

Comparison of Compressive Strength of Bulk-Fill Composites and A Hybrid Composite

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ABSTRACT

Background: Comparison of the compressive strengths of three bulk-fill composites (Sonic Fill, Filtek Bulk-fill, and Tetric N Ceram) with a universal hybrid composite (Swiss Tec).

Materials and Methods: Three high viscosity bulk-fill composites were compared with a universal hybrid composite. The specimens were prepared for each group using a cylindrical plastic split mould with dimension 6mm in height and 4 mm in diameter and light-cured for 20 seconds followed by 24 hr water storage. The compressive strengths were measured by subjecting each specimen to a load of 1 mm/min under a universal testing machine (UTM).

Results: Comparison of compressive strengths of four groups was made using one-way Analysis of Variance (ANOVA) followed by post hoc Tukey's test for multiple comparisons. The analysis showed that Sonic fill showed the greatest compressive strength followed by Filtek Bulk-fill and Tetric N Ceram. The universal hybrid composite Swiss Tec exhibited the least compressive strength.

Conclusion: Bulk-fill composites exhibited better compressive strength.

Keywords: Composites, Compressive Strength, Bulk-fill, Hybrid.

INTRODUCTION

Composites have been counted as one of the most reliable materials used in dentistry today because of their similarity in colour with the original tooth structure and comparatively better mechanical properties thus making them a reliable material to be used for anterior as well as posterior restorations.¹ With the advent of bulk-fill composites, the need for tedious procedures involved in conventional composites has been eliminated as these can be used in thick layers (4mm) that saves operators time and improves

patient compliance. Constant efforts are being made in improving their overall properties.^{2,3} Dissatisfaction in the mechanical performance of material becomes a major concern as it affects the longevity of the restoration over the period. So the manufacturers have been continuously trying to improve the quality of these materials in terms of their long term use by adding certain fillers and reducing the size of their constituent elements more or less with the same basic structure as given by Dr Bowen in 1962.^{4,5}

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1) The present in vitro study aims at comparing the compressive strengths of three bulk-fill composites (Sonic Fill, Filtek Bulk-fill, and Tetric N Ceram) and a conventional hybrid composite (Swiss Tec).

2) To find out the best material among the tested materials.

MATERIALS AND METHODS

The present in-vitro study was carried out in the Department of Conservative Dentistry and Endodontics, Himachal Institute of Dental Sciences, Paonta Sahib, Himachal Pradesh India.

Distribution of Samples

Table 1: Materials used and their composition.

PRODUCT	TYPE	COMPOSITION
SONICFILL	Bulk-fill restorative material	Fillers: SiO ₂ , glass, oxide Filler loading: 83.5% by weight and 61% by volume. Resin: Bis-GMA, TEGDMA, EBPDMA
FILTEK BULK-FILL	Bulk-fill restorative material	Fillers: Zirconia/silica, Ytterbium trifluoride. Filler loading : 76.5% by weight and 58.4% by volume. Resin : Bis-CMA, UDMA, Bis-EMA
TETRIC N CERAM	Bulk-fill restorative material	Fillers : Barium glass, YbF ₃ , oxides and prepolymers. Filler loading : 80% by weight and 60% by volume. Resin: Dimethacrylate comonomers
SWISS TEC	Hybrid composite	Fillers : Methacrylates, Barium glass, silanized amorphous silica Filler loading : 59% by vol and 79% by weight

The specimens were then subjected to Compressive testing on a universal testing machine at a crosshead speed of 1mm/min.

RESULTS

The highest compressive strength values were obtained for Sonic fill and Filtek bulk-fill followed by Tetric N Ceram. Conventional hybrid composite (Swiss Tec) showed the least values (Table 2, Graph 1). However, no significant differences were seen between compressive strengths of sonic fill and filtek bulk-fill.

Three commercially available bulk-fill composites Sonic Fill (Kavo Kerr), Filtek bulk-fill (3M ESPE), Tetric N Ceram (Ivoclar) and a universal hybrid composite Swiss Tec (Coltene) were used in this study (Table 1).

A total of 10 cylindrical specimens in each group of height 6mm and diameter 4mm of each resin-based composite were prepared for each group using a cylindrical plastic split mould. Composite was packed inside the split mould using a bulk-filling technique and for the conventional hybrid composite using the incremental technique. Light curing for each layer was done for 20 sec using a light-emitting diode with output 550mW/cm². After the specimens were polymerized, they were carefully removed from the moulds and were stored in a hydrated state in water for 48 hours.

