Bond Strengths of Three Different Dentin Adhesive Systems to Sclerotic Dentin

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The two-fold aims of this study were: (1) to evaluate the microtensile bond strengths of different adhesive systems to sclerotic and sound palatal dentin; and (2) to observe the respective resin-dentin interfaces. Thirty extracted human incisor teeth were divided into two groups. Group I comprised sclerotic defects in the palatal zone. Group II comprised sound palatal dentin surfaces as control. Each group (n=15) was divided into three subgroups according to dentin adhesive systems: self-etch (Clearfil SE Bond), total-etch (Scotchbond Multi-Purpose Plus), and glass ionomer (Reactmer Bond) adhesive systems. The specimens were subjected to tensile forces. Obtained data were analyzed by two-way ANOVA and *post hoc* Duncan's test. Fracture sites and resin-dentin interfaces were observed using a light microscope and SEM. With sound dentin, Clearfil SE Bond showed a significantly higher bond strength than the other adhesives ($p < 0.05$). With sclerotic dentin, although there were no significant differences in bond strength among the adhesives groups ($p > 0.05$), the bond strength values of Clearfil SE Bond and Scotchbond Multi-Purpose Plus were significantly decreased. On resin-dentin interface observation, different images were presented by different bonding systems.

Key words: Sclerotic dentin, Microtensile bond strength, Total-etch, Self-etch, Glass ionomer

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INTRODUCTION

Wear of the natural dentition is a normal physiologic process that occurs throughout life. However, problems arise if the rate of loss or the degree of destruction becomes excessive, causing functional or esthetic problems or sensitivity for the patient¹. The etiology of tooth wear is a multifactorial phenomenon involving acids and other tooth-softening chemicals, abrasion, tooth flexure² and attrition, each playing a role to a greater or lesser degree from patient to patient and tooth to tooth^{1,3,4}. The most common causes of excessive palatal wear are attributed to parafunctional activities such as bruxism, chemical erosion due to the introduction of gastric acid into the oral cavity occurring with repeated regurgitation³, and eating disorders such as anorexia nervosa or bulimia⁵. Loss of occlusal and palatal tooth tissues may result in changes in occlusal vertical dimension⁶, pulpal sensitivity, and weakening of the teeth, thereby requiring restorative treatment^{1,3,4}.

Enamel is the main tissue subjected to wear. However, advanced enamel wear exposes increasingly large areas of dentin. Compared to enamel, dentin is a more difficult bonding substrate due to its complex and variable histological features⁷. Accelerated partial or complete obliteration of the dentinal tubules with tube- or rod-like crystals and peritubular dentin forms sclerotic dentin^{8,9}, which protects the

pulp by rendering the dentin less susceptible to the effects of external stimuli¹⁰. Depending on the sensitivity of the noncarious cervical lesion, varying levels of tubular patency may be observed, with most dentinal tubules being occluded with insensitive transparent dentin¹¹, thereby compromising the formation of resin tags^{8,12}.

The existence of a hypermineralized layer on the surface of noncarious cervical lesion and the presence of a layer of possibly remineralized denatured collagen at the bottom of the hypermineralized surface layer^{8,11} precludes optimal acid-etching of sclerotic dentin. Despite increased etching time, regional bond strength to sclerotic dentin was found to be lower than to sound dentin¹³⁻¹⁵. An adhesive strategy involving micromechanical interlocking by the formation of a resin-dentin interdiffusion zone combined with resin tag formation into the dentinal tubules would be less effective when applied to the hypermineralized sclerotic dentin¹³. The potential benefit of additional chemical interaction between functional monomers and tooth substrate components has recently gained new attention¹⁶. The preservation of hydroxyapatite within the submicron hybrid layer of self-etch adhesives may serve as a receptor for additional chemical bonding^{16,17}.

The two-fold aims of the present study were: (1) to examine the bond strengths of different dentin adhesive systems (self-etch system: Clearfil SE

Bond; total-etch system: Scotchbond Multi-Purpose Plus; and glass ionomer adhesive system: Reactmer Bond) to sound and sclerotic palatal dentin; and (2) to observe the changes in the resin-dentin interfaces with these adhesive systems. The null hypothesis was that there will be no differences in tensile bond strength between the adhesives at sound and sclerotic palatal dentin.

