



## A Comparative Assessment of Microleakage of Packable Composite Using Two Liners

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### KEYWORDS

Liners, composites, microleakage, restoration

### ABSTRACT:

**AIM:** This study evaluates the microleakage of packable composites with liners using self etch and total etch dentin adhesive.

**MATERIAL & METHOD:** Standardized Class II cavities were prepared on 60 extracted maxillary premolars. Group Ia and IIa are control group restored with Filtek P 60 Packable composite using 3M single bond Adper and 3M single bond universal as bonding agent without using any liner.

In group Ib, Ic teeth were restored using Filtek P 60 Packable composite along with Filtek Z350XT flowable restorative and 3M ESPE Vitribond RMGI as liner with 3M single bond Adper. Similarly in group IIb and IIc 3M single bond universal was used as bonding agent. Thermocycling was done at 5,37 and 55degree3 followed by dye penetration, sectioning and stereo microscopic evaluation.

**RESULTS:** Kruskal Wallis, ANOVA was performed for intergroup comparison. It was concluded that group IIa had maximum microleakage followed by IIb and IIc. Also Group Ia had more microleakage as compared to Ib, Ic. Moreover Ia had more microleakage than IIb and IIc.

**CONCLUSION:** Resin modified glass ionomer cement when used as liner in combination with self etch adhesive and packable composite exhibited least microleakage and this difference is statistically insignificant when compared with flowable composite as a liner.

### INTRODUCTION

Dentistry is facing a transition into the age of adhesive restorations. Direct composites have become increasingly popular as tooth colored restorative material for extensive restorations in posterior teeth.<sup>1,2</sup> However, no one composite material has been able to meet both the functional needs of posterior class I or II restoration and establish a good marginal seal, which is a paramount factor for longevity of any restoration.<sup>3</sup>

Polymerization shrinkage is regarded as the main limitation of resin composites as it generates stress at the tooth restoration interface leading to marginal gap

formation, thus promoting microleakage.<sup>4</sup> Polymerization shrinkage can be decreased by reducing the mass of restorative material using liners and bases.<sup>5</sup> Flowable composites were created by retaining the same small particle size of traditional hybrid composites but reducing the filler content and allowing the increased resin to reduce the viscosity of the mixture. The property of flowable composites that make them useful as liner is the lower modulus of elasticity and a unique characteristic of being injectables, flowable and thixotropic. Flowable composites presents stress values similar to those of more densely filled composites. Their low filler content causes them to develop high



volumetric shrinkage resulting for their high contraction stresses. It is possible that their low elastic modulus could reduce the stress build up and help in maintaining the marginal seal of restoration. The use of flowable composites for initial increment in proximal box portion of class II restoration is at best controversial.

Packable composites were introduced to compensate for reduced wear resistance, lack of fracture toughness and marginal adaptation problems. Packable composites are more viscous to afford a feel on insertion. They have improved handling properties and wear resistance due to the filler loading and its distribution.

Resin-modified glass ionomer cement (RMGIC) when used as a liner or base, can be valuable in controlling microleakage. Its placement using a sandwich technique can provide reliable chemical adhesion to dentin, a micromechanical bond to the overlying resin, pulp protection, anti-cariogenicity from fluoride release and a reduction in volume of resin used, thereby reducing the degree of shrinkage stress in the composite resin.<sup>6</sup>

Composite restoration using total etch adhesive system involve a degree of application technique sensitivity that may compromise longevity and marginal integrity of the restoration. Unpredictable postoperative sensitivity may appear if certain precautions are not taken. Self-etch adhesives are an alternative approach to etch and rinse technique based on the use of non-rinse acidic

monomers that simultaneously condition and prime dentin thereby reducing sensitivity and increasing longevity.

Hence the present in vitro study was conducted to evaluate microleakage at the occlusal and proximal margins of class II packable composite restoration using resin modified glass ionomer and flowable composite as liners, using two- step etch and rinse and self - etch dentin bonding system.

