Abstract:
Direct tooth colored restorations are widely used in dentistry due to patients' aesthetic demands for the restoration of dental caries, crown fractures, tooth wear and congenital defects. Hence, composites are widely used nowadays in these cases. Bulk fill restorative materials are newly introduced composites that are placed in increments exceeding 2-mm thickness. These newly developed 'bulk-filled' resins claim to offer single increment placement thickness ranging from 4 to 6 mm instead of the conventional 2 mm value commonly used. Microleakage has been defined as “a clinically undetectable movement of bacterial fluids, molecules and ions in microgaps (10⁻⁶ μm) between the cavity wall and the restorative material applied to it.” This often leads to failure of restorative materials. However, much studies have not been done on microleakage in bulk fill composites.

AIM: To evaluate and compare microleakage in bulk fill and conventional composites in class I cavities.

METHOD: 24 freshly extracted human permanent maxillary and mandibular posteriors with no structural deformities were selected. 24 class I cavities were made on the teeth and the depth of the cavity was kept 4 mm. Adper single bond 2 (3M) bonding agent was applied to the etched surface, gently dried and cured. The teeth were then randomly divided into four groups of 6 teeth each. Group I Filtek (3M ESPE) Packable composite, Group II: SonicFill Bulk Fill composite (Kerr/Sybron), Group III: Fill-Up! Bulk Fill composite (Coltene / whaledent), Group IV: SureFil SDR Bulk Fill Flowable Composite (Dentsply). Samples were then covered with two layers of nail varnish, except the resin composite restoration and 1 mm area around it, followed by immersion in 0.6% aqueous rhodamine dye for 48 h. The specimens were rinsed and sectioned at CEJ and then sectioned mesiodistally using diamond disc. Then microleakage was measured using confocal microscopy at 10 X magnification.

RESULTS: It was seen that Sonic fill had more microleakage followed by Fill-Up and Filtek while Surefil SDR had least microleakage. Considering the results of this study, it can be concluded that the microleakage is not only related to the restorative material used but also to the placement technique and the overall interface quality between the enamel and the restoration.

CONCLUSION: In Class I restorations, microleakage is observed regardless of the type of composite material used. The results suggest that microleakage is influenced by various factors including the type of composite material, the placement technique, and the overall interface quality. Further studies are required to understand the underlying mechanisms and to develop strategies to minimize microleakage.
composite used and SureFil SDR Bulk Fill shows lesser microleakage when compared with other Bulk fill composites.

**Key Words** - Bulk fill, Conventional Composites, Microleakage, Confocal Microscopy

**Introduction**

Composites are tooth colored restorative materials which have been successfully used in dentistry and has widely replaced other materials. A composite restorative material consists of a continuous polymeric or resin matrix into which inorganic fillers are dispersed. They can be described as a dispersed (filler) phase mixed into a continuous (matrix) phase.

Restoring large cavities using incremental technique is time consuming. To overcome this, new types of light-curing resin composites have been introduced which claim to be curable to a thickness of 4 mm and are known as 'Bulk fill' composites.

**Bulk Fill composites** possess specific characteristics which includes enhanced flowability to achieve consistent adaptation to the cavity preparation, elasticity and low polymerization shrinkage stress which reduces microleakage, postoperative sensitivity, secondary caries and improved depth of cure thus eliminating the need for layering.

Composite materials shrink while polymerizing and this is referred as polymerization shrinkage. It leads to gap formation at the composite and tooth interface. Polymerization contraction of dimethacrylate-based composites ranges from 2-6% of volumetric shrinkage. The detrimental effects of polymerization shrinkage stress include bond failure, cuspal flexure, interfacial gap formation and subsequent microleakage.

Microleakage is considered to be a major factor influencing the longevity of dental restorations which results in hypersensitivity, recurrent caries and pulpal pathoses. Besides pulpal irritation and secondary caries, microleakage also results in marginal discoloration which is often misdiagnosed as recurrent caries at the margins leading to unnecessary restoration replacement and further tooth structure loss.

Microleakage is commonly assessed in vitro using dye penetration to detect bond failure at the enamel–resin interface. Confocal laser scanning microscopy (CLSM) is a non-destructive technique. Its advantage is that it clearly indicates leakage limits, eliminating the stain spread caused by specimen sectioning and also avoids polishing artifacts that exaggerate dye penetration.

The magnitude of the stress induced during polymerization shrinkage also depends upon other factors, such as the configuration factor (C-factor) of the cavity and the effect of light-curing mode.

In this study, the cavities had standard dimensions with standard light curing mode and thus similar C-factor.

The aim of this study was to evaluate and compare the microleakage in three different bulkfill composites with increment fill composite.

**MATERIALS AND METHODS**

24 freshly extracted human permanent maxillary and mandibular posteriors with no crack, decay, fracture, abrasion, previous restorations, or structural deformities, which were periodontally compromised were collected and stored in normal saline. Residual tissue tags were removed and specimens were cleaned.

