



A COMPARISON OF THREE DIFFERENT BULK- FILL COMPOSITES WITH REGARD TO MARGINAL INTEGRITY: AN IN VITRO DYE LEAKAGE ANALYSIS

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ABSTRACT

Aim: To evaluate the microleakage with three different bulk fill composite restorative materials in proximal restorations.

Materials and Methods: Class II proximal cavities in 150 mandibular molars were divided into 3 groups of 50 each and restored with Filtek composite resin in Group 1, Tetric N-Ceram Bulk Fill in Group 2 and Estelite Bulk Fill composite in Group 3. After completing the restorative procedure for all the cavities, teeth were immersed in 2% aqueous methylene blue dye for 24 hours at room temperature. After taking out from dye, each tooth was sectioned mesio-distally through the centre to cut it in two equal halves and dye leakage at the tooth restorative interface was measured using stereomicroscope.

Results: Tetric N ceram bulk fill showed the least microleakage while the Filtek composite resin and Estelite Bulk Fill composite showed the highest.

Conclusion: Of the three bulk fill composites, Tetric N ceram bulk fill showed good bonding to the enamel and dentin and thus can be used in deep Class II cavities with maximum of 4mm bulk increment.

Keywords: bulk- fill composites, microleakage, dye leakage.

Introduction

Resin-based restorative materials have been a common choice of dental practitioners for restoring almost all areas and any lesion of teeth because of their excellent esthetics, wear, and handling characteristics.¹ New resin composites and adhesive materials have been developed to improve marginal adaptation, reduce polymerization shrinkage and shrinkage stress and work effectively on enamel, dentin and cement in Class II direct composite restorations.² Initial composites showed many shortcomings and possessed high polymerization shrinkage, low wear resistance, low strength and compromised surface characteristics.³ In addition to different application techniques, improvements in the restorative materials, have led to reduce

marginal leakage. In deep Class II mesio-occlusal distal (MOD) restorations, the use of resin composites can decrease the curing light intensity depending on the depth of the material.² Placement techniques have been found to be most important factor for reduction in shrinkage stresses. Incremental restoration technique has been widely accepted and clinically proven to be able to reduce polymerization shrinkage thereby attaining effective marginal seal.⁴ But the latest version of bulk fill composites for simplifying restorative procedure is the bulk-filling posterior cavities intended to be bulk-cured in one increment up to 4 mm.⁵ Bulk filling technique when used for standard composites has proved to be ineffective in obtaining an acceptable marginal seal and thus not recommended.⁶ Since the bulk-fill

methacrylate-based composite resins using polymerization modulator technology specially designed for bulk-filling technique have been introduced, it has become possible to place composite resin at thicknesses greater than 4 mm, which results in significantly shorter chair times during the restorative procedures.⁷ At present, the chief concern about curing bulk-fill composite resins is the amount of polymerization shrinkage and the subsequent gap formation. Most of the research on microleakage for these composites showed micro leakage scores which were not much different from those with conventional composites in deep class II cavities.^{8,9} This leads to the assumption that though bulk-fill composites are superior to other composites in terms of ease of use but are not successful in arresting microleakage at gingival margins. The present study was undertaken to evaluate the marginal integrity of Filtek One Bulk Fill Restorative (3M), Estelite Bulk Fill (Tokoyama Dental) and Tetric EvoCeram Bulk Fill (Ivoclar Vivadent) bulk- fill composites by dye leakage test under stereomicroscopic examination.

Materials and methodology

One hundred fifty mandibular molar teeth were collected from the Oral and Maxillofacial Surgery Department of our College. Teeth were cleaned of remaining tissue and calculus, and stored in 1% thymol solution. The teeth to be prepared were mounted in a plaster block. Using a cylindrical diamond bur under air-water cooling, an experienced operator prepared Class II proximal box cavities of depth of 6 mm (measured along the lateral wall), a width of 3 mm (pulpal wall) and length of 3 mm (approximal wall). The dimensions mentioned above were con-firmed with the use of a #15 UNC periodontal probe. Bevels were not placed at the cavosurface margins. The teeth were randomly assigned to 3 groups with 50 teeth with cavities in each group. The mesial and distal cavities of all the samples were etched for 15 seconds, rinsed and dried with cotton pellets. Group 1: Filtek Bulk Fill composite (3M ESPE), Group 2: Tetric N-Ceram Bulk Fill composite (Ivoclar Vivadent) and Group 3:

Estelite Bulk Fill(Tokoyama Dental) Packable Posterior Bulk Fill composite.

