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Shear Bond Strength of Composite Resin on Exposed Dentine Surface Using Vth Generation Bonding Agent With And Without Hybrid Layer –An in Vitro Study & SEM Analysis

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Abstract: *The purpose of this study is to remove the collagen layer left back after acid conditioning with 5% sodium hypochlorite and subsequent bonding onto partially demineralised dentine thereby producing more durable adhesion to the hydroxyapatite component of dentine substrate. Twenty recently extracted premolar teeth were divided into 2 groups of 10 teeth each. The enamel on the occlusal surface of teeth was ground to expose dentine and the surface was made flat. The teeth were prepared so that only the crowns remained and embedded in self cure acrylic resin. Each of the prepared 20 teeth were individually embedded in rectangular blocks of self cure acrylic resin. In one group Single bond (3 M) adhesive was used to bond the composite specimen after acid conditioning of the dentinal surface and in the other group acid conditioning was followed by Sodium hypochlorite treatment of the dentinal surface. The test specimens were subjected to Hounsefield tensometer, type W horizontal 2 ton to test the shear bond strength.. The present study concludes that acid conditioning followed by 5% NaOCI treatment creates a dentine substrate which provides more shear bond strength for the Vth generation Single bond adhesive.*

Keywords: *single bond, hybrid layer, hypochlorite, shear bond strength.*

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I. Introduction

The possibility of bonding restorative materials to dentin and enamel has intrigued the dental profession for many years. The stability of the bond between composite resin and dentin is of critical importance for longevity of the restoration.

Several current dentin adhesives rely on the permeation of hydrophilic monomers into acid-etched moist dentin; subsequent polymerization creates a transitional zone of resin reinforced dentin called "hybrid layer" or "resin-dentin interdiffusion zone" which was first described by Nakabayashi in the year 1982. [1]Optimal bond strength is derived from complete resin penetration of chemically altered dentine. It has been suggested that dentine bonding agents do not fully diffuse through the collagen network that remains after acid conditioning of dentine. Failure to adequately penetrate the collagen network into the partially demineralised dentine may produce a weak porous layer of collagen protected neither by hydroxyapatite nor encapsulated by resin. Subsequent hydrolysis of exposed collagen fibrils would lead to degradation of the dentine - resin bond resulting in decreased bond strength and increased micro leakage over time[2].

Recent studies are concentrated on removing this collagen network completely thereby preventing the formation of unsupported collagen fibrils.Removal of organic collagen following acid conditioning and subsequent bonding onto partially demineralised dentine layer may produce more durable adhesion to the hydroxy apatite component of the dentine substrate Sodium hypochlorite is a non-specific proteolytic agent that effectively removes organic compounds at room temperature[3]. A "reverse hybrid layer" has been shown to form when this technique is applied to sound dentin, and bond strength assays using this technique have shown system dependent high-bond strength values. [4] The purpose of this study is to remove the collagen layer left back after acid conditioning with 5% sodium hypochlorite and subsequent bonding onto partially demineralised dentine thereby producing more durable adhesion to the hydroxy apatite component of dentine substrate. The study was undertaken to evaluate the shear bond strength of a Vth generation resin to dentine with and without hybrid layer and also to examine the interdiffusion zone under SEM."

II. Review of literature

Nakabayashi and others [2] have suggested that the demineralised zone should be kept to a minimum to reduce possibility of long term bond degradation caused by incomplete penetration of resin through collagen network. Recent studies are concentrated on removing this collagen network completely thereby preventing the formation of unsupported collagen fibrils. Many studies undertaken to study the effect of removal of surface collagen fibrils on resin dentine bonding have concluded that acidic conditioners used for exposing collagen matrix results in the formation of a soft delicate mesh of collagen that can collapse preventing resin infiltration.[4].Another study evaluates the effect of NaOCI on shear bond strength and morphology. Bond strength were compared following acid etching and NaOCI wash and higher shear bond strength was shown when NaOCI is used following etching. In these cases it is proposed that adhesive interacts with mineral phase of dentin strongly.[5]Several other studies conducted has showed that collagen removal improves bond strength for acetone based adhesives system[6].

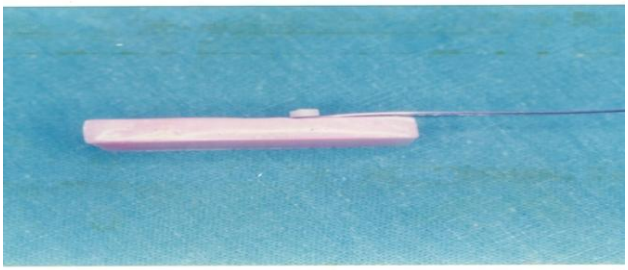
III. Materials And Methods

Twenty recently extracted premolar teeth for orthodontic purpose were obtained for the present study. The teeth were thoroughly cleaned and used within one month of extraction and storage.

