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Evaluation of marginal adaptation of two different composite: A Dye leakage study

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***Abstract*---**This study aimed to investigate evaluation of marginal adaptation of two different bulk fill composites. 10 freshly extracted teeth were divided into two groups of 5 teeth each. Class v cavity was prepared in the CEJ of maxillary first premolars. Restored with sdr flow+ and coltene fill up.Artificial aging was done with thermocycling machine done and samples were immersed in methylene blue solution for 24 hours.samples were sectioned in center of the restoration and viewed under stereomicroscope. Data were subjected to the NPar test and mann-whitney test (a=0.05). Overall result showed both bulk fill composites showed significant leakage after evaluating with stereomicroscope. It was found that there is no statistically significant difference between the two groups. Bulk fill flowable resins provided significantly better marginal seal in dentin,both before and after artificial aging. Both bulk fill flowable resins showed similar microleakage values at enamel margins.

***Keywords*---**artificial aging, bulk fill, dentin, enamel, microleakage.

Introduction

Dental caries is an infectious disease that causes the hydroxyapatite on teeth to deteriorate. This is primarily due to acid erosion of tooth structures. To prevent the disease from progressing, the contaminated tissue must be removed and replaced with a filling material (1). With advancements in materials science and

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clinical techniques, the indications for resin-based composites (RBCs) have expanded to include significant posterior stress-bearing restorations that were previously restored with amalgam. Because of the increasing demand for high quality aesthetic results in everyday practise, composite resins are considered materials of choice in restorative dentistry. Composites were first introduced in the 1960s and have since undergone extensive research and development. This has resulted in the development of microhybrid composites with mean particle sizes in the 0.6-0.7 micrometre range (2). Nonetheless, posterior resin based composite (RBC) restorations remain technically challenging due to the gradual layering technique and depth-of-cure issues(3,4).

Hooke's Law states that stress is determined by volumetric shrinkage and the elastic modulus of the material(5).The main drawbacks of composite resin materials are polymerization shrinkage and polymerization stress, which result in internal microcracks within the material's bulk, separation of the bonding agent from the cavity wall, resulting in gap formation, marginal microleakage, and postoperative sensitivity; enamel microcracks; marginal staining; wear; discoloration; decreased fracture resistance; recurrent caries; and tooth deformation (5,6)(7)(8). Flowable composites, with their low elastic modulus, compete with stress development, potentially assisting in the maintenance of the restoration's marginal seal. Furthermore, flowable composites are easy to work with and adapt to cavity walls, and their use can help to reduce marginal defects in restorations (9,10)

The composite-to-tooth structure bond must ensure the restoration's marginal integrity and retention during functional loading, thermal stress, water sorption, and dimensional changes (11). The most common reason for removing resin-based composite restorations is secondary caries caused by microleakage. However, because of their inferior physical and chemical properties in comparison with the conventional dental restorative materials and their lack of moisture-resistant bonding to hard dental tissues, cavity lining materials do not provide a satisfactory solution to the problem of marginal leakage(12). Modified UDMA, TEGDMA, EBPADMA, Barium borosilicate glass 68 wt%, 44 vol%. The use of a base material, cavity liners, and bulk fill materials in class I and II restorations was investigated in comparison to traditional composite and bulk-fill resin composite. Short-fiber–reinforced composite, everX Posterior, and a conventional resin surface layer all showed less leakage.

Fill up (coltene) TMPTMA, UDMA, bis-GMA, TEGDMA, dibenzoyl peroxide, benzoyl peroxide, Zinc oxide coated. 65 wt% filler load; 49 vol% filler load. Concerns about the mechanical properties of strength over traditional RBC were raised by a dual cure content. To our knowledge, no research has been published that evaluates the degree of microleakage of these new flowable resins on both enamel and dentin. The aim of this in vitro study was to evaluate the marginal sealing ability of two bulk- fill flowable resin composite on both enamel and dentin substrates before and after artificial aging. The null hypothesis tested is that bulk−fill flowable composite resins do not lead to better marginal seal on enamel or dentin, in comparison with other flowable composite materials.

Materials and Methods

In total,10 recently extracted upper premolars were selected for this in vitro study. Immediately after extraction, the teeth were stored in normal saline solution at 37 ° C. Then class V cavities were prepared with 1 to 2 mm depth at the level of CEJ with a diamond bur at 200000 rpm with air water cooling. After cavity preparation the teeth were separated into two groups each having ten teeth (n=10).Teeth in the first group A were filled with SDR flow+ bulk fill composite and teeth with another group B filled with Fill up .Cavity preparation was done at a depth of 2 mm and enamel margins were conditioned with 37% ortho phosphoric acid and then washed for 15 seconds and dried for 15 seconds. A thin layer of bonding agent (IVOCLAR VIVADENT) was applied to all conditioned enamel surfaces and polymerized with the light cure for one minute. Restorations were performed with two different composites and the restorations were polished with SHOFU (Super-Snap mini kit) .