24 class I cavities were made on the teeth and the depth of the cavity was kept 4 mm. Periodontal probe was used to measure the depth of preparation. Each cavity was prepared by number 245 carbide...
bur. After six tooth preparations a new bur was used. Final dimension of the cavity showed 2 mm occlusal width and 4 mm depth.

All the prepared cavity surfaces were dried with oil free compressed air, etched with 37% phosphoric acid for 15 s and then rinsed and dried. Adper single bond 2 (3M) bonding agent was applied to the etched surface, gently dried, and cured. The teeth were then randomly divided into four groups of 6 teeth each. Group I Filtek (3M ESPE) Packable composite, Group II: SonicFill Bulk Fill composite (Kerr/Sybron), Group III: Fill-Up! Bulk Fill composite (Coltene / whaledent), Group IV: SureFil SDR Bulk Fill Flowable Composite (Dentsply). The specimens in each group were restored with the corresponding Bulk Fill composite and cured for 20 s according to manufacturer's instructions.

The specimens were stored in 100% relative humidity at 37°C for 24 h. They were then covered with two layers of nail varnish, except the resin composite restoration and 1 mm area around it, followed by immersion in 0.6% aqueous rhodamine dye for 48 h. The specimens were rinsed and sectioned at CEJ and then sectioned mesiodistally using diamond disc.

The microleakage was measured using confocal microscopy at 10 X magnification (Confocal Fluorescence Imaging Microscope, Leica TCS-SP5, and DM 6000-CFS) in the fluorescent mode. Approximately, six photographs of each specimen were taken to obtain the full perimeter of the restoration. With a digital scale (Snagit digital scale), the width of interface between restoration and tooth surface was calculated and microleakage area was also calculated.³³

RESULTS

The following bar chart shows the mean microleakage area of different Bulk fill composites. It was seen that Sonic fill had more microleakage followed by Fill-Up and Filtek while Surefil SDR had least microleakage. There was statistically significant difference between the Sonic fill and Surefil SDR group (P < 0.05) and between the Fill-Up and Surefil SDR group (P < 0.05).
DISCUSSION

Microleakage is defined as the clinically undetectable passage of bacteria, fluids, molecules, or ions between a restorative material and the cavity wall to which it is applied. Microleakage at the tooth-restoration interface is considered a major factor in determining the longevity of dental restorations. It is related with polymerization shrinkage and shrinkage stresses. Minimizing microleakage would improve marginal cavity adaptation. Light intensity is highest at the restoration surface decreasing the pre-gel phase and leading to contraction forces and material shrinkage.

The decrease of the polymerization shrinkage and consequent microleakage, can be obtained by an oblique layering technique with increments or cavity designs with a low C-factor. The incremental layering technique and use of low-modulus intermediate liner material such as flowable composites have been suggested to reduce this shrinkage. As increment layering technique is time consuming as well as cumbersome so bulk fill composites are widely used nowadays. An ideal bulk fill composite would be one that could be placed into a preparation having high C-factor design and still exhibit very little polymerization shrinkage stress, while maintaining a high degree of cure throughout.

Currently, bulk fill materials are available in different viscosities, which is low, variable or medium. Dual-cured resin composites have been mainly used as a core material for the reconstruction of non-vital teeth and as dentin substitute in the open sandwich filling technique. Advantages of using dual-cured composites as restorative material are bulk insertion which saves clinical time, the polymerization in deep areas due to chemical curing and the development of low contraction stresses.

This study revealed that Sonicfill resin composite had more microleakage while Surefil SDR had least as compared to other bulk fill composites. It could be because Sonicfill combines the attributes of a low viscosity composite and a universal composite and when the composite is activated with sonic energy, the composite changes its consistency until it reaches a higher viscosity. Due to this higher viscosity internal voids are created in the composite which causes microleakage.

Surefil SDR is mono-component light-curing composite with minimal internal polymerization stresses because of longer pre-gel phase, which is accomplished by using “polymerization modulator” that interacts with camphoroquinone to reduce the contraction modulus and increase the number of linear bonds. The immediate result is lower shrinkage stress and preserved polymerization degree and this reason could be responsible for its less microleakage.

Considering bulk fill placement technique, it has been demonstrated that Surefil SDR showed better internal adaptation than conventional composites in high C-factor cavities. Another study (A. Moorthy et. al.) showed similar levels of microleakage of bulk fill (Surefil SDR X-tra Base) and standard (GrandioSo, VOCO) composites.

CONCLUSION

Based on the limitations of this study, it may be concluded that in Class I restorations, microleakage is observed regardless of the composite used and SureFil SDR Bulk Fill shows lesser microleakage when compared with other Bulk fill composites.

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