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Clinical Evaluation of a Two-step Etch&Rinse and a Two-step Self-etch Adhesive System in Class II Restorations: Two-year Results

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Clinical Relevance

The two-step etch&rinse and the two-step self-etch adhesive systems tested in this study demonstrated similar clinical performance in Class II cavities after two years.

SUMMARY

Objective: This study evaluated the clinical performance of a two-step etch&rinse and a two-step self-etch adhesive system in Class II restorations after two years of clinical service.

Methods: Thirty-three patients with primary caries or insufficient restorations were enrolled in the study. A total of 87 Class II cavities were restored, 44 using a two-step etch&rinse adhesive system (Single Bond, 3M ESPE) and 43 cavities using a two-step self-etch adhesive (Clearfil SE Bond, Kuraray). Filtek Z250 (3M ESPE) was used as a restorative material for all the restorations. The restorations were evaluated at baseline, six months, and one and two years after placement for retention, marginal discoloration, marginal adaptation, postoperative sensitivity, secondary caries, color match and anatomical form, according to the modified Ryge criteria.

Results: At two years, the retention rates for Single Bond and Clearfil SE Bond were 94% and 100%, respectively, (p=0.493). No significant dif-

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ferences were found between both groups for the other parameters evaluated.

Conclusion: Both of the adhesive systems that were tested demonstrated similar clinical performance at the end of this two-year clinical trial.

INTRODUCTION

Over the past decade, as a result of research pertaining to the enamel/dentin bonding concept, two different adhesion strategies were developed: the etch&rinse and the self-etch approach.[1] The etch&rinse adhesion strategy includes three steps: a) application of the acid etchant, b) application of the primer and c) application of the bonding agent. Although the simplified two-step version combines the primer and bonding agent steps, it still has a separate etch&rinse step. A number of previous studies reported effective bonding efficacy to enamel and dentin when using these etch&rinse adhesives.[2-4] A disadvantage of this system is the possible discrepancy between the depth of dentin demineralization and that of monomer penetration. An acid-etching procedure, which can be penetrated by resin, demineralizes the dentin surfaces and exposes the collagen network; however, when the dentin surface is dried with air after the rinsing step, this collagen network can shrink and collapse easily. Any collapse of the collagen matrix because of over-drying may prevent monomers from penetrating into deeper areas and increase the risk of adhesive failures and nanoleakage.[5]

Self-etch adhesives were developed in order to overcome the problem of etch&rinse adhesives achieving similar demineralization and resin penetration depth. The non-rinsing acidic monomer of these systems can etch and prime the tooth surface simultaneously. Consequently, the demineralized dentin and exposed collagen-rich meshwork can be completely and homogeneously infiltrated by resin monomers to obtain a reliable dentin adhesion.[6] Elimination of the rinsing step and partial removal of the smear layer and smear plugs with these adhesives leads to less technique-sensitive and time-consuming procedures and can possibly reduce postoperative sensitivity.

Self-etch adhesives, especially the mild two-step self-etch adhesives (those with a pH of approximately 2), demonstrated an effective dentin-bonding capacity in previous studies.[3,7-8] These adhesives create a hybrid layer 0.5–1 μm thick in which hydroxyapatite crystals that interact chemically with functional monomers can still be found.[9] However, the quality of adhesion to enamel with these mild self-etch adhesives is still controversial. While some authors reported a lower bonding effectiveness with these systems compared to etch&rinse adhesives,[7-8] others found a similar bonding effectiveness.[10-11] In addition, *in vitro* durability studies of mild two-step self-etch adhesives demonstrated a significant decrease in enamel bond strengths after thermo-cycling,[12] thermo-mechanical fatigue loading[3] and water storage.[11]

Among the mild two-step self-etch adhesives, Clearfil SE Bond has been associated with favorable laboratory results and clinical findings, especially with non-carious Class V lesions.[3,10,13-14] With this in mind, the clinical performance of Clearfil SE in posterior Class II restorations is not well studied. Class II restorations include a large amount of enamel margins, where the bonding effectiveness of mild self-etch adhesives was controversial, especially when beveling was not performed. In addition, the gingival cavity wall of a Class II restoration was reported to be susceptible to the formation of secondary caries, irrespective of the type of restoration.[14] On the other hand, two-step etch&rinse adhesives are generally applied onto the moist dentin; however, determining the degree of wetness for effective bonding is difficult. This operator-dependent technique sensitivity makes it difficult to apply these adhesives properly in complex *in vivo* cavity configurations.[15] In light of the above mentioned reasons, Class II restorations were used to test the clinical performance of adhesive systems in the current study.

