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Flexural Strength of Nanohybrid Composite Resin: An *in-vitro* Study

[1] Hasan Ali, [2] Nahid Khuram Choudhury, [3] Abdul Gaffer, [4] Md. Mukhlachur Rahman, [5] Fouzia Sultana, [6] Masud Ahmad, [7] Farhana Hoq Shusta, [8] Toushik Hossain, [9] Mozammal Hossain

[1] Assistant Professor & Head, Department of Conservative Dentistry and Endodontics, Islamic Bank Medical College, Dental Unit, Rajshahi, Bangladesh

[2] Associate Professor & Head, Department of Dental Pharmacology, Islamic Bank Medical College, Dental Unit, Rajshahi, Bangladesh

[3] Associate Professor, Department of Orthodontics, Mandy Dental College, Dhaka, Bangladesh

[4] Assistant Professor, Department of Oral Pathology and Periodontology, Udayan Dental College, Rajshahi, Bangladesh

[5] Assistant Professor, Department of Oral & Maxillofacial Surgery, Delta Medical College, Dental Unit, Dhaka, Bangladesh

[6] Assistant Professor, Department of Dental Pharmacology, Delta Medical College, Dental Unit, Dhaka, Bangladesh

[7] Associate Professor & Head, Department of Dental Chemistry, Delta Medical College, Dental Unit, Dhaka, Bangladesh

[8] Department of Electrical and Electronic Engineering, Brac University, KHA 224, Progati Sarani, Merul Badda, Dhaka-1212, Bangladesh

[9] Chairman, Department of Conservative Dentistry and Endodontics, Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh

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Corresponding Author: **Hasan Ali**

Abstract

In the present study, the Flexural strength of nanohybrid composite was compared with conventional microfilled composite resin *in vitro*. Thirty nanohyrid and 30 conventional microfilled composite resins were subjected to Flexural strength measurement as follows; a teflon mold (4 mm in diameter and 6 mm in depth) was filled with materials, light cured through the glass slides for 40 sec top and bottom surfaces. Then the specimens were taken out from the mold, again light curing for 40 sec, stored in dry condition and placed into a Flexural strength tester and loaded until fracture of the sample. Student t-test was performed to assess the differences between two groups and a value of p >0.05 was considered as statistically significance. The results showed that the means ± SD Flexural strength of nanobybrid and conventional microfilled composite resin were 118.70 ± 3.90 Mpa and 77.43 ± 2.65 Mpa, respectively and the differences were statistically significant. It can be concluded that nanohybrid is superior to conventional microfilled composite resin in respect to Flexural strenth in class II restorations of permanent molar teeth.

Keywords: Flexural Strength, Composite Resin, Nanotechnology

Introduction

Esthetic restorative resins are the most favored materials for restoration because of modifications in their physical, mechanical and optical properties. Various fillers and resh 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, stiffiness, 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 suffaces need to be cheecked since they are still the key concern for the clinical success of composite materials. Nonohybrid composites contain a lower organic matrix percentage and a higher percentage of fillers and exhibit lower polymerization shrinkage than microfilled composites [4, 5]. The structure and viscosity of recent composite materials differ and need to be checked for all the parameters.

Recently, peoples are interested in oral health to increase their quality of life. This encouragges the requirements of tooth colored restoration with favorable clinical results. Although different kind of composite restorative material such as macrofilled, microfilled and hybrid have been developed [6]. The disadvantages of microfilled composite resin includes poor mechancial properties, poor color stability, low wear resistance, less modulus of elasticity and inadequate compressive and tensile strength [7-8]. Furthermore, it cannot resist the polyhmerization shrinkage that leads to improper sealing, microleakage as well as postoperative sensitivity and recurrent caries [9]. Therefore, it is considered not suitable for restoration in stress bearing area.

To overcome the above mention disadvantages of microfilled composite resin, a nano ceramic technology with nano fillers and nano particles has been introduced in dentistry and its use for all anterior and posterior direct restorations has been expected in the field of operative dentistry [10]. The advantages of nano hybrid composite includes high Flexural strength due to high filler content, more wear resistance, better color stability, radio opacity and polishibility than that of microfilled composite resin [11]. The only disadvantage is its high cost.

