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EFFECT OF DIFFERENT DEPROTEINIZING AGENTS ON SHEAR BOND STRENGTH OF RESTORATIVE COMPOSITE TO DENTIN:- AN IN-VITRO STUDY

Dental Science

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ABSTRACT

Aim: To compare the deproteinizing effect of bromelain enzyme and trichloroacetic acid regarding shear bond strength of composite resin to dentin.
Materials and methods:- Thirty freshly extracted human premolars were selected and occlusal surface of teeth was wet grinded to expose superficial dentin. The teeth were divided into 3 groups(n=10). In group I teeth were etched; In group II teeth etched and deproteinized with 3% bromelain; In group III teeth were etched and deproteinized with 5% TCA. Upon completion of this adhesive protocol, composite resin was inserted in to stainless steel mould & light polymerized. All specimens were stored at 37^0c in water for 24 hrs and tested for shear bond strength evaluation under universal testing machine with cross head speed of 1mm/min.
Results:- 3% bromelain treatment increased the shear bond strength value followed by 5%TCA.
Conclusion:- Bromelain enzyme treatment after acid etching removed the unsupported collagen fibers thus increasing more resin infiltration and increased bond strength.

KEYWORDS

INTRODUCTION

Formation of stable hybrid layer or resin dentin interdiffusion zone (RDIZ) plays the most crucial role in any of the adhesive type of restorations.[1] Hybridization is a complex process which involves both the physical and chemical interactions between the adhesive material and the unaffected zone of the dentin substrate.[2] Effective penetration of resin monomers is essential for the formation of stable hybrid layer. But many of the studies stated that there is disharmony between depth of dentin demineralization and resin infiltration after acid etching process.[3]

Wettability is one of the most important factor to be considered in adhesion.[4] There is need of intimate contact between the adhesive and the acid etched dentin surface (partially deproteinized) to allow for the formation of an hybrid layer.[5] For the above process to happen surface tension of the adhesive must be as low as possible, and the substrate surface energy must be as high as possible.[4,6] But unfortunately the role of collagen fibers in dentin adhesion has been questioned by some authors.[7,8] They reported that dentin collagen does not contribute to dentin adhesion and may even interfere with the bonding mechanisms because of the fragile structure and low surface energy of collagen fibers after etching.[7,8] And moreover the attachment based on protein structures may be unstable over a period of time.[5] So it is highly desirable to increase the surface energy of the acid etched surface by the process called deproteinization.[9] After deproteinization, dentin is a porous area with multiple irregularities capable of allowing some type of mechanical retention. This type of substrate is rich in hydroxyapatite crystals and may result in a stable interface over time because it is essentially composed of mineral phases.[9] Hence the aim of the present is to compare the deproteinizing effect of Bromelain enzyme and Trichloroacetic acid regarding shear bond strength of composite resin to dentin.

MATERIALS AND METHODOLOGY:-

Thirty freshly extracted premolar teeth were collected and stored in distilled water until they were used for the purpose of the study.

All the teeth were mounted in the self cure acrylic resin blocks of size (2.5cm *2.5cm).

All the samples were wet grinded until the dentin surface is exposed using a diamond bur and high speed handpiece. Teeth were now divided into three groups based on the use of different dentin deproteinizing agents.

Group 1 :- Teeth were etched with 37% phosphoric acid for about 15 sec and then rinsed off and blot dried, followed by application of normal saline for about 1 min and then rinsed off and blot dried.

Group 2 :- Teeth were etched with 37% phosphoric acid for about 15 sec and then rinsed off and blot dried, followed by

application of 3% bromelain for about 1 min to deproteinize the etched dentin surface. And 3% bromelain is washed off using distilled water and blot dried.

Group 3:- Teeth were etched with 37% phosphoric acid for about 15 sec and then rinsed off and blot dried, followed by application of 5% Trichloro acetic acid (TCA) for about 1 min to deproteinize the etched dentin surface. And 5% Trichloro acetic acid (TCA) is washed off using distilled water and blot dried.

UNIVERSAL Dentin Bonding Agent (DBA), **Tetric N bond Universal(ivocular vivadent)** was applied according to the manufacturer's instructions. After completion of adhesive protocols, standardized Teflon coated metal ring of size 2*3mm were placed over the dentin surface. The resin composite Tec economy plus (by ivocular vivadent) was inserted in to Teflon coated rings in two increments and photo polymerized. The Teflon coated metal rings were removed to

expose the resin cylinders on dentin surface. All the specimens were stored in distlled water at 37^{0}C for about 24 hours to simulate oral environment. After storage, the specimens were placed under universal testing machine individually and tested for analysis of shear bond strength at crosshead speed of 1mm/min.(fig 1and fig 2)

Figure 1:- placement of specimen under universal testing machine

Table 1: mean and standard deviation(S.D) of all three groups

Shear bond strength in Mpa					
Group	N	Minimum	Maximum	Mean	SD
Normal saline	10	9.87	12.24	10.93	0.84
Bromelain	10	14.96	17.54	16.51	0.89
TCA	10	11.91	13.97	12.90	0.65
P<0.001					

Table 2:- pairwise comparison of three groups by Post hoc tests-Dunnetts, Tuckey test.

