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Clinical Research

Randomized Clinical Trial of Four Adhesion Strategies: 18-Month Results

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Clinical Relevance

The 18-month retention rate of the two self-etch adhesives used in the present study was similar to that of two etch-and-rinse adhesives from the same manufacturer. However, the quality of enamel margins was significantly better for the two etch-and-rinse adhesives.

SUMMARY

Statement of the Problem: With Institutional Review Board approval, 39 patients who needed restoration of noncarious cervical lesions (NCCLs) were enrolled in this study. A total of 125 NCCLs were selected and randomly assigned to four groups: 1) a three-step etch-and-rinse adhesive, Adper Scotchbond Multi-Purpose (MP, 3M ESPE, St Paul, MN, USA); 2) a two-step etch-and-rinse adhesive, Adper Single Bond Plus (SB, 3M ESPE); 3) a two-step self-etch adhesive, Adper Scotchbond SE (SE, 3M ESPE); and 4) a one-step self-etch adhesive, Adper Easy Bond (EB, 3M ESPE). A nanofilled composite resin was used for all restorations. Restorations were evaluated at six months and 18 months using modified U.S. Public Health Service (USPHS) parameters.

Results: At six months after initial placement, 107 restorations (85.6% recall rate) were evaluated. At 18 months, 94 restorations (75.2% recall rate) were available for evaluation. The 6 mo/18 mo overall retention rates (%) were 100/90.9 for MP; 100/91.7 for SB; 100/90.9 for SE; and 96.4/92.3 for EB with no statistical difference between any pair of groups at each recall. Sensitivity to air decreased significantly for all adhesives from the preoperative to the postop-

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erative stage and was stable thereafter. Interfacial staining did not change statistically from baseline to six months; however, interfacial staining at the enamel margins was statistically worse at 18 months than at baseline for the two self-etch adhesives EB and SE. Marginal adaptation was statistically worse at 18 months compared with baseline only for EB. This tendency was already significant at the six-month recall.

Conclusion: Although 18-month retention was similar for the different adhesion strategies, enamel marginal deficiencies were more prevalent for the self-etch adhesives.

INTRODUCTION

Before the advent of the etch-and-rinse bonding strategy, dentin adhesives were designed not to remove the smear layer, but rather to modify it through preservation of a modified smear layer with concomitant slight demineralization of the underlying dentin surface. Despite promising laboratory results,[1] some of the earlier bonding mechanisms never resulted in satisfactory clinical results. Retention rates for early dental adhesives in noncarious cervical lesions (NCCLs) were in the range of 63% at six months[2] to 50% at one year,[3] even with enamel etching.

Recent developments in the chemistry of dentin adhesives have resulted in *in vitro* dentin bond strengths and clinical retention that approach those usually associated with enamel bonding.[4-8] In spite of different classifications of adhesives, current strategies depend on how the adhesive interacts with the smear layer. Etch-and-rinse adhesives remove the smear layer upon acid-etching, while self-etch adhesives make the smear layer permeable without removing it completely.[9]

Multi-bottle etch-and-rinse adhesives involve separate etching and rinsing steps followed by priming and application of a bonding resin. Etching and priming are considered technique-sensitive application procedures.[9] Two-step etch-and-rinse adhesives also involve a separate etching step but combine primer and adhesive resin into one solution. These two-step adhesives may need more than one application to achieve an acceptable micromechanical interlocking of monomers into the collagen-rich etched dentin.[9,10] Three-step etch-and-rinse adhesives have resulted in better laboratory and clinical performance than two-step etch-and-rinse adhesives.[11,12]

Two-step self-etch adhesives consist of nonrinsing acidic monomers dissolved in an aqueous solution and a hydrophobic resin layer as the second step. One-step self-etch adhesives lack this hydrophobic resin. The aggressiveness of acidic monomers in self-etch adhesives (therefore, their ability to demineralize dentin and enamel) depends on their pH, that is, mild, moderate, or aggressive self-etch adhesives.[13] Self-etch adhesives rely on their ability to infiltrate through smear layers and partially dissolve hydroxyapatite to generate a hybrid layer with minerals incorporated.[9] Because the preparation is not rinsed, these materials are more user-friendly as application time is reduced, compared with etch-and-rinse adhesives.

