Original Article

Comparative Evaluation of Shear Bond Strength of Self-Adhering Flowable Composite and Flowable Composites Bonded with Different Generation Adhesives to Dentin: In Vitro Study

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ABSTRACT

Objective: The purpose of this study is to measure and compare the shear bond strength of a self-adhering flowable composite to the different generation of adhesive technique used in conventional flowable composite to dentin.

Material and method: Thirty extracted caries free permanent teeth divided randomly into 3 groups and their dentin surfaces exposed. Flowable composite with different types of adhesive and the self-adherent flowable composite were grouped as follows; Group I:-Filtek Z350XT (3M ESPE, USA) conventional Flowable composite, with 5th generation total etch adhesive Prime and Bond NT (Dentsply, Caulk), Group II:-Filtek Z350XT conventional Flowable composite (3M) with self-etch adhesive 7th generation One Coat 7.0 Universal (Coltene, Switzerland), group III:- Self Adherent Flowable Composite, Dyad Flow (Kavo Kerr, USA). Cylinders of flowable composites were prepared on the exposed dentin surface in each group (n=10). Composite cylinders were subjected to universal testing machine to know shear bond strength of each type of flowable composite/bonding system. Resuts were subjected to statistical analysis.

Result: The result of present study showed that there is significant difference in all the three groups. The group I showed highest bond strength followed by group II while as group III has lowest bond strength.

Conclusion: Group I have more bond strength than group II and group III. Self-adhesive flowable composite showed the least bond strength.

Keywords: Dentin, flowable composite, shear bond strength, self-etch adhesive

INTRODUCTION

Flowable composites are an integral part of the restorative process since its introduction to the market.[1] Though they are used for a wide range of restorative procedures their limitations are still unknown.[2] Evaluation for bonding durability is important since the long-term clinical success of tooth colored restorations might be dependent on the stability of the bond between restoration and tooth substrate. Bonding durability of the adhesive system is affected by technique sensitivity; therefore, to reduce the sensitivity, steps required for bonding procedures have been reduced. When selecting an adhesive system, bond strength is one of the significant factors that play a major role for the long term clinical success of the restoration.[3,4] New approaches have been introduced such as self-etch systems for bonding restorative materials to tooth substrate. More recently, the newer formulation has been introduced which is self-adhering flowable composite, here we have used Dyad Flow (Kavo Kerr, USA). [5]

Dyad flow is a self-adhering, flowable composite resin, whose bonding mechanism based on the adhesive monomer glycerol phosphate dimethacrylate (GPDM). GPDM is a functional monomer that is responsible for etching the tooth structure and also for chemically bonding to the calcium ions within the tooth structure.[6] On the other hand, it has two methacrylate functional

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groups for copolymerization with other methacrylate monomers to provide increased cross linking density and enhanced mechanical strength for the polymerized adhesive. The resin also contains hydroxyethyl methacrylate, which is used to provide wetting and resin penetration in dentin.

MATERIALS AND METHODS

Fifteen extracted caries free permanent teeth, which have been stored in distilled water after extraction, were selected for the study. The roots of the teeth were removed and the crowns were embedded into autopolymerizing acrylic resin with occlusal surfaces facing up. Enamel surfaces were flattened with a diamond disk until the dentin was exposed. The exposed dentin surfaces were prepared using 400 grit and 600 grit silicon carbide papers. All the samples were divided randomly into three groups (n=10).

Following materials were applied according to the manufacturers' instructions to dentin surfaces by packing the material into a cylindrical-shaped plastic matrix with an internal diameter of 4 mm and height of 3 mm [Fig. 1(a)].

Materials used were grouped into 3 as follows [Fig. 1(b)];

Group I: Filtek Z350XT (3M ESPE, USA) conventional Flowable composite, with 5th generation total etch adhesive Prime and Bond NT (Dentsply, Caulk)

Group II: Filtek Z350XT conventional Flowable composite (3M ESPE, USA) with self-etch adhesive, 7th generation One Coat 7.0 (Coltene, Switzerland)

Group III: Self Adherent Flowable Composite, Dyad Flow (KavoKerr USA).

