Research Article

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Comparative Evaluation of Micro Tensile Bond Strength of Different Solvent Based One Step and Two Step Adhesive Systems to Dentin: An In-Vitro Study

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ABSTRACT

Background: To compare and evaluate the micro tensile bond strength of two step Optibond S and one step G Bond adhesive systems to dentin in vitro.

Material and Method: Thirty intact, non-carious and unrestored human premolars were taken for the microtensile bond study and divided into 2 groups of 15 each. The teeth were embedded in acrylic resin and the occlusal enamel was removed perpendicular to their long axis, to expose a flat, midcoronal dentin surface. Group A:15 teeth bonded using two step bonding agent-Optibond S (Kerr). Group B:15 teeth bonded using a single step bonding agent-G-bond (GC Corporation). Bonding agents were applied according to the manufacturer's instructions and resin composite was built up incrementally to a height of 5 mm. These teeth were mounted onto a custom acrylic jig and subjected to micro tensile bond strength testing using a Universal Testing Machine with a cross head speed of 1 mm/min and stressed to de-bonding of the composite resin from the tooth.

Results: Results obtained were subjected to statistical analysis and evaluated by using Tukey HSD test. The mean bond strengths for both groups were as follows. Group A (optibond S) was 84.748 MPa and group B (G bond)was 55.226 MPa.

Conclusion: The results established that the microtensile bond strength of optibond S is better than G bond. Difference obtained was found to be statistically non-significant with P = 0.116.

Keywords: Adhesive, Bonding, Microtensile bond strength, 2-step adhesive, 1-step adhesive.

INTRODUCTION

The use of composite resin as a restorative material has increased significantly over the past decade and has become a well-established dental procedure for the direct restoration of anterior and posterior teeth.[1] Adhesion to enamel and dentin is a fundamental requirement prior to the insertion of tooth coloured restorative material. The success rate of resin restorations is dependent on adhesion to enamel and dentin, that maintains the restorative material inside the tooth preparation and prevents microleakage.[2] This minimally invasive approach provides the advantages of conservation of tooth structure, an ability to retain restorative material without any form of secondary retention, including pins and posts, an improvement in the quality of the interface between the restorative material and the tooth, work simplification and reduced treatment time.[3]

Adhesive systems have constantly evolved in terms of clinical simplicity, reduced application time and minimized procedural errors.There has been

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evolution of bonding agents from 1st generation to 8th generation, each with their pros and cons.

Bond strength to enamel and dentin is an important indicator of an adhesive system's effectiveness since the bonding layer must compensate, not only for the composite shrinkage stress, but also occlusal loads in stress-bearing areas, in order to avoid gap formation leading to micro leakage, secondary caries and post-operative sensitivity.

This study was carried out to evaluate the micro tensile bond strength of the two-step,5th generation adhesive system Optibond S with the one step,7th generation adhesive system G bond to dentin.

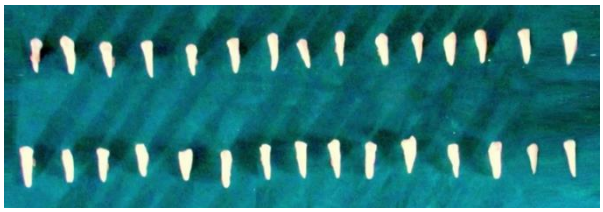

Fig 1: Teeth collected for the study.

Fig-2 Measuring of specimen with Vernier calliper to produce specimens of 4x4mm2

Fig 3: Specimens after sectioning to produce specimens of 4x4 mm2

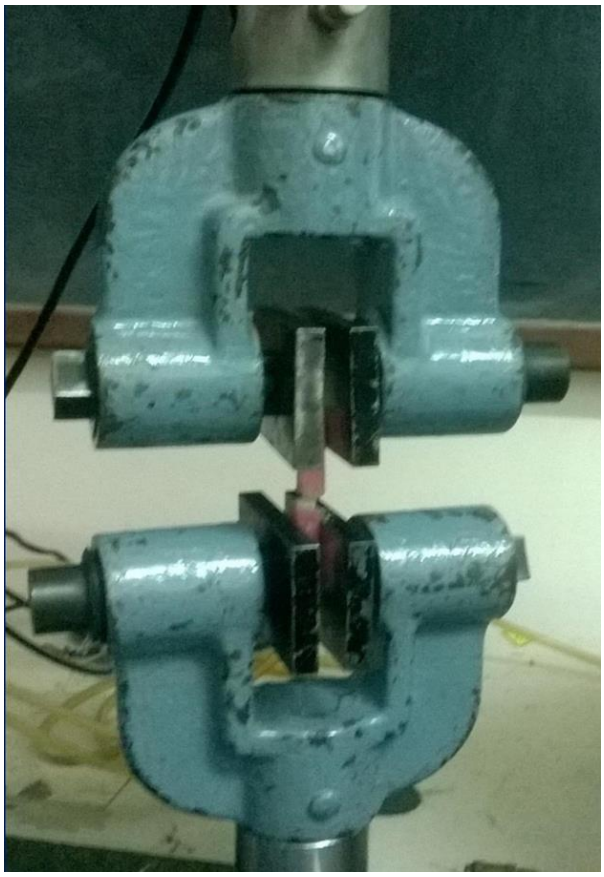

Fig 4: Universal testing machine

MATERIALS & METHODS

Thirty intact, non-carious and unrestored human premolars extracted for orthodontic purpose were taken for the study. These teeth were scraped of residue with ultrasonic scaler and kept in 3% sodium hypochlorite (NaOCl) to remove the residues for 10 minutes, followed by rinsing under running water and stored in isotonic saline at room temperature for 24 hours. Teeth were embedded in acrylic resin and the occlusal enamel was removed perpendicular to their long axis, to expose a flat, midcoronal dentin surface using a low speed, diamond disc. This surface was polished with silicon carbide paper to produce the smear layer and then rinsed under copious running water and immediately dried with moisture free air with chip blower for 5 seconds. Teeth were randomly divided into two groups:

