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Research Article

MICROLEAKAGE OF CLASS II PACKABLE RESIN COMPOSITE LINED WITH CONVENTIONAL GIC, FLOWABLE COMPOSITE AND RESIN MODIFIED GLASS IONOMER CEMENT: AN IN VITRO STUDY

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ABSTRACT

Background: Packable composites most commonly used as posterior restorative materials however, disadvantages like polymerization shrinkage limited their use, so the aim of this in vitro study was to investigate the microleakage of posterior packable composite(Filtek™ P-60) using different liner materials; conventional GIC (GC Fuji), flowable resin composite(flowplus manufactured by medicept) and resin modified glass ionomer cement (3M ESPE St. Paul MN Vitremer) using open sandwich technique at the proximal box of class II preparation located 1mm apical to cemento-enamel junction (CEJ).

Aim and Objective: This in vitro study aimed to evaluate the microleakage in class II cavities restored with various types of lining materials as the first increment followed by composite resin restoration.

To compare sealing ability of the composite resin using different liners like flowable resin, conventional GIC, resin modified GIC.

Materials and methods: 45 samples will be randomly divided into three equal groups consisting of 15 samples of each group and will be restored accordingly. The specimen will be subjected to 1500 cycles of thermocycling between specific temperature with dwell time of 30 seconds and 10 seconds interval between the baths. 2 coats of nail varnish were applied to all tooth surfaces expect for 1mm around restoration margins. Seal apices with sticky wax or acrylic resinthe teeth were subjected to dye solution. After dye exposure teeth were thoroughly cleaned under running tap water. Mesio-distal sections were prepared with diamond disk. The degree of dye penetration was assessed under stereomicroscope.

Results: Microleakage observed was as follows

Conventional GIC > flowable composite > resin modified GIC.

Conclusion: Concluding from study Conventional GIC and flowable composite are not as efficient as RMGIC under subgingival class II composite restorations.

Keywords: Conventional GIC, Flowable Composite, Microleakage, Packable Composite, Resin Modified GIC.

INTRODUCTION

Microleakage may be defined as clinically undetectable passage of bacteria, fluids, molecules or ions between a cavity wall and the restorative material[1]. Clinically, microleakage can lead to staining around the margins or restorations, post operative sensitivity, secondary caries, restoration failure, pulpal pathology or pulpal death, partial or total loss of restoration.

Composite resin were introduced in dentistry in the mid 1960's and have undergone developmental improvements and performance characteristics such as aesthetics, wear rate and handling, however, a major disadvantage of composite restoration in their high polymerization shrinkage which may lead to failure. The ultimate success of the material is indicated by its longevity in the oral cavity. Therefore various liners have been used in clinical practise to reduce microleakage[2].

Since the introduction of GIC in 1972, it has been widely used in as liners. Their main advantages are relative ease of use, bonding potential to enamel and dentin and fluoride ion release. RMGICs were introduced to overcome the

disadvantages of the conventional GIC such as moisture sensitivity and low early strength.[3] Flowable composite is recently introduced material which is used as liner due to its increased adaptation and reduced elastic modulus.

Different liners used in this In Vitro study are conventional GIC, RMGIC and Flowable composite.

MATERIALS AND METHODS

45 molars extracted due to periodontal problem were collected. They were intact noncarious, without any restorations. Occlusal and proximal buccolingual width of cavity was kept at 3mm with an axial depth of 1.5mm, gingival seat was kept 1mm apical to the CEJ. Gingival seat was placed 1mm apical to box cavities of dimension 3*2*2 were prepared on either proximal surface using inverted cone bur ISO size (no.014), straight fissured bur (no.010) and a high speed water cooled hand piece. These teeth were then randomly allocated into three groups of 15 teeth each.

Restorative materials were placed according to manufactures instructions. Lining materials used as RMGIC (3M ESPE St. Paul MN Vitremer) , Flowable light cure composite (Medicept) , Conventional GIC (GC Fuji). Thickness of the liner were kept 0.5mm thick and were verified with periodontal probe. Restorations were then completed with composite resin (Restofill manufactured by anabond stedman pharma research ltd)

Specimens were then subjected to 1500 cycles of thermo-cycling between temperature 1.2^{0}C to 80^{0}C with dwell time of 30 secs and 10 secs interval between the baths. Apices of teeth were sealed with acrylic resin or sticky wax and two coats of nail varnish were applied to tooth within 1mm of restoration margins. Teeth were then immersed in 0.5% basic fuschin for 24hrs at room temperature. All the specimens were then sectioned mesiodistally in vertical plane using a diamond dish revolving at speed of 20,000 rev/sec. degree of die penetration were then recorded under a stereomicroscope at 10x magnification (Optofilo).