Flexural strength analysis is an important part to assess the longevity of the restoration, especially for class II cavity where high masticator force usually needed during chewing of food. Therefore, it is considered that before application of this materialo for restoring class II cavity of posterior tooth, the Flexural strength of nanohybrid composite resin is needed to justified. In the present study, the Flexural strength of nanohybrid composite resin was measured and compared to conventional microfilled composite resin, *in vitro.*

Materials and methods

Thirty nanohyrid and 30 conventional microfilled composite resins were subjected to Flexural strength measurement. This study was performed in collaboration with Department of Pilot Plant & Process Development Center, BCSIR (Bangladesh Council of Scientific and Industrial Reseaarch) and performed according to Cattai-Lorente *et al*. [12] study as follows: A Teflon mold was constructed, 4mm in diameter and 6mm in depth. The assenbled mold was filled with materials, any excessive materials were squeezed out and two microscope glass slides were placed over both ends of the mold. All specimens were light cured through the glass slides for 40 sec top and bottom surfaces. Then the specimens were taken out from the mold and again light curring for 40 sec on each cylindrical slide surface. A well controlled LED light unit (Smart light, Densply) was used throughout the study. After polymerization, all specimens wee removed from the molds and then stored in dry condition. For measurement of Flexural strength, the specimens were placed into a Flexural strength tester (Testometric AX, Universal Testing Machine) and were loaded to the fracture of the sample. The compressive strength for each specimen was determined from Eq:

$$F = \frac{3LS}{2WH^2}$$

Where F is the Flexural strength in MPa. L is the maximum at fracture, and S is the Span, W is the Width, H is the Hight of the specimen. Date of Flexural strength were collected and recorded in the data collection sheet individually. Statistical analysis of the results was done by using computer based statistical software, SPSS 20.0 verson (SPSS Inc. Chicago, USA). For significance of difference, student t-test was performed; 95% confidence interval (p value <0.05) were followed for testing level of significicance.

Result

It was found that there was significannt difference between Flexural strength nano hybrid and conventional microfilled composite resin. The mean ± SD Flexural strength of nano hybrid and conventional microfilled composite resin were 118.70 ± 3.90 MPa, 77.43 ± 2.65 Mpa, respectively.

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 bhybrid 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 microfilled composite.

Many previous studies have indicated that there is significant correlations between clinical and laboratory outcomes such as frature, flexural strength and compressive strength [14]. They are also responsible for clinical wear and retention of composite resin. n the present study the clinicl and laboratory results of nanohybrid composite resin have been investigated and compared with microfilled composite resin. Furthermore, a recent study suggested that there is some association between flexural strength and clinical outcome of class II cavities [15]. When the flexural strength of the restorations was verified, it was found that there was significant difference between nanohybrid and conventional microfilled composite resin. The means ± SD flexural strength of nanoyhybrid and conventional microfilled composite resin were 118.70 ± 3.90 Mpa, 77.43 ± 2.65 Mpa, respectively. Thre are severl reasons of better results achieved by nano hybrid than that of conventional microfilled composite resin restoration. Nano-hybrid resin composite has been developed which is defined as nanoceramic resin composite, thre methacrylate modified silicon-dioxide-containing nanofiller (10mm) substitutes for the microfiller that is typically used in todays hybrid resin matrix is replaced by a matrix full of highly dispersed methacrylate modified polysiloxance particles [16]. The ceramic particles are described as inorganic-organic hybrid particles where the inorganic siloxane part provides strength and the organic methacrylic part makes the particles polymerisable with the resin matrix. Two recently published clinical evaluations showed clinical acceptable survival rates after two and four years for the nanohybrid combined with etch-and-rinse adhesives [17].

The effect of the filler composition and contents on physical and mechanical properties of microfilled composites was investigated by some of the previous studies. Suzuki *et al.* [18] found that the highest value of strength was obtained (96.0+/-3.5 Mpa) when the TMPT-PEDA filler was 46 ratio. Compared the flexural strength and microleakage of three nanofilled composites and found that highest flexural strength were obtained in nanofilled composite resin when a radio isopope was used. The results of compressive strength are similar to our present study. There are some results which differ from the compressive strength of our present study and it could be due to the compositional differences of the filler or due to the technique used for compressive strength testing.

Conclusion

Nanohybrid is superior to conventional microfilled composite resin in respect to flexural strength *in vitro*.

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