

# In Vitro Comparative Evaluation of Microleakage in newly introduced Dyad Flow with Total etch and Self etch adhesives in class V Resin Composite Restorations

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## ABSTRACT

**AIM** – The aim of this study was to evaluate marginal sealing ability of newly introduced Dyad Flow with total etch & self-etch adhesive system at the coronal and apical margins of class V resin composite restorations.

**Methods**- A standard class V cavity (3 mm mesiodistal width, 3 mm occlusogingival height, and 1.5 mm axial depth) was prepared on the buccal surface of freshly extracted sound human teeth. The occlusal and the gingival margins of the cavities were located on the enamel and cementum/dentin, respectively. Teeth were randomly assigned into three groups ( $n = 10$ ) and restored with different composite materials following the manufacturer's instructions: groups I was restored with nanohybrid resin composite using Self etch bonding agent ; group II: was restored with nanohybrid resin composite using Total etch technique; group III: flowable composite (Dyad Flow), respectively. After finishing and polishing, the teeth were stored in distilled water at 37°C, coated with nail varnish, and immersed in a rhodamine B dye, and then longitudinally sectioned. Dye penetration was examined with a stereomicroscope and scored separately for occlusal and gingival on a 0-3 ordinal scale. Data were analyzed with Kruskal-Wallis, Mann-Whitney and Wilcoxon tests ( $\alpha=0.05$ ).

**Results** – Coronal and apical margins were scored separately using a 0-3 ordinal ranking system and the recorded values were statistically analyzed using Kruskal-Wallis, Mann-Whitney U-test and Wilcoxon signed rank test. Statistical analysis showed that there was less microleakage in Total-etch and Self-etch Bonding agents at coronal region, overall Total-etch showed less marginal permeability in both coronal and apical regions. Comparison of three groups showed that microleakage, although seen in all samples, but seen significantly more in cervical regions restored with Dyad Flow.

**Conclusion**- Specimens restored with the Total-etch and Self-etch adhesive systems revealed reduced leakage at the coronal margin. At the apical margin, DyadFlow showed greater leakage than the other group.

## INTRODUCTION

The search for the ideal dental restorative material, exhibiting appropriate physical and mechanical properties, as well as, excellent aesthetics, has resulted in the introduction of light cured composites. These resins have been widely used as restorative materials for both anterior and posterior teeth.

With passage of time various changes are seen in composite bonding system. Due to polymerisation shrinkage of these materials, successful adhesion to enamel and dentin is an indispensable prerequisite for clinical success; else gap formation would endanger the clinical success.<sup>1,2</sup>

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Enamel bonding is meanwhile accepted as clinically strong and durable, because acidic etchants, such as 30–40% phosphoric acid, create enamel microporosities allowing the penetration of monomers consecutively generating micromechanical retention.<sup>3,4</sup> In contrast, dentin is an unpredictable substrate for adhesion due to facts like tubular structure, high organic content, and intrinsic wetness.<sup>5-7</sup>

To solve the problem, different approaches are reported in the literature of the field. In two-step total-etch systems, a separate etch and rinse phase is still involved, but a hydrophilic primer and hydrophobic resin are combined into one application. Although increased technique sensitivity is reported<sup>8-9</sup> for total-etch adhesives, a similar clinical performance is achieved for both conventional and simplified total-etch adhesive versions.<sup>10-11</sup>

Self-etch adhesives represent an alternative approach in enamel-dentin bonding. They do not require a separate acid etch step and are based on the use of nonrinse acidic monomers that simultaneously condition and prime dentin and enamel.<sup>8,12,13,14</sup> This approach eliminates the rinsing phase and does not require application of the primer in particular conditions of wetness due to the self-etch adhesives' water content; reduced technique-sensitivity and the risk of making errors during application are achieved. For these reasons, their popularity is increasing.<sup>15</sup>

Flowable restorative resins with a low viscosity are recommended as the material of choice for restoring Class V cavities. Flowable composites are easier to place and more selfadaptable compared to conventional restorative resin composites.<sup>16</sup>

Dyad Flow is new self adhesive flowable composite resin which can be seen as an alternative to the previous time-consuming procedures. It is self adhering composite in which no separate bonding protocol is required. It has fluoride releasing property and its translucent quality provides excellent aesthetics in the vast majority of situations.