All specimens were cured with LED curing light and then stored in distilled water in an incubator at 37°C for 24 h. The specimens were subjected to shear loading using the universal testing machine [Fig. 2 and Fig.3]. The shear bond strength values were calculated as the ratio of fracture load and bonding area and expressed in megapascals.

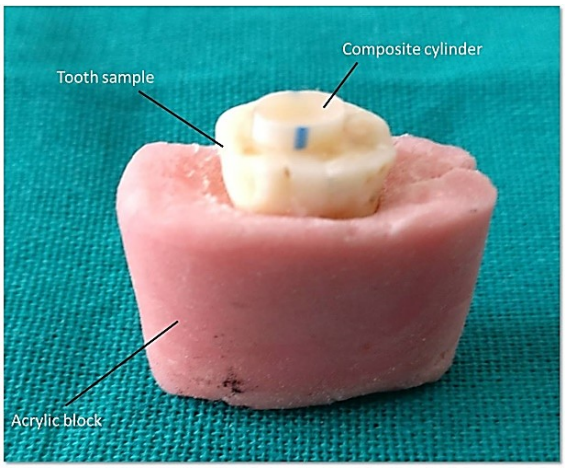

Figure 1 (a) Teeth embedded in acrylic resin as specimens (n=10, for each group) and preparation of sample by flowable composite cylinder on dentin surface (3mm x 4mm)

Figure 1 (b) Composite materials LED curing light.

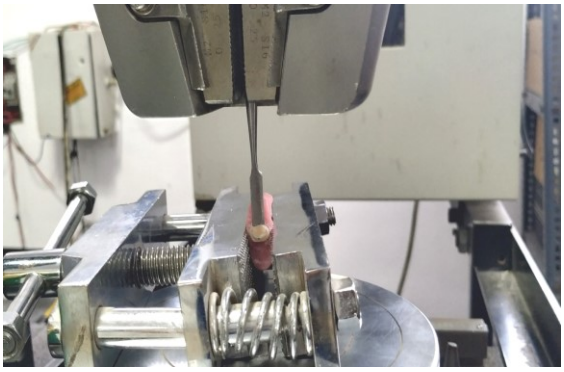

Figure 2. Sample being subjected to UTM, for evaluation of shear bond strength

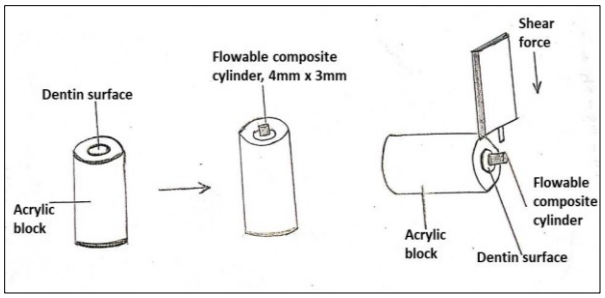

Figure 3: The image showing the pictorial representation for preparation of acrylic blocks with embedded dentin and the composite cylinders, followed by application of shear force using Universal Testing Machine.

STATISTICAL ANALYSIS

Data was entered into Microsoft excel data sheet and was analyzed using SPSS for Windows (Statistical Presentation System Software, SPSS Inc., version 17.0).

Continuous data was represented as mean and standard deviation. Data was found to be not normally distributed. Kruskal-Wallis Test was used. Probability that the result is true of <0.05 was considered as statistically significant after assuming all the rules of statistical tests ($p < 0.05$).

RESULTS

The result of present study showed that there is significant difference in all the three groups. The mean shear bond strength of group I was higher followed by group II whereas group III showed least shear bond strength.

Mean shear bond strength values were ranked as follows (Table 1); Filtek Z350XT with prime and bond NT (Dentsply) > Filtek Z350XT with One Coat 7.0 (Coltene) > Dyad Flow (Kerr).

DISCUSSION

Adhesion in dentistry could be stated as the relationship between bonding and stress. The restoration would be successful if the bonding could withstand the stress.[7] Strong and durable bonding between restorative material and tooth substrate are essential when judging mechanical, biological, and esthetic aspects. When compared to enamel bonding, the bonding of resin based restorative materials to dentin has always been more challenging.[8] Therefore in the present study, we aimed to test the bond strength of a self-adhering flowable composite to dentin.