This study evaluated the two-year clinical performance of a two-step etch&rinse and a two-step self-etch adhesive system in Class II restorations. The hypothesis tested was that a two-step self-etch approach is equally effective in restoring Class II cavities as a two-step etch&rinse adhesive.

METHODS AND MATERIALS

Patient and Lesion Selection

Thirty-three patients (16 males and 17 females), ranging in age from 20 to 54 years (with a mean age of 33.1), were included in the study. The Committee for Medical Ethics of the University approved the study protocol, and each patient signed an informed consent form following an explanation at the beginning of the study related to the nature and objectives of the clinical trial. The inclusion/exclusion criteria were as follows:

Inclusion Criteria

1. Good general health.
2. Indications for placement of the restorations were primary caries or replacement of existing insufficient restorations.
3. Having at least two comparable cavities or existing defective (insufficient) restorations, including proximal surfaces in premolars or molars that have normal functional occlusion with at least one cusp in occlusal contact.

Exclusion Criteria

1. Absence of the adjacent and antagonist teeth.

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2. Severe periodontal diseases and extremely poor oral hygiene.
3. Symptoms of pulpitis, such as spontaneous pain or sensitivity to pressure.

The adhesive materials tested were a two-step etch&rinse adhesive, Single Bond (3M ESPE, Seefeld, Germany) and a two-step self-etch adhesive system, Clearfil SE Bond (Kuraray, Osaka, Japan). The same restorative material (Filtek Z250, 3M ESPE, St Paul, MN, USA) was used for both adhesives. The teeth were randomly assigned for restoration with either Single Bond (SB) or Clearfil SE Bond (C-SE). Randomization was performed by first selecting the adhesive system by flipping a coin, then applying the particular adhesive system to the tooth with the lowest tooth number. The other adhesive was then applied to the remaining tooth. This procedure was performed on the tooth with the lowest number to the tooth with the highest number, provided that more than two restorations had to be placed. Table 1 shows the distribution of restorations according to their location.

Restorative Procedure

A total of 87 restorations, 44 SB and 43 C-SE, were placed. Before treatment, initial periapical radiographs of the teeth to be treated were taken. Vitality test scores of the teeth were recorded with a vitality tester (Parkell Pulp Vitality Tester, Parkell Electronics DN, Farmingdale, NY, USA). The cavities were prepared and the old restorations removed using round diamond (MANI, Tochigi, Japan) and fissure burs at high-speed with water cooling. Hand instruments and slow-speed tungsten carbide burs were used to remove the caries. If needed, local anesthesia was applied to prevent patient discomfort during the restorative procedures. Control of the excavated cavity floor was mainly conducted by probing with a sharp explorer and by means of the color of the underlying dentin. For primary caries, the conservative cavity (adhesive) design was used according to the principles of minimal invasive dentistry, while the replacement of amalgam resulted in the larger conventional Class II cavities (Table 1). The common characteristics of these cavity designs were: a) none of the cavity preparations involved one or more cusps, b) all of the gingival margins included sound enamel and were placed above the gingival sulcus and c) no beveling was applied to the cavity walls. However, there were also some differences between these cavity designs. Unlike the conservative design, the mesiodistal and buccolingual widths and the depth of the occlusal cavities and facial, lingual and gingival extensions of the proximal boxes of the conventional preparations were dictated by the old amalgam restorative material rather than the carious lesion. For this reason, the conventional preparations: a) generally required more facial, lingual and gingival extentions for preparation of the proximal boxes, b) had less mesiodistal width and occlusal depth and c) had buccolingual width that was between one-third and two-thirds of the distance between the facial and lingual cusps, while the buccolingual width of the conservative preparations generally did not exceed one-third of this distance.

