Original Article

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COMPARATIVE EVALUATION OF MICROLEAKAGE IN CLASS II RESTORATION USING FLOWABLE RESIN COMPOSITE AND RESIN MODIFIED GLASS IONOMER CEMENT USING STEREOMICROSCOPE

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ABSTRACT:

Aim and Objectives: To evaluate whether the intermediate layers of Flowable Resin Composite and Resin Modified Glass Ionomer Cement used prior to packable composite resin restoration would eliminate or significantly decrease microleakage at the gingival floor and which is the most suitable intermediate layer under packable composite resin restoration .

Materials and Methods: Standarized Class II box only cavities (1.5mm mesio-distal extension, 3.0 mm buccal-lingual extension and the gingival seat placed at the CEJ) were restored as follows: Group A Restortion with packable composite alone, Group B 1mm flowable composite liner + packable composite, Group C 1mm resin modified glass ionomer liner + packable composite. The specimens were thermocycled, stained with methylene blue dye, sectioned to evaluate the dye penetration. Data were analysed using one way ANOVA and Bonferroni test.

Results: There was no statisticaly significant difference between the groups.

Conclusions: None of the groups was able to eliminate microleakage completely. Flowable resin composite when used as a 1mm thick liner under a packable resin composite at the gingival margins showed overall less microleakage than the other two groups to some extent.

Keywords: Flowable resin composite; intermediate layers; marginal microleakage; packable composite; resin modified glass ionomer

INTRODUCTION:

Resin composites, introduced in 1960, now dominate the materials used for direct esthetic restorations. A declining acceptance of amalgam among clinicians and patients however, began in the early 1980's due to inherent problems like amalgam's corrosion, difficulty in bonding to tooth structure, the necessity to remove sound tooth structure for enhancing the retention, lack of esthetics and mercury toxicity [1]. With the increasing patients' interest in esthetics and declining acceptance of dental amalgam, development of new

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tooth colored restoratives and techniques resulted [2]. Lutz calls it the "Post Amalgam Age" [3]. In the mid 1980s, significantly improved light cured composite resins intended for universal use called hybrids which had a particle size of 1µm were introduced. Further refinements in these materials led to the term microhybrid, being used to describe resins with mean particle sizes in the 0.6- 0.7 µm range [4]. Although successful techniques for posterior resin placement have been developed, they present challenges when clinicians attempt to place morphologically correct and functional Class II restorations [5].

Despite advances that have been made, they are unable to establish their superiority over conventional hybrid composites because of their most undesirable characteristic of polymerization shrinkage [6]. Stress from shrinkage-strain can cause clinical problems such as post-operative pain, fracture of the tooth and opening of the restoration margins that can result in microleakage and recurrent caries [7,8].The factors involved in the shrinkage stress are: the cavity geometry which includes configuration factor, cavity size and the placement technique which includes, layering and light curing mode and the restorative material which includes stiffness (modulus of elasticity) and dimensional change (shrinkage) [9]. To overcome this shortcoming, an intermediate layer of restorative material including auto polymerizing composites, flowable resin composites [10,11], self cured and resin modified glass ionomer cements [12].

Flowable composites being less viscous, improves the wettability by flowing onto all prepared surfaces creating an intimate union with the microstructural defects in the floor and the walls of the cavity preparation [10,11]. Resin Modified Glass Ionomer Cement has molecular bonding to dentin and enamel, bacteriostatic action, thermal expansion similar to that of enamel and dentin and a slow setting reaction with a low setting shrinkage [12].

Hence, the present in vitro study is designed to evaluate whether the intermediate layers of flowable resin composite and resin modified glass ionomer cement would eliminate or significantly decrease microleakage at the gingival margin of Class II packable composite restorations.

MATERIALS AND METHODS

Sixty human extracted first molars free of caries and restorations were taken ultrasonically cleaned and stored in normal saline until used. All the teeth were mounted in dental plaster with the adjacent premolar and Class II cavities (box only preparation) were prepared on the mesial surface of all the teeth. Each cavity was prepared using a high speed contra-angle handpiece (NSK, Japan) with a carbide bur (# 245, SS White). For every five preparations, a new bur was used. The final preparation measured with a standard William's periodontal probe showed the following dimensions: 1.5mm mesio-distal extension, 3.0 mm

buccal-lingual extension and the gingival seat was placed at the CEJ. After the application of Tofflemier band with retainer (Hanenkratt, Germany) and plastic wedges, teeth samples mounted in the dental plaster were randomly divided into three major test groups.

