Original Article

Assessment of Microshear Bond Strength: Self-Etching Sealant versus Conventional Sealant

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Abstract

Objective: Recently, self-etching fissure sealants have been introduced to reduce technical sensitivity; however, their efficacy should be assessed. The aim of this study was to assess of the microshear bond strength of self-etching and conventional fissure sealants.

Materials and Methods: Thirty non-carious third molars were randomly divided into three groups (N=10). Microcylinders of Concise fissure sealant were bonded to prepared buccal and lingual surfaces using the two following procedures. In the first group, phosphoric acid was used to prepare the substrate; whereas in group two, Concise was used in combination with Prompt L-Pop. In group 3, a self-etching fissure sealant (Enamel Loc) was utilized per se. After 24 hours, the samples were subjected to 500 rounds of thermocycling and shear bond testing using a microtensile tester machine with a crosshead speed of 0.5mm/min. Data were analyzed using one-way repeated measure ANOVA and Bonferroni Post HOC tests (SPSS version 16).

Results: The mean and standard deviation of microshear bond strength of the groups were as follows: *Group 1*: Concise+ etching (14.59 ± 1.19 MPa), *Group 2*: Concise+Prompt L-Pop (12.86 ± 1.98 MPa), and *Group 3*: Enamel Loc (5.59 ± 0.72 MPa). One-way ANOVA revealed that all the differences were significant and the conventional sealant exhibited the highest mean bond strength.

Conclusion: Conventional sealant using phosphoric acid etch application prior to fissure sealant application demonstrated more bond strength in comparison with that of self- etch bonding and self- etch sealant.

Keywords: Pit and Fissure sealant; Bond strength; Self- etching

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INTRODUCTION

The effectiveness of pit and fissure sealants in the prevention of primary and secondary caries is well documented [1].

Studies have shown that resin-based sealants, which require acid etching of the tooth surfaces, are more effective than glass ionomer cements in caries reduction 24 to 44 months af-

ter placement in permanent teeth of children [2, 3]. However, their long-term retention depends upon their bonding effectiveness and proper placement [4]. Sealant application typically requires appropriate acid-etching of the tooth surface; and good isolation to prevent saliva contamination during sealant placement and polymerization [5]. Recently, a self-etch sealant has been introduced which does not require any acid-etching, rinsing or drying. Thus it has simplified the application procedure. This important feature of the self-etch sealants may be a suitable alternative for the standard acid-etch technique, particularly for children who because of behavioral problems, dental phobia, strong gag reflex or disability may be unable to cooperate [6, 7]. Existing studies on techniques to improve retention of pit and fissure sealants have focused on the use of adhesive materials as an intermediary layer between etched enamel and resin sealants [8]. Other studies have investigated self-etching primers/adhesives to simplify the steps of the sealant procedure and have found varying results compared to the standard total- etch technique [9, 10]. Recently, a new type of fissure sealant, Enamel Loc, was introduced to facilitate and expedite the process. This fissure sealant does not require acid etching or primer and the manufacturer claims that its application yields acceptable results.

If proven to be as effective as conventional fissure sealants, it would be highly recommended especially for children because not only does it reduce the time of the procedure, it also alleviates the isolation of the teeth.

A bond strength that is greater or equivalent to that obtained with the standard total-etch technique is required to justify the use of a self-etch sealant [11-13]. The purpose of this in vitro study was to determine the microshear bond strength of a self-etch sealant material (Enamel Loc) to enamel and compare it to bond strength of a conventional sealant (Concise) with a total etch technique or a self-etching adhesive (Prompt L-pop).

MATERIALS AND METHODS

Thirty caries-free extracted human third molars were stored in 1% chloramine T solution at 4ºC and were used within 1 month following extraction.

A thin sectioning machine (Hamco machines, Rochester, USA) was used to separate the crowns from roots and to produce two buccal and lingual surfaces from each tooth.

The lingual and buccal surfaces of each tooth were lapped with 400-800 grit silicon paper in order to obtain a flat enamel surface.

The specimens were divided into three groups (N=20).

Distribution of the samples between the groups was done using a randomized number table. In group 1, Concise sealant (3M ESPE, St Paul, MN, USA) was placed on the prepared surfaces via Tygon tubes (0.7 mm diameter and 1mm height) after etching with 37% phosphoric acid etching gel (3M ESPE, St Paul, MN, USA) for 20 seconds, rinsing for 30 seconds and drying for 15 seconds. The sealant was cured for 30 seconds with a light-curing unit (MONITEX BlueLEX GT1200, Tip=8mm, 1600 MW/CM2, Taiwan).

In group 2, Prompt L-Pop dentin bonding (3M ESPE, St Paul, MN, USA) was applied on the surface, air dried for 10 seconds and then polymerized for 10 seconds with the light cure unit. Concise sealant was placed using the same procedure as described in group 1.

In group 3, Enamel loc (premier dental, PA, USA) sealant was used utilizing Tygon tubes with no preconditioning of enamel surface and cured for 30 seconds according to the manufacturer's instructions.

All specimens were stored in distilled water at 37ºC for 24 hours, after which they were subjected to 500 rounds of thermocycling at 5ºC and 55ºC with a dwell time of 5 seconds.

The specimens were then mounted in a metal ring with treated surfaces parallel to the shearing rod of the microtensile testing machine (Bisco, USA) at a crosshead speed of 0.5mm/minute and subjected to shear stress.