One experienced operator who was familiar with adhesive dentistry placed all the restorations by using rubber dam isolation (Powder Free Dental Dams, Royal Shield, Selangor Darul Ehsan, Malaysia; Rubber Dam Clamps, Hu-Friedy, Chicago, IL, USA). Calcium hydroxide (Dycal, Dentsply/Caulk, Milford, DE, USA) was only used in deep cavities and was applied directly over the deep portion of the preparation. All the cavities

Table 1: *Baseline Data Regarding the Lesions Included in This Study*

Characteristics of the Class II Lesions	Number of Lesions	
	Single Bond	Clearfil SE Bond
Untreated/Previously Treated Lesions		
Untreated carious lesion (conservative cavity design)	39	34
Previously treated lesion and replacement old restoration (conventional cavity design)	5	9
Tooth Distribution		
Maxillary premolars	12	24
Mandibular premolars	16	6
Maxillary molars	10	7
Mandibular molars	6	6
Liner		
No liner	23	21
Calcium hydroxide liner	21	22
Glass ionomer lining	–	–
Preoperative Sensitivity		
No preoperative sensitivity	44	43
Yes preoperative sensitivity (air, probe)	–	–

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Table 2: *Composition and Application Procedure of the Materials Used*

Material	Composition	Application
Clearfil SE Bond, (Kuraray, Osaka, Japan) Lot #41594	**Primer:** 10-MDP, HEMA, hydrophobic aliphatic dimethacrylate, camphorquinone, water, accelerators, dyes **Bond:** HEMA, BisGMA, 10-MDP, hydrophobic aliphatic dimethacrylate, colloidal silica, dl-Camphorquinone, initiators, accelerators	1) Apply primer to entire surface with a disposable brush tip with rubbing 2) Leave in place for 20 seconds 3) Dry with air for 5 seconds (dentin surface must appear glossy) 4) Apply bond 5) Gentle air-blow 6) Light cure for 10 seconds
Adper Single Bond, (3M ESPE, Seefeld, Germany) Lot #4KE	**Etch-gel:** 37% H_3PO_4 **Bond:** Water, ethanol, HEMA, BisGMA, dimethacrylates, a novel photoinitiator system and a methacrylate functional copolymer of polyacrylic and polyitaconic acids	1) Apply etch-gel on enamel and dentin for 15 seconds 2) Rinse with water (15-30 seconds) 3) Dry with air blow without desiccating dentin and leave surface moist 4) Apply two consecutive coats of bond to entire etched tooth surface 5) Dry gently 2-5 seconds 6) Light cure for 10 seconds
Filtek Z250 (3M ESPE, St Paul, MN, USA) Lot #: 20030916 Shade: A_1, A_2, A_3, $A_{3,5}$, C_2, D_3	**Matrix:** Bis-GMA, UDMA, Bis-EMA **Filler:** zirconia/silica (0.01-3.5 μm)	1) Apply in 2 mm increments 2) Light cure for 20 seconds

**Bis-GMA; Bisphenol-glycidyl methacrylate, HEMA; 2-hydroxyethyl methacrylate, 10-MDP; 10-methacryloyloxydecyl dihydrogen phosphate, UDMA; urethane dimethacrylate, Bis-EMA; Ethoxylated bisphenol A dimethacrylate.*

were restored using a sectional metal matrix fixed with a ring (Palodent, Dentsply/DeTrey, Konstanz, Germany) in order to reestablish the anatomical shape and proximal contacts of the teeth. After the cavity preparation, separate protocols that were recommended by the manufacturers were adopted for SB and C-SE adhesives (Table 2). The restorative composite (Filtek Z250, 3M ESPE) was placed in 2 mm layers and cured for 20 seconds using a light-curing unit (Heliolux DLX, Ivoclar Vivadent, Schaan, Liechtenstein) with a power density of 550 mW/cm^2. Following removal of the matrix band, the proximal regions of the restorations were additionally polymerized buccally and lingually/palatinally for 20 seconds. Final contouring and finishing of the restorations was performed at the same appointment using fine grit diamond burs under water-cooling to remove gross excess and flexible points impregnated with silicone dioxide to obtain smooth surfaces (Astropol, Ivoclar Vivadent). For finishing and polishing of the proximal surfaces, aluminum oxide finishing strips (Dentonics Inc, Monroe, NC, USA) were used. The quality of the interproximal contacts was checked with dental floss.

Evaluation Procedure

All the restorations were evaluated at baseline and after six months and one and two years by two calibrated examiners who were not the operator placing the restorations. The restorations were examined by using the modified Ryge criteria (USPHS)[16-18] for retention, marginal discoloration, marginal adaptation, postoperative sensitivity, secondary caries, color match and anatomical form (Table 3). The restorations were scored as follows: Alpha represented the ideal clinical situation; Bravo was clinically acceptable; Charlie represented clinically unacceptable situations where the restoration had to be replaced.[16] Postoperative sensitivity was measured by blowing a stream of compressed air for three seconds at a distance of 2–3 cm from the restoration and by moving the probe over the restored tooth surface. At each recall, bitewing radiographs were taken for secondary caries and vitality tests were recorded. When disagreement occurred during evaluations, the restorations were re-evaluated by both dentists and a consensus was obtained.