To assess the bond strength of restorative materials, various tests have been presented. Shear bond strength test is comparatively simple, reproducible, and commonly accepted. [9] It has been reported that thermocycling has no significant effect on bond strength.[10,11] In recent years most of the studies did not use thermocycling for shear bond strength,[12-15] as in the current study we have not included thermocycling into the testing procedures.

The residual smear layer disturbs monomer infiltration into underlying dentin and it effects stable adhesion as seen with self-adhering flowable composites, here we use Dyad flow (Kerr, USA). Smear layer removal or modification is essential for the formation of a high quality hybrid layer and it provides optimal adhesion to dentin.[16]

The bonding mechanism of Dyad Flow (Kerr, USA) relies on the adhesive monomer glycerol phosphate dimethacrylate (GPDM) and its phosphate group is responsible for acid etching and chemical bonding with calcium ions of the dental substrate. Mechanical strength is provided to the material by the crosslinking of methacrylate functional groups with other methacrylate monomers. To promote the interaction of the acidic monomers, the company recommends brushing the first layer of material onto the entire cavity surface for 20 seconds.

Based on the findings of the present study, the self-adhering flowable composite Dyad Flow (K-

Groups	Number (n)	Standard Deviation	Minimum	Maximum	Mean	P-value
I	10	73.166	168	335	224.40	0.008*
II	10	32.122	99	201	161.80	
III	10	24.499	56	191	106.60	

Table 1: Groupwise mean shear bond strength

-err, USA) (Group-III) displayed the lowest bond strength than other types of adhesive to conventional flowable composite (Table 1). Fifth generation (Group- I) has high bond strength because phosphoric acid removes the smear layer and demineralizes the surface to depth of 5µm exposes collagen and dentinal tubule network for resin bond. 7th generation (Group-II) incorporates the smear layer into interface. It demineralizes and penetrates dentin simultaneously leaving a precipitate on hybrid layer.

Self-adhering flowable composite (Group-III) has lowest bond strength because residual smear layer disturbs the monomer infiltration into underlying dentin and effect the stable adhesion. Further low bond strength may be due to reduced wetting of dentin surface which decreases the penetration of monomer.

Similar to this study of Juloski et al.[17] have reported Vertise Flow (Kerr, USA) has lower shear bond strength than self-etch and etch & rinse . Pretreatment with phosphoric acid did not significantly change their adhesion potential. Vichi et al[8] stated that vertise flow (Kerr, USA) has low shear bond strength than all in one adhesive when used to restore class I cavity.

Tuloglu et al. have investigated the shear bond strength of Vertise™ Flow (Kerr, USA) with and without application of an adhesive system. The results of the study showed that Vertise™ Flow with an adhesive system had the higher bond strength values than it is used individually and also similar to our study.[18] A study was done to investigate the shear bond strength of various flowable composites on orthodontic brackets which showed that Aelite flo (Bisco Inc. USA), used without etching, had the least SBS among all flowable resins used.[19] Furthermore, in different in vitro studies, Vertise™ Flow (Kerr, USA) has displayed lower shear bond strength values than etch & rinse and all-in-one adhesive used.[20] In an another study Bektas et al. have reported that Vertise™ flow (Kerr, USA) (self-adhering) combined with adhesive resin provided stronger dentin bond strength than when it was used individually.[21]

CONCLUSION

According to the results of our study; we can conclude that minimizing the bonding procedures decrease the bond strength. As well as, according to the manufacturers, the material eliminates additional steps of etching/priming/bonding necessary to bond a resin\ composite to dentin or enamel, but before application it requires an additional step of brushing a thin layer of the material for 15–20 second. Within the limitation of this study it is concluded that 5th generation has the highest Shear bond strength & self-adhering flowable composite has lowest. Further in vitro and clinical studies are needed to evaluate self-adhering flowable composite for long time success.

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Conflict of interest : None reported

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