Equipment and Accessories used in the study .

1. A circular Teflon mold of height 2 mm on which two circular holes of diameter 3.4 mm were punched.
2. A loop made of stainless steel wire of gauge 23 mm.
3. A rectangular mold of dimension 4 cm x 2 cm x 0.6 cm made out of mild steel.
4. Hounsefield Universal Testing machine.

SPECIMEN SHOWING MATERIAL BONDED TO CONDITIONED DENTIN



WIRE LOOP CONTOURED AROUND BASE OF CYLINDER

Fig-I - Resin bonded to conditioned Dentine.

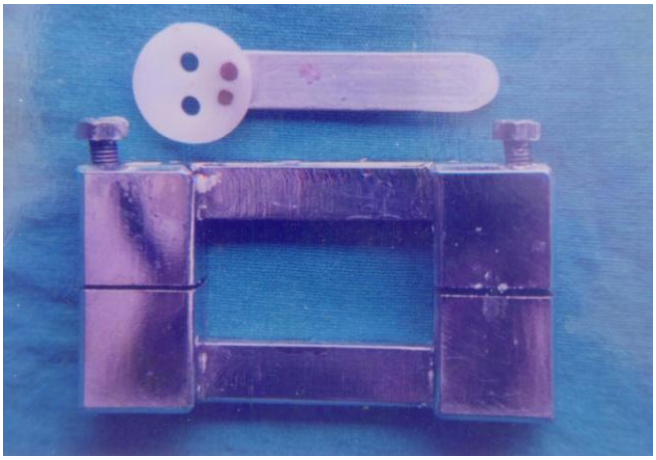


Fig- 2- Teflon Die

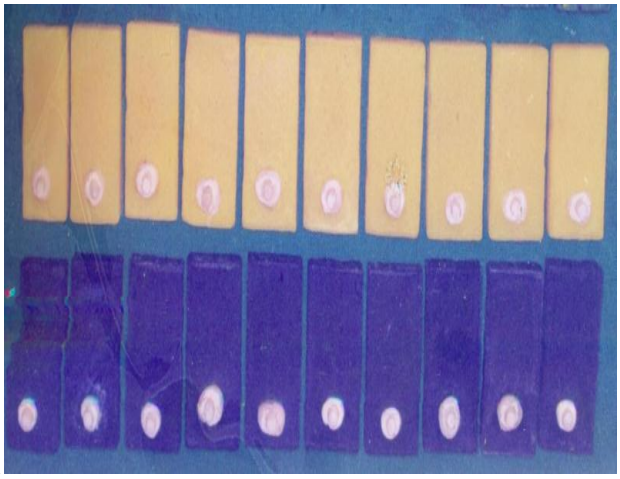
i 

Fig- 3- Prepared specimens

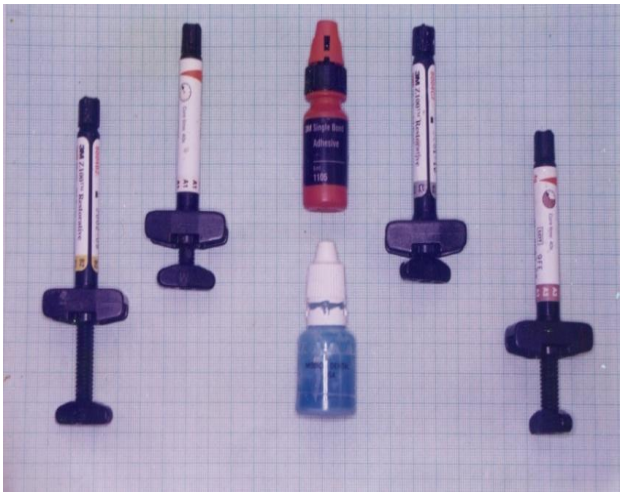


Fig- 4- Single bond Adhesive (3M) and Z-100-Composite Resin

3.1 Preparation of Specimen

20 Teeth wee divided into 2 groups of 10 teeth each.

Group 1 Single bond (3 M) adhesive was used to bond the composite specimen after acid conditioning of the dentinal surface.

