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Research Article

A COMPARATIVE ANALYSIS BETWEEN PACKABLE AND FLOWABLE BULK FILL COMPOSITE RESINS ON THE CUSPAL FLEXURE OF TEETH SUBJECTED TO OCCLUSAL LOADING-AN IN-VITRO STUDY

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ABSTRACT

Cuspal flexure is inseparable from the shrinkage stress, adhesion, and curing of a restorative system. Shrinkage stresses are generated by shrinkage and development of elastic modulus during polymerization, but they will arise only if the composite has been bonded to the tooth structure. The main concern regarding a bulk fill technique is whether the composite cures fully; enough in the deeper portions to create a material that has acceptable physical and biocompatible properties. The aim of this study was thus to evaluate cuspal flexure of teeth restored with four different bulk fill composite resin restorative materials subjected to occlusal loading.

Material and methods: The study was done in-vitro, using 40 extracted maxillary first premolars. Mesio-occluso-distal cavities were prepared. The cuspal flexure was measured before (unaltered teeth) and after restoring the teeth using a load of 150 N. Four different Bulk fill composite resins were used- Smart dentin replacement (Dentsply, Konstanz, Germany), Filtek bulk fill (3M ESPE, USA), Surefil (Dentsply Caulk, USA), Tetric N Ceram (Ivoclar Vivadent, Liechtenstein).

Results: Teeth restored with Tetric N Ceram (Ivoclar Vivadent, Liechtenstein) showed lesser amount of cuspal deflection, but there was no statistically significant difference among the four groups.

Conclusion: Surefil (Dentsply Caulk. USA) was the least effective than the rest. But no significant difference was observed amongst these even after application of sufficient load.

INTRODUCTION

Cuspal flexure indicates deformation of the tooth structure, which signifies the presence of shrinkage stresses. Cuspal flexure is inseparable from the shrinkage stress, adhesion, and curing of a restorative system. Shrinkage stresses are generated by shrinkage and development of elastic modulus during polymerization, but they will arise only if the composite has been bonded to the tooth structure.[1, 2] If the composite-tooth bond remains intact, stresses transferred to tooth structure may result in cuspal flexure, enamel fracture, or fractured cusps.[3] The incremental technique may be necessary for adequate light penetration, its disadvantages include the possibility of trapping voids or contamination between layers and the increased time required to place the restoration.[2] Clinically the utilization of an incremental method of composite filling reduces stress development and shrinkage (that is an indication of cuspal flexure) but an alternative to this is the use of Bulk filling composite materials, though the ADA recommendations do not strongly support this.[4] The main concern regarding a bulk technique is whether the composite cures fully enough in the deeper portions to create a material that has acceptable physical and biocompatible properties.[2] Although a lot of research works has been conducted still no concrete conclusion have been recommended. We tried to emancipate the degree of flexure among extracted teeth using bulk filed composite. The

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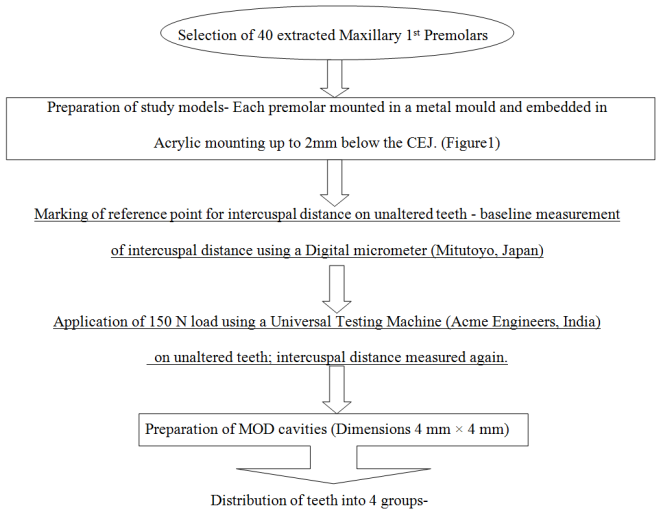
METHODOLOGY



1. ***Group I:*** Smart dentin replacement (Dentsply, Konstanz, Germany)
2. ***Group II:*** Filtek bulk fill (3M ESPE , USA)
3. ***Group III:*** Surefil (Dentsply Caulk,USA)
4. ***Group IV:*** Tetric N Ceram (Ivoclar Vivadent , Liechtenstein)

The teeth were then restored and cured using Elipar Deepcure-S (3M ESPE,USA) according to manufactures instructions for each bulk fill composite resin . The intercuspal distance was measured 5 min after curing completion, and after subjecting the restored teeth to 150 N load.

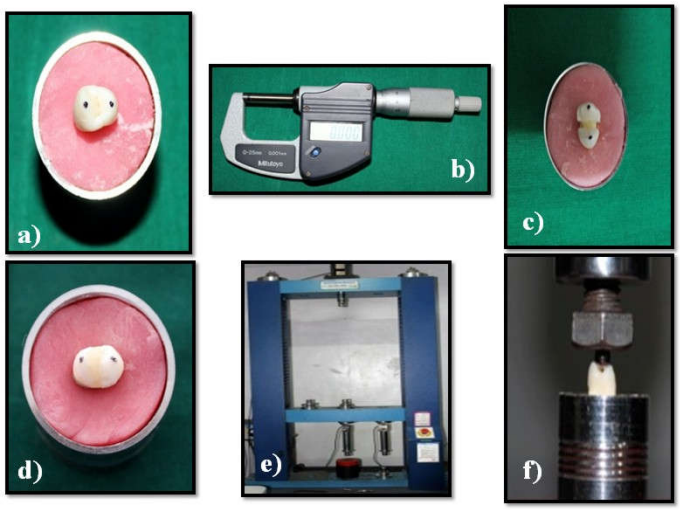


Figure 1 a) Study model b) Digital micrometer c) MOD cavities prepared d)Bulkfill restoration completed e) Universal testing machine f) 150N occlusal load