The overall success rate was determined using the parameters of retention, marginal adaptation, marginal discoloration and secondary caries. Retention loss, severe marginal defects, discoloration that needed repair or replacement and the occurrence of caries along the restoration margins were considered to represent clinical failures.[19]

Statistical Analysis

The statistical analysis was processed with the SPSS 13.0 software system. The differences in ratings of the two materials after six months and one and two years were tested with the Chi-square test. The Fishers Exact Test was used to evaluate whether there were any differences between the groups in terms of location of the restorations (premolar and molar) and cavity design (conservative and conventional). For all tests, the probability level for statistical significance was at α=0.05.

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Table 3: *Modified Ryge Criteria Rating System [16].*

Category and Rating	Criteria*	Evaluation Method
Retention	A: Retained B: Partially retained C: Missing	Visually (after air-drying the tooth) and tactilely using a sharp probe.
Marginal Adaptation	A: Undetectable crevice along the margin B: Detectable V-shaped defect in enamel only C: Detectable V-shaped defect in DEJ	Tactilely by moving a sharp probe over the restorations margins.
Marginal Discoloration	A: No discoloration anywhere along the margin B: Superficial staining (removable, usually localized) C: Deep staining (not removable, generalized)	Visually after air-drying the tooth and after removing plaque (if necessary).
Secondary Caries	A: No evidence of caries B: Evidence of caries along the margin of the restoration	Visually, tactilely using a probe (after air-drying the tooth) and bitewing radiographs.
Postoperative Sensitivity	A: No postoperative sensitivity at any time of the restorative process and during the study period B: Experience of sensitivity at any time of the restorative process and during the study period	Blowing a stream of compressed air for 3 seconds at a distance of 2-3 cm from the restoration.
Color Match	A: No shade mismatch in room light in 3-4 seconds B: Perceptible mismatch but clinically acceptable C: Esthetically unacceptable	Visually using a mirror.
Anatomical Form	A: The restoration is continuous with existing anatomic form B: Generalized wear but clinically acceptable (50% of margins are detachable, catches explorer going from material to tooth) C: Wear beyond the DEJ (clinically unacceptable)	Visually (after air-drying the tooth) and tactilely using a sharp probe.

*A=Alpha; B=Bravo; C=Charlie

RESULTS

There were no significant differences between study groups in terms of location of the restoration and cavity design. After the two-year follow-up examination, 66 of the 87 restorations were evaluated (76% recall rate). Five patients (15 restorations) were unavailable at the six-month and one-year recalls and the number of unavailable patients increased from five to nine by the two-year recall. Reasons for not attending at each recall were checked. These patients were unavailable for recall appointments because some of them moved away from the city, and for others, there were unknown reasons; however, no patient reported any negative appreciation for the restorative procedures that were performed. The modified Ryge criteria for the evaluated restorations are displayed in Table 4.

Retention. Two restorations from the etch&rinse group were lost at the two-year recall, resulting in a retention rate for SB of 94% and 100% for C-SE (p=0.493).

Marginal Discoloration. At the two-year recall, three SB and three C-SE restorations showed superficial discoloration and scored Bravo (p=1.000). Marginal discoloration was observed at the enamel margin for all restorations.

Marginal Adaptation. At the two-year recall, while small detectable V-shaped enamel marginal defects (Bravo) were recorded for both adhesives, no significant differences were found between them (p=0.356). These small marginal defects were recorded at the enamel margins for all restorations.

Postoperative Sensitivity. None of the restorations was sensitive to air or tactile contact, postoperatively.

Secondary Caries. No secondary caries was observed after two years of clinical service.

Color Match. Slight differences in color match were observed in four SB and three C-SE restorations after two years, but these shade mismatches were clinically acceptable (Bravo) (p=0.704).

Anatomical Form. Minor wear change was observed in only one SB restoration at six months and one year (p=1.000); however, this restoration could not be checked at two years, because the patient with this restoration was unavailable due to relocation away from the city.

