24-Month Clinical Performance of a Universal Adhesive on Non-Carious Cervical Lesions: Self-Etch and Etch-and-Rinse Techniques

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Purpose: To evaluate the 24-month clinical performance of Adhese Universal (ADH) (Ivoclar Vivadent) using two different application modes (etch-and-rinse vs self-etch) when restoring non-carious cervical lesions.

Materials and Methods: Twenty-six patients participated in this study. A total of 117 non-carious cervical lesion restorations (N = 117) were assigned to two groups: 1) ADH in the etch-and-rinse mode (n = 59) and 2) ADH in the self-etch mode (n = 58). The same resin composite (Tetric EvoCeram, Ivoclar Vivadent) was used for all restorations. The restorations were evaluated at baseline and at 24 months using the World Dental Federation (FDI) criteria. The results were analyzed statistically using the McNemar test ($\alpha = 0.05$) and a generalized estimating equation.

Results: In self-etch mode, significant differences were found for marginal coloring ($p = 0.002$), marginal adaptation ($p = 0.031$), and hypersensitivity ($p = 0.031$) between baseline and the end of the 24-month period. In the etch-and-rinse mode, significant differences were found for marginal coloring ($p = 0.004$), fractures/retention ($p = 0.002$), marginal adaptation ($p = 0.002$), and hypersensitivity ($p = 0.000$). Significant differences were also detected between groups at 24 months for fractures/retention ($p = 0.001$). At 24 months, 10 restorations of the etch-and-rinse group were lost and 2 restorations of the self-etch group were lost.

Conclusion: In terms of fractures and retention criteria, this universal adhesive obtained better results when applied in self-etch mode than in etch-and-rinse mode.

Keywords: clinical trial, self-etch mode, etch-and-rinse mode, universal adhesive, application modes, non-carious cervical lesions.

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Universal adhesives were introduced on the market to allow clinicians to choose application modes appropriate for a specific clinical situation. These adhesives allow simplification of adhesion because they can be used in etch-and-rinse, self-etch, or selective etching modes, and can also provide adhesion to multiple substrates, eg, resin composites, metals, zirconia, and silica-based ceramics.[6]

Universal adhesives have high bond strengths to dentin in both etch-and-rinse (ER) and self-etch (SE) techniques. This may be due to the introduction of certain amphiphilic monomers, such as glycerol phosphate dimethacrylate (GPDM) or methacryloyloxydecyl dihydrogen phosphate (MDP), which promote chemical bonding to the tooth.[7,23,31] It has been shown that for universal adhesives applied on enamel, bond strengths are always higher using the etch-and-rinse than the self-etch mode.[26,39]

Table 1 Distribution of NCCLs and characteristics of subjects and lesions

Characteristics of subjects and lesions	Number of NCCLs	
Age distribution (years)		
20–29	4	
30–39	6	
40–49	36	
50–59	39	
>60	32	
Tooth distribution	**SE technique**	**ER technique**
Incisors	11	8
Canines	11	11
Premolars	36	40
Arch distribution		
Maxilla	29	28
Mandible	29	31

A direct correlation between laboratory and clinical results is not always given. It has not yet been confirmed whether in vitro results are also obtained in vivo. To date, only a few clinical trials have investigated the effectiveness of universal adhesives, despite their importance for evaluating the clinical performance of those adhesives.[22,27] Some of these clinical studies[22,27,38] reported no differences in the behavior of the universal adhesive when applied using the etch-and-rinse vs self-etch technique. However, other studies demonstrated that the etch-and-rinse technique achieved better results than the self-etch technique.[25,33]

In general, to determine the clinical effectiveness of adhesives, non-carious cervical lesions (NCCLs) are considered ideal because the restoration will be bonded to both enamel and dentin. Access is simple and does not require complicated restorative techniques; in addition, restoration with a low C-factor is possible.[12,40] Furthermore, because they provide minimal, if any, macroretention and hence all retention relies solely on the adhesion effectiveness of the adhesives tested, ineffective bonding results in restoration loss.[40]

This randomized, controlled clinical study compared the clinical effectiveness of a universal adhesive (Adhese Universal, Ivoclar Vivadent; Schaan, Liechtenstein) in two different application modes (etch-and-rinse and self-etch) on NCCLs after 24 months. The null hypothesis was that there was no difference in clinical performance between the etch-and-rinse and self-etch application modes.