The objective of this study is to assess the microleakage of class V cavities restored with a

new self-adhesive flowable composite resin and to compare with two-step total-etch & Self-etch adhesive system; another objective was to determine whether the tested adhesives would perform as well on enamel as on dentin.

## MATERIALS & METHODS

A total of 30 sound human teeth were collected and stored in saline solution at room temperature for 30 days. A standard class V cavity (3 mm mesiodistal width, 3 mm occlusogingival height, and 1.5 mm axial depth) was prepared at the cemento-enamel junction (CEJ) on the facial surface of each tooth

The teeth were randomly assigned into three groups (3 group's × 10 teeth):

**Group A** was restored with 3M nanohybrid resin Composite using Total etch technique with **3M Single Bond Adhesive**.

**Group B** was restored with 3M nanohybrid resin composite using Self etch technique with **Clearfil self etch bonding agent**.

**Group C** was restored with **Dyad Flow composite**

Resin composite shade A2 was used for each group. These were placed in two increments; each increment was cured for 20 s according to manufacturer's instructions. The restorations were finished with finishing diamond burs & polished with aluminum oxide discs under constant air/water coolant.

The root apices of specimens were sealed with sticky wax; all external surfaces were covered with two layers of nail varnish except for 1.0 mm around the restorations and then immersed in a Rhodamine B dye solution for 24 hours.

The specimens were rinsed in running water, dried & then sectioned faciolingually. The dye penetration depth along the cavity wall (including both occlusal and gingival margins) was measured with a stereomicroscope. The microleakage score was recorded separately for both occlusal and cervical margins on a nonparametric ordinal scale from 0 to 3.

Data were analyzed using Kruskal-Wallis analysis of variance and Mann-Whitney U-test for comparing the restorative materials.

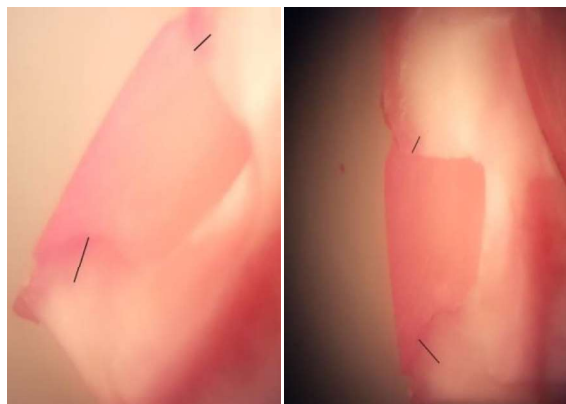
Microleakage score	Result
0	no microleakage
1	dye penetration less than ½ of axial wall
2	dye penetration more than ½ of axial wall
3	dye penetration spreading along the axial wall