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DISCUSSION

Since the 1990s, adhesive technology has progressed rapidly. Many of the adhesive systems were frequently replaced by a successor that was claimed to be better, without clinical validation.[20] In order to predict the clinical performance of adhesive materials, laboratory tests that simulate optimal clinical conditions as accurately as possible have been performed. As a result, laboratory testing methods do not always reflect the actual clinical performance of the adhesive systems and clinical testing of these materials is recommended.[21]

In the current study, no restorations were lost until 12 months. However, after two years, the retention rate for SB decreased to 94% (two lost restorations), while C-SE showed no lost restorations. Other clinical trials reported different retention rates, varying from 75 to 100, with different two-step etch&rinse adhesives after one to three years.[22-26] Brackett and others[25] reported retention rates of 84% and 81% for Class V restorations placed using SB after one and two years, respectively. Swift and others[22] demonstrated a 93% retention rate for Optibond Solo (Kerr) and an 89% retention rate for Prime & Bond 2.1 (Dentsply) in Class V restorations after three years. Perdigão and others[26] recorded a higher retention rate (100%) using One-Step (BISCO) after one year of clinical service in posterior restorations. Different results from these trials may result from the differences in cavity designs, various ingredients of adhesive systems and duration of evaluation periods.

The debonded restorations of SB in the current trial are probably due to technique sensitivity of the system used. One of the reasons for this technique sensitivity is its separate etching step. Over-etching with subsequent deep demineralization and a collapsed collagen network due to air-drying can lead to incomplete resin infiltration and a porous zone in the hybrid layer.[27] In the long term, durability of the bond may be compromised.[28] In addition, SB was applied to moist dentin in the current study; however, determining how moist the dentin should be in order to ensure effective bonding is rather difficult, and the necessity of leaving the dentin moist leads to operator-dependent technique sensitivity.[29] Especially in complex cavity configurations, such as Class II cavities, it is more difficult to control the wetness of the dentin surface.[15] Furthermore, this two-step etch&rinse adhesive was used in multiple layers in the current study. When the ethanol-water or water-based adhesive layers are applied in thick and multiple layers, poor solvent evaporation can occur and result in a decrease in bonding effectiveness.[30]

Table 4: *Results for Different Parameters Evaluated in This Study*

Parameter Rating		Baseline		6 Months		1 Year		2 Years	
		SB	C-SE	SB	C-SE	SB	C-SE	SB	C-SE
Retention	A	44/44 (100)	43/43 (100)	36/36 (100)	36/36 (100)	36/36 (100)	36/36 (100)	33/31 (100)	33/33 (100)
	B	44/0 (0)	43/0 (0)	36/0 (0)	36/0 (0)	36/0 (0)	36/0 (0)	33/0 (0)	33/0 (0)
	C	44/0 (0)	43/0 (0)	36/0 (0)	36/0 (0)	36/0 (0)	36/0 (0)	33/2 (0)	33/0 (0)
Marginal discoloration	A	44/44 (100)	43/43 (100)	36/36 (100)	36/34 (100)	36/35 (100)	36/34 (100)	31/28 (100)	33/30 (91)
	B	44/0 (0)	43/0 (0)	36/0 (0)	36/2 (6)	36/1 (0)	36/2 (6)	31/3 (10)	33/3 (9)
	C	44/0 (0)	43/0 (0)	36/0 (0)	36/0 (0)	36/0 (0)	36/0 (0)	31/0 (0)	33/0 (0)
Marginal adaptation	A	44/44 (100)	43/43 (100)	36/33 (92)	36/32 (89)	36/33 (92)	36/31 (86)	31/30 (97)	33/29 (88)
	B	44/0 (0)	43/0 (0)	36/3 (8)	36/4 (11)	36/3 (8)	36/5 14)	31/1 (3)	33/4 (12)
	C	44/0 (0)	43/0 (0)	36/0 (0)	36/0 (0)	36/0 (0)	36/0 (0)	31/0 (0)	33/0 (0)
Postoperative sensitivity	A	44/44 (100)	43/43 (100)	36/36 (100)	36/36 (100)	36/36 (100)	36/36 (100)	31/31 (100)	33/33 (100)
	B	44/0 (0)	43/0 (0)	36/0 (0)	36/0 (0)	36/0 (0)	36/0 (0)	31/0 (0)	33/0 (0)
Secondary caries	A	44/44 (100)	43/43 (100)	36/36 (100)	36/36 (100)	36/36 (100)	36/36 (100)	31/31 (100)	33/33 (100)
	B	44/0 (0)	43/0 (0)	36/0 (0)	36/0 (0)	36/0 (0)	36/0 (0)	31/0 (0)	33/0 (0)
Color match	A	44/42 (95)	43/41 (95)	36/33 (92)	36/32 (92)	36/33 (92)	36/33 (92)	31/27 (87)	33/30 (91)
	B	44/2 (5)	43/2 (5)	36/3 (8)	36/3 (8)	36/3 (8)	36/3 (8)	31/4 (13)	33/3 (9)
	C	44/0 (0)	43/0 (0)	36/0 (0)	36/0 (0)	36/0 (0)	36/0 (0)	31/0 (0)	33/0 (0)
Anatomical form	A	44/44 (100)	43/43 (100)	36/35 (97)	36/36 (100)	36/35 (97)	36/36 (100)	31/31 (100)	33/33 (100)
	B	44/0 (0)	43/0 (0)	36/1 (3)	36/0 (0)	36/1 (3)	36/0 (0)	31/0 (0)	33/0 (0)
	C	44/0 (0)	43/0 (0)	36/0 (0)	36/0 (0)	36/0 (0)	36/0 (0)	31/0 (0)	33/0 (0)
Overall clinical success rate		44/44 (100)	43/43 (100)	36/36 (100)	36/36 (100)	36/36 (100)	36/36 (100)	33/31 (94)	33/33 (100)

