

In-Vitro Analysis of Gap Formation between Tooth Restoration Interfaces Using Bulk Fill and Incremental Fill Composites

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Abstract

Aim: To identify a composite system with minimum Gap formation

Materials and Methods: Standard class I cavity was prepared in 12 intact human premolars. Samples were divided into two groups (n=6), according to the materials used one Bulk Fill composites (Sonicfill) and one increment fill composites (Spectrum TPH). Thermocycling was done and then the samples were sectioned buccolingually. The samples were then examined under scanning electron microscope for gap formation.

Statistical Analysis: Kruskal wallis test and Post hoc pairwise comparison of Gap formation using Mann Whitney U test

Results: Bulk fill composite showed the best adaptive capacity as compared to incremental fill composite.

Conclusion: Bulk-fill composite showed better adaptability and less gap formation than incremental composite.

Keywords: bulk fill, composites, Gap formation, incremental fill

Introduction

Light cured composites are the material of choice for direct restorations because they offer prolonged manipulation time and on command curing.¹ Composite has shown a level of success as a restorative material. There have been continuous efforts to improve its physical and mechanical properties and the operating techniques used to apply it.² Adhesive bonding to tooth structure has been an integral part of modern restorative dental practice that obviously improves the biomechanical and esthetic quality outcomes of restoration.³ Gap Formation occurs, if the interfacial stresses exceeds those that can be supported by the adhesive layer.⁴ Less contraction stress around cavity walls and margins will generate, if depth of cure of resin composite is limited, thus possibly disguising an improved marginal adaptation due to poor polymerization.⁵

Various methods of composite placement have been employed; the incremental curing technique being one of them.⁶ However, this technique has many disadvantages: It is difficult to place the multiple increments leading to an increase in the arduousness of the task and the time it takes to complete it. If not performed properly, placing multiple layers can result in polymerization shrinkage and marginal leakage.⁷

In light of this, a group of new products were recently introduced, known as —BulkFill composites. These materials are recommended for insertion in a maximum 4-mm bulk due to their high reactivity to light curing. The rationale of the bulk-fill resins is to reduce clinical steps by filling the cavity in —single| increment, leading to a reduced porosity and a uniform consistency for the restoration, this will reduce the clinical time taken and also the cost.⁸

The use of the bulk-fill technique undoubtedly simplifies the restorative procedure and saves clinical time in cases of deep, wide cavities. However, the data available for these materials are currently limited, and therefore further laboratory studies are required in order to provide insight into likely clinical outcomes.⁹

Materials and Method

12 intact human Premolars were selected randomly for the study. Standardized Class I cavity to the depth of 4mm was prepared in each tooth, (distance of margins to the proximal surface will be 1.6mm) using standard ¼ round bur under profuse water cooling. The depth of Class I cavity prepared was 4mm checked with Williams probe. The samples were then divided into two groups of 6 teeth each according to the type of material.

GROUP I	GROUP II
(BULK FILL) (n=06)	(INCREMENTAL FILL) (n=06)
SONICFILL	SPECTRUM TPH

The teeth were etched using 3M ESPE Scotch Bond multipurpose etchant for 20 sec following which the specimens were washed with distilled water for 15-20s and further blot dried for 20s. Then Adper Single Bond adhesive (3M ESPE) was applied to and scrubbed on the surface for 20s to create a good hybridization of the etched area. Next, the adhesive was air-thinned until the entire carrier was evaporated. It was then light-cured for 20s All the cavities prepared were then restored with different materials.

Group A (n=6):The teeth were restored with Sonicfil Composite

Group B (n=6):The teeth were restored with Spectrum TPH Composite

Specimens were then subjected to a thermocycling regimen of 500 thermal cycles by alternating immersion in water by +5 to ±8°C and +55 to ±8°C with a dwell time of 2 min and transfer time of 5 sec in each bath. All specimens were sectioned buccolingually with diamond disc. Among two sections from each sample one was taken to check the Gap Formation. Which makes it 6 samples per group. A total of 12 samples were subjected to SEM analysis

Each specimen was taken to vacuum desiccators and sputter coated with gold palladium and then was examined under Scanning Electron Microscope for Gap Formation under 1500X magnification. The dentin restoration interface was analysed at 7 sites in the buccolingual sections. The size of the gaps in different locations was measured and means gap was calculated for each investigated material. The results were calculated, tabulated and subjected to statistical analysis

Statistical Analysis

The Statistical analysis was performed by using SPSS program (Statistical Package for Social Sciences) for Windows, version 17.0. Continuous variables are

presented as mean ± SD. Data were checked for normality before statistical analysis using Shaipro Wilk test.