MATERIALS AND METHODS

This study followed the Consolidated Standards of Reporting Trials (CONSORT) statement.[47] This double-bind, randomized, clinical trial took place in the clinic of the Faculty of Dental Medicine at the Universidade de Lisboa. All participants were informed about the study protocol and signed a consent form prior to starting treatment; however, they were not aware of which lesions received the treatments under evaluation. The local ethics committee reviewed and approved the protocol and the consent form for this study (No: 911107).

Inclusion and Exclusion Criteria

Twenty-six participants who were at least 18 years old, in good general health, had acceptable oral hygiene, with at least 20 teeth in occlusion and with at least two NCCLs in incisors, canines, and pre-molars (Table 1), were enrolled in the study. The lesions had to be non-carious, non-retentive, deeper than 1 mm, and had to involve both the enamel and dentin of vital teeth without mobility. The cavosurface margin could not involve more than 50% of the enamel.[24] Every tooth included in the study was in occlusion and in proximal contact with the adjacent tooth. All patients were given oral hygiene instructions before operative treatment was performed. Patients with severe xerostomia, bruxism habits, poor oral hygiene, severe or chronic periodontitis, allergies to components of resin-based restorative materials, orthodontic appliances within the previous three months, long-term use of anti-inflammatory, analgesic, or psychotropic drugs, abutment teeth for fixed or removable prostheses, teeth or supporting structures with any symptomatic pathology, and smoking habits were excluded from the study.[22,27]

Restorative Procedure

All of the NCCLs were restored by the same clinician. The clinician was not blinded to group assignment when performing restorations; however, patients were blinded to the group assignment. The stratified randomization process within the subjects was performed using computer-generated tables by a staff member not involved in the research protocol. Each patient received at least two cervical restorations: one with the self-etch technique and the other with the etch-and-rinse technique.

Before isolation with rubber-dam, the clinician anesthetized the teeth with lidocaine, 2% epinephrine 1:80,000 (Xilonibsa 2%, Inibsa; Barcelona, Spain). Then, all teeth were cleaned with pumice and water using a rubber prophylaxis cup to remove the salivary pellicle and dental plaque. They were then rinsed with water and dried. In compliance with the American Dental Association (ADA) guidelines,[1] the clinician did not prepare any additional retention or bevel. Each patient received at least one restoration from each group, with a maximum of three restorations per group placed in one patient.

A total of 117 cervical lesions were restored: 58 with Adhese Universal (ADH) in the self-etch mode and 59 with Adhese Universal in the etch-and-rinse mode. The adhesive was used according to the manufacturer's instructions

Table 2 Components, composition* and application mode of the tested adhesive

Material	pH	Components	Manufacturer's instructions
Adhese Universal Ivoclar Vivadent; Schaan, Liechstein	2.5	10-MDP, dimethacrylate resins, HEMA, ethanol, water, MCAP (methacrylated carboxylic acid polymer), fillers, initiators	1. Only for etch-and-rinse procedure: apply phosphoric acid gel first onto the prepared enamel and then onto the dentin. The etchant should be left to react on the enamel for 15–30 s and on dentin for 10–15 s. Then rinse thoroughly with a vigorous stream of water for at least 5 s and dry with oil- and water-free compressed air until the etched enamel surfaces appear chalky white. 2. Application of the adhesive: starting with the enamel, completely coat the tooth surfaces to be treated with Adhese Universal. The adhesive must be scrubbed into the tooth surface for at least 20 s. This time must not be shortened. Applying the adhesive on the tooth surface without scrubbing is inadequate. Disperse Adhese Universal with oil- and moisture-free compressed air until a glossy, immobile film layer results. Important: Avoid pooling, since this can compromise the fitting accuracy of the permanent restoration. Light cure the adhesive for 10 s.

*Information supplied by the manufacturer.

