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Original Article

EVALUATION OF SHEAR BOND STRENGTH (SBS) OF ORTHODONTIC BRACKETS BONDED WITH AND WITHOUT PRIMER – AN INVITRO STUDY

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ABSTRACT

Introduction: Primer usually is an unfilled resin whose primary function is to improve the effectiveness of the final bond. Secondarily,they also claimed to protect enamel from the consequent demineralization by the acid etching and to reduce marginal leakage. The use of primer adds a step in the bonding procedure which increased chair time, therisk of moisture contamination and an increased procedural cost.

Material and method : Eighty extracted human premolars ,were collected and divided into two groups that are conventional adhesive system with and without primer ,the teeth were cleaned and dried and stored in aqueous thymol solution, later acrylic blocks where made and the teeth where bonded with brackets with and without primer and then the shear bond strength (SBS) was done by using universal testing machine (UTM). **Results:**The shear bond strength (SBS) values were obtained in MPa for the 2 sample groups: group I (with primer), group ii(without primer) and the bond strength value was 10.22± 2.4 MPa and 9.11 ± 1.596 MPa respectively. **Conclusion:** A conventional adhesive system with and without primer bond showed shear bond strength (SBS) in the range satisfactory for clinical usage.

Introduction

Buonocore in 1955 introduces the acid etch technique which heralds a new era in adhesive dentistry, which has initiated varied applications in the field of dentistry including bonding of orthodontic attachments.1

Newman in 1965 introduced bonding orthodontic attachments to the tooth surfaces by means of an epoxy adhesive. This procedure improved overall treatment results by eliminating band occupying interdental spaces decreased gingival irritation and easier removal of plaque and decreased risk of calcification. [2]

Various dental adhesives and methods of bonding orthodontic attachments have been reported to enhance the bond strength of the orthodontic attachments by pretreatment of enamel surfaces[3]

Previous generation bonding systems used conventional adhesives that comprising of 3 different agents, an enamel conditioner, a primer solution, and an adhesive resin during the bonding of orthodontic brackets to enamel.[4]

The constant query for better bonding systems to reduce the technique sensitivity of the adhesion procedures, to improve the bond strength, to reduce the loss of enamel

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and to reduce the number of clinical application steps as well as chair side time has resulted in the innovation of many bonding agents. Fewer steps in the bonding process mean fewer human errors.[5,6]

Though composite resin has wide clinical acceptance because of various advantages. Several drawbacks have been reported which include loss of enamel during acid etching and debonding, enamel decalcification around brackets and lowered bond strength in the presence of water or moisture, incomplete polymerization.[7,8]

Also, leaching of the residual monomer has also been reported to have potent mutagenicity and estrogenicity.[9]

Flowable composites were marketed for bonding of brackets during the early 21st century. Flowable composite has advantage of clinical handling characters of non-stickiness, fluid injectabilityand shear bond strength comparable to that of traditional composite adhesives.[10]

Ostertag et al [11] designed an experimental study to evaluate the influence of adhesive filler concentration on bond strength, keeping the filler particle size constant. The results of that study indicate that there is an increase in shear and torsional bond strength with increasing concentrations of adhesive filler.

Some authors believe that charged particles in the composite resin limit the free flow of adhesive into the enamel pores, inhibiting the formation of resin tags.[12,13] others believe that the liquid phase of the composite is present in sufficient amount to flow into the conditioned enamel porosities and act independently of the charged particles. These workers use this as an explanation for the equal size of resin tags obtained when the composite resin or the sealant is applied directly to the conditioned enamel.[14,15]

Sufficient bond strength is a factor that contributes to the clinical success of orthodontic treatment and data collected after 24 hours have generally been used to measure the bond strengths of orthodontic adhesives.