Group 2 Single bond (3 M) adhesive was used to bond the composite specimens after acid conditioning followed by 5% Sodium hypochlorite treatment of the dentinal surface.

The enamel on the occlusal surface of the experimental teeth in group I and II were ground to expose dentine. The exposed dentine was made into a flat surface using standard diamond disks and points uniformly. The teeth were sectioned below the cervical line and only the crowns remained. A rectangular mould of dimension 4 cm x 0.6 cm was utilized to embed the prepared tooth in self cure acrylic resin. Each of the prepared 20 teeth were individually embedded in rectangular blocks of self cure acrylic resin with the dentine on the occlusal surfaces exposed. All specimens were stored in buffered saline solution.

3.2 Method

The stored specimens were retrieved and the dentinal surfaces were cleaned with slurry of pumice using a rubber cup. All the 20 specimens were then washed with water under air pressure and then dried with air from an oil free air source.In experimental group I, The dried dentin surface was treated with phosphoric acid gel etchant (37%) for 15 seconds, rinsed with water for 30 seconds and dried optimally to remove excess water leaving back a moist surface. Single bond adhesive was applied according to the manufacturer's instructions.

The excess solvent was removed with air syringe and light cured for 10 seconds. For optimal results a second layer was applied and solvent removed immediately and light cured for another 10 seconds.

The Teflon mould was located at the predesigned location. With the help of a cement carrier composite resin (Z 100 composite resin) was artfully teased into the circular punch hole to obtain a cylinder of diameter 3.4 mm and height 2 mm. The composite was then light cured for 40 seconds. Once the composite was cured the Teflon mould was gently lifted out.In experimental group II the dried dentine surface was treated with 37% phosphoric acid gel for 15 seconds. After etching these specimens were treated with 5% sodium hypochlorite for 2 minutes, then rinsed and dried to remove excess water. After this Single bond (3M) bonding agent was applied on to the dentinal surface. Oil free air was blown gently to remove excess solvent. This layer was polymerized for 10 seconds. For optimal bonding a second layer of bonding agent was applied, excess solvent removed quickly and polymerized for another 10 seconds. Following this the Teflon mould was located at the pre designed location. With the help of a cement carrier composite resin was artfully teased into the punch hole of the above mentioned dimension. The composite resin was cured for 40 seconds. After polymerization the Teflon mould was gently lifted out. The teeth in the different groups were labelled and acrylic blocks colored for reference. All the 20 test specimens were stored under humid conditions and kept in an incubator at 37° C for 24 hours.

3.3 Testing Shear Bond Strength

\The mounted prepared tooth was held in one grip of the shear chuck available especially for testing shear bond strength. The inner surface of configuration of the shear chuck is so contoured as to hold firmly the acrylic block in which the test specimen is embedded. The wire loop was contoured to hold the base of the cylinder. The two parallel arms of the wire loop were then held in the other grip of testing shear chuck. Care was taken not to unnecessarily tense the wire. The loading was done incrementally until the shearing of composite cylinder from the dentinal surfaces occurred..All specimens were sectioned vertically to expose the resin/dentin interfaceThese specimens were further polished with 60µm, 15µm and 5 µm grit sand paper. Further refined by polishing over ground glass in presence of pumice. After polishing specimen were immersed in 10% orthophosphoric acid for 15 seconds. This was followed by rinsing for 15 seconds in water. The specimens were further treated with 10 % NaOCI for 2 minutes. Fixation followed with the help of 2% gluteraldehyde. After fixation the specimens were dehydrated in an ascending ethanol solution followed by storage in air tight containers.

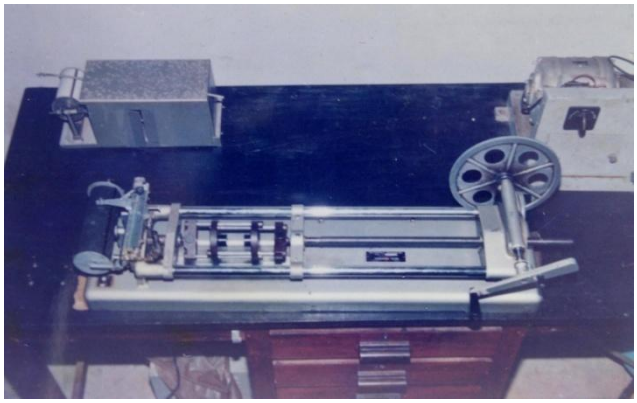


Fig-5-Hounse Field Tensometer

3.3 Equipment Operation Details

The equipment was adjusted to operate on a load range of 0-30 kgs. A cross head speed of 0.5 mm/minute was used. The breaking load was measured by tabulating the increase in mercury column provided by the mercury scale. The breaking shear loads in kilograms were then converted into bond strength in mega Pascal's.