RESTORATIVE PROCEDURE

GroupA

The cavities were bonded (XenoV, Dentsply) and restored with packable posterior resin composite (Surefil, Dentsply/Caulk) using the oblique incremental technique with each increment being 1mm. Each increment was cured for 20 seconds from the occlusal aspect. The restoration was then light cured from the buccal and lingual aspects for 20 seconds each, after the matrix band was removed.

GroupB

After bonding (XenoV, Dentsply), flowable resin composite (EsthetX Flow, Dentsply) was injected onto the gingival floor of the cavity to a thickness of approximately 1mm, confirmed by a standard William's periodontal probe and light cured for 20 seconds. The cavity was then restored with packable posterior resin composite (Surefil, Dentsply/Caulk) using the oblique incremental technique with each increment being 1mm. Each increment was cured for 20 seconds from the occlusal aspect. The restoration was then light cured from the buccal and lingual aspects for 20 seconds each, after the matrix band was removed.

GroupC

After bonding (XenoV, Dentsply), Resin modified glass ionomer cement (GC, Gold Label) was mixed and placed on the gingival floor of the cavity to a thickness of approximately 1mm, confirmed by a standard William's periodontal probe and light cured. The cavity was then restored with a packable posterior resin composite (Surefil, Dentsply/Caulk) using the oblique incremental technique with each increment being 1mm. Each increment was cured for 20 seconds from the occlusal aspect. The restoration was then light cured from the buccal and lingual aspects for 20 seconds each, after the matrix band was removed.

Following the restorative procedures, the teeth were stored in water at 37°C for 24 hours. All restorations were then finished after 24 hours with fine & ultra fine finishing disks and all specimens were thermocycled in a thermocycling unit for 1000 cycles at 5°C and 55°C with a dwell time of 60 seconds in distilled water and a five second transfer time.

Interfacial Microleakage Evaluation

The root tips were sealed with sticky wax and the teeth were coated with two applications of nail varnish up to 1mm from the gingival margins. All the teeth were immersed in a freshly prepared aqueous 1% methylene blue solution (ph 7.0) for 4 hrs at 37°C and then washed in water. Finally, each tooth was sectioned vertically through the centre of the restoration in a mesio-distal direction with a diamond disk. Microleakage at the gingival floor was evaluated with an

optical stereomicroscope at an objective of 2X and eyepiece of 10X.

Scoring for dye penetration for marginal microleakage on the gingival wall (Figure 1-4) :

0 - No dye penetration

1 – Dye penetration into half extension of gingival floor

2- Dye penetration into more than half or complete extension of gingival floor

3 - Dye penetration into gingival floor and axial walls toward the pulp

RESULTS

The results were tabulated and evaluated by ANOVA test and Bonferroni test for stastical significant differences among the groups. (Table 1).

The *P* value (according to Bonferroni test and One Way ANOVA) is greater than 0.05; indicative of homogeneity between the three groups which showed that there wasn't any statistically significant difference among the groups compared.

DISCUSSION

The results of the present study showed that there isn't any appreciable difference between the three groups which are in agreement with the studies which have attained similar results of inefficacy of any liner to act as a barrier in the complete prevention of microleakage at the gingival margin. Results of this study infer that leakage scores aren't effected when a packable composite was used alone to when an intermediate layer was used [10,11,13].

The low polymerization shrinkage of the packable composite, the oblique incremental technique used for curing the resin, the newer generation adhesive system used might have improved the marginal integrity. The oblique incremental technique as has already been elaborated reduces C factor ultimately depreciating the polymerization shrinkage [14].

Regarding the adhesive system, XenoV is a seventh generation bonding agent. It is a single step procedure combining the action of etching, priming and adhesion in just one step. They provide the bond strength of 20-30 Mpa to dentin enhancing the bond towards dentin, stabilizes the bonded interface and reduces marginal percolation.

The results of this study also showed that, although none of the groups among the three was able to completely eliminate microleakage at the gingival margins but comparing the three groups on the criteria of the results obtained, the second group in which FRC is placed as a 1 mm thick liner under the packable composite, although hasn't proved itself very much significant, but improved the sealing ability a bit and performed better than the other two groups with respect to the prevention of microleakage extension.

These results are in agreement with the studies[10,13,15,16,17,18,19] which can be attributed to the several advantages of

flowable resin composites that they are dispensed from syringe and can flow into the preparation, resulting in greater ease of placement and allow to cover the entire preparation. This more accurate method of preparation reduces the possibility of voids at the interface. Secondly, the flowable composite may act as a flexible intermediate liner, which helps relieve stresses during polymerization shrinkage of the restorative resin. Since it has less filler content, the coefficient of thermal expansion of flowable composite is close to that of the tooth structure and this further increased the marginal adaptation when the specimens are thermocycled [18].