MATERIALS AND METHOD

2.1 Methodology:

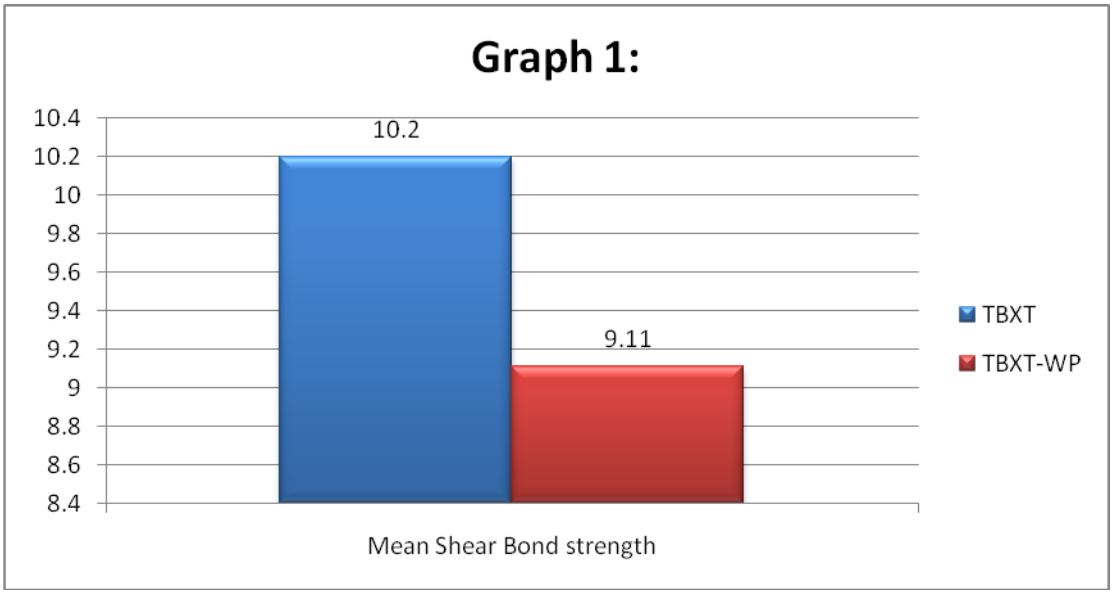
80 sound human premolar teeth indicated for orthodontic extraction were collected. These teeth were stored in 0.5% aqueous thymol solution after extraction to control bacterial growth. After selection, the teeth were rinsed thoroughly with distilled water. Each tooth was embedded in self-curing acrylic resin. The exposed buccal crown surface of each premolar was rinsed, dried after a 15-second polish with fluoride free pumice in a rubber cup and rinsed in distilled water. The enamel was dried with moisture free compressed air.

Later the teeth were divided into 2 groups with 40 teeth in each group (n=40).

In one group conventional adhesive system (Transbond XT) primer was gently rubbed onto the buccal surface of teeth and dried with moisture-freeair, using light cure adhesive, then the bracketswere bonded to the prepared enamel and excess adhesive was removed and light cured according to the manufacturer's instructions.

In another group, the same procedure is followed but without the use of a primer. The samples were to be used to test the shear bond strength of conventional composites (n=40x2=80) under the influence of early orthodontic forces.

After preparation, all specimens were stored indistilled water at $37^0$for 24 hours to simulate the oral environment. Shear Bond Strength (SBS) testing was carried out for 2 groups with auniversal testing machine (UTM) (Mecmesin10-*i*).



Graph 1: Comparison of shear bond strength (SBS)in two groups with mean values.

2.2 MECHANICAL TESTING:

The bond strength of these specimens was tested and with the help of a universal testing machine (UTM) (Mecmesin 10-*i*). A crosshead speed of 1mm/min was used to test the shear bond strength of the orthodontic adhesive. The specimens were secured in a special jig attached to the base plate of a universal testing machine. A chisel-edge plunger was mounted in movable crosshead of the testing machine and positioned so that the leading edge were aimed at the enamel-composite interface before being brought into contact. The load was applied to the incisal wings of each bonded bracket and parallel to long axis of each mounted tooth.

