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RESEARCH ARTICLE

EVALUATION OF THE EFFECT OF FLOWABLE COMPOSITE AND FIBER INSERTS ON GINGIVAL MICRO LEAKAGE IN DEEP CLASS II RESIN COMPOSITE RESTORATIONS: AN IN VITRO STUDY

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ABSTRACT

Introduction: Evolution of dental materials has increased the indication of esthetic restorative procedures. However, composite resin materials are not suitable for posterior class II restorations because of their high wear rate and insufficient marginal adaptation. Resin composite materials undergo volumetric polymerization contraction of at least 2% which results in gap formation at cavity margins. The purpose of this study was to evaluate the effects of glass and polyethylene fiber inserts and flowable composite as a liner on the micro leakage of class II composite restorations with gingival margins on root surfaces.

Methods: Class II slot preparation was on both the proximal sides of seventy five freshly extracted mandibular molars and were divided into five groups depending on the type of fiber inserts and use of flowable composite as a liner. The specimens were thermo cycled and stained with basic fuchsin dye and sectioned to evaluate the dye penetration under stereomicroscope. Statistical analysis was done using Kruskal Wallis test and Mann Whitney U test.

Results and Conclusion: the study showed that the fiber inserts group showed significantly less micro leakage as compared to other groups. However no statistically significant difference was found between the groups with fiber inserts.

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INTRODUCTION

The cosmetic parameters dictated by society have compelled patients to seek dent facial harmony and improve their physical appearance. In addition the evolution of dental materials has increased the indication of esthetic restorative procedures. Previously, amalgam was the material of choice for the restoration of posterior teeth. But due to alleged health concerns and environmental considerations for amalgam, tooth colored restorations especially resin based composites are becoming the restoration of choice in posterior teeth (Goldberg *et al.,* 1992 and Wilson NHF *et al.,* 1998).

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However, composite resin materials are not suitable for posterior class II restorations because of their high wear rate and insufficient marginal adaptation (Freiberg *et al.,* 1998). Resin composite materials undergo volumetric polymerization contraction of at least 2%(Feilzer, *et al.,*1988) which results in gap formation at cavity margins.(Lutz, *et al.,*1991) Such gaps ultimately result in micro leakage which in turn leads to post operative sensitivity, marginal deterioration, recurrent caries and pulpal injury (Kid, 1976 and Dejou, 1996). Various efforts have been done in order to decrease this problem with class II composite restorations. Resin modified glass ionomer was placed in gingival portion to reduce micro leakage. (El-Mowafy *et al.,* 2007) However the ability of packable composites to adequately adapt to the cavosurface margins has been of great concern. Flowable composite to be used as a liner

has been suggested in order to reduce this problem. This acts a flexible intermediate layer that helps to relieve stresses during polymerization shrinkage of the restorative resin (Attar *et al.,* 2004). Bowen RL conducted a study and concluded that if the total amount of composite material used to restore a class II cavity could be reduced, the overall amount of polymerization shrinkage would be proportionately reduced (Bowen *et al.,* 1991). Hence different types of fiber inserts were incorporated in composite in order to reduce polymerization shrinkage and improve restoration adaptation. These fibers have the ability to withstand tensile stresses and stop crack propagation in composite material (Vallitu, 1999). So, the purpose of this study was to evaluate the effect of flowable composite and fiber inserts on gingival micro leakage in deep class II resin composite restorations.

MATERIALS AND METHODS

Seventy five freshly extracted, intact, non carious, unrestored human mandibular molars were collected. The teeth were cleaned with the periodontal scalers and were mounted in plaster of paris base up to 2mm apical to the CEJ and stored in distilled water in a refrigerator until restored. Class II slot cavities were made on both the proximal sides of each molar with a #245 tungsten carbide bur. The gingival floor of the slot cavities was located 1mm below the cemento enamel junction on the root surface. The dimensions of the cavities were as follows: buccolingually 3.0 mm wide and 1.5mm in axial depth. The dimensions of the cavity were verified with calibrated periodontal probe. Tofflemire matrix retainer was placed around each prepared tooth and was supported externally by low fusing impression compound. Each cavity was acid etched with 37% phosphoric acid for 15 seconds and then rinsed with water for 20 seconds and gently air dried for 5 seconds to leave the surface wet. Bonding agent was applied to all the cavities according to manufacturer instructions. Packable composite was used to restore all the cavities. The teeth were randomly divided into five groups based on the type of fiber inserts used and flowable composite used as a liner.