A systematic review analyzed 85 full articles and abstracts focused on the clinical effectiveness of adhesives in NCCLs.[14] The lowest retention failure rate was shared by glass ionomer–based materials and three-step etch-and-rinse adhesives, whereas the highest retention failure rate was associated with one-step self-etch adhesives. A recent clinical trial in NCCLs compared four adhesives representing all adhesion strategies.[15] Only the three-step etch-and-rinse adhesive resulted in retention rates above 90% at 18 months, which is the American Dental Association (ADA) threshold for full acceptance.[16]

Given that dentists are confused about the efficacy of different generations of dentin adhesives, this study tested the null hypothesis that there are no differences in the clinical retention of four adhesion strategies from the same manufacturer, when applied to NCCLs.

METHODS AND MATERIALS

Before participating in the study, subjects gave informed consent. Both the consent form and this research protocol were reviewed and approved by the Paulista University Institutional Review Board. All 39 subjects, with ages ranging from 22 to 78 years (average 47.6), had been referred to the Operative Dentistry Clinic for restoration of Class V lesions. All subjects received a dental examination by a member of the clinical faculty. The dental health status of patients was normal in all other respects. Patients with fewer than 20 teeth were not included in the study when all other characteristics of dental status were considered normal, including the periodontal condition. With caries as an exclusion criterion, teeth included in the study had NCCLs without undercuts. Other exclusion criteria included the following:

- History of existing tooth sensitivity
- Bruxism and visible wear facets in the posterior dentition
- Known inability to return for recall appointments

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- Fractured or visibly cracked candidate tooth
- Current desensitizing therapy, including desensitizing dentifrices or other over-the-counter (OTC) products
- Long-term use of anti-inflammatory, analgesic, or psychotropic drugs
- Pregnancy or breast-feeding (potential conflicts with recall dates)
- Allergies to ingredients of resin-based restorative materials
- Orthodontic appliance treatment within the previous three months
- Abutment teeth for fixed or removable prostheses
- Teeth or supporting structures with any symptomatic pathology
- Existing periodontal disease or periodontal surgery within the previous three months

The teeth to be restored were vital (positive response to cold sensitivity test), had a normal occlusal relationship with natural dentition, and had at least one adjacent tooth contact. Cavo-surface angles were not beveled, and no retentive grooves were placed.

Materials, respective batch numbers, composition, and manufacturer's instructions for use are provided in Table 1. Approximately 91% of the lesions were classified as degree 1 or 2 on the University of North Carolina (UNC) sclerosis scale[17] and were equally distributed among the four groups. The distribution of restorations was 51.2% in the maxillary arch and 48.8% in the mandibular arch; 82.6% of restorations were placed in premolars or molars. Differences in lesion size and in other characteristics were minimal. Mean lesion volumes were not significantly different among the four restorative groups (one-way analysis of variance [ANOVA], $p=0.98$).

A total of 125 NCCLs were restored in this study. Each subject had up to four restorations placed, with each dentin adhesive applied to one tooth. The dentin adhesives were randomly assigned with separate randomization for each subject (adhesive material vs tooth): 1) a three-step etch-and-rinse adhesive Adper Scotchbond Multi-Purpose (MP, 3M ESPE, St Paul, MN, USA); 2) a two-step etch-and-rinse adhesive Adper Single Bond Plus (SB, 3M ESPE); 3) a two-step self-etch adhesive Adper Scotchbond SE (SE, 3M ESPE); and 4) a one-step self-etch adhesive Adper Easy Bond (EB, 3M ESPE). All operators had advanced training in Operative Dentistry and were individually instructed by the study coordinator on how to apply each adhesive. Operators placed at least one restoration in extracted teeth to practice the technique before performing the first actual restoration placement. The insertion protocol for each adhesive was printed and posted in each dental unit so the operator was able to easily review the instructions before and while applying each adhesive. Each operator inserted approximately the same number of restorations (± 2). Because of the specialized field of the operators, it was not possible to insert the restorations blindly. All operative procedures were performed with cotton-roll isolation without local anesthesia.

After application of the dentin adhesive, Filtek Supreme Plus (3M ESPE) was inserted in increments of 1.0–1.5 mm. Each increment was polymerized for 40 seconds with a light-curing unit (Elipar Freelight 2, 3M ESPE). The intensity of the light exceeded 500 mW/cm^2. After polymerization, finishing was accomplished with aluminum oxide disks of decreasing abrasiveness (Sof-Lex XT, 3M ESPE).