Statistical Analysis

Statistical analysis was done using the statistical package of social sciences. Normality testing was done using the Shapiro Wilk test, which showed the data were normally distributed. Based on this, a comparison of the compressive strengths of the four groups was made using one-way Analysis of Variance (ANOVA) (Table 3) followed by post hoc Tukey's test for intergroup comparison (Table 4). The level of significance was fixed at 0.05.

Table 2: Measurement of compressive strength of different composites.

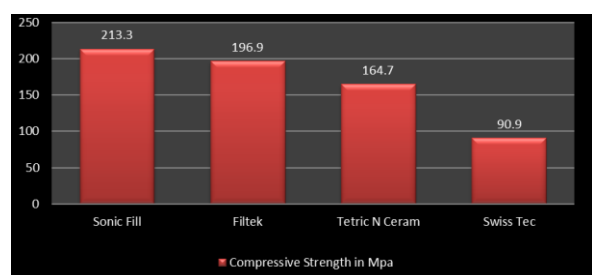
	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Sonic fill	10	213.3000	23.19028	7.33341	196.7107	229.8893	185.00	250.00
Filtek	10	196.9000	14.24742	4.50543	186.7080	207.0920	180.00	222.00
Tetric N Ceram	10	164.7000	18.69076	5.91054	151.3294	178.0706	140.00	190.00
Swiss Tec	10	90.9000	16.05165	5.07598	79.4173	102.3827	65.00	112.00
Total	40	166.4500	50.75327	8.02480	150.2183	182.6817	65.00	250.00

Table 3: Comparison of compressive strength of different groups using ANOVA test.

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	88329.900	3	29443.300	87.383	.000
Within Groups	12130.000	36	336.944		
Total	100459.900	39			

Table 4 : Intergroup comparison of compressive strengths between groups.

Groups	Mean Difference	p-value
1 and 2	16.4	>0.05
1 and 3	48.6	<0.05
1 and 4	122.4	<0.05
2 and 3	32.2	<0.05
2 and 4	106	<0.05
3 and 4	73.8	<0.05



Graph 1: Compressive strength of the various group of composites.

DISCUSSION

Resin-based composites are materials of choice in today's dentistry. These show not only superior aesthetics but also good mechanical properties.⁶

Since day one attempt has been made to improve their qualities in all aspects. This led to the development of a newer class of composites called Bulk-fill composites that allow one-time placement into the cavity thereby saving time.^{2,7,8}

Since most of the masticatory forces are compressive, therefore compressive strength tests give an adequate idea about the strength and hence longevity of the used material in the mouth. Materials with low compressive strength do not last long in the oral cavity under masticatory stresses thereby fracture causing treatment failure.^{9,10,11}

It has been assumed generally that higher the filler loading higher is the mechanical strength of the

composite.¹²In this study,Sonic Fill showed the highest compressive strength values. It is a high viscositybulk-fill composite with the greatest filler loading (83.5%) that has to be attached to a handpiece that delivers composite in a flowable form with the help of internal vibrations that lower the viscosity to the point such that it attains the adaptability of a flowable composite.¹³

Filtek Bulk-fill is a high viscosity, non-flowable bulk-fill composite that in addition to the usual resins (Bis-GMA, Bis-EMA)also contains addition-fragmentation monomers(AFM) that encourage the formation of cross-links during polymerization. This not only aids in the mechanical strength of this material but also provides stress relief in the developing network. Its filler loading is about 76 % by weight which provides excellent strength and durability to the material. In this study, Filtek Bulk-fill showed better compressive strength as compared to Tetric N Ceram and the universal hybrid composite. ^{6,14} Tetric N Ceram is also a high viscositybulk-fill composite that contains a high filler content. It contains a special photoinitiatorIvocerinthat enables it to be cured in the depth of 4-5 mm.¹⁵ Swiss Tec (Coltene) is a highly filled hybrid composite that is a syringeable, sculptable composite.¹⁶

According to the results of this study, Bulk-fill composites have shown superior compressive strengths than hybrid composite with a statistically significant difference between compressive strengths of all the tested materials. The improved quality of these bulk-fill materials can be attributed due to a reduction in the number of voids within the mass of these materials as it does not include multiple methodical layering rather these include placement of the entire material in one single step.^{17,18} Recently, there has been an increasing trend in the use of bulk-fill composites; however, more studies are needed to evaluate their clinical success in the long term.^{6,19} Within the limitations of this study, the bestbulk-fill material in terms of highest compressive strength was found to be Sonic Fill.

CONCLUSION

The present study investigated the compressive strength of three bulk-fill resin composites and compared them with a conventional hybrid

composite. The results showed bulk-fill composites exhibited better compressive strength.

CONFLICTS OF INTEREST

The authors declare they have no potential conflict of interests regarding this article.

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