3.4 Specimen Preparation for SEM Study

SEM study was carried out to confirm the effect of 5% NaOCI exposure on acid conditioned dentinal surface. Specimens both with 5% NaOCI wash and without 5% NaOCI wash were prepared and bonded with Single bond (3 M) adhesives . Two specimens from each group (same as previously mentioned) were prepared and evaluated under SEM.Freshly extracted premolar teeth were ground to expose dentine. The exposed tooth surface was cleaned with pumice slurry and dried later. Acid etching was carried out using 37% phosphoric acid gel for 15 seconds. In group I - the acid conditioned dentinal surface was rinsed with water for 30 seconds and air dried optimally for 15 seconds to leave back a moist surface. Single bond [3M] was applied and light

polymerized for 20 seconds. Composite resin was applied flat over the entire dentinal surface alone and cured for 40 seconds.

IV. Results And Observations

The shear bond strength of composite resin to exposed dentinal surface with and without hybrid layer using Single bond (3M) adhesive was evaluated. 20 specimens were collected and grouped into 2 groups for the purpose of this study. Table I - represents the shear load in kilograms required to shear off the composite material from the prepared occlusal dentinal surface. Table II - Represents shear bond strengths in MPa.
Graph I - Shows comparison of shear bond strength among the groups. According to the results summarized, Group I (Single bond without NaOCI treatment) showed the lowest bond strength, 17.3150 Mpa. when compared to that after Naocl wash.(20.0280).Students t test carried out to find out the standard deviation and significance of the study. The study was statistically significant($p<0.001$)

Table -I

Hear Bond Strength In Kg -Single Bond

Sl. No.	Single bond (KG)	Single bond (NaOCI wash)
1	15.33	19.6
2	14.481	16.75
3	16.259	18.8
4	16.6	15.703
5	14.5	17.6
6	16.453	19.1
7	15.5	18.9
8	18.8	19.1
9	15.77	18.9
10	16.629	21.0

Table-II

Shear Bond Strength In Mpa -Single Bond

Sl. No.	Single bond (Mpa)	Single bond (NaOCI wash)
1	16.56	21.16
2	15.64	18.09
3	17.56	20.30
4	17.93	16.99
5	15.66	19.0
6	17.77	20.62
7	16.74	20.41
8	20.30	20.62
9	17.03	20.41
10	17.96	22.68

Table-III

Groups	N	Mean	Standard deviation	Standard error
SBS1	10	17.3150	1.35393	.42815
SBS2	10	20.0280	1.61326	.51016

Shear Bond Strengths In Mpa

Formula for conversion into MPa $= \frac{\text{Load}}{\text{Area}} = \frac{(\,)\ \text{Kgs x 9.8 (Newton)}}{\pi(d/2)^2}$

$= \frac{(\,)\ \text{Kg x 9.8}}{9.8\ \text{mm}^2} = \frac{\text{Newton}}{m^2}$

$= (\,)\ \text{Kg x } 1.08 = (\,)$

student t test

Group statistics

Table - IV

	Levene's Test For Equality Of Variances		T Test For Equality Of Variances		
	F	Sig	T	Df	Sig(2-Tailed)
SBS1 Equal Variances Assumed	.257	.618	-4.074	18	.001
Equal Variances Not Assumed			-4.074	17.474	.001