Clinical Evaluation

In addition to assessment of sensitivity immediately before insertion, postoperative sensitivity was assessed one week after the restorative procedure via telephone interview. Restorations were evaluated immediately after insertion, at six months, and at 18 months using the UNC-modified USPHS criteria[17] (*alfa*, *beta*, *charlie*) for retention, color match, interfacial staining, wear, marginal adaptation, surface texture, preoperative sensitivity (air syringe), and postoperative sensitivity (query) (Table 2). Two clinicians evaluated the restorations blindly at each recall but did not evaluate the restorations that they had inserted. In case no consensus was reached, a third clinician evaluated the restoration. To help with the evaluation, intraoral color photographs were collected at baseline and at the recall appointments. Clinical photographs consisted of digital images obtained using a Nikon D40X camera with a 200-mm Medical Nikkor lens (Nikon Inc, Melville, NY, USA). Statistical analyses included the Mann-Whitney nonparametric test to compare the performance of the four adhesives at each recall, and the McNemar nonparametric test to compare changes in each adhesive from baseline to six months and to 18 months (Statistical Package for the Social Sciences [SPSS], version 14.0, SPSS Inc, Chicago, IL, USA). The level of significance was set at $p<0.05$.

RESULTS

At six months, 107 restorations (85.6% recall rate) were evaluated. At 18 months, 94 restorations (75.2% recall rate) were available for evaluation. A summary of direct evaluations is shown in Table 3.

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Table 1: *Materials, Batch Numbers, Compositions, and Instructions for Use*

Material	Composition	Instructions for Use
Adper Easy Bond (also known as Adper Easy One) Lot 359668	BisGMA; HEMA; water (10–15 Wt%); Ethanol (10–15 Wt%); phosphoric acid-6-methacryloxy-hexylesters; silane-treated silica; 1,6-hehadeniol dimethacrylate; copolymer of acrylic and itaconic acid; (dimethylamino) ethyl methacrylate, camphorquinone; 2,4,6-trimethylbenzoyldiphenylphosphine oxide	Dry the cavity by using gentle stream of air free of water and oil, or by blotting with cotton pellets. Do not overdry. Apply the adhesive with the disposable applicator for 20 s to all surfaces of the cavity. Rewet the disposable applicator as needed during application. Subsequently, air thin the liquid for approximately 5 s until the film no longer moves, indicating complete vaporization of the solvent. Cure the adhesive with a commonly used curing light for 10 s.
Adper Scotchbond SE (also known as Adper SE Plus)		
Liquid A: Lot 8BH	Liquid A (Pink wetting solution): water (80%), HEMA, surfactant, rose bengal dye	Liquid A: Apply to the cavity so that a continuous red layer is obtained on the surface.
Liquid B: Lot 8BJ	Liquid B (Adhesive): UDMA, TEGDMA, TMPTMA, HEMA phosphate and MHP, bonded zirconia nanofiller, initiator system based on camphorquinone	Liquid B: Scrub into the entire wetted surface of the bonding area during 20 s. Red color will disappear quickly, indicating that the etching components have been activated. Air-dry thoroughly for 10 s. Apply second coat to the entire bonding surface. Light air application. Light cure for 10 s.
Adper Single Bond Plus (also known as Adper Single Bond 2 or Adper Scotchbond 1XT)		
Etchant: Lot 8MP	Etchant: amorphous silica-thickened 35% phosphoric acid gel	Apply Scotchbond Etchant to tooth surface for 15 s. Rinse thoroughly for 10 s. Blot excess water using a cotton pellet or a mini-sponge. Do not air-dry! Apply 2–3 consecutive coats of adhesive for 15 s with gentle agitation using a fully saturated applicator. Gently air thin for 5 s to evaporate solvent. Light cure for 10 s.
Adhesive: Lot 9WJ	Adhesive: ethyl alcohol (25–35 Wt%); silane-treated silica (nanofiller); BisGMA; HEMA glycerol 1,3-dimethacrylate; copolymer of acrylic and itaconic acid; diurethane dimethacrylate; water (<5%)	
Adper Scotchbond Multi-Purpose		
Etchant: Lot 8MP	Etchant: amorphous silica-thickened 35% phosphoric acid gel	Apply Scotchbond etchant to enamel and dentin. Wait 15 s. Rinse for 15 s. Dry for 5 s. Apply Adper Scotchbond multi-purpose primer to etched enamel and dentin. Dry gently for 5 s. Apply Adper Scotchbond multi-purpose adhesive to primed enamel and dentin. Light cure for 10 s.
Primer: Lot 9CC	Primer: water (40–50 Wt%); HEMA (35–45 Wt%); copolymer of acrylic and itaconic acids (10–20 Wt%)	
Adhesive: Lot 9RL	Adhesive: BisGMA (60–70 Wt%); HEMA (30–40 Wt%)	
Filtek Supreme Plus (A2B: 8XA; A2E: 8GR; A3B: 8UU; A3E: 8EX; A3D: 8EK; A3.5: 8JG; A4D: 8CL	BisGMA, UDMA, TEGDMA, BisEMA, silanated silica, silanated zirconia; photoinitiators	