When intergroup comparison of Mean Gap Formation was done using Kruskal Wallis test, then the difference was found to be statistically significant between all Groups having the p value <0.05

Post hoc pairwise comparison of Mean Gap formation among two study groups was done using Mann Whitney U test.

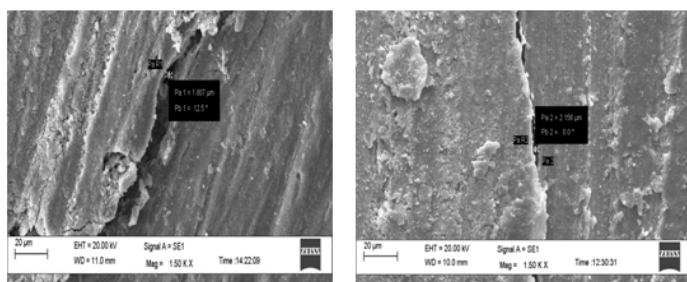
Results

The results of the study showed that the bulk-fill composite demonstrated less gap formation than incrementally filled composite.

Table 1: Mean and Standard Deviation values for Gap Formation for all groups

Gap Formation			
Groups	Mean	N	Std. Deviation
Gr A	2.2403	6.0000	0.2181
Gr B	5.2977	6.0000	1.4840
P ^a value	<0.0001		

Kruskal wallis Test



Group A (Sonicfill)

Group C (Sperctrum Tph)

Fig. 1: Scanning Electron Microscope View Of Samples Of Bulk Fill And Incremental Fill Groups For Gap Formation.

Discussion

Self-cured traditional composites which were prepared as two components mixed just before use, resulting in inadvertent air incorporation leaving pores as mechanical defects that were extremely deleterious to strength.¹⁰

Then incrementally placed composite resins came, but the big challenge faced by them was the, bond failures between increments, incorporation of voids or contamination between composite layers, because of limited access in conservative preparations leads to difficulty in placement, and the increased time required to place and polymerize each layer.¹¹ Then came bulk fill composites which were having less incorporation of voids between composite layer than any other composite placement technique, require less chair side time thus making the restorative process comfortable to the patient.

In this study Bulk Fill composite demonstrated Significantly better results than the Incremental Fill Composite. This is because that Bulk Fill Composites demonstrated enhanced flowability leading to good adaptation, elasticity and Low Polymerisation Shrinkage stress which reduces microleakage, reduced postoperative sensitivity and secondary caries and can be cured in bulk as they are highly translucent which in turn allow light to sufficiently penetrate to the bottom of single increment layer. The mean score values for Gap formation for Group A was 2.2403µ and Group B was 5.2977µ, and Standard Deviation for Group A 0.2181 and Group B was 1.4840 (Table 1).

When intergroup comparison of Mean Gap Formation was done using Kruskal Wallis test, then the difference was found to be statistically significant between the two Groups having the p value <0.05 (Table 1)

Post hoc pairwise comparison of Mean Gap formation among two study groups was done using Mann Whitney U

test and it was found that the Mean Gap formation among Group A was significantly lower than that among Group B samples. The results showed that the minimum Gap Formation was found in Sonicfil composite, indicating that the Incremental Fill composites have more microscopic Gaps than Bulk Fill composites.

According to **Sabbagh J et al**¹² Sonic Fill is a fast and reliable new technique for posterior restorations which does not require any additional capping layer. The manufacturer stated that as Sonic energy is applied through the handpiece, the modifier causes the viscosity to drop (upto 87%), increasing the flowability of the composite, enabling quick placement and precise adaptation to the cavity walls,

Conclusion

The following conclusion was drawn:

- The Bulk Fill Composite (SonicFill) showed lesser Gap Formation when compared to the Incremental Fill Composite (Spectrum TPH).

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