MATERIALS AND METHODS

Tooth type and preparation

Fifteen maxillary anterior teeth with deep natural sclerotic lesions on the palatal surface, and which were extracted for periodontal reasons, were used for bond testing in this study. Another 15 extracted sound maxillary anterior teeth were used as the control group.

The teeth were cleaned with an ultrasonic scaler to remove plaque and calculus. They were then stored in 0.5% chloramine-T solution at 4°C and used within one month of extraction. In the control group, artificial palatal lesions (*i.e.*, sound dentin) were prepared on the palatal surfaces of sound maxillary incisor teeth at the incisal and cervical margins in the same manner as the natural lesions (4.0 mm wide and 3.0 mm deep). This was done using a

high-speed handpiece (Compact Torque 636 P, KaVo, Germany) with a tungsten carbide bur (FG 6, AD Burs, Gloucester, UK) under copious water cooling. A new bur was used for every five lesions. The artificial dentin surfaces of incisors in the control group were ground with 600-grit SiC paper to obtain flat dentin surfaces.

Both experimental and control groups were divided into three subgroups according to dentin adhesive systems (five teeth for each bonding system): self-etch (Clearfil SE Bond), total-etch (Scotchbond Multi-Purpose Plus), and glass ionomer (Reactmer Bond) adhesive systems. Five to six standardized sticks were made from each tooth, but only three to four suitable dentin sticks per tooth were chosen for bonding test use. Fifteen sticks were tested for each adhesive group, and the bonding systems were applied according to manufacturers' instructions.

Sclerotic dentin was visually identified according to the North Carolina Dentin Sclerosis Scale as reported by Heymann and Bayne¹⁸⁾:

Category 1: No sclerosis is evident; dentin is opaque, light yellow or whitish in color with no discoloration. Little translucency or transparency is evident.

Category 2: Irregular translucency over less than

Table 1 Materials used in this study and their composition

Adhesive Materials	Composition	Lot No.	Restorative Resin Materials	Lot No.	Manufacturer
Self-etch System Clearfil SE Bond (CSE Bond)	Primer : 10 MDP, HEMA, hydrophilic dimethacrylate, CQ, N, N-diethanol p-toluidine water	008618A			
	Bonding : 10 MDP, Bis-GMA, HEMA, CQ, hydrophobic dimethacrylate, N, N-diethanol p-toluidine, silanated colloidal silica	00876A	Clearfil AP-X	00435C	Kuraray Medical Inc. Japan
Total-etch System Scotchbond Multi-Purpose Plus (Scotchbond MPP)	Etchant : 35% phosphoric acid	J11093			
	Primer : Polyalkenoic acid copolymer, HEMA, water	5W	3M Silux Plus	570340	3M ESPE, Germany
	Bonding : Bis-GMA, HEMA, photoinitiator	5PB			
Glass-ionomer System Reactmer Bond (RB)	Bond A : FASG (Fluoro Alumino Silicate Glass), F-PRG (full reaction type pre-reacted glass-ionomer fillers), water, acetone, new initiators	080309			
	Bond B : 4-AET (4-acryloylethyl trimellitic acid), UDMA, 2-HEMA, photo-initiator	080309	Reactmer	070309	Shofu Inc, Japan

50% of the surface area.

Category 3: Irregular transparency or translucency over 50% of the surface area.

Category 4: Dentin is glossy in appearance, dark yellow or slightly brownish in color, with the majority of the dentin exhibiting translucency or transparency.

The degree of sclerosis in the sclerotic dentin was classified as Category 3 or 4. Sclerotic dentin was glossy, yellow or dark yellow, and the sclerotic region was more than 3.0 mm in diameter.

Adhesive agents and bonding procedures

Table 1 lists the materials used in this study and their compositions.

Self-etch protocol: Clearfil SE Bond (CSE Bond) was applied according to the manufacturer's instructions. Self-etching primer was applied to the entire lesion with a disposable brush tip applicator (Dentsply DeTrey GmbH, D-78467, Konstanz, Germany) and left undisturbed for 20 seconds. Volatile ingredients were evaporated with mild air and adhesive resin was applied and cured (Hilux Curing Light 250, Benlioglu, Turkey) for 10 seconds. After the bonding procedures, each lesion was restored with Clearfil AP-X composite resin in two increments and each increment was light-cured for 40 seconds.