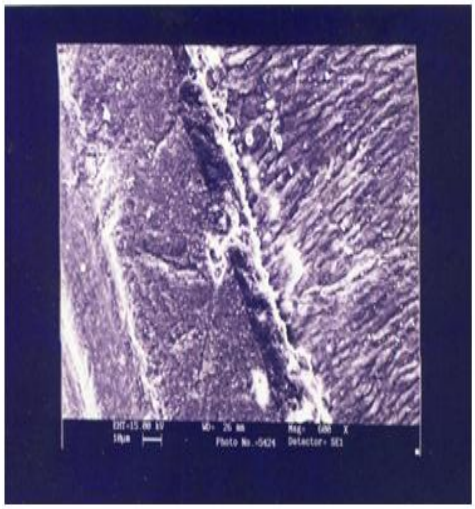


Fig-6-SEM Photograph showing resin –Tooth Interdiffusion Zone after 5% NaOcl

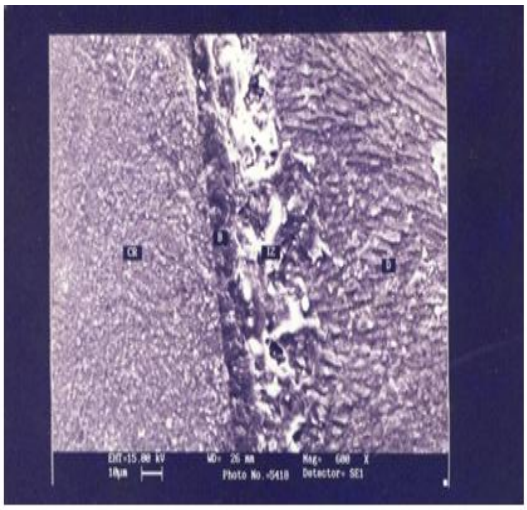


Fig-7- SEM Photograph showing resin –Tooth Interdiffusion Zone without 5%Naocl

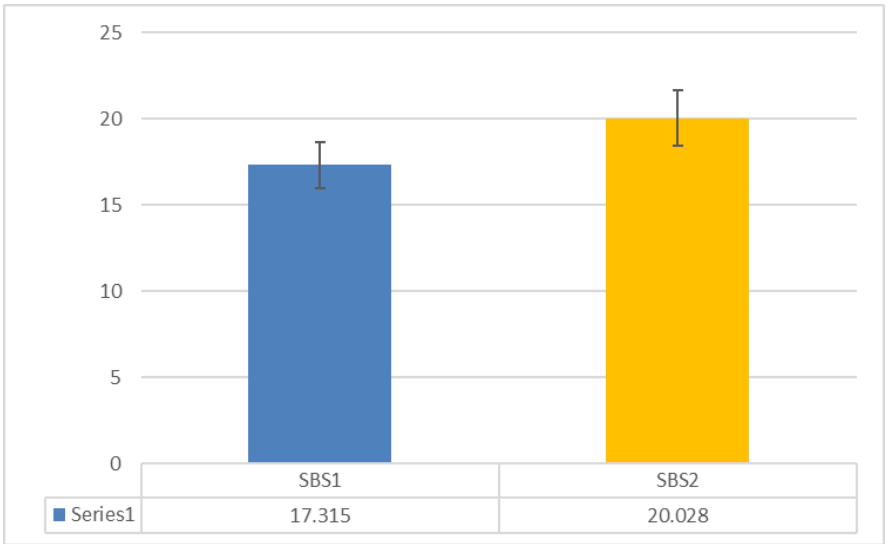


Fig-8 Graph showing comparison of shear Bond strength between Group I and Group II .

V. Discussion

After observing the industrial use of Phosphoric acid to improve adhesion of paints and resin coatings to metal surface, Buonocore [7] in 1955 applied acid to teeth to render the tooth surface more receptive to adhesion. This brought about the concept of enamel bonding. Phosphoric acid was used to etch the enamel to attain micromechanical bond between the resin and tooth structure. Enamel bonding was used with high degree of predictable clinical success from those days itself. The first bonding agent marketed for this technique were unfilled Bisphenyl - A - Glycidyl di methacrylate (Bis-GMA)[7]. These early bonding agents reported to provide shear bond strength in the range of 18 to 21 Mpa10.Unlike enamel bonding, dentine bonding is considered to be more difficult to attain clinically because of many reasons. The exact nature of this bond is unknown; whether it is primarily chemical, micromechanical or a combination of both is a matter of debate. It is well known that dentin has relatively high organic and water content (inorganic -70%, organic - 18% and water 12%) which inevitably complicates bonding procedures[8]. In addition the morphology and compositional nature of dentine is highly variable . Apart from these factors the presence of smear layer on dentinal surface and the pulpal response towards these materials further complicates dentine bonding procedures[8]. Finally the polymerization contraction shrinkage of composite resin materials results in formation of gaps at the resin - dentine interface. This in turn causes ultimate bond failure leading to loss of restoration or marginal leakage

with recurrent cervico- gingival marginal caries . Only recently have dentine adhesive systems produced laboratory results that approach those of enamel bonding and achieve a predictable level of clinical success.

Dentine adhesion is considered to work on the following strategies-

1. Bonding via resin tag formation in the tubules of conditioned dentine.
2. Formation of precipitate on pre - treated dentine surface followed by chemical or mechanical bonding.
3. Chemical union to either organic or inorganic component of dentine.

