COMPARATIVE EVALUATION OF SHEAR BOND STRENGTH OF A SELF-ADHERING FLOWABLE COMPOSITE TO DENTIN OF PERMANENT TEETH WITH DIFFERENT FLOWABLE COMPOSITES USED WITH SELF-ETCH BONDING AGENTS: AN EX-*VIVO PILOT* STUDY

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Abstract
Background: Bonding durability of the composite adhesive system is affected by technique sensitivity during various steps of dentin bonding. Therefore, to overcome this problem bonding procedures have been simplified by reducing steps. Even further, the self-adhering flowable composite formulation has been introduced. The present study was undertaken to evaluate and compare the shear bond strength of oneself-adhering flowable composite with three different flowable composites used with self-etch bonding agents.
Materials and Method: Occlusal dentin surfaces of 16 freshly extracted teeth were exposed and restored using following materials:
Group I: Constic (self-adhering flowable composite)
Group II: Tetric N-flow+ Tetric N-bond universal
Group III: Filtek Z350 XT+3M ESPE single bond universal
Group IV: Solare Flo +Solare universal bond.
After this the shear bond strength was evaluated for each group using a universal testing machine.
Results: Statistically significant differences were found among allthe groups.
Conclusion: The present study concluded that the new Constic self-adhering flowable composite is comparable with other flowable composites utilizing one-step self-etch adhesives.
Key words: Dentin, Self-adhering flowable composite, Self-etch bonding agents, Shear bond strength.

Introduction

Flowable composite were first introduced in 1995 to restore class V lesions. Based on traditional hybrid composites, flowable composites are characterized by smaller filler concentration, low modulus of elasticity, low viscosity and remarkable wettability.[1]Flowable composites were developed principally to provide their own unique brand of handling characteristic, rather than their physical properties.

Evaluation for bonding durability is important since the long-term clinical success of tooth colored restorations is 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.[2-4]

There is constant evolution of dentin bonding systems to minimize the steps in bonding, the latest ones being self-etch bonding systems. More recently, a new self-etching, self-adhesive flowable composite Constic (DMG Germany)is introduced which is the new 3-in-1 flowable composite. It combines an etching gel, bonding agent and flowable composite in one single product. It has been promoted to be used in small restorations of class I and small occlusal primary tooth cavities, pit and fissure sealing, base lining of class I and II restorations and blocking out and filling of undercuts.[5]

Different properties of composite resin are evaluated to authenticate their use in clinical practice i.e. strength, fracture toughness, wear resistance, flow, polymerizationshrinkage, marginal integrity and shear bond strength. Shear bond strength is one of the significant factors that a major role for the long-term clinical success of the restoration. Due to higher polymerization shrinkage and polymerization shrinkage stress, shear bond strength of flowable composite is lesser compared to traditional composite. For this issue, newer flowable composites were developed with modification of their chemical formulation.Various studies have been conducted by different authors for comparison of shear bond strength of self-adhering flowable composite with different flowable composites to dentin with variable results.[3,6,7]

The aim of the present pilot study was to measure and compare the shear bond strength of the newly introduced Constic; a self-adhering flowable composite with that of different flowable composites used with self-etch bonding agents such as Tetric N-Flow, Filtek Z350 XT and Solare flow.

Materials and Method

Sixteen caries free, intact permanent premolar teeth, were obtained from department of oral and maxillofacial surgery, extracted for orthodontic purpose and periodontal reasons.The selected teeth were cleaned and stored in distilled water after extraction till use. Occlusal enamel surfaces were flattened with a diamond disc until the dentin were exposed(Figure 1).The exposed dentin

surfaces were smoothened using silicon carbide papers. Then the teeth were embedded into auto polymerizing acrylic resin with occlusal surfaces facing up.
These prepared teeth samples were divided randomly into four groups of four teeth each:

- Group I: Constic(DMG, Germany) (self-adhering flowable composite)

Figure 1: Dentin surfaces exposure by cutting through the coronal third with a diamond disc

- Group II: Tetric N-flow+ Tetric N-bond universal(Ivoclar- vivadent,Liechtenstein)
- Group III:Filtek Z350 XT+3M ESPE single bond universal(3M-ESPE,USA)
- Group IV: Solareflo + Solare universal bond(GC Aichi,Japan)

All the materials were applied to dentin surfaces by packing the material into a cylindricalshaped plastic matrix with an internal diameter of 3 mm and height of 2 mm held on to dentine surfaceand light cured(Figure 2).

Figure 2: Composite build up of standard dimensions&Curing with bluephase curing light

All the materials weremanipulated as per the respective manufacturer's instructions. The specimens were stored in distilled water for 24 h. Then these were subjected to shear loading using the universal testing machine(25 kn servo hydraulic universal testing machine ASI sales Pvt.Ltd.) (Figure 3).The shear bond strength values werecalculated as the ratio of fracture load and bonding area and expressed in Megapascals(Mpa).