In this study, the results obtained for the third group, where 1mm of RMGIC was used as an intermediate layer, performed next to flowable resin composite. This is in agreement with a study which concluded that the FRC proved better than an injectable glass ionomer [10]. The leakage was attributed to porosities and micro gaps with the glass ionomer due to difference in particle size and higher viscosity [10].

RMGIC in this study performed little superior than the control group, where the packable composite is placed without any liner although this isn't much significant. This is in agreement with the studies which showed a reduction in the cervical marginal microleakage when an RMGIC intermediate layer is used [20,21].

This supports the demonstration by Dietrich in relation to microleakage control, which recommends extending the RMGIC liner to the external surface in an "open sandwich" technique [21]. The use of RMGIC over conventional GIC in this study has been attributed to the improved compressive strength and bond strength [20]. They reach a chemical maturation far more rapidly than conventional GIC. Apart from this, the use of the newer RMGIC as a base appeared to minimize microleakage and crazing of the gingival enamel and resists the occlusal stresses better [21]. Regarding the handling properties, the mixing and application are straightforward and light curing is a significant advantage which supports the performance of RMGIC in this study [20].

The inference of comparison between the three groups regarding complete elimination of microleakage suggests that the second group, using FRC as a liner acted superlatively than the other two groups with the maximum number of specimens having no microleakage at all.

CONCLUSION

Within the limitations of the methodology followed and procedures performed; the following conclusion can be drawn.

There is no any significant difference in microleakage among the three groups. None of the groups was able to eliminate microleakage completely. FRC when used as a 1mm thick liner under a

packable resin composite at the gingival margins showed overall less microleakage than the other two groups to some extent.

Based on the results of this study, the placement of a low modulus, elastic flowable resin composite as a liner of approximately 1mm thickness is recommended under packable resin composites at the gingival margins in restoring deep Class II cavities

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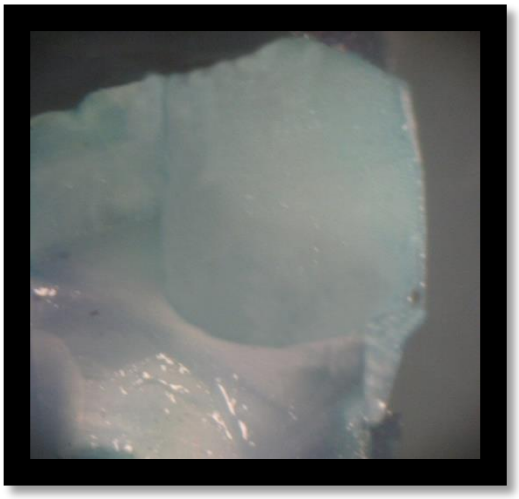
TABLES:

Table 1 : Prospective Comparison of results of marginal microleakage evaluated by ANOVA test and Bonferroni test.

		SCORE					
GROUPS	N	0	1	2	3	Mean± SD	P Value (OneWay ANOVA)
Control Group	20	2	6	8	4	1.70 ± 0.93	0.688
FRC	20	4	6	7	7	1.45 ± 0.99	
RMGIC	20	1	9	7	7	1.60 ± 0.83	

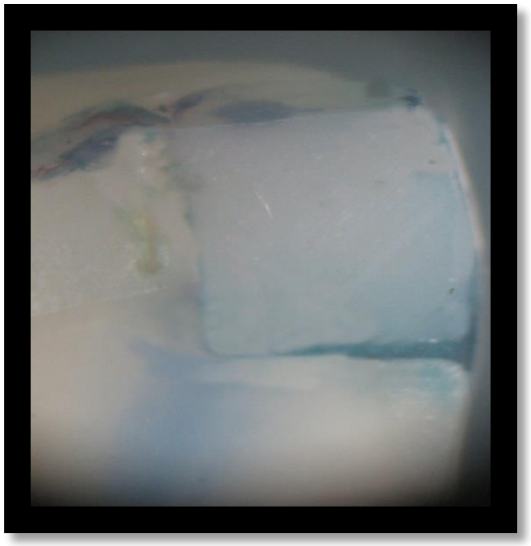
FIGURES

Photographs of dye penetration viewed under stereomicroscope



Score 0

Score 1



Score 2

Score 3