Hybridization of dentine is a process that creates a molecular -level mixture of adhesive polymers and dental hard tissues.Intact mineralised dentine does not permit monomer resin diffusion in clinically relevant time periods. Therefore the dentine has to be suitably conditioned to create channels between collagen fibrils to allow monomers which have good affinity for demineralised dentine to diffuse into the substrate. This demineralization permits diffusion of monomers into these hard tissues (enamel and dentine) to form what is called the "Hybrid Layer". Briefly the substitution of resin for mineral in the subsurface of mineralized tissues is the essence of the creation of a hybrid layer[9].Fifth generation bonding agents combined the priming and resin application steps to achieve bonding with one component resin formula. Similar to 4tn generation bonding agents the 5tn generation bonding agents rely on hybridization to achieve adhesion. These materials generally rely on residual moisture in dentine and hydrophilic water chasing composition to effect resin penetration. The bonding agent contains BISGMA., BPDM (Biphenyl dimethacrylate) and HEMA in an acetone solvent carrier. Some other formulations may contain PENTA (Phosphate adhesion promoter) TEGDMA and an elastomeric UDMA resin in acetone. Mean shear bond strength achieved exceeded 20 MPA. One bottle systems simplify the clinical procedure by reducing the bonding steps and thus the working time.Current theories on dentine bonding suggest that 2 fundamental processes are involved in bonding an adhesive to dentine-

1. First the mineral phase must be extracted from the dentine substrate without damaging the collagen matrix;
2. The micro spaces left back by the mineral must be filled with an adhesive resin that penetrates the exposed
3. collagen fibril network into the underlying partially dematerialized dentine[10].

Optimal bond strength is derived from complete resin diffusion into the chemically altered dentine. It has been suggested that dentine bonding agents do not fully diffuse through collagen network that remains after acid conditioning of dentine. Incomplete resin infiltration of the demineralised dentine can leave the exposed collagen at the dentine - adhesive interface supported neither by the resin nor by dentine[12]. This naked collagen may be penetrated and degraded by various exogenous substances including bacterial proteases.

Invitro and in vivo studies have proved that incomplete penetration of dentine adhesive via a hybrid layer leads to hydrolytic breakdown, micro leakage and premature failure of resin composite restoration[13]. study. Nakabayashy (1992) and others have suggested that demineralised zone be kept to a minimum to reduce the possibility of long term bond degradation caused by incomplete penetration of resin through collagen network[11]. Removal of organic collagen layer following acid conditioning and subsequent bonding directly to partially demineralised dentine layer may produce more durable adhesion to the hydroxyapatite component of the dentine substrate. This deproteinization can be carried out by exposing the collagen to sodium hypochlorite[4]. In the present study Vth generation bonding agent namely Single bond (3M) was chosen for the study. SEM evaluation was also carried out to study the dentine adhesive inter - face with and without hybrid layer. Single bond consist of HEMA, BISGMA and dimethacrylate resin and a unique methacrylate functional co - polymer of poly acrylic and polyitaconic acid in water and ethanol solvent base.

In the present study we utilized the occlusal dentine after grinding the enamel to an area slightly beyond the dentin enamel junction to an extent that all enamel was removed and only dentine remained to come in contact with testing materials.There does not seen to be a major controversy related to site of bond testing to teeth because molars or premolars are used for bonding to occlusal dentine. It has been found that higher bonding values could be generated using superficial dentine but more consistent results were obtained at depths above the pulp horns. Several other studies showed that the common depth of dentine was 1.5 mm below DEJ.

Twenty teeth were divided into four groups of ten teeth each.

Group I. Exposed dentinal surface was acid etched with 37% phosphoric acid gel for 15 seconds followed by rinsing for 30 seconds. Drying was done with oil free air in such a manner not to desiccate the dentine leaving back a moist surface. Single bond (3M) adhesive was applied and cured for 20 seconds followed by application of composite resin which was light cured later for 40 seconds from all sides. Mean shear bond strength attained was about 17.3150 Mpa which is in accordance with the average bond strength required i.e 17 Mpa.

Group II: The specimens were acid conditioned with 37% phosphoric acid gel for 15 seconds followed by rinsing for 30 seconds. The acid conditioned dentinal surface was exposed to 5% NaOCI for 2 minutes. This was followed by a rinsing and optimal drying. Drying was done in such a manner that a moist surface was left

back. Single bond adhesive was applied and cured for 20 seconds. Composite resin of the afore mentioned dimensions were applied and polymerized for 40 seconds from all sides. Mean shear bond strength attained for this group was 20.0820 Mpa.