Bis-EMA - ethoxylated bisphenol-A dimethacrylate; BisGMA- bisphenol A diglycidyl methacrylate; HEMA; 2-hydroxyethyl methacrylate; MHP - methacryloyloxyhexyl phosphate; TEGDMA - triethyleneglycol-dimethacrylate; TMPTMA - trimethylolpropane trimethacrylate; UDMA - urethane dimethacrylate.

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Table 2: *UNC-Modified USPHS Direct Evaluation Criteria*	
Color Match	Alfa = No mismatch in room light in 3–4 s
	(margins exempted from grading)
	(interfacial staining should not affect grading)
	Bravo = Perceptible mismatch (but clinically acceptable)
	Charlie = Esthetically unacceptable (clinically unacceptable)
Interfacial Staining	Alfa = None
	Bravo = Superficial staining (removable, usually localized)
	Charlie = Deep staining (not removable, generalized)
Recurrent Caries	Alfa = None
	Charlie = Present
Wear	Alfa = No perceptible wear (or only localized wear)
	Bravo = Generalized wear (but clinically acceptable)
	(<50% of margins are detectable)
	(catches explorer going from material to tooth)
	Charlie = Wear beyond the DEJ (clinically unacceptable)
Marginal Adaptation (Ditching)	Alfa = Undetectable
	Bravo = Detectable (V-shaped defect in enamel only)
	(catches explorer going both ways)
	Charlie = Detectable (V-shaped defect to DEJ)
Surface Texture	Alfa = Smooth (better than or equal to microfilled standard)
	Bravo = Rougher than microfilled standard
	Charlie = Pitted
Postoperative Sensitivity	Alfa = None
	Charlie = Present
Retention	Alfa = Retained
	Bravo = Partially retained
	Charlie = Missing
Fracture	Alfa = None
	Bravo = Small chip, but clinically acceptable
	Charlie = Failure due to bulk restoration fracture
Other Failure	Alfa = None
	Charlie = Present

Abbreviations: DEJ, dentoenamel junction; UNC, University of North Carolina; USPHS, U.S. Public Health Service.

Two restorations were lost at 18 months for each of the adhesives EB, SE, and MP. All SB restorations were retained. Six- and 18-month retention rates (%) were 100/90.9 for MP; 100/91.7 for SB; 100/90.9 for SE; and 96.4/92.3 for EB, with no statistical difference between any pair of groups at each recall.

Interfacial staining did not change statistically from baseline to six months for any of the adhesives; however, interfacial staining around the enamel margins was statistically worse at 18 months than at baseline for the two self-etch adhesives EB and SE (both at $p<0.031$). Marginal adaptation was statistically worse at 18 months compared with baseline only for the adhesive EB ($p<0.0001$). This tendency was already significant at the six-month recall ($p<0.016$). Sensitivity to air improved significantly for all groups from preoperative conditions to one week after insertion and remained stable thereafter (Table 4). No statistical differences were noted for any of the other parameters.