Group A: Comprised of 15 teeth bonded using two step bonding agent-Optibond S (Kerr)

Group B: Comprised of 15 teeth bonded using a single step bonding agent-G-bond (GC Corporation). (Fig-1,2,3,4,,5)

The teeth assigned to A group were etched with 37% orthophosphoric acid and those of B group were not etched. Bonding agents were applied according to the manufacturer's instructions and resin composite was built up incrementally to a height of 5 mm. Each increment was light cured for 40 s and finished with Sof-lex finishing and polishing discs and specimens were stored in distilled water at room temperature for 24 hours. Sectioning was done in the mesio-distal direction and then the teeth were rotated at 90° and again sectioned in the bucco-lingual direction to obtain beams with an approximate cross-sectional area of 4x4mm^2. These sections were mounted onto a custom acrylic jig and subjected to micro tensile bond strength testing using a Universal Testing Machine with a cross head speed of 1 mm/min and stressed to de-bonding of the composite resin from the tooth.[4,5,6,7,8,9]. Results obtained were subjected to statistical analysis and evaluated by using Tukey test.

RESULTS

Inter comparison of mean and standard deviation of bond strength between the group A and B, revealed that Bond strength was higher in group A (84.748 MPa) as compared to group B (55.226 MPa). Difference in bond strength between group A and Group B was -29.522 MPa. Difference obtained was found to be statistically non significant with P = 0.116.

Table 1: Inter group comparison of bond strengths between Group A and Group B (Tukey HSD)

Groups	Mean ±	SD	Difference	P value
Group A	84.748MPa	40.410	-29.522	0.116 NS
Group B	55.226MPa	27.292		

DISCUSSION

The fundamental principle of adhesion to tooth substrate involves removal of calcium phosphates, by which micro porosities are created in both, enamel and dentin surfaces. That is followed by infiltration and subsequent in-situ polymerization of resin, within the created surface micro-porosities.The conventional three step procedures are considered as the gold standard in adhesion. But due to the increased number of steps, the two step adhesives were preferred as compared to the three step adhesives. 5 th generation bonding system combines the primer and adhesive into one bottle. They pursue similar adhesion strategies like the three bottle adhesives (4th generation). But there are certain disadvantages of 5th generation as well. Water is an essential part for good adhesion but the dentin substrate should neither be over dried nor kept wet; hence its application becomes very technique-sensitive. Also, the adhesive technique uses phosphoric acid as surface conditioner, hence it demands more number of clinical steps and a longer application time, therefore increasing the probability of errors. These lead to post-operative sensitivity, due to lack of marginal seal. In the interest of saving chair side time and to overcome the incomplete sealing of dentin, which was believed to be caused by the improper use of etch-and-rinse system leading to postoperative sensitivity research was directed at formulation of simpler and single step bonding systems combining the conditioning, priming, and adhesive functions into one single application which led to the formulation of the 7th generation bonding agent.[10,11,12,13]

The advantages of 7th generation of bonding agent, include reduced technique sensitivity and reduced number of clinical steps. The collapse of the collagen network and discrepancies occurring between the depth of etching and resin monomer infiltration is prevented, because monomers infiltrate concomitantly as the tooth structure is demineralized. Moreover, the mild self-etch adhesives leave hydroxyapatite crystals available for chemical bonding of functional monomers to calcium, which may contribute to the interface stability. But there are certain disadvantages of 7th generation. It is too hydrophilic and susceptible to degradation within hybrid layers leading to ineffective enamel and dentin adhesion. It leads to low bond strength, reduced bond durability and shelf life, increased micro leakage and nanoleakage.

In this study, we had chosen the microtensile test as it is considered the most reliable technique for

assessing the "true" interfacial bond strength between an adhesive material and the substrate of interest. The results of this study showed that Group A (Optibond S ,5 th generation) exhibited higher bond strength to dentin than G Bond, 7 th generation bonding system.

The good bond strength of Optibond S (5th generation) could be attributed to the fact that it has the highest filler loading (26%) among all 5th generation adhesives for enhanced strength. The filler has low elasticity that favours a stronger, more long-lasting bond by acting as a relatively flexible layer that absorbs stresses due to the contraction of the first layer of composite. This reduces the overall stress at tooth restoration interface and helps maintain marginal integrity. Another advantage of filled adhesive is that the filler is thick enough to eliminate the problem of inhibition by oxygen. It has ethanol as its carrier to make the adhesive less sensitive to the wetness of the acid etched dentin surface and therefore less technique sensitive.[14,15,16]

CONCLUSION

Thus, it appears that 5th generation bonding systems are better than 7 th generation bonding systems in terms of bond strength to dentin in-vitro. However,the results of in-vitro studies cannot be directly interpolated to the clinical scenario. Also, it also appears that other parameters, such as chemical interaction with the tooth surface and bond stability over the long-term, may be important for the long-term clinical success of bonded restorations. The results of the microtensile study should be complemented with microscopic observations and validated by the findings of in vivo trials.

CONFLICTS OF INTEREST

The authors declare they have no potential conflict of interests regarding this article.

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