Specimen preparation

Restored specimen were immersed in methylene blue solution for 30 mins at 25°celcius .The teeth were removed from the dye,cleaned under tap water for 1 min(13).Following thermocycling, the teeth were split longitudinally with a diamond saw, passing through the middle of the labial and lingual restorations.The samples were then viewed under Stereomicroscope to ascertain the penetration of the dye between the restoration and cavity wall.

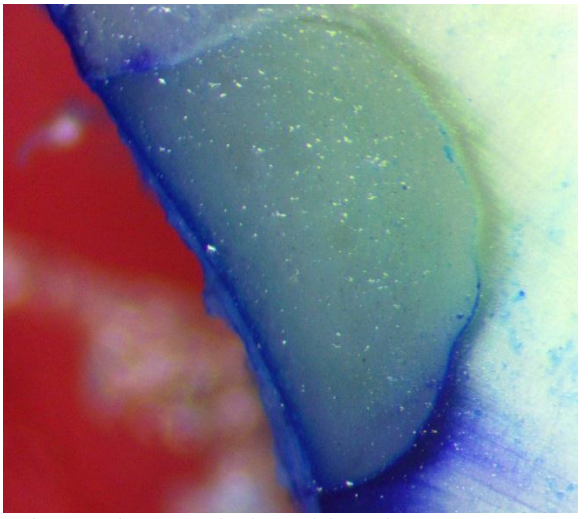

Figure 1. A and B shows that methylene blue dye penetration in the sectioned class V restored teeth

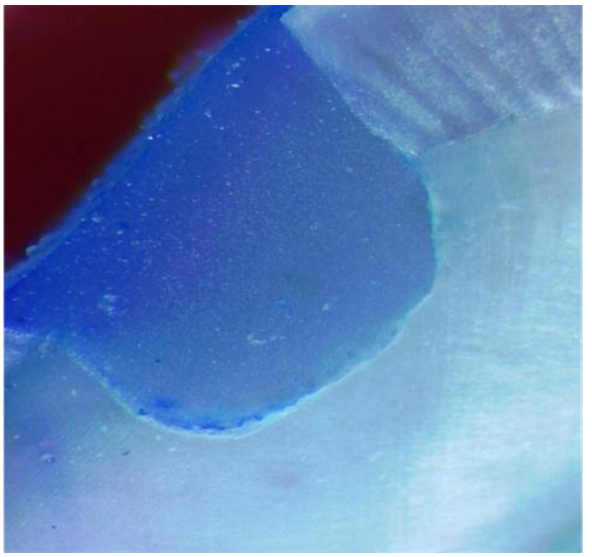

Figure 2. Sectioned samples showing dye penetration

The penetration of dye was classified as follows:

- no penetration of the dye;
- penetration of the dye limited to the interface of the enamel and the restoration;
- penetration of the dye along the cavity walls, but not reaching the axial wall;
- penetration of the dye including the walls and floor of the cavity; and
- penetration of the dye partly or completely through the dentin to the pulp chamber. (Author for scoring criteria)

Result

Confidence Interval will be within the interval of 95%.

Table 1
DYE penetration in the margin of the restoration according to the score that given above

Samples	SDR	COLTENE
1.	2	2
2.	2	3
3.	3	2
4.	1	2
5.	1	0

The result were summarized in table: I.only one teeth showed 0 penetration. The remaining specimens showed variable depths of penetration of the dye from the surface; the dye penetration in both the group was same.