Table 1: List of Materials and Manufacturers

Etchant gel	3M ESPE Dental products, St Paul MN
Bonding agent	3M ESPE Dental products, St Paul MN
Resin modified GIC	3M ESPE Dental products, St Paul MN VITREMER
Flowable composite	Flowplus manufactured by Medicept
Conventional GIC	GC Fuji
Composite resin	Restofill Anabond Stedman pharma research ltd

Scoring system for the extent of microleakage occlusal score
Cervical score
Score 0 No dye penetration Score 0 No dye penetration
Score 1 dye penetration into enamel Score 1 dye penetration into ½ of the cervical wall
Score 2 dye penetration into all the cervical wall Score 3 dye penetration into the dentine including the pulpal wall
Score 3 dye penetration into cervical and axial wall

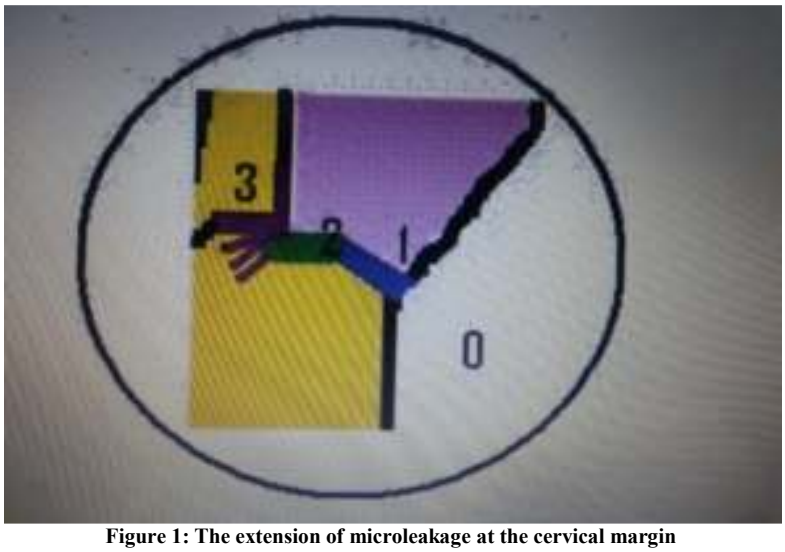


Figure 1: The extension of microleakage at the cervical margin

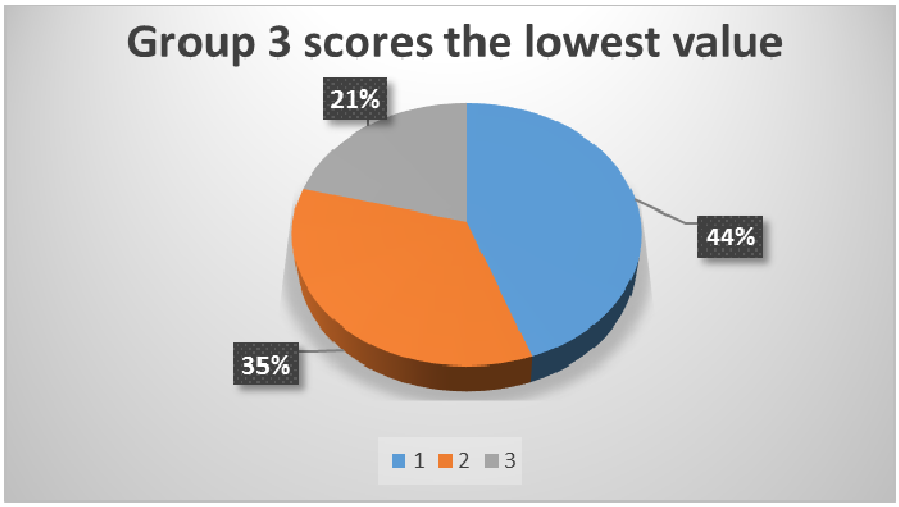
RESULTS

Gingival margins of class II cavities showed microleakage regardless of the liner used. Microleakage was least with RMGIC group compared with conventional GIC as well as Flowable composite groups. Microleakage was compared using t-test and ANOVA test. Statistically significant difference was observed between conventional GIC and RMGIC groups as well as flowable composite and RMGIC groups.