Table 3 World Dental Federation (FDI) Criteria Used for Clinical Evaluation

	Esthetic property	Functional properties		Biological properties	
	1. Marginal staining	2. Factures and retention	3. Marginal adaptation	4. Postoperative (hyper) sensitivity	5. Recurrence of caries
1. Clinically very good	1.1. No marginal staining	2.1 Restoration retained, no fractures/ cracks	3.1 Harmonious outline, no gaps, no discoloration	4.1 No hypersensitivity	5.1 No secondary or primary caries
2. Clinically good (after correction very good)	1.2 Minor marginal staining, easily removable by polishing	2.2 Small hairline crack	3.2.1 Marginal gap (50 µm) 3.2.2 Small marginal fracture removable by polishing	4.2 Low hypersensitivity for a limited period of time	5.2 .2 Very small and localized demineralization, no operative treatment required
3. Clinically sufficient/ satisfactory (minor shortcomings with no adverse effects, but not adjustable without damage to the tooth)	1.3 Moderate marginal staining, not estheticaly unacceptable	2.3 Two or more or larger hairline cracks and/or chipping (not affecting the marginal integrity)	3.1 Gap <150 µm not removable 3.3.2 Several small enamel or dentin fractures	4.3.1 Premature/ slightly more intense 4.3.2 Delayed/weak sensitivity, no subjective complaints, no treatment needed	5.3 Larger areas of demineralization, but only preventive measures necessary (dentin not exposed)
4. Clinically unsatisfactory (repair for prophylactic reasons)	1.4 Pronounced marginal staining; major intervention necessary for improvement	2.4 Chipping fractures that damage marginal quality; bulk fractures with or without partial loss (less than half of the restoration)	3.4.1 Gap >250 µm or dentin/base exposed 3.4.2 Chip fracture damaging margins 3.4.3 Notable enamel or dentin wall fracture.	4.4.1 Premature/very intense 4.4.2 Extremely delayed/weak with subjective complaints 4.4.3 Negative sensitivity/intervention necessary but not replacement	5.4 Caries with cavitation (localized and accessible and can be repaired)
5. Clinically poor (replacement necessary)	1.5 Deep marginal staining not accessible for intervention	2.5 Partial or complete loss of restoration	3.5 Filling is loose but in situ	4.5 Very intense, acute pulpitis or nonvital. Endodontic treatment is necessary and restoration has to be replaced.	5.5 Deep secondary caries or exposed dentin that is not accessible for repair of restoration
Acceptable or not acceptable (N, % and reasons)	Esthetic criteria	Functional criteria		Biological criteria	

(Table 2). The resin composite (Tetric EvoCeram, Ivoclar Vivadent) was applied in increments not exceeding 2 mm, each one was light cured for 40 s with an LED light-curing unit (Elipar S10; 3M Oral Care; St Paul, MN, USA) with a light intensity of 600 mW/cm^2 (6 J/cm^2). The output of the curing light was periodically verified as > 600 mW/cm^2 with a radiometer (Curing Radiometer P/N 10503, Kerr; Orange, CA, USA) throughout the study. The restorations were finished immediately with fine-grain diamond burs (Diatech Dental; Heerbrugg, Switzerland). Polishing was performed with rubber points (Astropol, Ivoclar Vivadent).

Clinical Evaluation

Two independent, calibrated (see below), experienced dentists evaluated the restorations using 2.5X-magnification dental loupes at baseline and after 24 months. They were

Table 4 Number of evaluated restorations for each experimental group classified according to the World Dental Federation (FDI) Criteria