Figure 3: Shear bond strength testing using the universal testing machine

ANOVA followed by Post hoc test was applied to know the statistical significance.

Results

Descriptive statistics including mean and standard deviation were calculated for each group. Table 1 shows the mean values of shear bond strength of all the groups.Mean shear bond strength values were ranked as follows:

Material	n	Min	Max	Mean SD	P value
Constic(DMG German)	4	12.74	17.84	15.86(2.29)	
Tetric N-flow+ Tetric N-bond universal (Ivoclar-vivadent)	4	11.61	17.42	14.94(2.47)	
Filtek Z350 XT+3M ESPE single bond universal (3M ESPE, USA)	4	15.01	18.83	18.09(2.11)	0.042
Solareflo + Solare universal bond (GCAichi,Japan)	4	7.08	17.98	12.31(4.89)	

Table 1: *Mean shear bond strengths of all the groups in MPa with standard deviations*

Filtek Z350XT (group III) shows highest shear bond strength (18.09Mpa) followed by Constic(15.86Mpa) and Tetric N-flow(14.94Mpa) while Solare flow (12.31Mpa) shows lowest shear bond strength.
Statistically significant ($p<0.05$) difference was found between Filtek Z350XT and Constic, Tetric N-flow and Solare flow.

Discussion

Self adheringflowable composites are comparatively newer members to the family of conventional composites. They still do not provide conclusive results of their performance in the oral environment, studies for evaluation of their appropriate properties followed by long term clinical trials are necessary. The shear bond strength is one of the significant factors that plays a major role for the long-term clinical success of the restoration.It is a simple evaluation procedure done with a universal testing machine to test the adhesion of dental adhesives. In vitro testing for the shear bond strength is useful and essential for predicting the clinical performance of adhesive systems and possible correlation with various clinical issues regarding restoration failures.
The present pilot study aimed to evaluate the shear bond strength of newly introduced self-adhering flowable composite Constic which has eliminated the steps of etching, priming, bonding and curing followed by restoration and just need to be applied directly to

prepared tooth surface and cured. In the present pilot study evaluated the shear bond strength of Constic to dentin of permanent teeth and compared it with (a)Tetric N-Flow ;which is a light-curing, radiopaque flowable nano-hybrid composite based on nano-optimized technology used with tetric N bond universal ; a one step self-etch adhesive,(b)Filtek Z350XT flowable; a low viscosity flowable nanocomposite used with 3M ESPE single bond universal which is one step, one coat all etch adhesive and (c)Solareflo; whichis a micro-filled hybrid resin composite with microfine pre-polymer resin fillers, a unique coupling agent and urethane dimethacrylate co-monomer matrix used with Solare universal bond;One step self-etch adhesive.

The resultsof the present pilot study showed that Constic had lower shear bond strength i.e.(15.86Mpa) than Filtek Z350XT(18.09Mpa) but comparable with Tetric N flow(14.94Mpa) and higher than Solareflo(12.31Mpa).The earlier study by Tulogluet alhave shown that self- adhering composites (Vertise flow) had inferior shear bond strength compared to other flowable composite (Filtek Ultimate)used with self-etch bonding agent(Optibond)[8], whereas in the present study, when compared with other flowable composites used with self-etch adhesives, it had comparable value of shear bond strength without the use of any adhesive.

Similarly, a study by Merve Erkmen Almaz et al (2017),who evaluatedand comparedthe shear bond strength of self-adhering flowable composite with different flowable composites to dentinalso concluded that self-adhering flowable resin composite (Vertise flow) had the lowest shear bond strength values while the two-step self-etch adhesive showed the highest shear bond strength among the materials tested. They used 7th generation bonding agents while in present study we used newer 8th generation dentin bonding agents, we used one step self-etch bonding agents instead of two step self-etch bonding agents.[9]

Similarly,C. A. Munoz-Viveros evaluated the bond strength values for Constic (self-etchself-adhesive flowable composite) with those of the other self-etching, self-adhesive flowable composites and concluded that Constic reaches very good results both on enamel and dentine compared to regular flowable composites bonded with an adhesive.[5]This study is in confirmation to results of this pilot study. This could be due to the improved formulation of this new self-adhering composite.

Thus, it can be seen that flowable composites shows an extensive variation in the composition and subsequently a variation in physical and mechanical properties. Dentist must be mindful of this inconsistency, thus choosing the most suitable material based on a specific clinical condition.

Conclusion

The present pilot study has concluded that this new self-adhering flowable composite bonds well with the dentin and the shear bond strength is comparable to tested flowable composites to Tetric N-flow; a bit inferior to Filtek Z350XT whereas Solareflo has shown inferior bond strength as compared to Constic.

Further studies with larger sample size and with and without thermocycling of the samples are required to come to concrete conclusion.

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