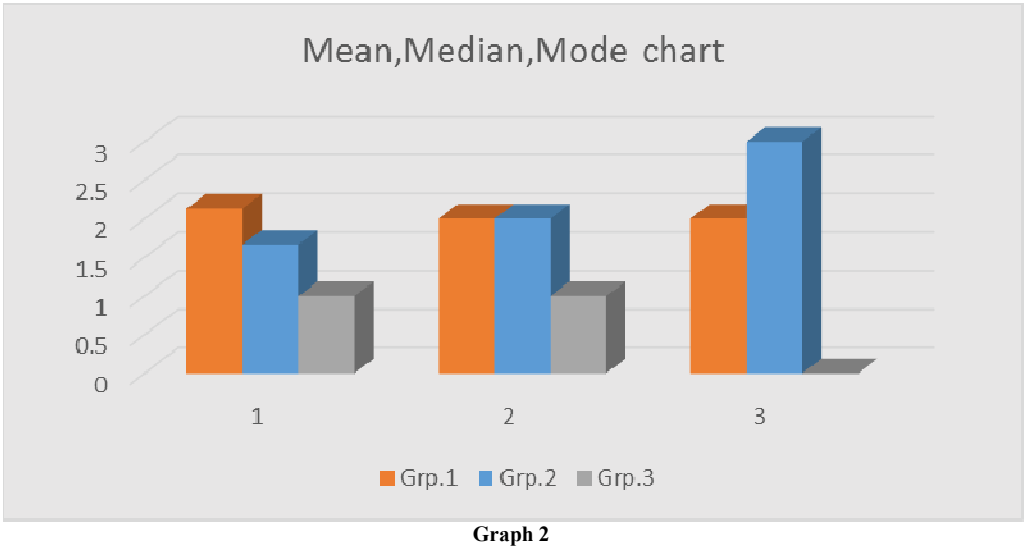
Table No 2

Group1 (conventional GIC)	Group2 (flowable composite)	Group3 (RMGIC)
1	3	2
2	3	0
3	0	0
1	3	1
2	2	1
2	3	3
3	3	2
2	2	0
3	0	2
2	0	2
3	0	0
2	2	0
3	2	0
1	0	1
2	2	1

	Grp.1	Grp.2	Grp.3
Mean	2.133333	1.666667	1
Median	2	2	1
Mode	2	3	0



Graph 1



Graph 2

To support the above result we have analysed the data through ANOVA and t-test -

Table 4: Based on the Analysis

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	9.733333	2	4.866667	4.535503	0.016465	3.219942
Within Groups	45.06667	42	1.073016			
Total	54.8	44				

Table 5: Summary

Groups	Count	Sum	Average	Variance
Column 1	15	32	2.133333	0.552381
Column 2	15	25	1.666667	1.666667
Column 3	**15**	**15**	**1**	**1**

DISCUSSIONS

Since the introduction of packable composites, most popular restorative material for posterior teeth is the packable composite. However disadvantage like polymerize shrinkage, high coefficient of thermal expansion, increased were as lead to reduction in their use. Therefore further research lead to impartments in were resistance and strength but the problem of polymerising shrinkage still remains.

Polymerization shrinkage resulted due to contraction of the resin during curing and is in the range of 1.67% and 5.68%. This leads to increase in microleakage under composite restorations. Various techniques and modifications in the material were proposed to overcome or minimize polymerization shrinkage.

When material is in more rigid state, most the polymerization cannot be observed and is transmitted to the adhesive interface. Here the contraction stress can become responsible for opening marginal gap[4]. It has been proposed that the "elastic" layer at the restoration base can be incorporated to act as a stress absorber, not only of the functional loads but also of the internal tensions induced by the composite polymerization[5].

In this study, three types of material were experimented as the liners.GIC has been used as liner since more than 40 years, but it takes more than 24 hours to set while other materials used were command set. This results in high moisture sensitivity. Therefore, maximum microleakage was found under conventional GIC group[6].

The second group in this study showed that using flowable composite as a liner under packable composite reduced microleakage than conventional GIC[7]. This occurred due to low filler loading of the flowable composite that enhanced flow & reduced elastic modulus. But due to its lower filler loading, it exhibits high curing shrinkage[8]. This was the possible reason for more microleakage as compared with RMGIC group.

The third liner used in this study is RMGIC. The sandwich restoration using RMGIC showed significantly least dye penetration.[9-10] The setting resection of the RMGIC follows two different mechanisms: resin polymerisation& acid base reaction.[11] When powder & liquid are mixed together, the initial setting reaction is by the polymerization of the methacrylate group. Since it is possible to light cure and initiate the setting reaction of the resin immediately, this set resin provides an umbrella effect and protects the ongoing acid base reaction within the cement[12-13]. This reduces early moisture sensitivity and gives high early strength to the mix.[14] The slower acid-base conventional reaction will complete the setting and will ultimately be responsible for the final strength of the cement. This RMGIC has three types of reactions taking place, namely, polymerization reaction by chemical cure, polymerization reaction by light cure and acid-base reaction of the glass ionomer. This setting mechanism is known as tricure mechanism.[15] Umbrella effect and tricure mechanism are the reasons for least microleakage compared with other liners used[16].

Further clinical trials are essential to know the in vivo variables which could affect the outcome of this study.

CONCLUSION

The use of resin modified glass ionomer (vitrebond TM 7150) in the open sandwich technique decrease the microleakage under posterior packable composite (Filtek^{TM} – 60) with margin located subgingivally

Conventional GIC and flowable composite are not as efficient as RMGIC under subgingival class II composite restorations.

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