For the Modified Ryge criteria, data shown is n of examined restorations/n of ratings (% of ratings).

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The excellent retention rate of C-SE may result from its two different bonding mechanisms: micromechanical and chemical bonding. This adhesive forms uniform and stable resin-infiltrated dentin, which is created by partial demineralization and infiltration of dentin with monomers.[6] Moreover, the functional monomer 10-MDP in C-SE interacts chemically with residual hydroxyapatite around the exposed collagen fibrils.[9] Consistent with the findings of the current study, Van Meerbeek[31] and Peumans and others[32] reported retention rates of 100% at two years and three years, respectively. Perdigão and others[33] also reported a perfect retention rate for C-SE at 18 months. Contrary to the current study, these investigators tested the clinical performance of C-SE in non-carious Class V lesions. Although Class II and V cavities differ in size, wideness and mechanical retention, the clinical performance of C-SE appeared to not be affected by these differences. Furthermore, increasing the bonding area by not using a liner or only applying a calcium hydroxide liner onto the dentin close to the pulp may have contributed to the good retention of this material in this trial.

Regarding marginal discoloration and marginal adaptation, all the restorations exhibited clinically acceptable results. Marginal discoloration was observed only as superficial localized marginal discoloration at enamel margins and did not require further treatment. As a result, it was considered to be clinically negligible. Marginal defects were also small and barely noticeable with the naked-eye. In fact, marginal defects could only be detected by moving a sharp probe across the restoration-tooth margin. Small marginal enamel defects occurred only slightly more often in the C-SE group; however, the differences between both groups were not significant. The inferior etching pattern of C-SE may be responsible for the slightly greater marginal defects. In previous studies by Van Meerbeek and others[31] and Peumans and others,[32] the clinical performance of C-SE with and without selective etching of the enamel using phosphoric acid was evaluated. Consistent with the findings of the current study, they reported excellent clinical performance with the non-etch group except for small enamel defects and superficial discoloration. These defects were defined as small and clinically negligible and, thus, additional etching of the enamel cavity margins was found to not be critical for its clinical performance in these studies.

Several patients were unavailable for recall appointments because they had moved or could not be reached at the phone numbers they provided; thus, the recall rate of the current study at the end of two years (76%) was relatively low; however, no patient reported any negative appreciation for the restorative procedure performed. Although the recall rate of this clinical trial was relatively low, the number of restorations evaluated at the end of two years in this study was in the range of other studies of Class II restorations. In previous studies, the number of Class II restorations examined varied between 17-36 per material.[34-37] Faqundes and others[34] evaluated a total of 33 Class II restorations (14 and 19 restorations per material) in order to test the clinical performance of two packable posterior composites. Ergücü and Türkün[35] examined the clinical success potential of two nanocomposites using a total of 47 Class II restorations (23 and 24 restorations per material). Furthermore, the number of restorations evaluated in the current study at two years (64 restorations) was higher than the minimum number of restorations (a total of 40 restorations) recommended by the American Dental Association (ADA) Council on Scientific Affairs for posterior restorations.[38]

CONCLUSIONS

Although SB restorations revealed more retention failures and C-SE restorations exhibited more small marginal enamel defects, these problems appear not to be critical for the overall clinical performance of these adhesives and no significant differences between the clinical performances of these adhesive systems were found. Further recalls are planned in order to follow-up on the clinical performance of these adhesive systems, because the negative effects of the environment on the clinical performance of resin-based materials may increase with time.