Total Etch

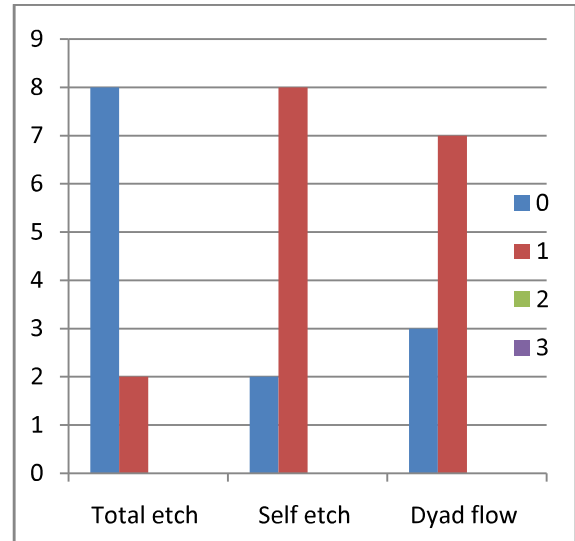


Self Etch

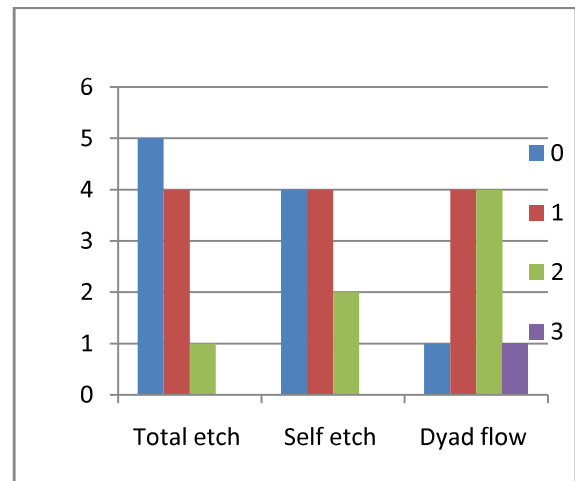


Dyad Flow

**Microleakage graph score at occlusal margin**



**Microleakage graph score at cervical margin**



Microleakage was observed in any restorations at the occlusal and cervical margins. Kruskal-Wallis analysis of variance revealed no significant microleakage differences among the Group A and B at occlusal and cervical margins ( $P = 0.001$ ). Group C (DyadFlow) showed significant microleakage differences at occlusal and cervical margins, ( $P > 0.05$ ).

Frequency, mean  $\pm$  SD of microleakage scores, and *P* value of the Wilcoxon signed rank test of the five flowable materials used on occlusal and gingival margins (*n* = 10)

Descriptive Statistics									
Group		N	Mean	Std. Deviation	Minimum	Maximum	Percentiles		
							25 <sup>th</sup>	50 <sup>th</sup> (Median)	75 <sup>th</sup>
total etch	occlusal	10	.20	.422	0	1	.00	.00	.25
	cervical	10	.60	.699	0	2	.00	.50	1.00
self etch	occlusal	10	.80	.422	0	1	.75	1.00	1.00
	cervical	10	1.10	.738	0	2	.75	1.00	2.00
dyad flow	occlusal	10	.60	.516	0	1	.00	1.00	1.00
	cervical	10	1.50	.850	0	3	1.00	1.50	2.00

Groups	Occlusal margins					Cervical margins					P Value*
	0	1	2	3	Mean $\pm$ SD	0	1	2	3	Mean $\pm$ SD	
Total etch	8	2	0	0	0.020 $\pm$ 0.422	5	4	1	0	0.60 $\pm$ 0.699	0.206
Self etch	2	8	0	0	0.80 $\pm$ 0.426	4	4	2	0	1.10 $\pm$ 0.738	0.180
Dyad flow	3	7	0	0	0.60 $\pm$ 0.516	1	4	4	1	1.50 $\pm$ 0.850	0.024*

Microleakage has been defined by Sidhu and Henderson as “The clinical undetectable passage of bacterial fluids, molecules or ions between a cavity wall and the restorative material applied to it”.<sup>17</sup> The primary objective of a dental restoration is to create a ‘perfect’ seal, and prevent leakage of contaminants contained in the oral environment. However, long-term microleakage occurs with all restorations.<sup>18</sup>

Microleakage is *more critical in class V* cavities located in both dentin and/or cementum, which may lead to a weaker marginal seal than that at the enamel surface; adhesion between composite resins and dentin is not as strong as with enamel<sup>19,20</sup>; material can be dislodged toward occlusal during polymerization contraction, causing a bad adaptation of the restoration at the cervical margins.<sup>21</sup> The higher organic component, tubular structure, fluid pressure and the lower surface energy of dentin make bonding to dentin more difficult than enamel.<sup>22</sup>

In present study, microleakage was compared between newly introduced Dyad Flow with total etch & self-etch adhesive system at the coronal and apical margins of class V resin composite restorations. The use of organic dye as tracer is

one of the most common methods of detecting micro leakage in vitro. The same was followed in this study.

