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Original Research

Evaluation of microleakage in class V composite restoration by using flowable composite and resin modified glass ionomer as liners

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ABSTRACT:
Micro leakage is critical at the margins of cervical lesions because of the lack of enamel. So the main objective of tooth restoration is the protection of exposed dentin against microbes and their toxins. The interface between restoration and dental hard tissue is an area of clinical concern as insufficient sealing can result in some dental pathology. **Context**: Micro leakage is a matter of concern because it leads to staining at the margins of restorations, recurrent caries, hypersensitivity and pulp pathology. **Aim**: The aim and objective of this study is to evaluate and compare the sealing ability and the amount of micro leakage caused by two different intermediate materials that is Flowable composite and Resin modified glass ionomer cement in class V composite restoration in enamel and cementum margins. Methods and Material: Thirty fresh human premolars were randomly divided into 3 groups of 10 teeth each, based on the presence or absence of liner or if present the type of liner. On the lower third of the buccal surface of each tooth , class V cavity were prepared with a high speed air rotor hand piece .The cavities were located on the cemento enamel junction , half in cementum and half in occlusal enamel. Then the teeth of each group were subdivided into thermocycled and not thermocycled subgroups and then the teeth were suspended in methylene blue solution for 12 hrs. The samples were sectioned buccolingually and the depth of dye penetration was measured with a stereomicroscope. **Statistical analysis:** Statistical test employed for the obtained data in our study was Chi-Square (χ^2) Test **Results**: The degree of microleakage in the gingival margin was more than in the occlusal margin. There is a significant statistical difference found between the intermediate materials in occlusal margin. Flowable composites showed less leakage than light cure RMGIC and the control group in which no liner was present. Thermocycling had no effect on microleakage in all the three groups at both occlusal and gingival margins. **Conclusion**: None of the two intermediate materials completely sealed the tooth/restoration interface at occlusal and gingival margin.

Key-words: Microleakage, Class five cavity, Liners, Flowable composite, Light cured RMGIC.

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INTRODUCTION

The main objective of tooth restoration is the protection of exposed dentin against microbes and their toxins. The interface between restoration and dental hard tissue is an area of clinical concern as insufficient sealing can result in some dental pathology.[1] Micro leakage is a matter of concern because it leads to staining at the margins of restorations, recurrent caries, hypersensitivity and pulp pathology.[2] Previous research has shown, polymerization shrinkage lead to bond failure and micro leakage of resin composite restorations.[3-5] In root surface V- shaped gap occurs because the force of polymerization of the composite is greater than the initial bond strength of the composite to

the dentin of the root.[6]Therefore the use of liner to act as a flexible intermediate layer between restoration and dental substrate has been suggested as a method of relieving the stress associated with polymerization shrinkage.[7] Despite the undisputable improvements, until today no material fulfils all requirements and desirable properties to hermetically seal the tooth / restoration interface at occlusal and gingival margins which raises concern regarding the marginal adaptation provided by currently available liners that is intermediate materials.[8]

Therefore this study will be performed to evaluate the micro leakage and sealing ability of an intermediate material between composite resin and dental substrate.

SUBJECTS AND METHODS:

Thirty non carious human premolar teeth extracted for orthodontic purposes were selected. The teeth were stored in normal saline soon after extraction and cleaned with slurry of pumice and water prior to preparation. On the lower third of the buccal surface of each tooth , a round shape class V cavity were prepared with a high speed airoter hand piece .The cavities were located on the cementoenamel junction , half in cementum and half in occlusal enamel..Enamel Cavosurface margins were bevel to approximately 45 degree and gingival (cementum) cavosurface margin are left at 90 degree. The cavities were approximately 3mm in diameter and 2mm in depth After cavity preparation, The specimens were randomly divided into 3 groups of 10 teeth each, 10 teeth each, based on the presence or absence of liner or if present the type of liner:

Group I: Control group

Group II: Flowable composite(Tetric N-Flow)

Group III: Resin modified glass ionomer cement (Kerr Light cure)

RESTORATION

For the cavities of group 1 and group 2, the total etch technique were done on enamel and cementum with 37 percent phosphoric acid (N- Etch ivoclar vivadent) for 20 sec. After application of etchant, the substrate was washed with an air water spray and excess humidity was removed with an absorbent paper. The enamel and dentin were saturated with a generous amount of bonding agent (Tetric N – Bond, Total etch , Dental adhesive 6g ivoclar , vivadent) for 10 seconds and then cure for 20 seconds. After that cavities of Group 1 were restored with packable composite (Charisma , Universal light curing hybrid composite, radiopaque) followed by curing for 20 seconds while in cavities of Group 2 a flowable composite(TETRIC N-FLOW) liner was inserted with the needle into the preparation in one increment and adaptation of composite material was done followed by curing for 20 seconds.