The load was applied till the bond failure occurred and the force required to debond the bracket were measured. The shear bond strength of each adhesive was recorded in kilogram force which was then converted into MPa, as it is a common SI unit generally referred for bond strength.

The load required to dislodge each bracket was recorded in kilogram-force, and shear bond strength (SBS) was calculated in megapascals (Mpa) by dividing the load by the cross-sectional area of the bracket base. The shear bond strength(SBS) was then calculated.

RESULTS

The study was aimed to compare the effect of shear bond strength(SBS) of adhesives with and without primer as shown in graph 1. The shear bond strength (SBS) values were obtained in MPa for the 2 sample groups(Group I, II)

Shear Bond Strength of the TWO Adhesives:

Group I: With primer application: The bond strength value was 10.22± 2.4 MPa .

Group II: Without primer application: The bond strength value was 9.11 ± 1.596 MPa. This difference was statistically insignificant (P≥ 0.05) confirmed by "Student t" Test as shown in graph 1

DISCUSSION

Direct bonding of the orthodontic brackets has been revolutionized and improved the clinical practice of orthodontic procedures. Traditional methods of bonding orthodontic brackets to teeth have relied on utilization of the acid-etch technique to achieve adequate retention. The early acidic primers were selectively compatible with certain adhesives and, as a result, either produced significantly lower bond strength or needed significantly more working time [3].To date, the conventional bracket bonding system, comprises an acid gel, a primer, and an adhesive paste. Conventional acid etch technique application was also the gold standard used in many shear bond strength (SBS) studies which assessed the orthodontic bonding effectiveness of the new products. In this study, the shear bond strength with primer is 10.22 ± 1.65 and without primer is 9.11 ± 1.52 both these results were subjected to "Student t-test" and p-value showed 0.074 which was not significant, indicating that there is no difference in shear bond strength with and without primer. The present research assessed the shear bond strength (SBS) of orthodontic brackets bonded with the conventional adhesive system (Transbond XT) with and without primer. The findings indicated that the use of without primer to bond orthodontic brackets to the enamel surface provided lower shear bond strength (SBS) values compared to bracket bonded with primer, in our present study were found to be near the clinically acceptable range recommended by Reynolds [16], who suggested a range of 5 to 8 MPa. A study was undertaken by O'Brien et al [17]found that no significant differences were detected between the bond strengths when an unfilled resin phase was utilized. When compared this results with our study it was found to follow the same results. Another study was done by Sarabjit Singh Nandhra et al [18]showed no significant difference in bond-up times. Bond failure was likely to happen more at the composite–enamel interface when bonded without a primer. The results which we got in our study was not co-relating with the present study as the study was carried out in the clinical set up when compared to our study which was carried out in-vitro. Another study was done by Farhan Bazarganiet al[19]where the results correlated with our present study.The conventional adhesive application was specifically developed for bonding orthodontic accessories to the enamel. The choice of the conventional orthodontic adhesive system as the group in this study was based on the results of several reports[20,21,22]confirming its effectiveness in orthodontic bonding. When the shear bond strength of adhesives without primer in the current study was compared with the conventional adhesive system, the latter showed consistently higher shear bond strength than the other group. In our study eighty, premolar extracted teeth were collected from the department of orthodontics and from the private clinics divided into two groups bonded with a conventional adhesive system that is with primer and without primer and tested for the shear bond strength. For all adhesive systems, statistically, insignificant difference was obtained in the sample with and without application of primer. These results indicate that conventional adhesive without primer can successfully bond orthodontic brackets. The favorable in vitro bond strength recorded in this study need to be confirmed by clinical studies and a prospective randomized controlled clinical trial with a split-mouth design and a larger sample size should be undertaken to confirm the suitability of these for orthodontic bonding purposes.

CONCLUSION

Based on the recorded data and the statistical analysis, the following conclusions were drawn from the present study.

A conventional adhesive system with and without primer bond showed Shear bond strength(SBS) in the range satisfactory for clinical usage.

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