The groups were as follows

Group I: with packable composite
Group II: packable composite with flowable composite as liner
Group III: packable composite with flowable composite as a liner. A 2×1.5mm preimpregnated polyethylene fiber was placed into the bed of uncured flowable resin and adapted against the gingival floor through the flowable composite and light cured for 20 seconds.
Group IV: packable composite with flowable composite as a liner and 2×1.5mm glass fiber inserted as described in group III
Group V: packable composite with flowable composite as a liner and 2×0.9mm glass fiber inserted as described in group III

A 2mm layer of packable composite was carefully adapted on the gingival floor and light cured for 40seconds. Rest of the cavity was filled with packable composite using horizontal incremental placement technique. All the composite restorations were then finished (Shofu composite finishing kit) and polished (Shofu super snap rainbow technique kit) on the occlusal surface. After storage for one week at room temperature in distilled water, all specimens were then subjected to 500 thermocycles between 5˚C and 55˚C in water bath with a 30 seconds dwell time. Apical foramina of the teeth were sealed with glass ionomer cement. Two layers of nail varnish were applied on the tooth surfaces except for 1mm above and below the gingival margins of the restoration. The teeth were immersed in a 0.5% basic fuchsin dye solution for 24 hours at 37˚C, after which the teeth were rinsed with tap water for five minutes to remove excess dye. Each tooth was then sectioned longitudinally in the mesiodistal direction into two halves. The extent of dye penetration was determined by examination with a stereo microscope (magnification 20X according to a six point scale)

0= no leakage
1= leakage extending to the outer half of the gingival floor
2= leakage extending to the inner half of the gingival floor
3= leakage extending through the gingival floor up to 1/3 of the axial wall
4= leakage extending through the gingival wall up to 2/3 of the axial wall
5= leakage extending through the gingival wall up to the Dentino- enamel junction level

The data collected was statistically analyzed to evaluate the effect of flowable composite and fiber inserts on gingival micro leakage in deep class II composite restorations.

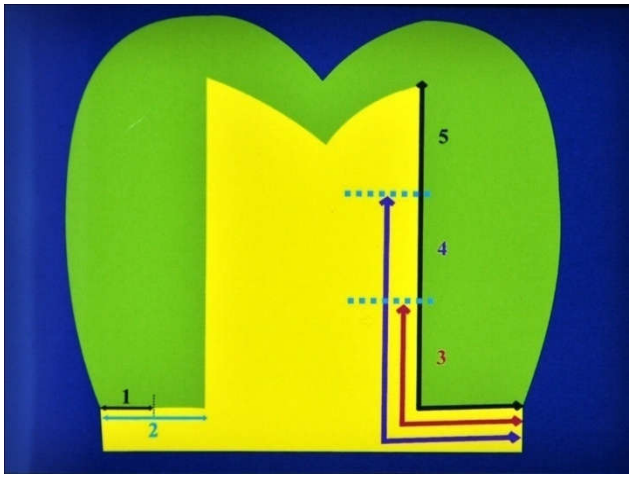

Figure 1. Schematic representation of scoring scale used

RESULTS

Results were expressed as percentages and mean scores. The means and standard deviations of micro leakage scores of all the groups are presented in the table. The fiber inserts group showed less micro leakage as compared to other groups. Kruskal Wallis analysis (ANOVA) showed that there was a statistically significant difference. Mann – Whitney test showed significant differences in mean micro leakage scores between group I and Group II and between group I and group with fiber inserts. However there was no statistically significant difference in the mean micro leakage scores between the fiber inserts group.