- Cavities of group 3 were conditioned for 10 seconds with conditioner, and then rinsed with water after that RMGIC (KERR LIGHT CURE) liner was applied between the dental substrate and composite restoration followed by light curing for 20 seconds.
- Then the teeth of each group were subdivided into 2 subgroups of 5 teeth each, one subgroup without thermo cycling and the other group were thermo cycled at 200 cycles for 60 seconds at 55 degree Celsius[9] Later the teeth were dried and sealed with nail polish on all external surfaces leaving a 1mm wide varnish free margin around the restoration. And then the teeth were suspended in 2% methylene blue solution at room temperature for 12 hrs and then rinsed in running water.

Preparation of specimens for microleakage evaluation

Now the samples were sectioned buccolingually through the centre of the restoration using a carborandum disc After that the depth of dye penetration was measured with a stereomicroscope at a magnification of X40 magnification and micro leakage associated with different liners were evaluated. and values were obtained in units. The depth of dye penetration were analyzed by Silveira de Araujo[10] according to a 0-3 scale scoring system-:

- 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 onto the axial wall.
- Score 3 – Dye penetration to full cavity depth involving the axial wall.

Statistical test employed for the obtained data in our study was:

Chi-Square (χ^2)Test: Chi-square test was used to evaluate the statistical significance of differences in frequencies between subgroups. Chi-square checks the difference between observed and expected values. The formula used for chi-square test is:

Formula

$$\chi^2 = \frac{\sum (O - E)^2}{E}$$

Where

O = Observed frequency E = Expected frequency

P Value denotes level of significance:
P > 0.05 Not significant
P <0.05 Significant (significant at 95% confidence level)
p <0.01 Highly Significant (significant at 99% confidence level)
p <0.001 Very Highly significant (significant at 99.9% confidence level)

RESULTS:
The statistical analysis showed that the chi-square test had a significant association between the penetration scores and the two intermediate materials for enamel walls in both thermocycled (P= 0.020)and not thermocycled subgroups(P= 0.001) , the worst dye penetration score was associated with group 1 (liner not present) while the smallest penetration score was associated with group 2 (flowable composite liner).But there was no significant association found between dye penetration scores and the three groups for cementum walls in both thermocycled and not thermocycled subgroups (P>0.05).All these findings were showed in Table1.
Also chi-square test presented a significant association (P= 0.037) between the microleakage scores and the cavity walls (enamel and cementum), the greater leakage scores was associated with cementum walls. But there was no significant association found between the penetration scores and thermocycling (P>0.05) as showed in Table 2 and Table 3.

Table 1: Effect of intermediate materials on the dye penetration scores in enamel and cementum margins.

		Thermocycled				**No Thermocycling**			
	Based on the presence or absence of liner	No liner present (control group)	Flowable composite	RMGIC (Light cure)		No liner present (control group)	Flowable composite	RMGIC (Light cure)	
Cavity walls	Degree of dye penetration				P value				P value
Enamel	Score 0	0	3	0	0.020 Sig	0	4	0	0.001 Sig
	Score 1	1	2	3		0	1	5	
	Score 2	3	0	0		3	0	0	
	Score 3	1	0	2		2	0	o	
	Total	5	5	5		5	5	5	
Cementum	Score 0	0	1	0	0.572 NS	0	1	0	0.392 NS
	Score 2	2	1	0		1	2	0	
	Score 2	1	1	2		2	2	3	
	Score 3	2	2	3		1	0	2	
	Total	5	5	5		5	5	5	

Table 2: Comparison of scores of microleakage between enamel and cementum walls.

Degree of dye penetration	**Enamel no.**	**Cementum no.**
Score 0	7	2
Score 1	12	6
Score 2	6	11
Score 3	5	11
Total	30	30

X^2=8.50 , p= 0.037(Significant) no.= number of samples

Table 3: Comparison of scores of microleakage between thermocycling and no thermocycling groups

Degree of dye penetration	**Thermocycled no.**	**No Thermocycling no.**
Score 0	3	5
Score 1	12	12
Score 2	6	9
Score 3	9	4
Total	30	30

X^2=3.02 , p=0.388(non significant) no.= number of samples

DISCUSSION:

One of the major objectives of tooth restoration is the protection of exposed dentine against bacteria and their toxins. The interface between the restoration and dental hard tissue is an area of clinical concern as insufficient sealing can result in marginal discoloration, secondary caries, and pulpitis. For that reason, adequate sealing is essential for optimal clinical performance.