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Table 3: *Summary of Direct Evaluations: Percentages of Restorations With* Alfa *Scores for Each Criterion at Each Evaluation Point*

Adper Easy Bond		Adper Scotchbond SE		Evaluation Criteria	Adper Single Bond Plus		Adper Scotchbond Multi-Purpose	
6 mo	18 mo	6 mo	18 mo		6 mo	18 mo	6 mo	18 mo
28/34 = 82.4%	26/34 = 76.5%	26/30 = 86.7%	22/30 = 73.3%	Recall rate	32/32 = 100%	27/32 = 84.4%	26/29 = 89.7%	22/29 = 75.9%
27/28 = 96.4%	24/26 = 92.3%	26/26 = 100%	20/22 = 90.9%	Retention	32/32 = 100%	27/27 = 100%	26/26 = 100%	20/22 = 90.9%
27/28 = 96.4%	24/26 = 92.3%	25/26 = 96.2%	19/22 = 86.4%	Color match	31/32 = 96.9%	26/27 = 96.3%	24/26 = 92.3%	20/22 = 90.9%
26/28 = 92.9%	18/26 = 69.2%	21/26 = 80.8%	14/22 = 63.6%	Interfacial staining	32/32 = 100%	27/27 = 100%	23/26 = 88.5%	18/22 = 81.8%
27/28 = 96.4%	24/26 = 92.3%	26/26 = 100%	20/22 = 90.9%	Recurrent caries	32/32 = 100%	27/27 = 100%	26/26 = 100%	20/22 = 90.9%
27/28 = 96.4%	24/26 = 92.3%	26/26 = 100%	20/22 = 90.9%	Wear	32/32 = 100%	27/27 = 100%	26/26 = 100%	19/22 = 86.4%
21/28 = 75.0%	12/26 = 46.2%	22/26 = 84.6%	16/22 = 72.7%	Marginal adaptation	29/32 = 90.6%	23/27 = 85.1%	20/26 = 76.9%	18/22 = 81.8%
26/28 = 92.9%	22/26 = 84.6%	25/26 = 96.2%	19/22 = 86.4%	Surface texture	29/32 = 90.6%	25/27 = 95.6%	25/26 = 96.2%	19/22 = 86.4%

DISCUSSION

As per ADA guidelines, retention rates at six months must be at least 95% for provisional acceptance. At 18 months, retention rates must be at least 90% for full acceptance.[16] All four adhesives in this study fulfilled these guidelines. Therefore, we failed to reject the null hypothesis, because the 18-month retention rate of the four different adhesive strategies from the same manufacturer did not differ significantly at any recall time.

Few published clinical studies have been performed with EB or SE. A recent study[18] on NCCLs reported retention rates very similar to those of our study: 92.86%, for SB, 97.62% for SE, and 100% for EB after 12 months. Another clinical trial in Class II restorations did not result in any statistical difference between SB and SE for any of the parameters at 12 months.[19] Clinical studies with Single Bond have resulted in excellent performance up to five years.[20-22] MP has resulted in excellent clinical retention at two to three years.[23,24] In fact, three-step self-etch adhesives are the golden reference for all other adhesives.[12,14]

Among contemporary adhesives, self-etch adhesives have become popular, especially because of their user-friendliness and short application time.[14] EB, similar to many other one-step self-etch adhesives, contains phosphoric acid ester methacrylates as functional monomers. Whereas SE is a "strong" self-etch adhesive with a pH=1, EB is considered an "ultra-mild" self-etch adhesive because its pH is relatively high pH (2.4). This high pH may explain the significant deterioration of marginal adaptation from baseline to 18 months for EB. Self-etch adhesives do not etch enamel to the same depth as phosphoric acid.[7]

Both self-etch adhesives in the present study resulted in a significant increase in marginal interfacial staining around enamel margins from baseline to 18 months. This increased staining may be the result of a shallow enamel-etching pattern, because interfacial staining has been associated with a poor enamel etching ability of self-etch adhesives,[25-27] even for those considered "strong" self-etch adhesives (pH=1), such as SE.[27]

One of the drawbacks of the acidic monomers in self-etch adhesives is their instability in water.[28] SE is not

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Table 4: *Incidence of Preoperative and Postoperative Sensitivity at Each Evaluation Time*

	Preoperative Sensitivity	Postoperative Sensitivity One Week Post Insertion	Sensitivity at Six Months	Sensitivity at 18 Months
Adper Easy Bond	11/34 (32.4%)	0/34 (0%)	1/28 (3.6%)	2/26 (7.7%)
		$p<0.002$[a]	NS[b]	NS[c]
Adper Scotchbond SE	8/30 (26.7%)	0/30 (0%)	1/26 (3.8%)	2/22 (9.1%)
		$p<0.008$[a]	NS[b]	NS[c]
Adper Single Bond Plus	8/32 (25.0%)	0/32 (0%)	1/27 (3.7%)	2/24 (8.3%)
		$p<0.008$[a]	NS[b]	NS[c]
Adper Scotchbond Multi-Purpose	7/29 (24.1%)	0/29 (0%)	1/26 (3.8%)	2/22 (9.1%)
		$p<0.016$[a]	NS[b]	NS[c]

