ORIGINAL ARTICLE

EVALUATION OF MICRLEAKAGE OF NANO-COMPOSITES USING THREE DIFFERENT RESTORATIVE TECHNIQUES

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ABSTRACT

In the present in-vitro study, microleakage was evaluated in deep class II composite fillings, restored with three different restorative techniques. Sixty proximal boxes with the gingival margin below the CEJ were cut in extracted posterior teeth and cavities were divided into three equal groups. Restorations were placed as follows. Group 1: Total-etch followed by bonding and incremental placement of nano-composite. Group 2: Resin modified glass ionomer cement as a gingival increment followed by total-etch, bonding and filling with nano-composite in increments. Group 3: Total etch and bonding followed by bulk-fill composite with final increment of nano-composite. Teeth were coated with nail varnish within 1-mm of tooth restorative interface and apices were sealed with sticky wax. Teeth were immersed into 2% aqueous solution of methylene blue dye for 24-hours, washed and sectioned mesio-distally. Dye leakage was studied under stereomicroscope. Statistical analysis was done using SPSS (V17). Descriptive statistics were employed. Result: There was no statistically significant difference in dye leakage scores among the three tested groups.

No technique was successful in arresting the dye leakage at gingival margin.

Key Words: *Class II Composites, Microleakage, Sandwich restoration, Bulk-fill composite.*

INTRODUCTION

Dental composites are one of the most important materials in aesthetic dentistry.[1] Since their introduction in 1960s, they have been extensively used as direct restorative materials.[2] Initial composites showed many short comings and possessed high polymerization shrinkage, low wear resistance, low strength and compromised surface characteristics.[2] Due to high shrinkage, values for microleakage were quite high in composites resulting in recurrent caries, marginal staining, sensitivity and in some cases pulpitis.[3] All of these factors contributed to shortened life span of these restorations especially in posterior teeth.

With continuous and ongoing research, lot of improvement has taken place in dental composites.[4] At the moment different varieties of composite materials are available in the market. These materials are said to have excellent esthetic and mechanical properties.[4] However, bonding of composite to dentine and cementum in deep class II cavities is still a challenge.[5]

In deep proximal cavities, the gingival floor is located deep in dentin or is sometimes extended to cementum, depending upon the extent of caries. Absence of enamel for bonding, number and orientation of dentinal tubules, problems with isolation and access all make bonding and restoration with composite a challenge in such cavities.[3]

Different restorative techniques have been tried to improve bonding and arrest microleakage in deep proximal cavities filled with composites.[6-8] Most of these studies have shown conflicting results and no standard protocol has been established that could be followed to have durable composite restoration in cases where gingival margin extends to cementum. It is very important to find out some standard restorative technique that could prevent microleakage in deep class II cavities. This study was designed to find out the extent of microleakage in deep posterior proximal restorations using three different restorative techniques.

METHODOLOGY

Sixty proximal boxes were made in extracted lower posterior teeth. Each box was 2-mm wide, 2-mm deep and gingival margin was placed 1-mm apical to dentino-enamel junction. Cavities were divided into three groups. Restorative procedure was done using

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the materials shown in table 1 as follows:

Group I: Total-etch followed by bonding and filling with incremental placement of nano-composite.

Group 2: Gingival increment of resin-modified glass ionomer cement followed by total-etch, bonding and filling with nano-composites in increments.

Group 3: Total-etch followed by bonding and filling with bulk-fill composite with final increment of nano-composite

After completing the restorative procedure for all the cavities, teeth were coated with nail varnish to within the 1-mm of restorative margins. Apices of roots were sealed by sticky wax. All the teeth were immersed in 2% aqueous methylene 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 (Isomet; Beuhler Ltd, Lake Bluff, IL, USA).

The length of dye leakage at the tooth restorative interface was measured using stereomicroscope (Olympus; 3×10 magnifications) and was scored as follows:

0: No leakage

1: Dye penetration to 1/3rd of gingival floor

2: Dye penetration to 2/3rd of gingival floor

3: Dye penetration to whole length of gingival floor

4: Dye penetration along the axial wall

Descriptive statistics were done and mean and mode for each group was calculated using SPSS (V17).

RESULTS

Microleakage scores for the three groups are shown in table 2.

None of the three techniques was successful in arresting the dye penetration at tooth restorative interface at gingival margin (Fig 1). No statistically significant difference was found among the mean values of dye leakage scores for the three groups.