Total-etch protocol: 3M Scotchbond Multi-Purpose Plus (Scotchbond MPP) was applied according to the manufacturer's instructions. Each lesion was conditioned with 35% phosphoric acid gel for 15 seconds, then rinsed with distilled water for 20 seconds leaving the surface slightly moist. Scotchbond MPP primer was applied to the moist surface and then evaporated for five seconds. Adhesive resin was applied and light-cured for 10 seconds. After the bonding procedures, each lesion was restored with 3M Silux Plus composite resin in two increments and each increment was light-cured for 40 seconds.

Glass ionomer protocol: Reactmer Bond (RB) was applied according to the manufacturer's instructions. Bond liquids A and B were mixed and applied to the entire lesion with a disposable brush tip applicator and left undisturbed for 20 seconds. Following evaporation of the volatile solvent, it was cured for 20 seconds. After the bonding procedures, each lesion was restored with Reactmer composite resin in two increments and each increment was light-cured for 40 seconds.

After the restorations were completed, the specimens were stored at 37°C in distilled water for 24 hours.

Microtensile test

Microtensile testing (μ TBS) was undertaken using

the non-trimming technique that was first described by Shono *et al.*^{19). Three 1-mm-thick vertical slabs were cut through the entire composite-bonded tooth and perpendicular to the bonded surface using a low-speed diamond saw (Isomet, Buehler Ltd., Lake Bluff, IL, USA) under water cooling. The slabs were further sectioned into 1×1 mm composite-dentin beams, and beams with standard dentinal thickness of approximately 2 mm were used for microtensile testing. The specimens were attached to a Bencor Multi-T testing apparatus (which was modified by Bernard Ciucchi, Danville Engineering Co., Danville, CA, USA) with a cyanoacrylate adhesive (Zapit, DVA, Anaheim, CA, USA), and then subjected to tensile forces in a microtensile testing machine (Multispeed Transmission, Harvard Apparatus Co., USA) at a cross-head speed of 1 mm/min. The exact dimensions of each fractured beam were determined using a digital caliper (Mitutoyo, Tokyo, Japan).}

After microtensile testing, failure modes of the specimens were determined using a stereomicroscope (Olympus, Japan) at ×20 magnification. Modes of failure were classified as adhesive if the failure occurred entirely within the adhesive, as cohesive in composite or cohesive in dentin if the failure occurred exclusively within the composite or within the dentin, and as mixed if the failure continued from the adhesive into either composite or dentin^{20).}

Statistical analysis

Bond strength data were analyzed by two-way ANOVA (sound *versus* sclerotic dentin; total-etch *versus* self-etch *versus* glass ionomer), and multiple comparisons were performed by *post hoc* Duncan's test. Data were tested at a significance level of 0.05 using a computer software (SPSS Ver. 11, SPSS Inc., Chicago, IL, USA).

SEM analysis

Three maxillary anterior teeth with deep sclerotic dentin and three teeth with artificial sound dentin on the palatal surface were used for SEM observations. The teeth were prepared in the same manner as per the bonding procedure. They were then sectioned longitudinally to the bonding surface under running water using a low-speed diamond saw. After storage for 24 hours in neutral formalin, the specimens were embedded in an epoxy resin (Epon 815, NISSIN EM Co. Ltd., Tokyo, Japan) and polished using wet silicon carbide papers and diamond pastes down to 0.25 μ m (DP-Paste, Struers A/S, Copenhagen, Denmark).

The specimens were subjected to argon ion etching (EIS-1E, Elionix Ltd., Tokyo, Japan) for five minutes at a constant voltage of 1 kV and ion current density of 0.2 mA/cm², with the ion beam directed at 90° to the specimen surface^{5).} The specimens were

then gold sputter-coated and observed by a scanning electron microscope (JSM 5400, JEOL Ltd., Tokyo, Japan).

Representative debonded specimens from each group with μ TBS values that were close to the mean value were fixed in 10% neutral formalin for 24 hours. They were then gold sputter-coated and observed using a scanning electron microscope.

