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Assessment of the Microleakage of CGIC, RMGIC, and Nano Filled RMGIC in Class V Cavities: An invitro Study

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Abstract

Background: Microleakage is the major factor responsible for the failure of Class V restorations. The present study assessed the microleakage of CGIC, RMGIC, and nano filled RMGIC in Class V cavities. **Methods:** 30 standardized Class V cavity preparations were prepared on sound extracted human molar teeth. Teeth were randomly assigned to three experimental groups of 10 teeth each and restored as follows: Group I, CGIC; Group II, RMGIC; and Group III, Nano-filled RMGIC. The specimens were placed in a solution of 2% Rhodamine-B dye for 24 h at room temperature under vacuum. Staining along the tooth restoration interface was recorded. Results were analyzed using Kruskal-Wallis one-way analysis of variance (ANOVA). **Results:** There were no statistically significant differences in dye leakage between all the three restorative materials for occlusal margins. Statistical difference was found between all the three restorative materials for gingival margins. **Conclusions:** All restorative materials exhibited some microleakage. However, Nano filled RMGI showed less leakage than CGIC and RMGIC at gingival margins.

Keywords:- Class V, GIC, Microleakage.

INTRODUCTION

Esthetic dentistry has shown considerable progress, leading to the development of a number of improved restorative materials. Currently, the main concerns regarding the performance of these materials refer to their durability and the integrity of marginal sealing, especially in cavities that involve the cementum region, where clinical problems are aggravated.[1]

The aim of restorative dentistry is to restore the tooth to its function and form. It has been given more importance to the retentive ability of a material and adhesion of dental restorative materials to the cavity walls to seal the cavity against passage of microorganisms and oral fluids.[2] The inability of the restorative materials to attain the complete marginal seal leads to the occurrence of micro gaps, in which the seepage of fluids, ions, and bacteria occurs, which causes secondary caries, hypersensitivity and pulpal infections.[3] Microleakage is the major factor responsible for the failure of Class V restorations, as gingival margins of such restorations are generally situated in

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dentin/cementum and the bonding to dentin is less to be expected than enamel due to its lower mineral content and complex pattern.[4]

Nowadays, restorative materials such as glass ionomers, hybrid ionomers, composite resins, and compomers are commonly used for restoration of Class V cavities. Resin modified glass ionomer cements (RMGIC) were introduced to overcome the problems of moisture sensitivity and low early mechanical strengths associated with the conventional GIC (CGIC). Nano filled resin modified glass ionomer cement was developed that combines the benefits of a resin modified light cured glass ionomer and bonded nanofiller technology.[5] The present study assessed the microleakage of CGIC, RMGIC, and nano filled RMGIC in Class V cavities.

MATERIAL AND METHODS

The present study comprised of 30 extracted human molar teeth, free of visible caries, cracks, and restorations. A standardized Class V cavity preparation was done on the buccal surface of each tooth.Teeth were divided into 3 groups of 10 each. Group I teeth were restored with CGIC, Group II with RMGIC and group III with nano filled RMGIC.

Table 1: Distribution of teeth

Groups	Group I	Group II	Group III
Material	CGIC	RMGIC	Nano-filled RMGIC
Number	10	10	10

The specimens were placed in a solution of 2% Rhodamine B dye for 24 h at room temperature under vacuum. In order to prevent leakage through the root apices, only the coronal portion of teeth was covered with the dye. After removal of the specimens from the dye solution, the surface-adhered dye was rinsed in tap water and nail varnish was removed with a BP blade. The teeth were sectioned longitudinally in a bucco-lingual direction through the center of the restorations using a water-cooled low-speed diamond disc. The section with the greater leakage was evaluated with a stereomicroscope at ×25 magnification to determine the extent of dye penetration at the occlusal and gingival margins by two evaluators who were blinded to the experimental groups. The depth of dye penetration was analyzed according to a 0-3 scale scoring system as suggested by Silveira de Araújo C.[6]

Score 0 = No evidence of dye penetration
Score 1 = Dye penetration along the occlusal/gingival wall to less than half of the cavity depth
Score 2 = Dye penetration along the occlusal/gingival wall to more than half of the cavity depth, but not extending on to the axial wall
Score 3 = Dye penetration along the occlusal/gingival wall to the full cavity depth and extending on to the axial wall.

Statistical analysis

Occlusal and gingival scores for each group of restoration were compared using Kruskal-Wallis one-way analysis of variance (ANOVA) to identify if any there was any statistical significant difference between the materials.

