

COMPARATIVE EVALUATION OF SHEAR BOND STRENGTH OF A SELF-ETCH ADHESIVE SYSTEM AND TOTAL-ETCH ADHESIVE SYSTEM TO NORMAL HUMAN PERMANENT DENTIN WITH AND WITHOUT CARISOLV TREATMENT

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ABSTRACT

The purpose of this study was to evaluate the influence of carisolv on the dentinal bonding of self etch and total etch adhesive systems. Freshly extracted human premolars were prepared to obtain a flat surface. The specimens were divided into four groups. In group I & II composites were bonded to specimen using self etch adhesive system. In group III & IV composites were bonded to specimen using total etch adhesive system. Group I & III were bonded with composite without carisolv treatment. Group II & IV were bonded with composite after treatment with carisolv for 5 minutes. A statistically high significance was found between Group II & I. Group II > Group I. A statistically high significance was found between Group III & IV Group III > Group IV.

Maximum shear bond strength was seen in specimens that were treated with carisolv followed by bonding with self etch adhesive system, as compared to total etch adhesive system.

Key words: Carisolv, self etch adhesive system, total etch adhesive system

INTRODUCTION

Caries removal methods have undergone tremendous developments from hand rotated instruments (1728) to air turbine hand pieces (1957). The drawbacks of air turbine system include the unpleasant sensation and pain perceived by the patient. Local anaesthetics are frequently required that render the patients anxious.

The quest for search of an alternative method led to the introduction of the chemomechanical caries removal system. Carisolv (Mediteam, Gothenberg, Sweden) has been introduced. This system utilizes a mixture of sodium hypochlorite and three amino acids in a gel preparation and is used with hand instruments supplied by the manufacturers.¹

In the treatment of caries lesions in dentin, the morphology and nature of the dentin surfaces prepared by various methods influences bonding of the adhesive restorative materials.² It has been reported that chemo-mechanically treated dentin has a high surface energy than conventionally prepared dentin.⁵ This

implies that chemo-mechanically treated dentine may have greater affinity for adhesive materials and greater bonding than conventionally prepared dentin.

The bonding mechanism of self-etching primers is based on this simultaneously etching and priming enamel and dentin without rinsing, forming a continuum in the substrate and incorporating smear plugs into the resin tags.³

METHODOLOGY

Forty freshly extracted (for orthodontic treatment) caries free human premolars in the age group of 10-18 years were selected. The teeth were stored in saline and later cleaned ultrasonically. The specimens were prepared by mounting the teeth with their buccal aspect of the crowns exposed in acrylic block of 4.5 x 15.2 cms dimensions using autopolymerising acrylic resin. To obtain a flat dentinal surfaces, the buccal surface of all teeth were cut using a slow speed diamond disc and water spray and the exposed surface was polished with 600 grit silicon carbide paper.

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The specimens were divided into four groups of 10 specimens each.

	Material used	Manufactures
I.	Carisolv	Mediteam Dental AB Goteborgsvagen, 74, SE - 43363 Savdelen Sweden.
II.	Adhe Se	Ivoclar - Vivadent AG FL - 9494 Schaan / Lichtenstein
III.	Prime & Bond NT	Dentsply Detrey
IV.	Tetric Ceram	Ivoclar-Vivadent AG FL - 9494 Schaan / Lichtenstein
V.	Sure File	Dentsply Caulk
VI.	34% Tooth conditioner gel	Dentsply Caulk

Group	Bonding Agent
Group I + II	Self etch adhesive system (AdheSE)
Group III + IV	Total etch adhesive system (Prime & Bond NT)
Group	Carisolv Treatment Time
Group I & Group III	Nil
Group II & Group IV	5 minute

Group I

Self etch primer brushed on to the dentinal surface for 30 secs. Excess amount of primer displaced with strong stream of air until the mobile liquid film has disappeared. Bonding agent (AdheSE) applied and dispersed with a weak stream of air. Bonding agent polymerized for 10 secs using curex lite light curing unit.

Group II

Carisolv Application

Carisolv is composed of two solutions red gel contains 0.1M Amino acid (L glutamic acid, L-Leucine and L-Lysine), Nacl, NaoH, erythrosine, and purified water. Clear liquid contains 0.5% Naocl.¹

The two gels are available in a New Twin syringe mixing system. The syringe stored in a refrigerator at 4°C is allowed to return to room temperature prior to use. The Syringe is fitted with disposable auto mixing tip and pressure applied, the two solutions are premixed and required amount is dispensed into a dappen dish.

The gel is then applied on the prepared dentin surface and gently agitated using a flat shaped hand instrument for 5 minutes and then air water rinsed and air dried. Self etch adhesive is then applied as described in group I.

Group III

The specimens were acid with 34% phosphoric acid (Tooth conditioner, Dentsply/caulk) for 15 secs and then rinsed with water for 10 secs. The excess water was removed by blotting with a tissue paper, leaving the dentin visibly moist. Bonding agent (prime and bond NT) was then applied to the dentin surface in copious amounts, leaving the surface wet and undisturbed for 20 secs. The adhesive was gently air-dried for 5 secs and light cured for 20 secs.

Group IV

Specimens were treated with carisolv for 5 minutes as described in Group II. Total etch adhesive system is applied to the prepared surface as described in Group III.

All treated specimens in group I and II were bonded with tetric ceram and group III and IV with surefil, using the specially designed devices.

Two special devices were made for placing the composite resin over the prepared dentinal surfaces of the specimen.

The bond strength was calculated using the formula.

$$\text{Bond strength} = \frac{\text{Breaking Load}}{\text{Surface area of bonding}} \frac{\text{Kg}}{\text{mm}^2}$$

$$\text{Kg/cm}^2 \times 0.09807 = \text{Mpa.}$$

The results were statistically analysed

RESULTS

The shear bond strengths of 4 groups were tested on Instron universal testing machine. The load at which bone failure occurred was recorded in kilograms and bone strength was calculated using the formula.