RESULTS

Microtensile bond strength

Table 2 shows the mean microtensile bond strength (μ TBS) values of CSE Bond, Scotchbond MPP, and RB to natural sclerotic and artificial sound dentin lesions. Table 3 shows the statistical analysis results. With sound dentin, CSE Bond showed a significantly higher bond strength than the other adhesive systems ($p < 0.05$), whereas with sclerotic dentin there were no significant differences in bond strength among all the adhesive groups ($p > 0.05$). The mean μ TBS values of CSE Bond and Scotchbond MPP in sound dentin were significantly higher than the bond strengths in natural lesions ($p < 0.05$). With RB, μ TBS values were not significantly different in artificial and natural lesions ($p > 0.05$). Hence, RB was the only adhesive which supported the null hypothesis that there would be no differences in tensile bond strength to both sclerotic and sound palatal dentin. As for CSE Bond and Scotchbond MPP, the original null hypothesis was rejected.

SEM observation

SEM observation of the resin-dentin interfaces in sound dentin showed that CSE Bond (Fig. 1) created a 1- μ m-thick hybrid layer, whereas the hybrid layer created with Scotchbond MPP (Fig. 2) was 3 μ m thick. With RB (Fig. 3), the hybrid layer could not be observed — but a thin intermediate layer could be discerned. SEM observation of the resin-sclerotic dentin interfaces in sclerotic dentin with CSE Bond (Fig. 4) and RB (Fig. 6) revealed no hybrid layer formation and resin tags. Hybrid layer created with Scotchbond MPP was 3 μ m thick (Fig. 5).

CSE Bond and RB could not form resin tags in the tubules of the natural sclerotic dentin, and mineral deposits were still evident in the tubules even after conditioning with phosphoric acid of the total-etch adhesive Scotchbond MPP (Fig. 5). The glass ionomer-based adhesive, Reactmer Bond, could not form any resin tags in both sclerotic dentin (Fig. 6) and artificially created sound dentin lesions (Fig. 3), hence resulting in equal tensile bond strength values.

Failure mode analysis

Table 4 shows the failure modes of the fractured specimens in the various groups. The predominant failure mode in sound dentin with all the adhesive systems and in sclerotic dentin with RB (Figs. 9a and b) was adhesive failure between resin and dentin. Most of the specimens bonded with CSE Bond (Figs.

Table 2 Mean microtensile bond strength values ($\pm$ SD) to natural sclerotic and sound dentin (MPa)

Bonding System	n	Natural Sclerotic Dentin Mean $\pm$ SD	Sound Dentin Mean $\pm$ SD
CSE Bond	15	27.36 $\pm$ 9.67 ^a	45.44 $\pm$ 9.72 ^c
Scotchbond MPP	15	25.66 $\pm$ 7.19 ^a	33.88 $\pm$ 6.22 ^b
RB	15	24.99 $\pm$ 7.30 ^a	28.29 $\pm$ 5.15 ^a

Means identified by different superscript letters are significantly different ($p < 0.05$)

Table 3 Statistical analysis of microtensile bond strength results using two-way ANOVA analysis of variance

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	4,531,059 (a)	5	906,212	15,161	,000
Intercept	86,151,246	1	86,151,246	1,441,361	,000
Dentin types	2,191,831	1	2,191,838	36,671	,000
Bonding systems	1,489,756	2	744,873	12,462	,000
Dentin types*	849,466	2	424,733	7,106	,001
Bonding systems					
Error	5,020,743	84	59,771		
Total	95,703,048	90			
Corrected Total	9,551,802	89			

a R Squared = .474 (Adjusted R Squared = .443)

Fig. 1 Resin-dentin interface in sound dentin created with CSE Bond, where a: filled adhesive, h: hybrid layer (arrow), and d: dentin.

Fig. 4 Resin-sclerotic dentin interface in natural sclerotic dentin created with CSE Bond, where a: filled adhesive, star: occluded tubule, and d: dentin. Hybrid layer was not evident, but a thin intermediate layer (arrow) was apparent.

Fig. 2 Resin-dentin interface in sound dentin created with Scotchbond MPP, where a: adhesive containing polyalkenoate-based electron dense particles, h: hybrid layer, and d: dentin.

Fig. 5 Resin-sclerotic dentin interface in natural sclerotic dentin created with Scotchbond MPP, where a: adhesive containing polyalkenoate-based electron dense particles, h: hybrid layer, d: dentin.

Fig. 3 Resin-dentin interface in sound dentin created with RB, where a: adhesive containing FASG and F-PRG fillers and d: dentin. A shallow intermediate hybridized layer (arrow) was apparent.