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References

1. Van Meerbeek B, De Munck J, Yoshida Y, Inoue S, Vargas M, Vijay P, Van Landuyt K, Lambrechts P & Vanherle G (2003) Buonocore Memorial Lecture: Adhesion to enamel and dentin: Current status and future challenges *Operative Dentistry* **28(3)** 215-235.
2. Peumans M, Kanumilli P, De Munck J, Van Landuyt K, Lambrechts P & Van Meerbeek B (2005) Clinical effectiveness of contemporary adhesives: A review of current clinical trials *Dental Materials* **21** 864-881.
3. Frankenberger R & Tay FR (2005) Self-etch vs etch-and-rinse adhesives: Effect of thermo-mechanical fatigue loading on marginal quality of bonded resin composite restorations *Dental Materials* **21** 397-412.
4. De Munck J, Peumans M, Poitevin A, Lambrechts P, Braem M & Van Meerbeek B (2005) Durability of adhesion to tooth tissue: Methods and results *Journal of Dental Research* **84** 118–132.
5. Pioch T, Kobaslija S, Schagen B & Götz H (1999) Interfacial micromorphology and tensile bond strength of dentin bonding system after NaOCl treatment *Journal of Adhesive Dentistry* **1** 135-142.
6. Tay FR, Sano H, Carvalho R, Pashley EL & Pashley DH (2000) An ultrastructural study of the influence of acidity of self-etching primers and smear layer thickness on bonding to intact dentin *Journal of Adhesive Dentistry* **2** 83-98.