## MATERIALS AND METHODS

Ethical Committee Clearance was obtained prior commencing the study (IDS/ETHCC/12/17). 60 extracted human maxillary premolar teeth were selected for the study. Standard Class II cavities were prepared using high speed hand-piece and water spray with Straight Bur (SSW SF 51C). The measurements of the cavity preparation were standardized as Depth of occlusal preparation=2 mm; Depth of occlusogingival preparation= 6mm; Width of proximal preparation (buccolingual width)= 3mm; Location of gingival cavosurface= 1mm below CEJ; Width of gingival floor=1.5mm; Width of occlusal preparation=2 mm

The sample teeth were randomly divided into 6 groups, each containing 10 teeth for evaluation of microleakage cervically.

Group Ia	Filtek P60 Packable Composite + 3M Single Bond 2 Adper
Group Ib	Filtek Z 350 XT Flowable Restorative+3M Single Bond 2 Adper+ Filtek P60 Packable Composite
Group Ic	3M ESPE Vitribond resin modified glass ionomer+3M Single Bond 2 Adper+ Filtek P60 Packable Composite
Group IIa	Filtek P60 Packable Composite + 3M Single Bond Universal
Group IIb	Filtek Z 350 XT Flowable Restorative+3M Single Bond Universal + Filtek P60 Packable Composite
Group IIc	3M ESPE Vitribond resin modified glass ionomer +3M Single Bond Universal + Filtek P60 Packable Composite

### Restoration Protocol Cervically

**Group Ia:** Each tooth was thoroughly dried before the procedure. The etchant gel (37% phosphoric acid-Ivoclar) was applied on the prepared teeth for 15 seconds. The teeth were rinsed for 10 seconds and blot dried. Immediately after blotting, 2-3 consecutive coats of adhesive (3M Single Bond 2 Adper) were applied to etched enamel and dentin for 15 seconds with gentle agitation using a fully saturated applicator followed by light curing for 10 seconds using LED (Diadent with light curing intensity 1600 mW/cm<sup>2</sup>, 10 Max light curing mode).

**Group Ib:** Bonding steps were same as in group 1a, prior to restoration with resin composite a 0.6 to 0.8 mm thick flowable composite, Filtek Z 350 XT was applied using the closed sandwich technique in an axiokingival line angle on gingival floor (0.7 mm to 0.9 mm away from cavosurface margin, measuring with periodontal probe), its thickness was tapered to zero on the axial wall midway from axiokingival line angle to dentino-

enamel junction, then it was light cured for 10 seconds using LED.

**Group I c:** Bonding steps were same as in group 1a, prior to restoration with resin composite cavity lining is performed with a vitribond resin modified glass ionomer in the same way as in group Ib.

**Group II a:** Scotchbond™ Universal Adhesive was used. Apply the adhesive to the tooth and rub it for 20 seconds. Air dry the adhesive for 5 seconds. Light cure for 10 seconds using LED light.

**Group II b:** Bonding steps were same as in group IIa, prior to restoration with resin composite a 0.6 to 0.8 mm thick flowable composite, Filtek Z 350 XT was applied using the closed sandwich technique in an axiokingival line angle on gingival floor (0.7 mm to 0.9 mm away from cavosurface margin, measuring with periodontal probe), its thickness was tapered to zero on the axial wall midway from axiokingival line angle to dentino-



enamel junction, then it was light cured for 10 seconds using LED.

**Group II c:** Bonding steps were same as in group IIa, prior to restoration with resin composite cavity lining is performed with a vitribond, resin modified glass ionomer in the same way as in group II b.

A tofflemire matrix retainer (API) and a mylar strip were placed on the tooth. Filtek P60 Packable Composite was placed in four layers using an incremental technique. To help adaptation, first 1mm layer was placed horizontally and three layers were placed obliquely in 2mm thickness and cured separately for 20 seconds each. Composite finishing kit (SHOFU) was used to finish the margins, which would be clinically accessible.

Teeth were stored in distilled water in a sealed container at 37<sup>o</sup> for 24 hours.

