The Influence of Desensitizing Agent on Shear Bond Strength of Dentin Using Two Dentin Adhesive Systems (In Vitro Study)

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Abstract: *This is in vitro study evaluate the effect of desensitizing agent on shear bond strength of two different adhesive systems scotch bond (water/ethanol/base adhesive system) and prim and bond NT (acetone base adhesive system). fouty-two human upper & lower premolar teeth recently extracted for orthodontic purpose were selected. These teeth polished and cleaned before embedded in acrylic block. 2mm from the buccal surface of the blocked tooth were ground to obtain flat surface with 600 grit silicon carbide paper. Each tested groups has been treated with desensitizing agent for 2 minutes and leave it without washing for 10 minutes. The tested and control groups were etched using 37% of the phosphoric acid, and the bonding system was applied according to manufacture instruction. The*

specimens were divided in two main groups. Each one subdivided in two subgroups:

Group A: *Treated with scotch bond 1 with 3m feltick Z 250 composite resin.*

Subgroup A1: *(control group).*

Subgroup A2: *(tested group, dentin surface pretreated with desensitizing agent before etching).*

Group B: *treated with prim& bond NT adhesive system with feltick Z 250.*

Subgroup B1: *(control group).*

Subgroup B2: *(tested group, dentin surface pretreated with desensitizing agent before etching).*

Shear bond strength was determined using instron testing machine and result showed that.

- *There is a significant decrease in shear bond strength for scotch bond -1 adhesive system and 3m feltick Z 250, after with desensitizing agent (soothe) for 2minutes.*
- *There is no significant difference in the shear bond strength after treatment the prepared surface of dentin with desensitizing agent (soothe) for 2minutes.*
- *The effect of desensitizing agent is depend on the type of bonding system were used.*

Aims of the study

The aim of this study in vitro study is to evaluate the effect of desensitizing agent on shear bond strength of:

1. scotch bond 1 adhesive system with 3m feltick Z 250 composite resin.
2. prim & bond NT adhesive system with 3m feltick Z 250 composite resin.

Introduction

Dentin hypersensitivity is defined as transient pain arising from exposed dentin. Typically in response to chemical, thermal, tactile or osmotic stimuli which can not be explained by any other dental defect or pathology [1], the reported prevalence of dentin hypersensitivity is between 10% to 35% depending on the population studied [2]. The relation ship between dentin hypersensitivity and potency of dentin tubules has been established [3]. So the occlusion of the tubules seems to decrease the sensitivity [4]. It also has been suggested that incorrect manipulation of adhesive materials namely those with acetone, may actually trigger post operative sensitivity [5].

Christensen, 1994 [6], has described the desensitization of a tooth after crown preparation in an attempt to avoid postoperative sensitivity.

More recently, dentin desensitizing solution also have been used under composite and amalgam restoration and crown to prevent post operative sensitivity [7]. The effect of desensitizing agent that occlude dentinal tubules to some extent can significantly reduced fluid filtration across dentin and can consequently lower the pain response [8]. One way of relieving postoperative sensitivity in the clinic is adjunctive use of oxalate desensitizing agent on acid etched dentin prior to adhesive application [9].

Poshely and co-worken 1992, demonstrated that sealing those dentinal tubules with polymeric resin desensitizer reduced sensitivity. So in this study used (soothe) desensitizing gel which

contain potassium nitrate for 2 minutes and do not wash for 10 minutes. Repeat for 2-3 times. After that washed under water spray of unit for 5 seconds according to manufacture instruction.

Pereira, 2002[10], the objective of this study was to evaluate the effect of desensitizing agent on shear bond strength of a dentin adhesive system.

Materials and Method

The specimens used in this study were prepared from randomly selected human non-carious teeth. Twenty six sound human upper & lower premolar teeth recently extracted for orthodontic purpose. Then the teeth were cleaned from debris by polishing them with pumice and a rubber cap used in allow speed hand piece. Then washed with distilled water. Before embedded in acrylic block in which the roots of teeth were sectioned at cemento-enamal junction, using diamond disc with straight hand piece. The acrylic block construction was done by usping a brass mold with an internal stone mold of 20x20x16mm in dimension. Half ball depression at the base of the mold of 6mm in diameter and 2mm in depth. The separating medium was varnished to the walls of the mold, then the sample was placed at this depression with the buccal surface to be treated faced down word & wax was used to fill the remnant space. The self cure acrylic was loaded in to the mold and after completion of the polymerization, the two parts of the mold were separated & excess acrylic was removed. To exposed the buceal surface of teeth was ground with could mechanical grinder (rotoflix), with 600 grit silicone carbide paper to obtain flat dentin surface.