Fig. 6 Resin-sclerotic dentin interface in natural sclerotic dentin created with RB, where a: adhesive containing FASG and F-PRG fillers, star: occluded tubule, d: dentin. Hybrid layer was not evident.

Table 4 Failure modes of specimens after microtensile bond test

Groups	Adhesive		Mixed		Cohesive in composite		Cohesive in dentin	
CSE Bond (NSD)	3	20%	9	60%	1	6.7%	2	13.3%
CSE Bond (SD)	2	13.3%	12	80%	1	6.7%	—	—
Scotchbond MPP (NSD)	3	20%	8	53.3%	2	13.3%	2	13.3%
Scotchbond MPP (SD)	3	20%	11	73.3%	—	—	1	6.7%
RB (NSD)	7	46.7%	4	26.7%	2	13.3%	2	13.3%
RB (SD)	8	53.3%	4	26.7%	1	6.7%	2	13.3%

NSD : Natural Sclerotic dentin ; SD : Sound dentin ; Adhesive : The failure occurred entirely within the adhesive, Mixed : The failure continued from the adhesive into either in composite or dentin, Cohesive in composite : The failure occurred exclusively within the composite, Cohesive in dentin : The failure occurred exclusively within the dentin.

Fig. 7 (a) Scanning electron micrograph of a fractured beam taken from a natural sclerotic dentin that was bonded with CSE Bond. A mixed failure mode could be observed, with cohesive failure within the composite (c) and dentin (d). (b) A higher magnification of the dentin site in Fig. 7(a). Tubular orifices (t) were evident but the self-etching primer system could not infiltrate into the tubules.

Fig. 8 (a) Scanning electron micrograph of a fractured beam taken from a natural sclerotic dentin that was bonded with Scotchbond MPP. A mixed failure mode could be observed, with cohesive failure within the composite (c), adhesive (a), and dentin (d). (b) A higher magnification of the dentin site in Fig. 8(a). Numerous resin tags (rt) could be seen, and failure occurred at the base of the hybrid layer.

Fig. 9 (a) Scanning electron micrograph of a fractured beam taken from a natural sclerotic dentin that was bonded with Reactmer. The specimen failed cohesively within the adhesive (a).
(b) A higher magnification of Fig. 9(a).

7a and b) and Scotchbond MPP (Figs. 8a and b) in sclerotic dentin showed a mixed failure pattern, *i.e.*, a combination of cohesive and adhesive failures.

DISCUSSION

Results of this study indicated that the bond strengths to sclerotic dentin with the self-etch adhesive CSE Bond and the total-etch adhesive Scotchbond MPP were significantly lower than those to artificially created dentin lesions. However, with RB, almost equal bond strength values to both sound and sclerotic dentin were yielded. These findings were in agreement with similar studies in published literature^{12,21,22}.

Some dentinal tubules of sclerotic dentin were found to be obliterated by mineralized deposits.

These deposits might have come from salivary minerals or minerals in dentinal fluid, or from both sources. They then interfere with both acid penetration and subsequent resin infiltration¹¹. Length of the resin tags does not contribute to bond strength⁷. However, resin tag hybridization to peritubular dentin is considered important for reliable bonding²³. Therefore, the primary reason for the lower bond strengths to natural sclerotic dentin lesions as compared with artificial sound dentin lesions might be the inhibition of resin tag formation with the self-etch adhesive CSE Bond (Fig. 4 and Fig. 7b respectively) and the loosely packed resin tags with the total-etch adhesive Scotchbond MPP (Fig. 5 and Fig. 8b respectively).

Thickness of the hybrid layer depends on the bonding system (total-etch *versus* self-etch), regional differences in dentin (superficial *versus* deep), and type of dentin (sound, sclerotic, or caries-affected)²⁴. Self-etch systems such as CSE Bond¹⁴ and glass ionomer-based adhesive systems such as RB^{25,26} produced very thin hybrid layers when they were applied to sound dentin. Hybrid layer thickness to sclerotic dentin was found to be much lower than that observed in sound dentin^{8,27}. In this study, the mild self-etch adhesive CSE Bond created a hybrid layer of about 1 μm in sound dentin (Fig. 1), whereas the glass ionomer-based adhesive RB resulted in only a thin intermediate layer (Fig. 3). The hybrid layer created with the total-etch adhesive Scotchbond MPP to sound dentin was 3 μm (Fig. 2). Consistent with previous research data, hybrid layer thickness did not correlate with bond strength^{24,28}. Scotchbond MPP, CSE Bond, and RB showed similar bond strengths to sclerotic dentin ($p > 0.05$), although SEM observation of the resin-sclerotic dentin interfaces indicated otherwise. The hybrid layers of CSE Bond (Fig. 4) and RB (Fig. 6) could not be discerned, whereas the thickness of the hybrid layer created with Scotchbond MPP was 3 μm (Fig. 5), the same as that in sound dentin.