The results were recorded in Megapascals (Mpa) and the data were analyzed by one-way repeated measure ANOVA and Bonferroni Post HOC tests using SPSS version 16. The threshold for statistical significance was set at $p<0.05$.

RESULTS

One-way repeated measure ANOVA with one within -subject factor (buccal and lingual) and one between-subject factor (the study groups) showed that the bonding surfaces (i.e. buccal and lingual) and the interaction of surfaces and groups had no statistically significant effect on micro-shear bond strength ($p= 0.284$ and $p=0.493$, respectively). The micro-shear bond strength of Enamel Loc sealant was significantly lower than Concise and Concise+Prompt L-Pop resin-based sealants ($p<0.001$). Also, the application of Concise fissure sealant using acid etch technique showed a higher value of microshear bond strength compared to its use with Prompt L-Pop ($p<0.001$) (Table 1). The results of the Bonferroni test to compare the paired groups indicated that the microshear bond strength of Enamel Loc fissure sealant was significantly lower in comparison to the use of Concise fissure sealant with acid etch ($p<0.001$) or Concise with Prompt L-Pop ($p<0.001$). Moreover, The microshear bond strength of Concise fissure sealant was significantly higher than that of the same product with Prompt L-Pop ($p<0.003$). The criteria for evaluating an ideal fissure sealant include biocompatibility, retention, microleakage and bond strength.

DISCUSSION

The basic factor to consider is that the efficacy and durability of a sealant is its bond strength with enamel.

This directly influences the efficacy of the seal and the reduction of debonding [14, 15].

Evaluating the bond strength utilizing the micro-shear bond strength test has advantages such as balanced distribution of stress, evaluation in smaller surfaces, reducing the effect of enamel defects and recognition of even small differences in bond strength for reliability [16]. It seems that self-etching and self-priming fissure sealants such as Enamel Loc eliminate the need for etching and bonding and their application is easier particularly for uncooperative children.

Self-etching adhesives have been introduced to improve bonding and reduce the technical sensitivity of the bonding procedure to tooth structures [17, 18]. Prompt L-Pop® is one of the most acidic self-etching adhesives effective on ungrounded enamel. It creates a thicker hybrid layer [19]; therefore we used Prompt L-Pop® for preparation of enamel. Our study showed that the microshear bond strength of the self-etching/priming fissure sealants (Enamel Loc) was significantly lower compared to that of conventional sealants; which are used either with total etch or with self etch primer/adhesives (Prompt L-Pop®). Wadenya showed that the shear bond strength of conventional sealants following acid etching was significantly higher than that of self etch sealant (Enamel Loc); which confirms the results of our study [20].

Table 1. The mean microshear bond strength (Mpa) and standard deviation for the fissure sealants

	Concise®+Prompt L-Pop®	Concise®	Enamel Loc®
Mean	12.86	14.59	5.59
SD	1.98	1.19	0.72

Perdiago et al. (2011) compared the leakage of conventional sealants either with acid- etching or following application of Prompt L-pop and Enamel Loc and concluded that acid etching showed the best sealing at the enamel sealant interface [21]. Similar results about lower microleakage of traditional sealants compared with self etch sealants have also been reported in several studies [22, 23].

The results of other studies have shown that the bond strength of a fissure sealant (Concise) using self etch bonding is less than that of total etch; these results are similar to ours [24]. Feigal et al. reported that the bond strength of Prompt L-Pop was higher than that of total etch technique [9].

Asmussen et al. have suggested the bond strength of total etch and self etch techniques to be similar in short-term as well as in long-term [5]. The differences of results between these studies and ours probably stem from the differences in the procedure. One of the reasons expressed in explanation of the lower bond strength of self-etching systems compared to total etch technique is the remaining of un-neutralized hydrophilic phosphoric acid in the contact surface of the sealant and tooth enamel. Therefore, the self -etching primers tend to absorb water resulting in the reduction of bond strength [25-27]. In self etch systems, conditioning and priming of tooth structure occur simultaneously; thus, the demineralization depth is shallow resulting in lower penetration of resins into the enamel and also a weaker bond [28].

It is believed that the pH of self etch monomers does not have a significant role in improving the bond strength, but it can reduce the gap size. Also, total etch systems have smaller gaps and higher bond strength [29]. Another reason expressed for higher microshear bond strength of Concise sealant when used with total etch compared to the other two methods is that the etching of the enamel increases the contact between the resins and enamel surface; which in turn reduces the contact angle and increases the wetting and penetration of resins and the depth and number of resin tags. Although Prompt L-Pop is a self etch primer, the lower bond strength in Enamel Loc compared to Concise and Prompt L-Pop is attributed to a lower amount of active monomers in Enamel Loc. Enamel Loc is a flowable composite with a higher viscosity compared to Prompt L-pop® which is a liquid and capable of better wetting. This is considered as another contributing factor to the lower surface contact and bond strength in Enamel Loc [29]. Wadeyna et al. stated that conventional resin-based sealant exhibited higher bond strength to enamel than Enamel Loc; which confirms the results of this study. In addition, they suggested that enamel shear bond strength of Enamel Loc can be increased significantly with additional phosphoric acid etching for a minimum of 10 seconds [30].

CONCLUSION

This study concludes that:

The microshear bond strength value of the self etch sealants is significantly lower than that of the conventional sealants which are used either by total etch or self-etching primers.

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