In this study, use two types of adhesive system .in group (A),use the scotch bond adhesive system which composed of conditioner 37% orthophesphoric acid with Bis-Gam-HEMA (2hydroxyle methacrylate) and adhesive composed of poly alkonic acid, copolymer intiator and Ethanol water .

In group(B) used the prime &bond NT ,so this adhesive system composed conditioner 37% orthophesphoric acid and adhesive

contain Di and trimethacrylate resin ,amporphus silica ,photo-intiators ,stabilizer and aceton .

In testing groups (A2 and B2) use the sooth agent composed of potassium oxalate 6.0% ,flourid Ions ,o.11% ,water 78.49% and thicker 15%, with sodium benzoate. The restoration was applied according to manufacture instruction, by using escrow with a condenser. The screw wider than condenser to prevent the condenser from going deeper than required. So this screw attached to weight 400g weight (attached to center of screw). Also use glass tube or plastic tube 4mm in diameter & 6mm in length was placed on pretreated dentin surface and the screw moved to get 2mm thickness of composite & excess removed with sharp probe, curing was done from mesial & distal direction by using asralis light cure according to manufacture instruction.

Then all specimens groups were stored in deionised water at 37C for 24hr. thermocycling was done by subjecting to 100 cycles. Thermocycling was done manually between two water bath. One maintained at 5C and other at 55C. the immersion time was for 30 second in each bath. After that the shear bond strength was tested with instron testing machine using stainless steel chisel. Shaped rod which was to deliver the shearing force with across head speed of 0.5mm per minute, the loaded weight set at 100kg. the tested specien were placed by the chisel was position at the interface between the tooth surface and the restoration, the forces recorded in Newton and to obtain shear bond strength should calculated in MPq [11]. Shear bond strength was tested with instron testing machine using a stainless steel chisel, shaped rod which was use to deliver the shearing force a cross head of 0.5 per minute, the load all was set at 100 kg . The tested specimens were placed in block holder and placed in tested machine. The chisel end of the rod is positioned at interface area between composite resin and composite. The specimen were loaded until failure the results in Mpa according to surface area of adhesion. Data were submitted to statistical analysis using ANOVA test.

Grouping the Samples

Group A: (treated with scotch bond-1 bonding system)

Subgroup A1: (control group):

The dentin surface was etched with phosphoric acid 37%, for 15 second, after washing the acid for 2 seconds. The bond applied according to manufacture instruction, after that the corresponding composite was applied.

Subgroup A2: (experimental group):

Dentin surface pretreated with desensitizing gel for 2 minutes and left for 10 minutes without washing. So the etching with phosphoric acid 37% for 15 seconds was done before application the desensitizing agent & then applied the bonding system according to manufacture instruction, after that the corresbonding composite was applied.

Group B: (with prim & bond NT adhesive system).

Subgroup B1: (control group):

The dentin surface was etched with phosphoric acid 37% for 15 seconds, after washing the acid with air\water spray of dental unit for 2 seconds. The prim & bond NT adhesive system was applied according to manufacture instruction, and then the corresponding composite was applied.

Subgroup B2: (experimental group):

The dentin surface etched as the same procedure was followed as for group B1. the desensitizing agent also applied to etched surface as the same procedure in group (A2), and then the bonding system (prim & bond NT) according to manufacture instruction, after that the corres bonding composite was applied.