Microleakage may be defined as the clinically undetectable passage of bacteria, fluids, molecules or ions between a cavity wall and the restorative material. Clinically, microleakage can lead to staining around the margins of restorations, postoperative sensitivity, secondary caries, restoration failure, pulpal pathology.[11-15]

Improvements in resin composites have increased their usefulness as restorative materials; however, polymerization shrinkage continues to remain one of the primary deficiencies of composite restorations. Polymerization shrinkage causes contraction stress within the restoration that leads to micro-leakage, as well as stress within the surrounding tooth structure.[16,17] The use of a liner as a flexible intermediate layer has been mentioned among numerous methods suggested for relieving the stress caused by polymerization shrinkage and thus reducing the microleakage.[18,19]

The present study evaluated the sealing ability and the amount of microleakage caused by flowable composite and light cure resin modified glass ionomer liners in class V composite restoration in enamel and cementum margins by using stereomicroscope. The result of the present study is as follows: Cementum margins showed more leakage as compared to enamel margins, flowable composite showed least microleakage in enamel margin.

Ammar and Chimello et al [20,21] conducted a study to evaluate the microleakage in cementum walls and enamel walls of cervical restoration and concluded that cementum walls showed higher microleakage than enamel walls with a significant statistical differences (P=.0001) In the current study , the cementum walls showed higher microleakage than the enamel walls with a significant statistical differences (P=.0001) and these findings are in agreement with other studies done by Ammar and Chimello et al [20,21]. There are two main reasons for this finding, First, the gingival margin of the cervical restorations is at cementum or dentin where there is no enamel. In composite group, the adhesion between the material and enamel is stronger than the adhesion of the material with dentin. Also, the difference in thermal expansion between enamel and composite is smaller than the difference between dentin and composite. For glass ionomer groups, the bonding by the material is achieved in part by mechanical retention and in part by chemical chelating; the former playing a more important role. [22] Second, the beveling of enamel at occlusal margins can be a great factor in this difference in microleakage between the gingival and occlusal margins. The beveling increases the surface area of the preparation for bonding and with the use of 37% phosphoric acid gel and bonding agent, a resin enamel hybrid layer formed while strengthening the marginal adaptation of the resin composites at occlusal margins and reducing the chance of microleakage.[23]

Gupta , et al [24] conducted a study to evaluate the microleakage of two different intermediate materials namely RMGIC and Self Cure GIC and concluded that RMGIC displayed less leakage than SELF CURE GIC in occlusal margins. This result disagrees the result of the present study were RMGIC showed more microleakage as compare to flowable composite. This can be related to that the initial light cured irradiation seemed to greatly reduce the acid base reaction during the early setting stages of resin modified GIC. Other studies have pointed out that significant dimensional changes and surface hardening can occur after initial light curing of the resin component of resin modified GIC and further contraction continue for the first 24 hours as the material matures[56].

Prabhakar AR, et al [25] studied to evaluate and compare the marginal seal of a Flowable composite , and a compomer and they concluded that smallest degree of microleakage in the occlusal margins were observed in flowable composite. This result agrees with the result of the present study i.e the smallest degree of microleakage was associated with flowable composite in the occlusal margin. The reason for this result can be related to the low viscosity, handling characteristics and delivery system of flowable composite which offer higher better cavity adaptation to the internal cavity walls[26]. Another reason is that flowable composite has low modulus of elasticity and increased flexibility, believed to ameliorate the stresses of polymerization shrinkage and better preserves the integrity of the bond to tooth structure[25].

Doerr CL, et al[26] , conducted a study to evaluate the effect of thermocycling on the microleakage of conventional and resin modified glass ionomer and they reported the absence of any influence of thermocycling on microleakage. In this present study, the difference in microleakage between thermocycled and non thermocycled groups was not significant statistically (P> 0.05) because this laboratorial method is not a suitable test to simulate the real significance of temperature changes in clinical conditions. However, in some studies there are significant differences in marginal microleakage of resin reinforced glass ionomer cement and resin composite restorations between thermocycled and non-thermocycled groups [27,28] .It should be noted that, the results obtained from

this study are based on in vitro data. For that reason, further studies should be done to evaluate the clinical performance of flowable composite and RMGIC using different methods of microleakage study.

CONCLUSION

Within the limitation of this study , it is concluded that:

- None of the two intermediate materials completely sealed the tooth/restoration interface at occlusal and gingival margin.
- The degree of microleakage in the gingival margin was more than in the occlusal margin.
- There is a significant statistical difference found between the intermediate materials in occlusal margin. Flowable composites showed less leakage than light cure RMGIC and the control group in which no liner was present.
- Thermocycling had no effect on microleakage in all the three groups at both occlusal and gingival margins

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