked for all the parameters.

Brilliant EverGlow™ is a universal submicron hybrid composite which, according to the manufacturers, claims outstanding polishability and retention of gloss. The highly esthetic material of universal shades provides smooth consistency, strong wettability, low instrument stickiness, and high abrasion resistance.

Brilliant NG™ is a universal nanohybrid composite, which according to the manufactures, simplifies application techniques and produces excellent esthetic performance. In addition to the high nanometric particle content, its pre-polymerized particle filling provides optimum consistency for manipulation and modelling, along with a significant decrease in shrinkage and high gloss surfaces that can be easily achieved. With the Duo Shade system, Brilliant NG is an outstanding alternative that simplifies color selection and great variety for the best esthetic performance.

Material properties are measured under stress by evaluating the physical properties like flexural strength, flexural modulus and fracture strength [6,7]. For composite materials, flexural strength is important because composite resins are subject to tension and compression forces, particularly when used to restore cavities under stress [6,8]. Thus, this study aimed to evaluate *in vitro* the flexural strength of two newer composite resin materials.

Material and Methods

Study Design and Sample

This in-vitro study comprised of 24 samples equally divided into Group 1 - submicron hybrid composite resin material (Brilliant EverGlow - Coltene Whaledent Inc., Cuyahoga Falls, OH, USA) and Group 2 - nanohybrid composite resin material (Brilliant NG - Coltene Whaledent Inc., Cuyahoga Falls, OH, USA). The duration of the study was 30 days.

Sample size was calculated with 80% power and 5% alpha to detect a change of 0.8. Twenty-four rectangular blocks (n=12) of 25 mm in length, 2 mm in width and thickness were prepared from two different composite materials. Blocks were created by applying composites to a customized split mold and formed between two parallel glass plates.

Before light-curing, blocks were covered with mylar strips. Mylar strips were used to achieve a smooth surface. Blocks were then rinsed for 10 seconds in water. Subsequently, blocks were stored in distilled water for 24 hours at 37°C and 100% humidity before testing. Each sample was placed within a suitable framework of aluminum. The length of gap between the support was 21 mm and the speed of crosshead at 1 mm/minute [9,10]. The compressing loads were applied to the center of specimen using a Universal testing

machine (Model 3343, Instron Corporation, Canton, MA, USA) [11]. The computer software following specimen failure (Bluehill, Instron Corporation, Canton MA, USA) was used to record values [12].

Statistical Analysis

Results for comparison between groups were subjected to an independent t-test. Using SPSS software, version 20.0 (IBM Corp., Armonk, NY, USA), statistical analysis was performed at significance $p < 0.05$.

Results

The result shows significantly less flexural strength in Group 1 compared to group 2 (Table 1).

Table 1. Comparison of mean flexural strength in Mpa.

	Brilliant EverGlow	Brilliant NG
Mean	77.43	118.70
SD	2.651	3.901
p-value		0.001*
t-value		42.85
Mean Difference		41.271

*Statistically Significant.

Discussion

Nanocomposites consist of submicrometer particles (nanofillers) to further amplify the resins' physical and optical properties. Nanofilled composite's performance and flexural properties are still being explored. Similarly, submicron hybrid composite is a relatively recent product and has not been researched much on its flexural properties. The goal of a new composite resin is to provide enhanced esthetic properties, optical properties, wear resistance, easy handling and decreased polymerization shrinkage [13].

The restorations in the oral environment are subjected to different types of occlusal forces. The flexural strength indicates the material's resistance to fracture when subjected to complex masticatory forces. In the present study, nanohybrid composite showed better flexural strength than submicron hybrid composite. Brilliant NG, a nanohybrid composite, has a filler content of about 80% by weight and 65% by volume. Glass fiber particles that improve the material hardness and bending force resistance may be an explanation for fracture resistance [14].

The mean flexural strength (MPa) of nanohybrid composite (Brilliant NG) and submicron hybrid composite (Brilliant Everglow) are presented in Table 1. The null hypothesis was dismissed as there was a substantial difference in flexural strength between the two composites tested when comparing the results obtained. The independent t-test demonstrated a significant difference between the mean flexural strength of nanohybrid composite and submicron hybrid composite ($p < 0.05$). Flexural strength simulates the use of composites in areas with high stress [15,16]. In addition, there is an ISO 4049/2009, with an 80 MPa limit for polymer-based restorative materials, stated by manufacturers to be suitable for occlusal surfaces [17].




Submicron hybrid composite is the material below this ideal value, with a questionable clinical performance in high stress-bearing areas. Also, the present investigation data indicate that composites' filler content does not necessarily impact flexural strength. Samples investigated had almost identical filler content. This would be in accordance with previous studies assessing the functional properties and curing depth of composites [15,18]. Because of its low standard deviation, a low variance of coefficient and less complicated

distribution of cracks than those provided by other test models, such as biaxial flexural test, the flexural strength was performed using a three-point bending test [19,20]. The result of this analysis showed that the nanohybrid composite's flexural strength was marginally higher.

Conclusion

Universal nanohybrid composite resin material was found to have greater flexural strength than universal submicron hybrid composite material. Since composite resins have variations in composition and viscosity, further studies need to be conducted for comparative evaluation of other parameters.

Authors' Contributions

AP		https://orcid.org/0000-0001-5005-0573	Conceptualization, Methodology, Formal Analysis, Investigation, Writing - Original Draft and Writing - Review and Editing.
SRA		--	Conceptualization, Methodology, Formal Analysis, Investigation, Writing - Original Draft and Writing - Review and Editing.
KG		https://orcid.org/0000-0002-1824-2054	Conceptualization, Methodology, Formal Analysis, Investigation, Writing - Original Draft and Writing - Review and Editing.
All authors declare that they contributed to critical review of intellectual content and approval of the final version to be published.			

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None.

Conflict of Interest

The authors declare no conflicts of interest.

Data Availability

The data used to support the findings of this study can be made available upon request to the corresponding author.

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