The latest development in dentin adhesion is based on simplification and reduced application time. This led to the introduction of Dyad flow in which no separate bonding protocols are required. *Selfetching adhesives* do not require a separate acid-etch-step as they condition and prime enamel and dentin simultaneously by infiltrating and partially dissolving the smear layer and hydroxyapatite to generate hybrid zone, which plays a major role in adhesion.

In total etch method, Phosphoric acid etches the enamel and removes the smear layer, it helps in deeper penetration of resin monomers and formation of longer tags which provides a durable marginal seal.<sup>23</sup>

Self-etch systems contain ester monomers with grafted carboxylic or phosphate acid groups dissolved in water. With these systems, the smear layer is dissolved and incorporated into the hybrid layer. The bonding mechanism for strong self-etch adhesives is very similar to that of etch-and-rinse systems. Their bond strength, particularly for all-in-one systems, is relatively low, probably because of their high initial acidity and high water content.<sup>23</sup>

Clearfil SE Bond is a mild two-step self-etch adhesive with a pH very close to 2 (Van Meerbeek B 2003).<sup>24</sup> In this study, the results showed greater microleakage scores at the cervical margins compared to the occlusal margins. In 3M ESPE Adper, occlusally 80% samples showed no microleakage and 20% samples showed dye penetration less than ½ of axial wall while cervically 50% samples showed no microleakage; 40% samples showed dye penetration less than ½ of axial wall & 10% showed dye penetration more than ½ of axial wall i.e score 2. Similarly with Clearfil SE; occlusally 20% samples no microleakage and 80% samples showed dye penetration less than ½ of axial wall compared to cervical margin where 40% samples showed no microleakage; 40% samples showed dye penetration less than ½ of axial wall & 20% samples showed dye penetration more than ½ of axial wall. However statistically this difference was not significant.

Flowable composites contain dimethacrylate resin and inorganic fillers with a particle size of 0.4 to 3.0 µm and filler loading of 42% to 53% by volume. Recently, self-adhesive flowable composites have become available.

Flowable composites have a low modulus of elasticity, which may make them useful in cervical abfraction areas. Because of their lower filler content, they exhibit higher polymerization shrinkage and lower wear resistance than universal composites. The viscosity of these composites allows them to be dispensed by a syringe with a needle tip for easy handling. (Craig's Restorative Dental Materials - 13th ed)<sup>16</sup>

Also DYADFLOW without acid etching and bonding agent showed the highest microleakage scores than other groups. This study showed that in dyadflow occlusally 30% samples showed no microleakage and 70% samples showed dye penetration less than ½ of axial wall; cervically 10% samples showed no microleakage, 40% samples showed dye penetration less than ½ of axial wall & 40% samples showed dye penetration more than ½ of axial wall & 10% samples showed dye penetration spreading along the axial wall. In

this group statistically significant difference was observed between microleakage at cervical and occlusal margins. This is in accordance with previous studies which reported that because of higher organic component, tubular structure and the lower surface energy of dentin bonding to dentin is more difficult than enamel.<sup>15</sup> Also previous studies reported that no flowable materials completely eliminated microleakage due to higher polymerization shrinkage and the coefficient of thermal expansion.<sup>25,26</sup>

As manufacturers launch new self adhesive flowable composites before the conclusion of independent ongoing studies, efforts toward future research should be directed to assess the quality and reliability of these materials through both laboratory and clinical evaluations.

## CONCLUSION

In class V restorations restored with composite resin, the choice of material affects the microleakage and retention of the restoration. Within the limitations of this *in vitro study*, it may be concluded that in class V cavities the application of acid etching provided better occlusal and cervical marginal sealing than those without. All adhesive under investigation exhibited a certain amount of microleakage in enamel and dentin. At both enamel and dentin margins, total etch adhesive performed better than other groups. At the apical margin, DyadFlow showed greater leakage than the other groups. However, *in vitro and long-term* clinical trials studies still are necessary.

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