Table 1. Microleakage scores

Groups	N	Microleakage scores						Mean	SD	Kruskal Wallis test mean rank
		0	1	2	3	4	5			
I	30	0	2	3	9	14	2	3.37	0.999	104.37
II	30	0	2	10	8	9	1	2.90	1.029	87.62
III	30	1	6	12	8	2	1	2.23	1.073	64.55
IV	30	5	5	10	4	4	2	2.10	1.470	62.05
V	30	5	7	6	8	4	0	1.97	1.326	58.92

DISCUSSION

One of the major drawbacks of composite resin restorative materials is the marginal micro leakage (Van Meerbeek *et al.,* 2003). Several factors have been suggested to reduce these destructive factors such as the use of rebonding agents, retention grooves, incremental placement of material, and application of glass ionomers, flowable composite and self cure composites under light cure composites, indirect resin inlay, suitable polishing techniques and slow polymerization speed. The utilization of glass insets has been proposed in the last decade by a number of investigators to decrease polymerization shrinkage and micro leakage (Mozzami *et al.,* 2007). A layer of flowable material at the gingival floor of class II composite restoration may be recommended to improve the marginal seal of a restoration. (Sadeghi, 2009) Bowen postulated that if the total amount of composite material used to restore a class II cavity could be reduced, the overall amount of polymerization shrinkage would be proportionately reduced. (Bowen *et al.,* 1991) Introduction of fibers of any type into the composite restoration is a step towards the postulate of Bowen. Three types of fiber inserts were used in the present study: group III Ribbond (polyethylene fiber), IV EverStick NET (glass fiber) and V EverStick Post 0.9mm (glass fiber). There was a significant reduction in micro leakage as compared to group I and II. When fibers were inserted into the bed of flowable resin, bond strength to cavity dentin was increased compared tp flowable resin lined group. Kolbeck reported that the reinforcing effect of glass fibers was more effective than polyethylene fibers. This was attributed to difficulty in achieving good adhesion between polyethylene fibers and resin matrix. (Kolbeck *et al.,* 2002) However no statistically significant difference was found between two different fibers supporting the study by Hamza *et al* (2004). In the present in vitro study, the mean micro leakage scores of group I (packable composite) with group II (Flowable composite and packable composite) were compared, statistically significant difference in the mean values between group I and group II was found. It could be due to low viscosity, increased elasticity and low surface tension of flowable composite. Thus it will better fill irregular internal surfaces and proximal boxes thereby improving final marginal integrity and reduced micro leakage and post operative sensitivity. The use of low modulus flowable composite may increase the flexibility of the bonded assembly and might act as a shock absorber and relieve stress induced by the polymerization shrinkage of the resin composite (Yazici *et al.,*2003). The low viscosity resin provides a cross partial connection with the dimethacrylate present in the restorative material. This connection allows the movement of molecule groups during the initial polymerization which results in better resin flow and consequent reduction in polymerization shrinkage (Peria *et al.,* 2003). The use of flowable composite as a liner underneath the resin composite may reduce the effect of "C factor". Lowering the C-factor may lower the internal stresses within the placed restoration. (Sadegi, 2007) In the present in vitro study when fiber inserts were inserted into the bed of flowable liner in group III (polyethylene fiber inserts), group IV (Ever stick net Glass fiber inserts) and V (Ever stick 0.9 POST inserts), there was a significant reduction in micro leakage as compared to group I and group II. This is in accordance with the study by Belli et al (2007) wherein flowable resin was used without fiber reinforcement and micro tensile bond strength to dentin decreased in cavities with a high C factor (Belli *et al.,* 2007) On the other hand when fibers were inserted into the bed of flowable resin, micro tensile bond strength to cavity dentin surface was increased as compared to the flowable resin lined group.

Conclusion

The use of flowable composite as a liner helped in reducing the micro leakage. The use of fiber inserts also significantly reduced micro leakage in class II resin composite restorations with gingival margins on the root surface as compared to the restorations in which fibers were not used. The difference in micro leakage between groups with fiber inserts was statistically significant. However further studies are required to find newer methods and materials to reduce/eliminate the problem of micro leakage along tooth restoration interface.

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