Sakoolnamarka *et al.*²⁹ and Kwong *et al.*²¹ reported that hybrid layers to cervical sclerotic lesions varied in thickness due to the hypermineralization of the sclerotic dentin surface, making it acid-resistant^{8,11}. Similarly, sclerotic dentin found on the palatal region might also have a hypermineralized surface layer which would not come into contact with the opposite tooth, hence affecting resin infiltration into intertubular dentin. On this suggestion, it is yet to be substantiated by TEM analysis — which would provide additional information on the structure of sclerotic dentin found in natural palatal lesions.

Mild self-etch systems, like CSE Bond, generally have a pH of about 2 and demineralize dentin only to a depth of 1 μm , keeping residual hydroxyapatite still attached to collagen¹⁰. The preservation of

hydroxyapatite within the submicron hybrid layer may serve as a receptor for additional chemical bonding along with micromechanical interlocking through hybridization. In this respect, 10-MDP (10-methacryloxydecyl dihydrogen phosphate) in CSE (Table 1) has been shown to have a chemical bonding potential to calcium of residual apatite¹⁷.

On the adhesion of glass ionomers to tooth substrates, micromechanical interlocking is achieved by shallow hybridization of the microporous apatite-coated collagen fibril network³⁰, whereas true primary chemical bonding occurs through forming ionic bonds between the carboxyl groups of the polyalkenoic acid and calcium of hydroxyapatite³¹. RB may be classified as a one-step, self-etching F-PRG giomer as it contains ion-leachable fluoroaluminosilicate glass (FASG) and the adhesion promoting monomer 4-AET (4-acryloethyltrimellitic acid), which has the ability to form hydrogen bonds with dentin collagen. The major feature of this material is re-chargeable full pre-reacted glass ionomer filler (F-PRG), where the entire filler particle is attacked by polyacrylic acid. This feature thus provides the potential of chemical bonding *via* an ion exchange process between the glass particles and partially demineralized tooth substrates^{26,31-33}.

In a study by Özer *et al.*³⁴, it was found that aging did not cause any decrease in bond strength of RB as it was in an self-etch bonding system (Clearfil Protect Bond). They attributed these results to the sclerotic structure of aged teeth³⁴. The chemical bonding potential of the mild self-etch system CSE Bond and the glass ionomer-based adhesive system RB thus accounted for their similar tensile bond strengths as the total etch system Scotchbond MPP to sclerotic dentin despite the lack of resin tags.

Adhesive failure accounted for majority of the failures in sound dentin with different adhesive systems (Table 4). Most of the specimens bonded to natural sclerotic dentin with CSE Bond (Fig. 7a) and Scotchbond MPP (Fig. 8a) showed a mixed failure pattern, a combination of cohesive and adhesive failures.

One recent clinical study compared the cumulative retention rates of a resin-modified glass ionomer cement (Fuji II LC), a two-step self-etching primer adhesive (Clearfil SE Bond), and a phosphoric acid etch single-bottle adhesive (Single Bond) when used to restore natural sclerotic dentin lesions³⁵. Unlike our findings, this study by Burrow and Tyas³⁵ reported that resin-modified glass ionomer cement was the best material for restoring noncarious cervical lesions, if esthetics were not a critical consideration. Cumulative retention rate of resin-modified glass ionomer cement was higher than the other two systems after three years' recall. It is noteworthy that results with adhesive systems may

change under clinical conditions.

CONCLUSIONS

The conclusions of this study can be summarized as follows:

1. The bonding systems used in this study rendered equal performance on sclerotic dentin surfaces.
2. The bond strength values of CSE Bond and Scotchbond MPP decreased significantly on sclerotic palatal dentin surfaces.
3. The bond strength values of RB did not change significantly according to dentin surface type (sclerotic *versus* sound dentin).

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