		Self-etch			Etch-and-rinse			p-value (between SE and ER)**	
Variables	Scale	Baseline N (%)	24 months N (%)	p-value Baseline to 24 months*	Baseline N (%)	24 months N (%)	p-value* Baseline to 24 months	Baseline	24 months
Marginal Staining	1	58 (100.0)	43 (81.1)	0.002	59 (100.0)	37 (80.4)	0.004	1.000	0.956
	2	0 (0.0)	3 (5.7)		0 (0.0)	3 (6.5)			
	3	0 (0.0)	3 (5.7)		0 (0.0)	1 (2.2)			
	4	0 (0.0)	0 (0.0)		0 (0.0)	3 (6.5)			
	5	0 (0.0)	4 (7.5)		0 (0.0)	2 (4.3)			
Fractures and retention	1	58 (100.0)	53 (96.4)	0.500	59 (100.0)	46 (82.1)	0.002	1.000	0.001
	2	0 (0.0)	0 (0.0)		0 (0.0)	0 (0.0)			
	3	0 (0.0)	0 (0.0)		0 (0.0)	0 (0.0)			
	4	0 (0.0)	0 (0.0)		0 (0.0)	0 (0.0)			
	5	0 (0.0)	2 (3.6)		0 (0.0)	10 (17.9)			
Marginal adaptation	1	58 (100.0)	47 (88.7)	0.031	59 (100.0)	36 (78.3)	0.002	1.000	0.057
	2	0 (0.0)	2 (3.8)		0 (0.0)	6 (13)			
	3	0 (0.0)	4 (7.5)		0 (0.0)	4 (8.7)			
	4	0 (0.0)	0 (0.0)		0 (0.0)	0 (0.0)			
	5	0 (0.0)	0 (0.0)		0 (0.0)	0 (0.0)			
Hypersensitivity	1	47 (81.0)	48 (96.6)	0.031	35 (59.3)	42 (91.3)	0.000	0.012	0.616
	2	7 (12.1)	5 (9.4)		16 (27.2)	3 (6.5)			
	3	4 (6.9)	0 (0.0)		6 (10.2)	1 (2.2)			
	4	0 (0.0)	0 (0.0)		2 (3.4)	0 (0.0)			
	5	0 (0.0)	0 (0.0)		0 (0.0)	0 (0.0)			
Recurrence of caries	1	58 (100.0)	55 (100.0)	1.000	59 (100.0)	56 (100.0)	1.000	1.000	1.000
	2	0 (0.0)	0 (0.0)		0 (0.0)	0 (0.0)			
	3	0 (0.0)	0 (0.0)		0 (0.0)	0 (0.0)			
	4	0 (0.0)	0 (0.0)		0 (0.0)	0 (0.0)			
	5	0 (0.0)	0 (0.0)		0 (0.0)	0 (0.0)			

*McNemar test; **GEE model analysis.

unaware of which material had been used; this created a double-blinded study. Each restoration was documented with photographs.

The restorations were evaluated according to the World Dental Federation (FDI) criteria (Table 3).[18,19] For each property of each FDI criterion, five scores can be given: three for acceptable (1. clinically very good; 2. clinically good; 3. clinically sufficient/satisfactory) and two for inacceptable (4. clinically unsatisfactory – repair for prophylactic reasons; 5. clinically poor – restoration replacement necessary).

Both examiners independently evaluated all the restorations once. All discrepancies between the examiners were resolved immediately at chairside.

Examiner calibration

The examiners were calibrated before the baseline evaluation, evaluating 15 restorations representative of each score for each criterion using 15 different patients. Each examiner evaluated each restoration at two different timepoints on two consecutive days. These subjects had cervical restorations and did not participate in this study. Intra- and inter-examiner agreement of at least 85% was necessary before beginning the study.[8]

Sample Size Calculations

Sample size calculations were performed using the G*Power Program Statistical Analysis (Düsseldorf, Germany)[10,11] with

$\alpha = 0.05$, power of 80%, and a two-sided test. To detect a difference of 20% among the tested groups, the minimum sample size was 50 restorations for each group.

Statistical Analysis

The statistical analysis followed the intention-to-treat protocol according to CONSORT recommendations.[47] This protocol includes all participants, even those who were unable to keep their scheduled recall visits. Descriptive statistics were used to describe the distributions of the evaluated criteria.

The results were statistically analyzed using the McNemar test ($\alpha = 0.05$) (SAS Institute; Cary, NC, USA) to compare the difference between baseline and 24 months. A generalized estimating equation (GEE) modeling analysis was also conducted to compare the difference between the two techniques. Cohen's kappa was used to test interexaminer agreement.

RESULTS

Results from evaluation of the restorations are presented in Table 4, summarized as frequencies and proportions. There was only one patient who did not attend the 24-month recall (moved to another city). The overall Cohen's kappa showed strong agreement (0.87) between the examiners at the 24-month follow-up.