#### Restoration Protocol Occlusally

**Group I:** Each tooth was thoroughly dried before the procedure. The etchant gel (37% phosphoric acid-Ivoclar) was applied on the prepared teeth for 15 seconds and the teeth were rinsed for 10 seconds and blot dried. Immediately after blotting, 2-3 consecutive coats of adhesive (3M Single Bond 2 Adper) were applied to etched enamel and dentin for 15 seconds with gentle agitation using a fully saturated applicator followed by light curing for 10 seconds using LED (Diadent with light curing intensity 1600 mW/cm<sup>2</sup>, 10 Max light curing mode).

**Group II:** Scotchbond™ Universal Adhesive was used. Apply the adhesive to the tooth and rub it for 20 seconds. Air dry the adhesive for 5 seconds. Light cure for 10 seconds using LED light

Filtek P60 Packable Composite was placed in four layers using an incremental technique. Two increments of 1 mm each were placed occlusally and cured for 20 seconds. Composite finishing kit (SHOFU) was used to finish the margins, which would be clinically accessible. Teeth were stored in distilled water in a sealed container at 37<sup>o</sup> for 24 hours.

Group wise the teeth were placed in a glass petri dish containing water and were subjected to thermo cycling which consisted 1000 cycles of 5<sup>o</sup>C, 37<sup>o</sup> C and 55<sup>o</sup>C with a dwell time of 30 seconds each.

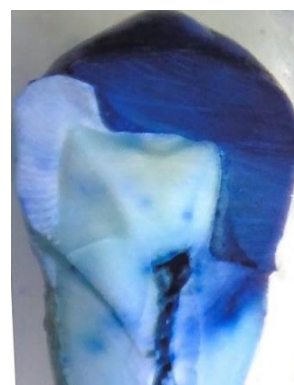
The apices of each tooth were sealed with self cure acrylic resin and the whole assembly was coated twice with nail varnish except for area of restoration and 2mm from area of restoration. The specimens were of each group were immersed methylene blue dye at 37<sup>o</sup> for 48 hrs in an incubator. The specimens were then rinsed in water to remove excessive dye.

The specimens were sectioned mesiodistally through the centre of the restoration using a diamond disc. Each of these specimens were then cleaned and observed under the stereomicroscope (40X resolution). The extent of the microleakage was scored using the ISO microleakage scoring system (ISO/TS 11405:2003) in Table 1.<sup>7</sup>

#### Stereomicroscopic images of specimens from different groups-



**Fig 1a-** Stereomicroscopic image of specimen from group 1a



**Fig 1b-** Stereomicroscopic image from group 1b



**Fig 1c-** Stereomicroscopic image from group 1c



**Fig 2a-** Stereomicroscopic image from group 2a



**Fig 2b-** Stereomicroscopic image of specimen from group 2b



**Fig 2c-** Stereomicroscopic image from group 2c

#### STATISTICAL ANALYSIS AND RESULTS

Kruskal Wallis ANOVA was performed for intergroup comparison (Table 5). It showed the comparison of dye penetration between groups Ia to IIc. On cervical surface mean rank obtained by group IIa was highest (83.56) with median score of 3 followed by IIb and IIc with mean rank of (54.44 and 43.65) and median score of 2 and 1 respectively. Group Ia, Ib and Ic have median score of 2, 1 and 1 respectively. Mean rank for Group Ia, Ib and Ic (58.13, 48.33 and 32.58) respectively. The difference in the mean rank as well as the median score

was subjected to statistical analysis Kruskal Wallis ANOVA and the difference was found to be statistically highly significant with a p value ( $p=0.001$ ). Thus it was concluded that group IIa had maximum microleakage followed by IIb and IIc. Also Group Ia had more microleakage as compared to Ib, Ic. Moreover Ia had more microleakage than IIb and IIc.

#### DISCUSSION

Recent advances in restorative materials as well as increased demand for aesthetics have led to the development of several restorative materials. Most restorative materials show varying degree of marginal leakage due to dimensional changes and lack of adaptability to the cavity walls. However, introduction of newer spectrum of composites, new adhesive systems and improved techniques of restoring the teeth with the materials has brought a revolution in the field of restorative dentistry. Studies have reported that in spite of the improved performance, these materials also show some amount of microleakage.<sup>8,9</sup> Hence, the present in-vitro study was chosen to investigate the extent of microleakage in most commercially available adhesive restorative materials.