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RESULTS

[Table 2, Figure 1] shows that dye leakage score at occlusal margin was 0 seen in 7 teeth, 1 in 1 tooth and 3 in 2 teeth in group I, 0 in 8 teeth, 2 in 1tooth and 3 in 1 tooth in group II and 0 in 6 teeth and 1 in 4 teeth in group III. The difference was not statistical significant among all the groups at occlusal margin (P>0.05).

[Table 3, Figure 2] shows that dye leakage score at gingival margin was 3 in 10 teeth in group I, 0 in 1tooth and 3 in 9 teeth in group II and 0 in 3 teeth and 3 in 7 teeth in group III. The difference was statistical significant among all the groups at gingival margin (P< 0.05). Group III showed significantly less microleakage than groups I and II at gingival margins.

Table 2: Assessment of mean microleakage score at occlusal margin.

Score at occlusal margin	Group I	Group II	Group III	P-value
0	7	8	6	0.12
1	1	0	4	0.08
2	0	1	0	0.07
3	2	1	0	0.06

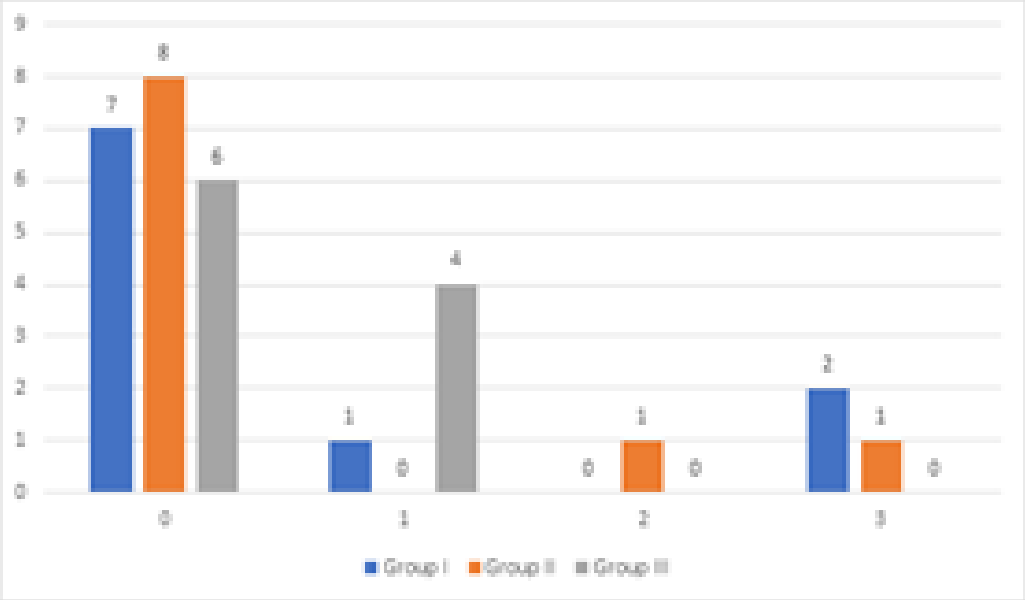

Figure 1: Assessment of mean microleakage score

Table 3: Assessment of mean microleakage score at gingival margin

Score at Gingival margin	Group I	Group II	Group III	P value
0	0	1	3	0.02
1	0	0	0	0
2	0	0	0	0
3	10	9	7	0.03