Discussion

In the current study, we examined the microleakage of different types of composite resins at enamel and dentin margins, after artificial aging.composite that we used for restoration are SDR flow+ and coltene fillup bulk fill flowable composite.usually this bulk fill composite were used in deep cavities for having a good compressive and flexural strength.For example, in class I, II, III, and IV cavities, RBCs with high flexural properties are usually selected to minimize fracture or deformation under the high occlusal forces, while in class V cavities, RBCs having low flexural modulus are preferred, as they can flex with the teeth during function and parafunction, which in turn reduces the stresses at the adhesive interface and decreases the chances of debonding(13,14)

One of the most critical goals of cavity restorations is to create a predictable marginal seal to avoid microleakage and its clinical effects including marginal discrepancies, marginal staining, recurrent caries, sensitivity, and pain.(15)).The chemically undetectable passage of bacteria, fluids, molecules, or ions between the cavity walls and the restorative materials is defined as microleakage, an essential property used to assess the success of restorative materials (16). Dye penetration is an established in vitro method for investigating marginal leakage along tooth–restoration interfaces and is generally assessed after cutting the teeth in the longitudinal direction.Various tracer dyes are available for microleakage studies, with fuchsin, silver nitrate, and methyelene blue being some of the most popular. Methylene blue is a popular tracer that can be used in a variety of concentrations.(17)

Marginal infiltration scoring is most commonly assessed by numerical scoring to the interface of scale o to 4.To address this issue,present study was calculated with the help of stereomicroscope after sectioning the restored tooth.At the tooth restoration interface, the percentage of infiltration was determined for both the enamel and dentin, which were filled with two different materials. Fill up(coltene) and SDR flow+.resin composite were not placed above the flowable composite. These characteristics of flowable composites can explain why they perform better on dentin substrates, where adhesive processes are less predictable and more difficult to achieve.(18)

The incremental layering technique is widely accepted as the gold standard in resin-based composite restoration. It should be placed in increments of no more than 2mm in thickness. However, recent advances in composite technology for posterior bulk fill composite material can be applied in thickness increments of up to 4mm. Bulk-fill RBCs can be applied in thicker layers due to the increased depth of cure obtained by expanded filler sizes and a reduced number of pigments.(19)As a result, manufacturers promote bulk-filling as being faster than incrementing. The materials could be cured in layers up to 4 mm thick for 20 seconds at low irradiance to achieve good mechanical properties (20). Bulk Fill resin composites have become increasingly popular in patient care due to the

demand for efficiency and performance.

As a result, thermocycling is an effective method for determining a restorative material's ability to seal. Thermocycling has been shown to be the most important factor in improving the microleakage process in previous research. The results of this study indicate that there was no statistical difference between two different bulk fill composites, which can be attributed to the fact that class V cavities are made up of dentin and cementum and are mounted at the CEJ. Because of the morphology, histology, and compositional variations between enamel and dentin, bonding to dentin has often been weak as compared to enamel..Owing to the higher density of dentin, bonding to it is difficult because of water and organic matter . The organic process of cement consists of coarser collagen fibres than dentin; as a result, it has a rougher texture.It's likely that the bonding would be weaker.(21). In our study there was significant difference in microleakage between two groups.Pair wise comparison was done on cervical wall using Mann-Whitney U-test, p value shows no significant result (p=0.82).

Conclusion

Based on the limitation of the study,it may be concluded that class V cavity microleakage is observed regardless of the two bulk fill composite. There is no significant difference between SDR+ and Coltene fill up bulk fill flowable composites

A)

B)

Figure 1: Distribution of Mean microleakage scores between SDR and COLTENE Groups

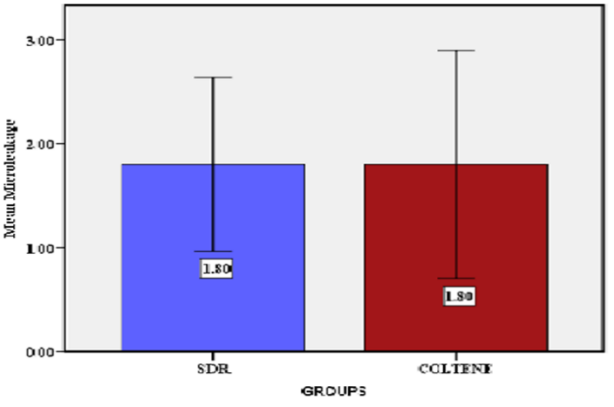

Table 1: Comparison of Mean microleakage scores between SDR and COLTENE Groups

GROUPS	Mean	Std. Deviation	Minimum	Maximum	Mann-Whitney U test value	P value
SDR	1.80	0.83	1.00	3.00	11.50	0.82
COLTENE	1.80	1.09	0.00	3.00		

Table 2

Samples	SDR	COLTENE
1.	2	2

2.	2	3
3.	3	2
4.	1	2
5.	1	0

Figure 1: A and B shows that methylene blue dye penetration in the sectioned class V restored teeth
Table 1 : comparison of mean microleakage scores between SDR flow+ and coltene fill up
Table 2:DYE penetration in the margin of the restoration according to the score that given above.

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