Results

Table 1

Groups		Mean Mpa	S.D	Minimum value	Maximum value	p-values	Sign
Scotch bond -1 with Z 250	Subgroup (A1)	42.70	4.914	20	31.50	0.002	H.S.
	Subgroup (A2)	16.65	5.161	10.22	24.18		

From the above table, It is shown that there is statically highly ($p<0,01$) in Comparing group.
A (control group with adding the sooth agent and group A2 with sooth)

Mean shear bond strength value for all the specimens tested which was subjected to:

Table :2 Descriptive statistics of group (A)

Spec. No.	Scotch bond-1 with 3M feltik Z 250 composite		Prim & bond NT with feltik Z 250 composite	
	A_1	A_2	B_1	B_2
	20.32	17.52	36.9	26.14
	20	10.22	25.52	30
	31.50	24.18	21.66	17.11
	28.19	15.43	12.50	16.62
	28	20.33	20.26	18.29
	21.44	12.25	13.40	20.5
Mean	24.70	16.65	21.71	19.74

Table 3. Descriptive statistics of group(B)

Groups		Mean Mpa	S.D	Minim m value	Maxim m value	p-values	Sign.
Prim & bond NT with Z 250	Sub group (B1)	21.71	8.95	12.50	30.9	0.321	NS.
	Sub group (B2)	19.74	6.97	10.90			

From this table, it is shown that comprising between shear bond strength before and after soothe agent there is no significant difference (p>o.o5) between control groups and experimental groups.

Discussion

Desensitization of teeth after cavity preparation or crown preparation has been recommended in an attempt to ovoid post-operative sensitivity [12].

Post-operative sensitivity is frequently encountered with the use of adhesives that require conditioning of dentin[13]. Although the mechanism of pain transmission across dentin are fully under stood. Both dentin permeability and sensitivity are reduced when dentin tubules are occluded [14].

A variety of materials, such as calcium hydroxide, cavity varnish, topical fluoride, ion-tropnorsis, laser irradiation and potassium nitrate have been used in an attempt to enervate dentin sensitivity [15]. Oxalate, glutaraldehyde and dentin bonding agent with or without resin-based are some of the materials currently is being used for treatment of this condition [16].

The using of soothe desensitizer agent on acid etched dentin has been shown to improve the efficacy of dentin bonding system in vitro. The enhanced bond strengths observed could be related to the covalent cross-linking between collagen and HEMA-collagen interaction has never been studied at biochemical level [17].

The interaction between these HEMA and collagen component was studied by Munkgarrd (1999)[18], which demonstrated that amino group-containing substance in dentin react with gluteraldehyde and start formation of HEMA polymer. Combining aresin adhesive with application of desensitizing gel seems to be contradicatory at first sight, some effective adhesive are expected to seal the etched dentin surface by intertubular and peritubular hyperidization and by resin tag formation.

(Dondidall, 2002) [19].who demonstrated the seal prevent fluid shift across the tubules according in response To-mechanical, thermal or osmotic stimuli. However, if the tags formed within dentin tubules were too long; it should be caused post-operative pain, desensitizing agent may be useful treatment in management persistent dentin hypersensitivity [20]. Soothe desensitizing agent is composed of potassium nitrate 6.0%, fluoride ions 0.11%, water 78.49%, thickner 15.0% & sodium benzoate 0.10%. the mechanism of action which coagulate and denature some protein in dental tubules fluid, so it is through that it facilitate the deep penetration of agent in dental tubules [21].

The component of adhesive system (scotch bond-1) used in first group (A1, A2) contains in its compositions acrylate including HEMA (2-Hydroxy ethlmthacrylate) and water as a solvent[22] HEMA can increase the dentin affinity to reactive monomers, and enhance the hydrophilic character of dentin. This confirm to mechanical interfacial interlocking beside micromechanical interlocking [23]. The water\ethanol base adhesive system resulted in higher bond strength to acid etch dentin (in control group) than acetone base adhesive system. This finding could be attributed to the enough water content can plasticize the collagen fibrils in a faster rate than resin\ solvent can stiffen them. Thus fibrils can gradually expand with the resin monomer in infiltrating it. So there is a possibility of greator amount of resin monomers can fill the expanding demineralized zone [24].

Swift EJ,1997[25]), showed that water\ ethanol based adhesive system may resulted in lower bond strength due to the water left might prevent the complete polymerization of the adhesive, so this disagreement with the result of this study .

In case of group (B1, B2) when used the prim & bond NT (acetone based adhesive system). This bond probably better in facilitative deep and more complete penetration of the resin in to dentin and enhanced the micromechanical retention of this resin where applied to dentin .