Bonding to dentine relies on the penetration of adhesives into the collagen fibres (Poly peptides) and encapsulation of irregular hydroxy apatite crystals at the bottom of the decalcified area to create a resin - reinforced interdiffusion zone called the "hybrid layer".Concerns have been raised that dentine bonding agents do not fully diffuse through collagen network that remains after acid conditioning. Hydrolysis of these bands of exposed collagen not protected either by resin or by dentine would occur with long term exposure to water. This leads to deterioration of adhesion between resin and dentine resulting in decreased bond strength. Therefore attempts were made to remove the collagen completely and bond the resin directly onto partially demineralised dentine. A two minute exposure of 5% Sodium hypochlorite solution was found to satisfactorily wash of the collagen fibres.In this study the teeth were divided into 2 groups-Group I utilized fifth generation bonding agent namely Single bond without 5% NaOCI treatment after acid conditioning. Group II used the same bonding agents i.e. Single bond with a two minute exposure of dentinal surface with 5% NaOCI after acid conditioning.Shear bond strength values obtained showed that groups exhibited bond strength of 18.5530 Mpa without NaOCI wash.When exposed to 5% NaOCI for 2 minutes Single bond adhesive exhibited bond strength values of 20.0280 Mpa .The study indicates that bond strength values were considerably higher when the collagen layer after acid conditioning was removed with 5% NaOCI.This deproteinization of dentinal surface done after acid conditioning has found to be a better substrate for bonding in the case Single bond . Studies have been carried out with different percentages of NaOCI like, 1.5% of NaOCI for 2 minutes and 5% NaOCI for two minutes. Both have shown to eliminate the collagen layer left back after acid conditioning. Here in this study the specimens were exposed to 5% NaOCI for two minutes after acid conditioning[4].

SEM evaluation conducted with regard to this deproteinization achieved by NaOCI shows that the morphology of acid etched and deproteinized dentine was completely different from the dentine acid etched alone. Studies have demonstrated that the diameter of open dentinal tubules increased from 1.8 to 4 u m after 10% NaOCI wash. It was found out that diameter of tubule orifices increased after NaOCI treatment of acid demineralised dentine due to loss of peritubular dentine. The diameter of the lateral branches of tubules also increased and became more numerous than with a conventional etching procedure[4]. According to the present study, for Single bond the acid etched and deproteinized dentine surface may represent a more suitable bonding substrate.In "reverse hybrid layer" formation acid conditioning removes the smear layer and exposes the collagen fibres of the dentine matrix. This is followed by application of NaOCI which not only removes the exposed collagen fibres but also solubilises the fibrils down into the underlying mineralized matrix to create submicron porosities within the mineral phase. Cylindrical channels (0.1µm in diameter) previously occupied by collagen fibres are now available for resin infiltration within the mineralized matrix[13].The shear bond strength of resin to dentine depends in its ability to distribute stresses within the bonded assembly. Stress distribution in turn depends upon the mechanics of testing procedure and the mechanical properties of the substrate[4].Acid etching of mineralized dentine decreases its modulus of elasticity from a relatively stiff 17 GPA to a very low of 5 Mpa due to the removal of apatite crystals. Infiltration of resins into demineralised dentine partially restores the stiffness of matrix to a level of about 2 -6 Gpa. The higher apparent bond strength of may be due to improved mechanical properties of the substrate as well as the increased diameter of resin tags in dentinal tubules.Research studies are underway regarding this concept of bonding. Studies conducted by C. Prati, S. Chersoni and D.H. Pashley [4] on the effect of removal of surface collagen fibrils on resin - dentine bonding showed that high bond strength can be obtained via "reverse hybrid layer" phenomenon caused by acid etching followed by NaOCI treatment when fifth generation bonding agents were used.

Similar studies were carried out by M. A. Vargas, D.S. Cobb and S.R.Armstrong. They compared shear bond strength of fourth generation bonding agents with and without hybrid layer and found that All-bond 2 adhesive gave better bond strength in the absence of collagen matrix which was removed prior to priming and bonding[2].Paulette Spencer and James .R. Swafford examined the nature of unprotected protein i.e. collagen left back after acid conditioning at the dentine adhesive interface. They found that this unprotected protein left back after acid conditioning served as the major inadequacy in long term bond stability[14]. Studies conducted by Inai. Kanemura and Tagani[5] showed that the bonding agent based on acetone systems yielded better bond strength after removal of collagen matrix with help of NaOCI.Contradicting studies have also been reported. Frankenberger and N. Kramer (compared fourth and fifth generation bonding agents with and without hybrid layer. He reported that shear bond strength were considerably low without hybrid layer[15]. Another study carried out by J. Perdiago and M. Lopez showed a decrease in bond strength after exposure to NaoCI gel[16].