RESULTS

The 4 different groups were studied under two major categories. Unaltered teeth- before and after application of 150 N of load, after the MOD cavity preparation and rstoration- before and after application of 150 N load and following composite restoration- before and after application of 150 N load. Even though the mean of the intercuspal distance was higher than in the altered teeth, it was not statistically significant (student t test) (Table 1). The total mean of all the 4 groups before the application of load was higher than that after the application of load but there was no statistically significant difference seen.(Table 2,3)

Table 1 shows the distribution of the mean across the altered and the unaltered groups.

	Unaltered teeth	After Preparation of MOD
Mean (SD) of intercuspal distance	6.6988 (0.66)	6.66 (0.70)
Mean (SD) of intercuspal teeth with 150 N load	6.74665 (0.65)	6.45 (0.74)

Table 2 Mean and SD of 4 groups before and after application of 150 N load.

Groups	Before application of 150 N load (mean SD)	After application of 150 N load (mean SD)
I	6.69(0.77)	6.55 (0.74)
II	6.42 (0.74)	6.33 (0.72)
III	6.93(0.53)	6.80 (0.52)
IV	6.45 (0.77)	6.17 (0.87)

The two-tailed P value equals 0.4115. This difference is considered to be not statistically significant.

Table 3 Mean SD and N before and after 150 N load application.

	Before application of 150 N load	After application of 150 N load
Mean	6.6225	6.4625
SD	0.2380	0.2737
SEM	0.1190	0.1368
N	4	4

DISCUSSION

This is a novel approach that we tried, where a flowable bulk fill composite was compared with packable bulk fill composite variety. Till now most of the studies have directly compared incremental technique to bulk filled materials only. Deflection is the manifestation of stress due to shrinkage. It is a well known fact that higher internal stresses are directly proportional to the cuspal flexure. Premolars were chosen for this study because the cuspal inclines render them more susceptible to force that may promote cusp fracture. Only the application of 150 N produced a significant effect on cuspal deflection in intact teeth, as suggested by Panitvisai and Messer and Jantarat and others, who reported that intact teeth behave very stiffly and show very little deformation under load. [5, 6] Campodonico et al state that when using resin-based composite restorative materials, clinicians should be more concerned about the effect of filling techniques on curing depth than about how these techniques affect shrinkage stresses. [2] We observed the highest flexure was seen with respect to Surefil (Dentsply Caulk, USA). Though each of the manufacturers claimed the superiority of each material we did not come across any significant difference amongst these using the bulk fill technique. Till date most of the studies have compared the conventional technique with bulk filled and tried to prove that since curing occurs in greater depths, the incremental technique is the best. Additional increments may increase the cuspal deflection owing to accumulation of incremental deformations of the weakened cavity walls. [7] The study by Do T et al showed greater cuspal flexure than our study with respect to Filtek Bulk Fill(3M ESPE ,USA) and Tetric EvoCeram

(Ivoclar Vivadent, Liechtenstein) Bulk fill composite. But they also did not find any significant difference between the bulk filling and incremental technique using different materials. [1] We found that Tetric N Ceram (Ivoclar Vivadent, Liechtenstein) showed the least flexure after load application followed by Filtek bulk fill (3M ESPE, USA) but it was not statistically significant. The main concern of curing is not compromised with bulk filling, since a minimum penetration of 4mm is observed. [1, 8] Jafarpour S et al report low flexure in bulk filled composite filling. [3] But they did not compare the materials unlike our study. The use of increments exposes each increment to the light, resulting in a complete cure, thus the development of greater shrinkage occurs. The effect on cusp movement is therefore more significant in increment technique.[1, 3] If the cuspal flexure after the insertion of material could be taken as a standard to determine the stress developed, Tetric N Ceram (Ivoclar Vivadent, Liechtenstein) in our study was the least. But this needs to be further studied. The cavity size also affects the amount of stress generated. Since MOD cavity results in a greater tooth loss, the amount of cuspal deflection is higher in this case. [9] Still restoring of composites with specific attention towards the angle could help in better cross polymerization. It is imperative to determine the depth of curing as well as microhardness of the materials before the best one amongst these is recommended for clinical use. So the literature data though may support any of the material form it is imperative to not compromise on the clinical cavity preparation and blindly depend upon the material property only. Composites with lower degree-of-cure shrink less and have a lower cusp flexure and hence experience a lower shrinkage stress.

CONCLUSION

Within the limitations of the study, we can state that of the 4 different materials used in bulk filling technique, Surefil (Dentsply caulk, USA) showed maximum cuspal deflection. This least cuspal flexure was shown by Tetric N Ceram (Ivoclar Vivadent, Liechtenstein) followed by Filtek bulk fill (3M ESPE, USA)and then Smart dentin replacement (Dentsply, Konstanz, Germany) . But no significant difference was observed amongst these even after application of sufficient. Since this was a novel approach towards comparing a flowable to a bulk filled composite further studies need to be conducted to test the superiority of these materials.

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