www.djas.co.in
ISSN No-2321-1482

ORIGINAL ARTICLE

DJAS 2(II), 91-95, 2014

Dental JOURNAL
of Advance Studies

EVALUATION AND COMPARISON OF SHEAR BOND STRENGTHS OF SELF ETCHING PRIMERS TO DENTIN– AN IN-VITRO STUDY

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ABSTRACT
An in-vitro evaluation was done to compare shear bond strength of four self etching primer adhesives to dentin. 75 human extracted molar teeth were selected. The occlusal surface of these teeth was ground to remove coronal enamel and expose dentin. The dentinal surface of each tooth was then abraded using series of silicon carbide (320, 400, 600 grit) abrasive paper. Teeth were divided into 5 groups of 15 teeth each and composite post were then built on the bonded surfaces using Z-100 hybrid composite. The teeth were then fractured applying shearing load through universal testing machine. Shear strength values were in the range of 15.96 to 22.64 Mpa. Clearfil S3 gave highest mean shear bond strength whereas Adhe SE gave lowest value of shear strength. Based on this study it could be concluded that contemporary self etching primer adhesives bond successfully to dentin and also their bonding ability seems to be comparable to conventional total etch system.
Keywords: Dentin bonding, Self etching primers, Shear bond strength.

INTRODUCTION

Adhesive dentistry is a rapidly evolving discipline. It has revolutionized restorative dental practice during the past 30 years. Recent advances in resin adhesives and restorative materials as well as an increased demand for esthetics, have stimulated a great increase in the use of resin based composites in anterior and posterior teeth. Improved adhesive materials have made resin based composite restorations more reliable and long lasting. Well placed composite restorations provide an excellent alternative to traditional posterior restorations.

As substrates for bonding to composite resins, enamel and dentin behave very differently. Early attempts to bond to dentin resulted in poor bond strength.[1] This is not surprising given the fact that while ename[1] contains little protein, dentin has 17% collagen by volume. This collagen is inaccessible due to surrounding hydroxyapatite crystals.[2]

Early dentin bonding was further complicated by the presence of smear layer as adhesives bonded to the smear layer. Smear layer was a weakest link in the system because of its loose attachment to dentin surface. This layer gave away easily when polymerization shrinkage stresses were encountered and the adhesive bond failed. To overcome this problem, the subsequent dentin bonding systems employed an additional step of acid application, to either modify or remove the smear layer before application of the actual adhesive.

Conditioning of dentin surface with acids suffered lot of resistance. The technique of total etch, though gave good bond strength, showed improved retention of restorations, but was still technique sensitive in terms of multiple steps involved in the bonding process.

Hence self etching primers were developed in an attempt to simplify the bonding procedures and to prevent

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Received: 23rd May 2014
Accepted: 16th Aug 2014
Online: 20th Sept 2014

discrepancies between the depth of dentin demineralized by the acid and the ability of the primer to penetrate this demineralized layer.[3,4] The self etching primers are designed to etch through smear layers into the underlying dentin. They utilize weaker acids that have been shown to remove partially the smear layer, maintain the smear plugs and to create thin hybrid layers. These systems act by simultaneously conditioning, demineralizing and infiltrating both the enamel and dentin.[5] The smear layer is altered but not removed and rinsing is not indicated. As acidic monomers are responsible for etching and bonding, the depth of demineralization is equal to the depth of penetration of the monomers and clinically this corresponds to a reduced chance of postoperative sensitivity.

Currently there are several self etching systems available but little is known about their capacity to adhere to dental hard tissues. Since bond strength testing is used as a screening tool to help understand and predict the clinical behaviour of adhesives, this invitro study was designed to investigate and compare the shear bond strength (SBS) to dentin achieved with several self etching primer/adhesive systems.

AIMS AND OBJECTIVES

The aim and objective of this in vitro study is to evaluate and compare the shear bond strength of four self etching primer/adhesives to dentin.

MATERIALS AND METHOD

This study was conducted in the Department of Conservative Dentistry and Endodontics, KLES's Institute of Dental Sciences, in association with Department of Civil Engineering, Gogte Institute of Technology, Belgaum with an objective to evaluate and compare the shear bond strength of self etching primer adhesives (sixth generation dentin bonding systems) to dentin.

A total of seventy five non carious intact extracted human permanent maxillary and mandibular molars were selected for the study.

