EVALUATION OF MICRO-SHEAR BOND STRENGTH OF SELF ADHERING FLOWABLE COMPOSITE COMPARED WITH CONVENTIONAL FLOWABLE COMPOSITE: IN-VITRO STUDY

Omar Osama Shaalan*; Amira Farid El Zoghby** and Shereen Hafez Ibrahim***

ABSTRACT

Objective: This study was performed to evaluate microshear bond strength of self adhering flowable composite to enamel compared with flowable composite after different surface pretreatments.

Materials & Methods: Sixteen molars were selected, enamel surfaces were flattened. Teeth were randomly divided into two main groups according to type of restorative material; flowable composite R1 and self adhering flowable composite R2, then each group was subdivided to four subgroups according to surface pretreatments (without surface treatment P0, etching only P1, self etch adhesive P2, etch & rinse adhesive P3). Teeth were restored for microshear bond strength testing using universal testing machine; load was applied till specimen’s fail.

Results: Flowable composite with surface treatment P3 has the highest bond strength to enamel, while least bond strength was for self adhering composite with surface treatment P2 and P0.

Conclusion: For better bond strength of self adhering flowable composite it’s recommended that it is preceded with etching when bonded to enamel.

INTRODUCTION

Bonding to enamel was and still one of the major challenges in restorative dentistry. Smear layer removal by using etch and rinse technique was the foremost system with accepted clinical results for enamel [1].

Smear layer dissolving using self etch bonding system was an alternative approach with no distinct etch and rinse steps. Self etch adhesives, especially mild and ultra-mild, have shown minimal ability to bond to enamel, leading to unpleasing quality of the restoration margins that was evident with clinical service. In order to enhance adhesion of self etch adhesives to enamel, pre-etching of the substrate using phosphoric acid was found to be beneficial. The technique known as ‘selective enamel etching’ [2]. The introduction of self adhesive resin cements to the dental market has led to the development of a new class of self-adhesive (restorative) composites (SACs)
that are bonded to tooth enamel without separate step of adhesive systems application [3].

New products of self adhering flowable composite are now in the market with limited information in literature that necessitates laboratory tests. Among laboratory tests, bond strength evaluation provides an assessment of bond performance of adhesive materials, which is a property of clinical relevance with significant correlation coefficient to failure rates of bonded restorations.

MATERIALS AND METHODS

Sixteen carious free extracted molars were select-ed in the current study. The teeth were wet ground to expose fresh flat enamel surface (E) which will carry five specimens. Teeth were randomly divided into two main groups according to restorative mate-rial tested; either flowable composite “R₁” (Filttek™ Z350 XT Flowable) or self-adhering composite “R₂” (Fusio™Liquid Dentin). Each group was di-vided into four subgroups according to surface pretreatment; either without any surface treatment “P₀”, with acid etching only “P₁”, with self etching adhesive system “P₂” and with etch and rinse bond-ing system “P₃”. A plastic tube (tygon tube), 0.7 mm in diameter and 1mm in length was held securely and immobilized using cotton pliers on enamel sur-face with or without surface treatment, then tubes were filled with either flowable composite or self-adhering flowable composite for microshear bond strength testing according to manufacturer instruc-tions. Microshear bond strength test was conducted immediately after 24 hours using universal testing machine at crosshead speed of 0.5 mm/min till specimens fail and bond strength was calculated.

RESULTS

Data were presented as mean and standard deviation (SD) values. Data were explored for normality using D’Agostino-Pearson test for Normal distribution. Microshear bond strength (MPa) showed normal distribution, so two way-ANOVA was used to study the effect of different restorative material and surface pretreatment on mean microshear bond strength (MPa). Tukey’s post-hoc test was used for pair-wise comparison between the means when ANOVA test is significant. Independent Mann–Whitney U test was used to study the effect of different restorative material on failure mode. The significance level was set at P ≤ 0.05. Statistical analysis was performed with IBM® SPSS® Statistics Version 22 for Windows.