DISCUSSION

Dental composites are considered as a material of choice for most of aesthetic restorations because of their improved mechanical properties, ease of application and durability.[9] However, the durability of these restorations may vary from case to case. In addition to material properties, caries risk of patient, location of carious lesion and operator skills are commonly cited factors to assess the longevity of composite restorations.[10] Among these, caries risk is one of the most important variable that affects the durability of restoration in clinical studies.[10] However, in lab studies, where all the restorations are placed in controlled environment, it is justified to assume that results should be quite better regarding the sealing ability of adhesive restorations.[11] The results are contradictory to this assessment in

TABLE: 1 MATERIALS USED FOR RESTORATIONS

Material	Brand Name	Company
Nano-Composite	Filtek Z 350 XT	3M ESPE
Bulk-Fill Composite	SDR	Densply
RMGIC	Vitremer	3M ESPE
Adhesive	Adper scotch bond	3M ESPE

TABLE 2: FREQUENCY OF SAMPLES IN EACH TESTED GROUP SHOWING DIFFERENT DYE LEAKAGE SCORES

Score	Group 1	Group 2	Group 3
0	4	3	3
1	1	0	2
2	1	3	3
3	6	5	4
4	8	9	8

TABLE 3: MEAN VALUES AND STANDARD DEVIATION FOR THREE RESTORATIVE TECHNIQUES. (P>0.5)

Technique	Score (Mean Value)	Standard Deviation
Group 1	2.65	0.35
Group 2	2.85	0.32
Group 3	2.6	0.34

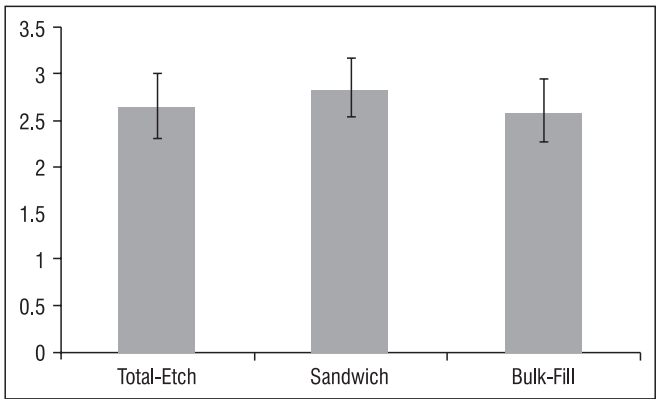

Fig 1: Mean Values For Dye Leakage Scores Among Three Restorative Groups

the present study and no technique was found to be successful in arresting the dye leakage completely. In all the tested samples, no leakage could be seen in enamel portion of teeth but at gingival margins high leakage scores were observed.

Among the tested techniques, total etch technique with incremental filling of composite is the one taken as standard technique for composite fillings. Most of the samples in this technique like other techniques showed high leakage scores (table 2).

These high leakage scores may be attributed to the location of gingival margin which is placed below the cemento-enamel junction. These high scores are in accordance with other studies where researchers found the high dye leakage in deep dentin.[12,13]

As bonding of composites to deep dentin with margins on cementum is unpredictable, sandwich technique with glass ionomer, resin modified glass ionomer or flowable composite has been suggested.[13] The rationale behind the use of these materials is their high elasticity to absorb polymerization stresses and hence improved adaptation and in case of glass ionomer cement, attaining some chemical adhesion at tooth restorative interface.[13]

However, conflicting results have been shown by different investigators regarding the use of these techniques. Few authors advocate the use of flowable composite,[14] while others prefer the use of resin modified glass ionomer cement.[15] Few researchers demonstrate no benefit of using the liner to control microleakage.[16] In the present study, RMGIC was used as a 1st increment on gingival floor in 2nd group of samples but the results failed to demonstrate any added benefit and dye penetration scores were not much different from the other techniques used. The reason for high leakage scores could be the absorption of dye by GIC due to its hydrophilicity as described by Fabianelli A.[17]

The technique tested in 3rd group was the use of bulk-fill composite. Bulk-fill composites are now used extensively because of ease of use of these materials.[18]Usually, for the deep class II cavities, after bonding protocol, cavity is filled with bulk-fill composite in one increment followed by final increment of nano or micro-hybrid composites. Most of the research on microleakage for these composites showed microleakage scores which were not much different from those with conventional composites in deep class II cavities.[8,19,20] 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.

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.[18]This might be the reason for the fact that clinical studies show now satisfactory performance of deep class II composites while lab studies demonstrate the failure in attaining the total arrest of dye-leakage in similar microleakage studies. However, still dye penetration method is the easiest and most commonly employed method to assess microleakage of dental restorations. At least it is helpful in comparing different techniques regarding their sealing ability.

CONCLUSION AND RECOMMENDATIONS

From the results of present study, it can be concluded that none of the tested restorative techniques arrest microleakage at gingival margin of deep proximal cavity. Further research is needed to develop a standard technique for deep class II composite restorations with gingival margin located below cemento enamel junction. Also there is need for more long term clinical studies to evaluate the efficacy of composite material in very deep posterior proximal restorations.

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