[a] *Statistical significance compared with preoperative condition.*
[b] *Not significantly different from the postoperative condition.*
[c] *Not significantly different from the postoperative condition or from the six-month condition.*

a conventional two-step self-etch adhesive, as the first bottle (Liquid A) does not contain acidic monomers to condition dentin and enamel. The concept behind the two separate bottles in SE is to keep water separate from the acidic monomers to increase their shelf life. After the pink water-based solution (Liquid A, Table 1) is applied to visibly wet the preparation, the second solution, which contains the resin monomers, or Liquid B (Table 1), is vigorously mixed with the pink solution. At this point, the color changes to yellow, which means that water has triggered ionization of the acidic monomers, and etching is occurring. After air-drying to evaporate residual water, a second coat of water-free Liquid B is brushed onto the treated surface and light-cured. Ideally, this technique would prevent water from remaining inside the dentin-resin interface.

Mine and others,[29] using Transmission Electron Microscopy (TEM), showed a thick, completely demineralized and acid-resistant dentin hybrid layer as a result of the application of SE. For EB, dentin interaction was not as deep, resembling other "ultra-mild" self-etch adhesives. Regarding bond strength studies, SE has resulted in statistically higher dentin bond strengths than EB.[30] The bond strengths obtained with SE are not affected by thermal fatigue when bonded to coronal dentin[31]; this may be a result of minimal residual water left entrapped within the dentin-adhesive interface.

A recent 18-month clinical study reported a high failure rate for two one-step self-etch adhesives.[32] The addition of an extra coat of a hydrophobic bonding layer, transforming one-step into two-step self-etch adhesives, significantly improved the clinical outcome. The one-step self-etch adhesive Clearfil S^3 Bond (Kuraray America Inc, New York, NY, USA) resulted in a 77.3% retention rate at 18 months. However, when an extra layer of a hydrophobic bonding resin was added (MP adhesive), the retention rate increased to 93.4%. In the same study, iBond (Heraeus Kulzer, South Bend, IN, USA), also a one-step self-etch adhesive, resulted in a 60% retention rate at 18 months. Retention increased to 83% when a coat of the same hydrophobic resin was applied over the cured iBond. In our study, nevertheless, no differences in retention rates were noted between the one-step self-etch adhesive EB and the two-step self-etch adhesive SE. One specific factor may have accounted for the differences between the two studies. The one-step self-etch adhesive used in our study, EB, contains 1%-5% of a polyalkenoic acid copolymer, also known as the Vitrebond copolymer (3M ESPE). Mitra and others[33] reported that this copolymer bonds chemically to calcium in hydroxyapatite. This idea was corroborated by a recent clinical study[34] that found no differences in retention rate for EB with and without a hydrophobic layer

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(MP adhesive) at 18 months. Both groups reported retention rates above 90%. In fact, for adhesive materials that do not require etching, chemical bonding between polycarboxylic monomers and hydroxyapatite plays an important role in the bonding mechanism.[35,36] It has been shown that two-thirds of the carboxyl groups in polyalkenoic acid are capable of bonding to hydroxyapatite.[35] Carboxylic groups replace phosphate ions on the substrate and make ionic bonds with calcium.[35] Adhesives that contain this copolymer have increased resistance to mechanical fatigue.[37]

One disadvantage of self-etch adhesives is that they do not etch enamel to the same depth as phosphoric acid.[7] In the present study, the quality of the enamel margins, specifically interfacial staining, decreased significantly for the two self-etch adhesives at 18 months. In spite of worse interfacial staining, the two self-etch adhesives resulted in similar retention rates compared with the two etch-and-rinse adhesives.

One of the limitations of this clinical investigation is that 18 months may be a short period for substantial changes to become noticeable regarding the clinical performance of dentin adhesives. Long-term clinical evaluations may better reflect the differences among the four adhesion strategies studied in this project.

CONCLUSION

In spite of enamel marginal deterioration associated with the two self-etch adhesives, the 18-month retention rates of four different adhesive strategies from the same manufacturer did not differ significantly at any recall time.

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