Group 1: In first group self-etch adhesive primer (3M ESPE, St. Paul, MN, USA) was applied to the cavity walls with a microbrush, following manufacturer's instructions. Then the cavities were restored with Filtek composite resin (3M ESPE, St. Paul, MN, USA) using the bulk-fill technique and light-cured with LED light-curing unit.

Group2: In second group self-etch adhesive primer (3M ESPE, St. Paul, MN, USA) was applied to the cavity walls with a microbrush, following manufacturer's instructions. Then the cavities were restored with Tetric N-Ceram Bulk Fill composite (Ivoclar Vivadent) composite resin using the bulk-fill technique and light-cured with LED light-curing unit.

Group3: In third group self-etch adhesive primer (3M ESPE, St. Paul, MN, USA) was applied to the cavity walls with a micro brush, following manufacturer's instructions. Then the cavities were restored with Estelite Bulk Fill (Tokoyama Dental) Packable Posterior Bulk Fill composite using the bulk-fill technique and light-cured with LED light-curing unit..

After completing the restorative procedure for all the cavities, teeth were immersed in 2% aqueous methylene blue dye for 24 hours at room temperature. After taking out from dye, each tooth was washed under running tap water and was mounted on a plaster block. Tooth sectioning was done mesio-distally through the centre to cut it in two equal halves using water cooled slow-speed diamond saw. The length of dye leakage at the tooth restorative interface was measured using stereomicroscope (Olympus; 10X magnifications) and the microleakage scoring was done using the method, as per Radhika et al.¹⁰

0 = No dye penetration;

1 = Dye penetration limited to outer half of the axial wall;

2 = Dye penetration limited to inner half of the axial wall;

3 = Dye penetration reach the pulpal wall;
4 = Dye penetration beyond the pulpal wall.

Results

Dye penetration rating were scored and noted in table 1. When the three groups were compared for microleakage using Kruskal–Wallis test. All the statistical tests were performed at a $p < 0.05$ level of significance.

None of the interfaces showed an absence of dye infiltration, although the degree of infiltration differed among different composites. There was a significant difference between Group I and Group III and Group II and Group III with $P = 0.001$ and $P = 0.003$, respectively with least micro leakage in group 2.

Table 1:

Group	n	Score 0	Score 1	Score 2	Score 3	Score 4
Group 1	50	10	16	11	9	4
Group 2	50	25	17	7	1	0
Group 3	50	11	12	16	7	4

Discussion

The marginal adaptability of restorations is necessary for successful restoration of teeth and is therefore regarded as an important determinant of their long-term success rate. Perfect adaptation is hard to accomplish because of inconsistent physical properties between tooth structure and restorative materials. Contrary to incremental insertion technique in which composite resins are placed in 2-mm-thick layers in the cavity to decrease polymerization shrinkage and achieve proper depth of cure, in the bulk-fill technique composite resin is placed in 4–6-mm layers in the cavity.¹¹ The present study assessed the cavity adaptation of three different bulk-fill composite materials. None of the interfaces showed an absence of infiltration as shown by the results of Sconti et al.¹² In the current study, same type of light-curing unit i.e. LED was used for polymerization of composite resin samples. Because, Casseli et al showed that the type of the light-curing unit affected gap formation at both the enamel and dentin interfacial areas.¹³ The results of the study showed that there is significant difference between microleakage of Filtek and Tetric N-Ceram and between Estelite Bulk Fill and Tetric N-Ceram. Tetric N-Ceram Bulk Fill is the efficient four millimetres posterior composite of the nano-optimized Tetric N-Collection. The patented light activator Ivocerin is responsible for ensuring the complete cure of the filling.

This group showed lesser microleakage values compared to Filtek and Estelite Bulk Fill. The results of our study are in concordance with those of Pathik et al.¹⁴ The results of our study are not in agreement with those of Orłowski et al. and Israa O. Nagy et al.^{15,16} In this study, methylene blue dye was used to measure the microleakage scores. According to few researchers, the dye penetration doesn't actually show the lack of bonding at the tooth-restorative interface. According to Fabianelli A, the staining may indicate only the partial conversion of the resin and not true leakage.¹⁷ This might be the reason for contradictory results of our study in comparison to some of the previous studies mentioned. However, we have chosen it because dye penetration method is the easiest and most commonly employed method to assess microleakage of dental restorations.

Conclusion

Within the limitation of this study and regarding the results, it is concluded that all the restorative systems tested in this study exhibited microleakage. This was inevitable and irrespective to type of material being used, and the microleakage was lower in the Tetric N-Ceram compared with the Filtek and Estelite. Also there is need for more long term clinical studies to evaluate the efficacy of these bulk fill composites in access cavities of endodontically treated teeth.

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