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7. De Munck J, Vargas M, Iracki J, Van Landuyt K, Poitevin A, Lambrechts P & Van Meerbeek B (2005) One-day bonding effectiveness of new self-etch adhesives to bur-cut enamel and dentin *Operative Dentistry* **30(1)** 39-49.
8. Van Landuyt KL, Kanumilli P, De Munck J, Peumans M, Lambrechts P & Van Meerbeek B (2006) Bond strength of a mild self-etch adhesive with and without prior acid-etching *Journal of Dentistry* **34** 77-85.
9. Yoshida Y, Nagakane K, Fukuda R, Nakayami Y, Okazaki M, Shintani H, Inoue S, Tagawa Y, Suzuki K, De Munck J & Van Meerbeek B (2004) Comparative study on adhesive performance of functional monomers *Journal of Dental Research* **83** 454-458.
10. Lopes GC, Marson FC, Vieira LC, de Caldeira AM & Baratieri LN (2004) Composite bond strength to enamel with self-etching primers *Operative Dentistry* **29(4)** 424-429.
11. Wang H, Shimada Y & Tagami J (2004) Shear bond stability of current adhesive systems to enamel *Operative Dentistry* **29(2)** 168-175.
12. Miyazaki M, Sato M & Onose H (2000) Durability of enamel bond strength of simplified bonding systems *Operative Dentistry* **25(2)** 75-80.
13. Inoue S, Vargas MA, Abe Y, Yoshida Y, Lambrechts P, Vanherle G, Sano H & Van Meerbeek B (2001) Microtensile bond strength of eleven contemporary adhesives to dentin *Journal of Adhesive Dentistry* **3** 237-245.
14. Mjör IA (1998) The location of clinically diagnosed secondary caries *Quintessence International* **29** 313-317.
15. De Munck J, Van Layduyt K, Peumans M, Poitevin A, Lambrechts P, Braem M & Van Meerbeek B (2005) A critical review of the durability of adhesion to tooth tissue: Methods and results *Journal of Dental Research* **84** 118-132.
16. Ryge G & Cvar JF (1971) Criteria for the clinical evaluation of dental restorative materials. US Dental Health Center, San Francisco: US Government Printing Office Publication. Publication No 7902244.
17. Swift EJ Jr, Perdigão J, Heymann HO, Wilder AD Jr, Bayne SC, May KN Jr, Sturdevant JR & Roberson TM (2001) Eighteen-mouth clinical evaluation of a filled and unfilled dentin adhesive *Journal of Dentistry* **29** 1-6.
18. Türkün SL (2003) Clinical evaluation of a self-etching and a one-bottle adhesive system a two years *Journal of Dentistry* **31** 527-534.
19. D'Agostino RB Sr & Massaro JM (2004) New developments in medical clinical trials *Journal of Dental Research* **83** C18-24 [spec no. C].
20. Van Meerbeek B, Perdigão J, Lambrechts P & Vanherle G (1998) The clinical performance of adhesives *Journal of Dentistry* **28** 1-20.
21. Platt JA, Winkler MM, Matis BA & Moore BK (1997) Correlation of dentin adhesive laboratory and clinical performance at two years *Journal of Dental Research* **76** 184-187.
22. Swift EJ Jr, Perdigão J, Wilder AD Jr, Heymann HO, Sturdevant JR & Bayne SC (2001) Clinical evaluation of two one-bottle dentin adhesives at three years *Journal of the American Dental Association* **132** 1117-1123.
23. Tyas MJ & Burrow MF (2002) Three-year clinical evaluation of One-Step in non-carious cervical lesions *American Journal of Dentistry* **15** 309-311.
24. Loguercio AD, Bittencourt DD, Baratieri LN & Reis A (2007) A 36-month evaluation of self-etch and etch-and-rinse adhesives in noncarious cervical lesions *Journal of the American Dental Association* **138** 507-514.
25. Brackett WW, Dib A, Brackett MG, Reyes AA & Estrada BE (2003) Two-year clinical performance of Class V resin-modified glass ionomer and resin composite restorations *Operative Dentistry* **28(5)** 477-481.
26. Loguercio AD, Reis A, Rodrigues Filho LE & Busato AL (2001) One-year clinical evaluation of posterior packable resin composite restorations *Operative Dentistry* **26(5)** 427-434.
27. Maciel KT, Carvalho RM, Ringle RD, Preston CD, Russell CM & Pashley DH (1996) The effects of acetone, ethanol, HEMA, and air on the stiffness of human decalcified dentin matrix *Journal of Dental Research* **75** 1851-1858.
28. Paul SJ, Welter DA, Ghazi M & Pashley D (1999) Nanoleakage at the dentin adhesive interface vs microtensile bond strength *Operative Dentistry* **24(3)** 181-188.
29. Gwinnett AJ (1992) Moist versus dry dentin: Its effect on shear bond strength *American Journal of Dentistry* **5** 127-129.
30. Zheng L, Pereira PN, Nakajima M, Sano H & Tagami J (2001) Relationship between adhesive thickness and microtensile bond strength *Operative Dentistry* **26(1)** 97-104.
31. Van Meerbeek B, Kanumilli P, De Munck J, Van Landuyt K, Lambrechts P & Peumans M (2005) A randomized controlled study evaluating the effectiveness of a two-step self-etch adhesive with and without selective phosphoric-acid etching of enamel *Dental Materials* **21** 375-383.
32. Peumans M, De Munck J, Van Landuyt K, Lambrechts P & Van Meerbeek B (2005) Three-year clinical effectiveness of a two-step self-etch adhesive in cervical lesions *European Journal of Oral Sciences* **113** 512-518.
33. Perdigão J, Lopes L, Lambrechts P, Leitao J, Van Meerbeek B & Vanherle G (1997) Effects of a self-etching primer on enamel shear bond strengths and SEM morphology *American Journal of Dentistry* **10** 141-146.
34. Fagundes TC, Barata TJ, Bresciani E, Cefaly DF, Jorge MF & Navarro MF (2006) Clinical evaluation of two packable posterior composites: 2-year follow-up *Clinical Oral Investigations* **10** 197-203.
35. Ergücü Z & Türkün LS (2007) Clinical performance of novel resin composites in posterior teeth: 18-month results *Journal of Adhesive Dentistry* **9** 209-216.
36. Dresch W, Volpato S, Gomes JC, Ribeiro NR, Reis A & Loguercio AD (2006) Clinical evaluation of a nanofilled composite in posterior teeth: 12-month results *Operative Dentistry* **31(4)** 409-417.
37. Gordan VV, Shen C, Watson RE & Mjör IA (2005) Four-year clinical evaluation of a self-etching primer and resin-based restorative material *American Journal of Dentistry* **18** 45-49.
38. American Dental Association-Council on Scientific Affairs Acceptance Program Guidelines: Resin Based Composites for Posterior Restorations, May, 2001.

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