Group X vs Y		Mean Difference (I-J)	SE	P-value	95%Confidence Interval	
					Lower Bound	Upper Bound
Bromelain	Normal saline	5.581	0.359	<0.001	4.692	6.470
	TCA	3.606	0.359	<0.001	2.717	4.495
TCA	Normal saline	1.975	0.359	<0.001	1.086	2.864
	Bromelain	-3.606	0.359	<0.001	-4.495	-2.717
Normal saline	Bromelain	5.581	0.359	<0.001	4.744	6.418
	TCA	1.975	0.359	<0.001	1.138	2.812

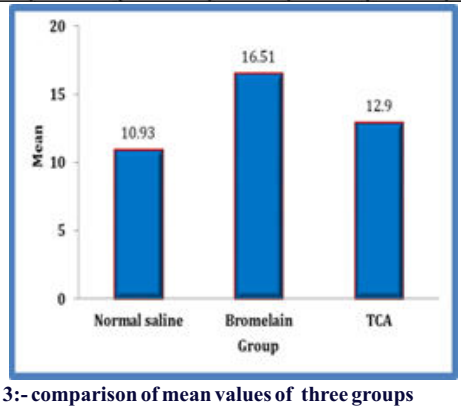

Figure 3:- comparison of mean values of three groups

RESULTS:-

Data was statistically analyzed using SPSS V24. Descriptive statistics were represented with mean and SD using ANOVA, Post hoc tests-Dunnetts, Tuckey test were applied to find significance and pairwise comparisons between groups. P< 0.05 was considered as statistically significant.

Shear bond strength values were significantly influenced by application of 3% bromelain enzyme(p< 0.05) as shown in Table 1. Statistically significant differences were seen between control group, TCA group and Bromelain enzyme group as shown in Table 2. The Highest shear bond strength was seen for bromelain enzyme treated group.

DISCUSSION:-

Adhesion to the dentin surface is complex process which depends upon several factors like type of dentin bonding agent, resin composites, surface characteristics, surface contaminants and etc.[10] Progressive reduction of shear bond strength is one the main reason for failure adhesive restorations over a period of time. Which is also

demonstrated by several studies.[11,12] One of the main factors that is responsible for this type degradation is incomplete penetration of resin monomers into unsupported collagen networks after acid etching with strong acids, which produces a zone of collagen without any support of either minerals or resins in the base of the hybrid layer.[12] Dentin is composed of two different substrates, collagen which has a low surface energy, and hydroxyapatite, which has a high surface energy. After acid etching the surface energy is decreased by the exposure of collagen fibers and loss of mineral component.[13]There is direct positive relationship between the degree of mineralization and the wetting ability of the adhesive.

Since the first step of the interaction between an adhesive and a substrate is the wetting of the substrate, acid etched surface is of low surface energy owing to incomplete

infiltration of resin monomers. Whereas Deep dentin is more wettable than superficial dentin due to surface treatments like deproteinization of dentin substrate done after acid etching. Deproteinization of dentin substrate leads to removal of unsupported collagen fibrils and results in exposure of underneath hydroxyapatite, which is more wettable and helps in formation of stable hybrid layer.[2]Toledano et al proposed that there is increase in dentin wettability after etching and deproteinization of dentin with sodium hypochlorite(Naocl). Numerous studies have evaluated the effects of NaOCl on adhesion process, and different results have been achieved. Some studies, however, have shown lower bond strength using NaOCl.[14] This decrease in bond strength can be attributed to the generation of oxygen after the disintegration of NaOCl into NaCl and O2. The released oxygen in this chemical reaction prevents the polymerization of adhesive agents.[14] This variance of results while using sodium hypochlorite in adhesive process led to search for other better deproteinizing agents with minimal variance and side effects.

So, in the present study bromelain and Trichloro acetic acid were chosen and compared. Bromelain enzyme was first used by Dayem and Tameesh et al[15] for the purpose of deproteinization due to its collagenase activity and its capacity to remove the collagen network from acid etched dentin efficiently and this will lead to increase the diffusion potential of the monomer to the intact dentin and minimizing the nanoleakage. This effective penetration of resin monomers also results in increase of shear bond strength in the present study.

In this present study bromelain enzyme showed high amount of shear bond strength with mean value 16.51 Mpa followed by Trichloro acetic acid group and control group with mean values of 12.93 and 10.93 respectively. And statistically significant difference was observed (p<0.05) when each group is compared with other groups.

Trichloro acetic acid was first introduced by Glaun et al. It is predominantly used for decalcification and fixation in microscopic studies and as a precipitating agent for proteins.[16] In this present trichloro acetic acid also showed increased shear bond strength when compared to control group this could be due to its capacity to remove the unsupported collagen left over after acid etching process.

CONCLUSION:-

Within the limitations of the present study removal of unsupported and weak collagen after acid etching process results in increased shear bond strength because of effective penetration of resin monomer into the dentin substrate. Further investigations and clinical trials are needed to substantiate the results of the present study.

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