Statistical Analysis

The data were analysed in a completely random design (one-way Anova) and found significant when $P < 0.05$ and highly significant when $P < 0.001$. The groups were compared using critical difference (CD).

TABLE 1: MEAN, STANDARD ERROR OF MEAN OF GROUPS I TO IV

Groups	A		B		A & B	
	MEAN	SEm	MEAN	SEm	MEAN	SEm
I	16.657	0.7658	11.097	0.5722	13.877	0.6690
II	24.002	1.5036	8.697	0.8225	16.3465	1.1631
MEAN	20.3295		9.897			
SEm	1.1347		0.6974			

Results of statistical analysis

Comparing the data of Group I and Group II, a statistically very high significance between Group II and Group I ($P < 0.001$) was found.

Group II > Group I

Comparing the data of Group III and IV, a statistically very high significance was found between Group III and Group IV.

Group III > Group IV

DISCUSSION

Carisolv is available in gel form and there is better contact with the carious lesion.²⁰ Chemo mechanical caries removal by carisolv exposed dentin adjacent to carious lesion.²

Carisolv usage requires a good deal of time. Ericson et al⁴ after a clinical study reported that complete caries removal using carisolv takes around 10.4 (\pm 6.1 mins).

Hence in this study the application time of carisolv to prepare dentinal surfaces was taken as 5 minutes, the approximate minimum time taken in a clinical situation. Thus the effects of carisolv in typical clinical treatments may be even pronounced than revealed in this investigation.

In the total etch technique, the biggest challenge for the hybrid layer and resin tag formation is considered to come in the form of a smear layer. Unless the smear layer is removed, neither hybridization nor resin tag formation can occur. Hence it becomes necessary to acid etch the dentin to remove the smear layer and smear plug.⁸

Total etch had certain disadvantages like increase in dentin wetness, potential for denaturation of collagen, discrepancy between depth of demineralization and depth of resin penetration. These led researchers to develop a new system called self etching adhesive system, which penetrated through the smear layer into

the underlying intact dentin to form both the hybridized smear layer and hybridized dentin.¹⁸

AdheSE (Ivoclar – Vivadent) a new self etch adhesive system was used in this study.

Advantages of Self etch adhesive systems over total etch adhesive system¹

Saves time, controls decalcification and hybridization of dentin and shows no risk of incomplete infiltration of etched dentin.

The results of shear bond test concluded that group II (24 Mpa) was significantly higher than group I (16.66 Mpa). Wennerberg¹⁹ demonstrated that carisolv when in contact with normal dentinal surface for 20 secs resulted in increased surface roughness.

Watanabe and Nakabayashi⁶ found that tensile bond strength of self etch adhesive systems to smear covered dentine depended on how the smear had been prepared, that is the difference in their amounts and mechanical properties reflected the hybridization of the smeared layer.

Koibuchi⁵ demonstrated that bonding of a self etch adhesive system to a smooth thin smear layer (600 # grit) yielded excellent bonding compared to thick, coarse smear layer (180 # grit) covered dentinal surfaces.

Hosoya et al⁷ found on observing through scanning electron microscope that normal dentin surface treated with carisolv for 3 minutes, had smear layers partially covering the dentin. The increase in bond strength of group II, could be attributed to the increased effectiveness of the acidic primer in the presence of partially dissolved smear layer.

The SEM analysis undertaken in this study confirmed the presence of smear layer partially removed from the dentinal surface in group II specimen.

Group III had significantly higher values compared to Group IV.

Katakawa treated dentin with 6% Naocl for 1 minute followed by etching with 10-3 solution for 30 secs on bovine permanent dentin and found that bond strength decreased significantly.

Hosoya⁵ found the bond strength to primary human dentine treated with carisolv for 3 mins followed by etching with 10-3 solution decreased significantly. He suggested that though the percentage of sodium hypochlorite in carisolv is 0.25% after mixing the solution which is much lower than that used in the study by Katakawa⁹, the carisolv contains other chemical components and the treatment time was 3 times longer. Hence he concluded that decreased bond strength could have been due to degradation of dentinal collagen.

Hosoya⁷ observed that on etching dentin treated with carisolv for 3 minutes resulted in dentinal tubules that were widely opened and mesh like structure was observed in the intertubular dentin.

Sakoolnamarka⁸ et al demonstrated that dentinal surfaces etched with 35% phosphoric acid following carisolv treatment led to porous irregular intertubular dentin. He suggested that this difference in morphology from that of the dentin acid etched without carisolv treatment would probably be the result of high PH (11) of carisolv and the sodium hypochlorite in gel would have caused some change to the dentin, especially collagen.

Perdigao et al⁹ suggested that depth of demineralization may not be important factor for dentin adhesion, the quality and/or integrity of the collagen available for resin infiltration may be of fundamental importance for adhesion. The loss of quality and integrity of collagen and the porous, eroded intertubular dentin may be the reason for the decreased bond strength exhibited by group IV.

SEM analysis of group IV specimen confirmed the presence of widely opened dentinal tubules and porous, eroded intertubular dentin. From this study it can be concluded that normal dentin in contact with carisolv tend to produce a higher bond strength with self etch adhesives compared to the total etch systems.

CONCLUSION

Maximum shear bond strength is seen in specimens that were treated with carisolv for 5 minutes and

bonded with a self-etching adhesive system. Bond strength tend to decrease when dentin treated with carisolv for 5 minutes is bonded with a total etch adhesive system. Readers may also like to examine the studies done by Doglas C, Marcelo T, Fatma El-Shehaby on this topic.^{9,10,11}

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