The teeth were thoroughly scaled and cleaned with a slurry of pumice powder and stored in saline solution at room temperature until use.

The teeth were then embedded in auto polymerizing acrylic resin in a rubber mold of 2x2 inch dimension. The teeth were then ground on a model trimmer to remove coronal enamel and expose adequate underlying dentinal surface for bonding. The exposed dentinal surface was then abraded with series of medium grit silicon carbide paper (320, 400, 600 grit Silicon carbide) in wet conditions. The samples were then stored in water for 24 hours at room temperature to assure full hydration of the teeth. The teeth were then randomly divided into 5 groups of 15 teeth each, that differed by the adhesive system used.

Group A – Adhe SE dentin adhesive
Group B – Adper prompt dentin adhesive
Group C – G bond dentin adhesive
Group D – Clearfil S3 dentin adhesive
Group E – Single bond dentin adhesive

The dentin adhesives were applied to the abraded surfaces strictly according to the manufacturer's instructions.

The composite resin was then bonded to this surface in 2 increments using the plastic matrix and cured for 40 sec each and additional of 20 sec after removal of matrix. The intensity of the curing light was constantly monitored with a curing radiometer and was in excess of 450mWcm2 throughout the study.

The matrices were removed from the teeth by slitting them with a Bard Parker blade along its length after the composite was set. The specimens were then stored in saline solution at room temperature for 24 hours.

After 24 hours, the teeth were subjected to thermocycling for 500 cycles between 50C to 550C (+ 10C) with a dwell time of 30 sec.

The specimens were then mounted on custom fixture for determination of shear bond strength using Universal testing machine. A knife edged chisel (0.5mm in cross section) was used to deliver the shearing force. The shearing load was applied at a speed of 0.2mm/min until fracture of the material occurred. The shearing force was noted and shear bond strength was calculated and recorded in Mega Pascal units.

RESULTS

Results derived from the study are tabulated as follows.

Table 1: Shear bond strength of the five groups to dentin in Mpa units

Specimen No.	Group A Adhe - SE	Group B Adper prompt	Group C G - bond	Group D Clearfil S3	Group E Single bond
1	16.48	19.43	15.16	20.02	18.40
2	17.66	20.31	18.69	24.20	15.45
3	15.45	17.66	15.31	23.99	22.96
4	15.69	16.16	17.06	20.60	20.60
5	16.37	18.84	14.72	22.78	17.81
6	15.31	23.25	19.43	22.08	19.13
7	15.04	20.75	14.72	19.57	18.99
8	15.60	22.37	18.69	24.73	18.25
9	17.40	19.57	16.78	21.19	19.72
10	14.86	20.90	14.86	21.90	16.78
11	16.48	16.93	19.28	20.60	21.34
12	15.89	15.60	15.60	19.13	18.10
13	17.37	19.13	18.69	22.96	20.02
14	16.34	21.19	17.07	21.34	19.43
15	16.63	20.02	14.86	232.96	19.57

Table 2: Statistical analysis of the shear bond strength of five groups of dentin adhesives was done by one way analysis of variance (ANOVA) and the following table was obtained.
ANOVA: Single factor

Source of variation	SS	Df	MS	F	p - value
Between groups	272.2	4	68.05	21.007	2.07x10 - 11
Within groups	226.756	70	3.2394		
Total	498.956	74			

SS- sum of squares, df- degree of freedom, MS- Mean sum of squares, F- Statistic F, p-value – 2.07 X 10-11
The very small value of P indicated that there was no homogenity among the means of the five groups.

DISCUSSION

The growing demand for esthetic restorations and the alleged toxicity of silver amalgam have stimulated intensive research focused on amalgam alternatives.6 Successful adhesion to hard tooth tissue is mandatory for the restoration of teeth with tooth coloured materials such as direct or indirect resin composites, ceramic inlays and veneers.[6]

The polymerization shrinkage of resin composites generates stress between bonded restoration and tooth, therefore shrinkage still remains the major antagonist to durable adhesion of resin composites.[6] A good marginal seal guarantees gap free margins and prevents microleakage, recurrent caries and pulpal irritation.[6]

Since its introduction, the enamel etch technique has provided an ideal surface for reliable bonding performance using adhesive resins. Success with approaches of bonding to dentin, however have been less reliable due to the characteristics of the dentin substrate, including high organic content, tubular structure variations and the presence of outward fluid movement.[6] Despite these difficulties dentin bonding has become more successful with the development of new dentin adhesive systems over the last 10 years.[6]