The present study agrees with Gwinnet's conclusion that the collagen layer does not significantly contribute to the interfacial strength of resin to dentine[17]. The study also throws light on the significance of removing the exposed collagen matrix completely after acid conditioning, which may otherwise undergo

hydrolysis due to incomplete penetration of the resin ultimately leading to resin - dentine bond failure.Removing collagen matrix after acid conditioning and subsequent bonding to partially demineralised dentine could eliminate or substantially reduce the micro leakage associated with polymerization shrinkage of composite resin. As the dentine substrate after acid etching / NaOCI treatment is more of a mineralized one, it can resist the polymerization stress more effectively. This could eliminate the two potential disadvantages commonly associated with composite resins namely secondary caries associated with micro leakage and discoloration. However the procedure of acid etching followed by NaOCI treatment is not advocated for resin bonding clinically. Further clinical and laboratory research have to be carried out to authenticate the results obtained from this study.

VI. Summary

20 recently extracted premolar teeth were randomly divided into 2 groups of ten teeth each. The occlusal surfaces of the teeth in the four groups were ground to expose dentine and reduced to obtain a flat surface of dentine perpendicular to the long axis of the teeth.A suitable mould of specific dimension was kept ready to mount all forty specimens to enable carry out shear bond strength studies. The teeth were sectioned just below the cervical line to facilitate embedding of these specimens in autopolymerising resin moulds with only the occlusal surface exposed.The resin was mixed to a fairly thick consistency poured into the rectangular mould and the prepared specimens with flat surfaces were embedded in the acrylic material and allowed to set. The master rectangular metal mould was designed to fabricate blocks that would fit the chuck of Hounsefield tensometer machine. The procedure of preparation of specimens was separate for all twenty specimens. These specimens were kept in normal saline solution at 37°C.

The specimens were grouped as follows -

Group I. Single bond bonding agent was applied on the dentinal surface without 5% NaOCI wash after acid conditioning.

Group II. 5% NaOCI wash for two minutes was carried out after acid conditioning of dentin. Single bond bonding agent was applied.

Sodium hypochlorite treatment of the acid conditioned dentine substrate was done to remove the collagen fibrils left back suspended after acid conditioning. In both the groups the dentinal surface were cleaned with pumice slurry and gently dried with oil free air. Acid conditioning was carried out with 37% phosphoric acid gel for 15 seconds followed by rinsing and drying to remove excess water. Single bond adhesive was used for bonding the specimens in group I and group II.. The specimens in group II were treated similarly as group I except for a two minute exposure with 5% NaOCI after acid conditioning. This was followed by rinsing and drying to remove excess moisture. Composite resin was applied over the adhesive for both groups using a Teflon mould with specific dimension to obtain a cylinder of restorative material. All twenty specimens were transferred to the Houns field tensometer for shear bond strength studies. Two specimens each for the two groups were prepared separately for SEM study. Bonding with and without 5% NaOCI treatment was done in above mentioned manner for all groups. Composite resin application was over the entire dentinal surface alone. The specimens were sectioned vertically to expose the resin/ dentine interface followed by standard SEM specimen preparation. All specimens were evaluated under SEM and photographs taken accordingly.

VII. Conclusion

The present study compares shear bond strength of composite resin on exposed dentinal surface using a fifth generation bonding agent with and without hybrid layer. The exposed collagen fibres after acid conditioning which constitutes the basis for hybrid layer formation was washed of with 5% NaOCI for 2 minutes.

1. Shear bond strength values were shown to be lowest when Single bond adhesive was used without removal of collagen fibers.
2. Group I showed bond strength values which were not statistically significant.
3. Group II, where Single bond were used after removal of collagen fibers showed better bond strength values when compared to group I where single Bond was used without removing collagen fibers after acid conditioning
4. SEM evaluation of the two groups were carried out. The results of SEM examination confirmed effective removal of collagen fibers left back after acid conditioning when exposed to 5% NaOCI for 2 minutes.

The present study concludes that acid conditioning/ 5% NaOCI treatment creates a dentine substrate which provides more shear bond strength. The study emphasizes on the importance of removing the collagen fibrils left back after acid conditioning completely. This may prevent the long term bond degradation of composite resins and subsequent micro leakage and discoloration.

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