Miyazakin M, 1998, reported that when compared the acetone to water adhesive system found the water inferior as a solvent for HEMA- based dentin primers, given lower bond strength.

The compositions of prim & bond NT is functionalized amorphous silica (non a filler). So the expected bonded technique is micromechanical water –based resin-containing oxalate desensitizing agent. the oxalic acid from the agent reacts chemically with calcium ions from tooth structure to form the insoluble calcium oxalate crystals which will block dentinal tubules (Gillam et al.,2001).based on this phenomenon outward fluid flow in the acid-etched dentin can be reduced by applying the oxalate desensitizer prior to adhesive application 9pashley et al.1993) hence, the possibility of post – operative dentin hypersensitivity to occur is reduced .

However, a study by yiu et al.(2005) may unravel all the puzzles they made evaluation on scanning electron microscopy of fractured surface of dentin treated with oxalate desensitizer, the adhesive systems used were fluoride contained adhesive systems , prime and bond NT (dentsply USA) they noticed spherical globules scattered on dentin surface blocking the dentinal tubules at those bonded with prime and bond NT (dentsply , USA). Those spherical globules scattered on dentin surface blocking the dentinal tubules at those bonded with prim and bond NT (24).Those spherical globules were similar to calcium fluoride (CaF2)found on enamel , since prime and bond NT (dentsply ,USA).adhesive system has a high fluoride content , the sources of fluoride to form spherical globule

most probably comes from this adhesive agent furthermore ,they found no spherical globules on non –fluoride containing adhesive system .

Those spherical globules found on the oxalate treated specimens may hinder adhesive in filtration and hybridization of demineralized dentin. The spherical globules may also contribute to stress raiser areas and that would create deboning at lower stress than would occur in their absence [26].

Conclusion

1. There is a significant decrease in shear bond strength for scotch bond adhesive system and 3M feltik Z 250 after treated with desensitizing gel.
2. There is no significant difference in shear bond strength for prim & bond NT adhesive system with 3M feltik Z 250 after treated with desensitizing gel.

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تقييم مضاد التحسس للأسنان على قوة الربط القصي للعاج السني باستخدام نظامين من المواد التعويضية الرابطة ـ دراسة مختبرية

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المستخلص

يقوم هذا البحث بدراسة تأثير مضاد التحسس السني على سطح العاج السني على قوة الربط القصي لنظامين من المواد التعويضية الرابطة وهي:

1. Scotch bond (water/ethanol/base adhesive system).
2. Prim & bond NT (acetone base adhesive system).

يبدأ هذا العمل بتجميع وتنظيف (اربعة وعشرين) سن من الضواحك للفك العلوي والسفلي ومن ثم صبا في قوالب اكريليكية بعد قطع 2 مليميتر من السطح الوجهي للسن للحصول على الطبقة السطحية بأستخدام ورق كاربيد السيليكون. ثم معالجة 16 سن بمادة مضاد التحسس لمدة دقيقتان ثم تركها لمدة عشرة دقائق بدون شطف. وبعد ذلك استعمال طريقة التخريش الحامضي لمدة عشرون ثانية لجميع العينات الـ 24 سن ثم تقسيم هذه العينات الى مجموعتين رئيسيتين وكل واحدة منها تقسم الى مجموعتين فرعيتين:

المجموعة أ : نستخدم في هذه المجموعة (scotch bond1).

أ1: الحامض المخرش + الرابط scotch bond 1.

أ2: مضاد التحسس + الحامض المخرش + scotch bond .

المجموعة ب : نستخدم في هذه المجموعة prim & bond NT.

ب1: الحامض المخرش + الرابط prim & bond NT.

ب2: مضاد التحسس + الحامض المخرش + الرابط prim & bond NT.

وبعد ذلك يتم تحديد قوة الربط القصي باستخدام آلة الأختبار (instron).

1. لقد تبين من النتائج الأحصائية نقصان في قوة الربط بعد المعاملة بمادة مضاد التحسس (soothe) مع الرابط scotch bond 1.
2. عدم وجود فرق احصائي في قوة الربط القصي بعد المعاملة بمادة مضادة للتحسس (soothe) عند استخدام المادة الرابطة prim & bond NT.