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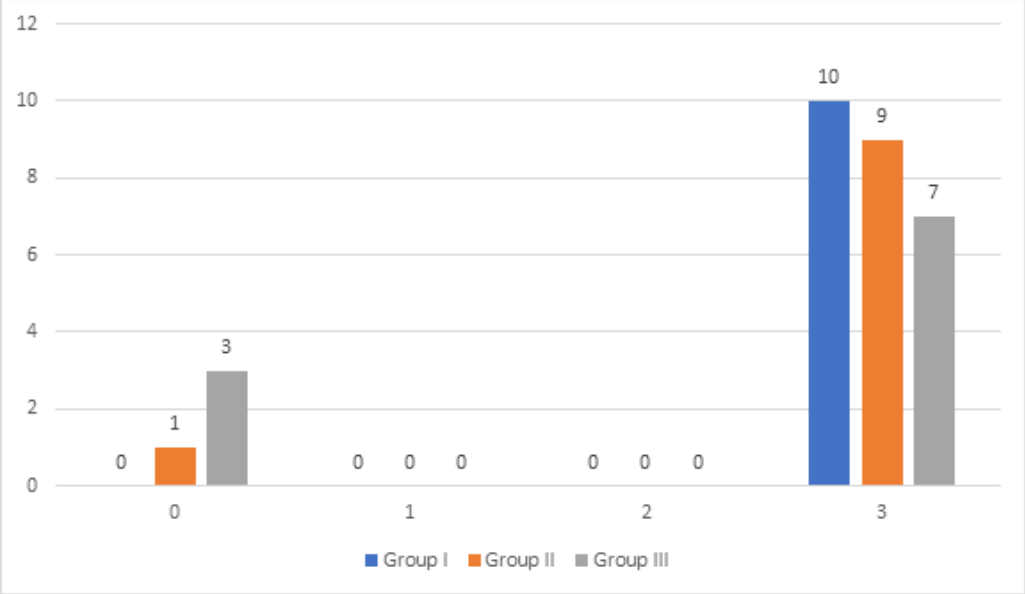

Figure 2: Assessment of mean microleakage score at gingival margin

DISCUSSION

Dentistry had always thrived to achieve biocompatible restorations that do not compromise the pulp and also maintain the dental seal. One of the significant contributions has been the development of resin-based technology. With the constant increase in aesthetic demands composites are the widely used restorative material.[7] Developments in filler technology and initiator systems have considerably improved composite physical properties and expanded their clinical applications. Cervical lesions are very often caused by incorrect tooth brushing and dental caries and usually have little or no enamel at the cervical margin. Cervical lesions have been a restorative challenge for dentists for many years.[8] The complex morphology of Class V cavities with margins partly in enamel and partly in dentin presents a challenging scenario for the restorative material. The primary problem associated with the restoration of this kind of cavity is leakage at the gingival margin located in dentin.[9] The present study assessed the microleakage of CGIC, RMGIC, and nano filled RMGIC in Class V cavities.

Gupta et al,[10] evaluated the microleakage of nano filled resin modified glass ionomer restorative (nano filled RMGI) in comparison with that of conventional glass ionomer cement (CGIC), and resin modified glass ionomer cement (RMGIC) in forty five standardized class V cavity preparations on sound extracted human molar teeth. Teeth were randomly assigned to three experimental groups of 15 teeth each and restored as follows: Group 1, CGIC; Group 2, RMGIC; and Group 3, nano filled RMGI. The specimens were placed in a solution of 2% Rhodamine B dye for 24 hour at room temperature under vacuum. There were no statistically significant differences in dye leakage between all the three restorative materials for occlusal margins (P = 0.464). Group 3 showed significantly less microleakage compared to Group 1 (P = 0.007) and Group 2 (P = 0.040) at the gingival margins. The degree of

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microleakage in the gingival margins of each group was more than that found in occlusal margins.

We found that dye leakage score at gingival margin was 3 in 10 teeth in group I, 0 in 1 and 3 in 9 teeth in group II and 0 in 3 and 3 in 7 teeth in group III. Several dye penetration studies have been performed using methylene blue, India ink, basic fuschin, crystal violet, as well as fluorescin. Rhodamine B dye was used in this study since its molecular size is as low as 1 nm which is smaller than the diameter of a dentinal tubule and can thus penetrate through even the smallest of gaps between the restoration tooth interfaces. It is an organic dye compounded by a red violet powder, classified as a xanthene dye and presents greater diffusion on human dentin than methylene blue.[11]

Abd El Halim,[12] reported that higher magnification of the bond interface of nano filled RMGI showed an indistinct interface between the margin of the tooth structure and the restoration, suggesting that a chemical bond had formed between the GIC and tooth.

The results obtained in this study showed that all the three restorative materials that were investigated exhibited more microleakage on the gingival margins than on the occlusal margins. However, no material was able to completely eliminate microleakage at the enamel, dentin, or cementum margin. This finding is in agreement with other studies which concluded that cavity preparations with enamel margin result in consistently stronger bonds. Unique challenges are encountered with dentin surface bonding due to enamel that is 92% inorganic hydroxyapatite and dentin that is 45% inorganic by volume.[13]

CONCLUSIONS

Within the limitations of this study, it is concluded that none of the three GIC were free from microleakage. The degree of microleakage in the gingival margins of each group was more than that in the occlusal margins. However, Nano filled RMGIC showed less microleakage than CGIC and RMGIC at gingival margins.

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