The use of self etching primers and adhesives is a recent approach towards the simplification of bonding techniques. This approach does not require rinsing and can be done in a two step method, combining the etching and priming functions or in a one step method, combining etching, priming and bonding functions. The rationale behind the use of the self etching systems is the formation of continuity between tooth surfaces and adhesive material, which is accomplished by the simultaneous demineralization and penetration of its agents. This could be an advantage compared to the claimed technique sensitivity of conventional total etch dentin bonding agents.[7]

According to the results obtained from the present study it was observed that group D (Clearfill S3) gave highest mean of shear bond strength compared to all the other groups.

Group B (Adper prompt) gave bond strength values similar to that of group E (single bond) control group.

Where as group A (Adhe-SE) and group C (G-Bond) gave lowest means of shear bond strength and was not statistically different from each other.

The highest mean of shear bond strength were obtained with group D i.e. (Clearfill S3 dentin adhesive).

The main objective of bond strength test is to establish a demonstrative value for how strong the bonding of an adhesive system is to dental hard tissues when composites are bonded the volumetric shrinkage that occurs under polymerization generates stresses on the bonded opposing walls in box like cavities. It has been stated that composite bond strength should be as high as 17 to 20 Mpa to resist this shrinkage stress.[8]

The in vitro methods used for evaluation of dentin adhesive have varied from one laboratory to another and wide variations in bond strength values are reported.[9] The variations in the values of in vitro bond strength indicate not only the complex nature of the testing procedures but also the sensitivity of handling and manipulation of these systems and the composite restorative material.

One among the many factors that may be responsible for large variations in shear bond strength values is the quality and structure of the dentin itself. Dentin factors affecting adhesion include the smear layer, dentinal tubule density, dentinal tubule length, size and content and sclerotic changes in the dentin.[9]

The result of the present study showed that there was significant difference in the in vitro dentin shear bond strength among the self etching primer adhesives tested, but there is no common factor which accounts for the differential performance of the systems tested. While in vitro testing is not a definitive predictor of clinical behavior, the Clearfill S3system generated values higher to, and Adper prompt system gave values similar to that of single bond total etch system that has had a long history of clinical success.

However due to the inherent limitation of an in vitro study, the bonding and sealing ability of these self etching adhesive systems to dentin warrant further investigation.

CONCLUSIONS

Based on the results of this study it appears that contemporary self etching primer adhesives bond to dentin successfully. Moreover the bonding ability of self etching systems seems to be comparable to the conventional total etch system.

However further long-term clinical evaluations are obviously necessary to confirm these observations and to decide if these systems can be seen as a good and adequate alternative to 5th generation products.

REFERENCES

1. MC Lean JW, Kramer IRH. A clinical and pathological evaluation of a sulphinic acid activated resin for use in restorative dentistry. Br Dent. J 1952;93:255-69.
2. Nakabayashi N, Kojima K, Masuhara E. The promotion of adhesion by the infiltration of monomers into tooth substrates. J. Biomed Mater Res 1982;16(3):265-73.
3. Haller B. Recent developments in dentin bonding. Am. J. Dent 2000;13(1):44-50.
4. Perdigao J, Lopez M. Dentin bonding – questions for the new millennium. J. Adhes. Dent 1999;1:191-209.
5. Perdigao J, Frankenberger R, Rosa BT, Breschi L. New trends in dentin/ Enamel adhesion (review). Am. J. Dent 2000;13(special No):25D-30D.
6. Frankenberger R , Kramer N, Petschelt A. Technique sensitivity of dentin bonding: effect of application mistakes on bond strength and marginal adaptation. Oper. Dent 2000;25(4):324-330.
7. Sensi LG, Lopes GC, Monteiro S Jr, Baratieri LN , Vieira LCC. Dentin bond strength of self etching primers/adhesives. Oper. Dent 2005;30(1):63-68.
8. Lopes GC, Marson FC , Vieira LCC, Andrada M, Baratieri LN. Composite bond strength to enamel with self etching primers. Oper. Dent 2004;29(4):424-429.
9. Leirskar J, Oilo G, Nordbo H. In vitro shear bond strength of two resin composites to dentin with five different dentin adhesives. Quintessence Int 1998;29(12):787-79

Source of Support: Nil, Conflict of Interest: None Declared