Deliperis et al<sup>10</sup> also stated that more microleakage was seen in one step self etch adhesive as compared to etch and rinse total etch adhesive cervically. Cardoso PE et al<sup>11</sup> and Bedran de Castro AK<sup>12</sup> had the results in agreement with the present study.

Moosavi H et al<sup>13</sup> evaluated microleakage of total etch adhesive and self etch adhesive by three methods including dye extraction, dye penetration and fluid filtration, the results of the study was similar to the present study concluding that self etch adhesives behave variously in different methods of microleakage assessment and proved to have more microleakage as compared to total etch adhesive.

For cervical microleakage it was observed that group Ia Filtek P60 packable composite and 3M Single Bond 2 Adper had less microleakage cervically as compared to group IIa, Filtek P 60 Packable composite and 3M single bond universal. A study done by Davidson DF et al<sup>14</sup> had results in agreement with this study stating that Single Bond 3M (two step total etch adhesives) have better results as compared to Clearfill cSE (two step self etch adhesive) and Xeno III (one step self etch adhesive). Similarly Gueders AM et al<sup>15</sup> evaluated microleakage of composite filling prepared with four etch and rinse and 3 self etch adhesives. The results were in favor of present study stating that self etch adhesives are less effective than etch and rinse adhesives.





However IRL Juan et al<sup>16</sup> stated that gingival sealing was done better by self etch adhesives. Similarly Saraswathi MV et al<sup>17</sup> stated that packable composites with self etch adhesives demonstrated minimum microleakage when compared to total etch system. The results of both the studies contradict our findings.

Our study stated that Group I B using Filtek Z 350 XT flowable composite as a liner on axial wall is better than Group IIA using filtek P60 Packable composite and 3M Single Bond Universal which was in agreement with the studies conducted by Leevailoj C et al<sup>18</sup> and Neme AL et al<sup>19</sup>. It may be due to the clinical handling characteristics which play an important role in-vivo. The ability to place a liner via syringe application prior to packing a more viscous material may help significantly to marginal adaptation regardless of material combination.

Conflicting results from other studies might be attributed to the difference in the type and brand of liners and restorative materials, type of dye used, number of thermocycles subjected, time of storage of samples, microleakage analysis, cavity design, restorative technique, curing mode, and resolution of stereomicroscope.

## CONCLUSION

1. Cervically highest microleakage was observed when self etch adhesives was used with packable composites followed by total etch adhesive with packable composite.
2. Least microleakage was seen when total etch adhesive were used with liners and restorative materials.
3. Minimal microleakage was observed when resin modified cement was used as a liner although statistically insignificant difference was observed when microleakage of flowable composite and resin modified glass ionomer cement were used as liners was compared.
4. Resin modified glass ionomer cement when used as liner in combination with self etch adhesive and packable composite exhibited least microleakage with it having statistically insignificant difference with flowable composite.
5. When liners were used with packable composites and total etch adhesives less microleakage was observed on their comparison with self etch adhesive with packable composite.
6. Addition of a liner significantly reduced the microleakage when self etch adhesive was used with packable composite.

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SCORE	OCCLUSAL SCORE	CERVICAL SCORE
0	No Dye Penetration	No Dye Penetration
1	Dye Penetration Into Enamel	Dye Penetration Into ½ Of The Cervical Wall
2	Dye Penetration Into The Dentine, Not Including The Pulpal Floor	Dye Penetration Into All The Cervical Wall
3	Dye Penetration Into The Dentine , Including The Pulpal Floor	Dye Penetration Into Cervical And Axial Wall

**TABLE 1: SCORING SYSTEMS FOR THE EXTENT OF MICROLEAKAGE**

Groups	N	Mean Rank	Median	H Value*	p value
Ia	12	58.13	2	31.01	< 0.001
Ib	18	48.33	1		
Ic	19	32.58	1		
IIa	17	83.56	3		
IIb	18	54.44	2		
IIc	20	43.65	1		

**TABLE 2 INTER GROUP COMPARISON KRUSKAL WALLIS ANOVA**