The results are shown in (figure 1 and table 1), two way-ANOVA showed that restorative materials and surface pre-treatments had significant effect on mean µSBS at P ≤0.001. The results showed that Filtek™ Z350 XT Flowable with pre-treatment using etch and rinse bonding system has the highest statistically significant bond strength to enamel, while least statistically significant bond strength was for Fusio™Liquid Dentin with surface treatment using self etch system and without any surface pre-treatment. Application of Filtek™ Z350 XT Flowable without surface pretreatment or with etching only showed premature failure.

Fig. (1) Bar chart showing the mean microshear bond strength (MPa) for different tested groups.
TABLE (1) Mean and standard deviation (SD) of microshear bond strength (MPa) for different tested groups.

<table>
<thead>
<tr>
<th>Interaction</th>
<th>Microshear Bond Strength</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
</tr>
<tr>
<td>R₁P₁S₁</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>R₁P₁E</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>R₂P₁E</td>
<td>11.30</td>
<td>5.70</td>
</tr>
<tr>
<td>R₂P₂E</td>
<td>11.54</td>
<td>2.37</td>
</tr>
<tr>
<td>R₂P₃E</td>
<td>13.47</td>
<td>1.71</td>
</tr>
<tr>
<td>R₂P₄E</td>
<td>18.34</td>
<td>2.78</td>
</tr>
<tr>
<td>R₃P₅E</td>
<td>19.50</td>
<td>1.18</td>
</tr>
<tr>
<td>R₄P₆E</td>
<td>20.65</td>
<td>2.07</td>
</tr>
</tbody>
</table>

DISCUSSION

Self adhering flowable composite was selected as an intervention for this study as it is a newly innovated material which abolishes the need for separate bonding step. Bektas et al. [4] claimed that it does not only minimize clinical application time but also it reduces technique complexity, diminishes the likelihood of performing technical errors during application and helps to minimize postoperative sensitivity.

Poitevin et al. [3] stated that self adhesive flowable resin composites applied without a separate adhesive step is expected to bond to enamel in lesser extent than when a flowable composite is used in combination with multi-step ‘gold-standard’ three steps etch and rinse. However bonding performance of a self adhering composite was predicted to minimally meet that of one step self etch adhesive system and flowable composite combination.

Microshear bond strength test was selected in agreement with Ansari et al. [5] because of its attributes such as small surface area for bonding, easier preparation of the samples, using less amount of material and fewer number of teeth are needed and also it is suitable for testing of adhesion to enamel. Foong et al. [6] claimed that microshear bond strength is more reliable, because the stress distribution is more homogenous on the bonding surface of specimens due to their lower dimension, so statistical analysis would be more accurate. Also the size of contact surface stress concentration is decreased, as a result failure modes shift to be adhesive instead of being cohesive and this will minimize methodological errors. It was claimed also that wire microshear testing has shown to be easier and more reliable in comparison to blade microshear testing.

In flowable composite group, etch & rinse pre-treatment showed significantly higher bond strength than self etch pre-treatment, this was in accordance with Hanabusa et al. [7] where they reported that bond performance of one step self etch adhesive was enhanced by etching enamel margins with phosphoric acid, Perdigao et al. [8] found also that single bond universal (etch & rinse mode) has statistically higher bond strength than self etch mode for enamel substrate and they recommended phosphoric acid etching to enamel prior to bonding. In self adhering composite group, preliminary etching either etching only or with etch and rinse pre-treatment showed statistically significant improvement in bond strength values and was statistically higher than self etch adhesive pre-treatment and self adhering composite alone, the least insignificant bond strength values were recorded for self adhering flowable composite alone, this was in agreement with Poitevin et al. [3] where they found that preliminary etching of enamel significantly improved the bonding effectiveness of self adhering flowable composite since phosphoric acid significantly increases surface energy of enamel and thus gives more micro retention.
CONCLUSIONS

Under the limitations of this study the following conclusions were derived:

1- For better bond strength of self adhering flowable composite it’s recommended that it is preceded with etching when bonded to enamel.

2- Still etch and rinse adhesive system is the gold standard technique when bonding to enamel.

CLINICAL RECOMMENDATIONS

Self adhering flowable composite simplified the procedure of applying flowable composite material and requires further clinical investigations to recommend its usage in clinical situations.

REFERENCES