For the self-etch mode, significant differences were found between baseline and the 24-month follow-up for marginal staining ($p = 0.002$), marginal adaptation ($p = 0.031$), and hypersensitivity ($p = 0.031$).

For the etch-and-rinse mode, after 24 months, significant differences were found for marginal staining ($p = 0.004$), fractures and retention ($p = 0.002$), marginal adaptation ($p = 0.002$), and hypersensitivity ($p = 0.000$).

Significant differences were detected between groups at 24 months on fractures/retention ($p = 0.001$). At 24 months, 10 restorations were lost from the etch-and-rinse group and 2 restorations were lost from the self-etch group, according to the FDI criteria.

For marginal adaptation, 2 (3.8%) restorations from the self-etch group and 6 (13.0%) restorations from the etch-and-rinse group received an FDI score of 2; 4 (7.5% for SE mode and 8.7% for ER mode) restorations of each group were scored as 3 ($p = 0.057$).

At baseline, significant differences between the two techniques were found for hypersensitivity ($p = 0.012$) (proportion of no hypersensitivity: 81.0% for the SE technique vs 59.3% for the ER technique). However, at 24 months, no differences were observed in postoperative sensitivity between the self-etch and etch-and-rinse modes ($p = 0.616$).

No restorations were lost due to caries. Representative images of restorations are presented in Figs 1 to 3.

DISCUSSION

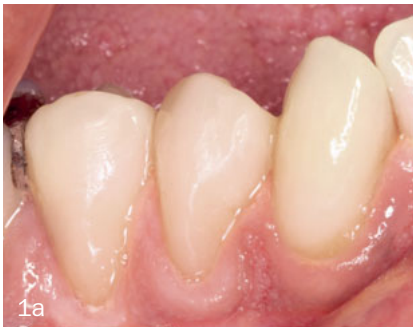
Considering that universal adhesives have only recently been introduced, most studies found in the literature are laboratory tests, with only a few clinical studies. Although in vitro studies can help us understand the behavior of adhesives,[43,55] clinical trials with controlled and standardized study designs are the first level of scientific evidence[15] to evaluate the clinical effectiveness of universal adhesives, preferably in NCCLs.[56]

This present study was designed taking the recommendations of the American Dental Association into consideration. These state that each group should have at least 30 restorations, with a minimum of 25 patients in the initial phase of the study and 15 patients after 18 months, as well as age and gender balance between study groups. In this study, the clinical performance of a universal adhesive was evaluated at baseline and after 24 months. A total of 117 NCCLs were restored in 26 patients, with the adhesive applied in self-etch and etch-and-rinse modes, combined with a resin composite. Each patient received at least two cervical restorations to ensure that they had at least one restoration from each technique and thus control for various environmental factors (such as oral hygiene, saliva composition, and diet).[52]

Due to the non-retentive configuration of the NCCLs, the retention of restorations is dependent on a strong and stable bond of restorative material to dentin. The occurrence of structural changes in enamel and dentin (eg, dentin sclerosis) resulting from age may have a negative impact on the quality of that bond and thus on retention and longevity of cervical restorations.[46] This is of special concern with NCCLs, where the dentin is often sclerotic and therefore more mineralized than normal dentin.[44,61] In fact, Mjör[30] and Van Meerbeek et al[54] attributed the rather poor performance of adhesives in clinical trials (in contrast to their laboratory results) to the extreme variability of dentin composition and structure found clinically.

Reactive sclerosis occurs in response to slowly progressing factors or mild irritations, eg, mechanical stimuli, chemical erosion, and abrasion, resulting from severe insults such as aggressive operative procedures, attrition, caries, etc.[48,54] Several studies have shown that dentin sclerosis increases with age,[17,48,54] which may explain why Bayne et al[4] found greater loss of restorations in older patients; patients aged 21–40, 41–60 and 61–80 years had restoration loss rates of 31%, 62%, and 75%, respectively. However, other authors found that retention failures cannot be associated with substrate type alone,[46] confirming that the process of adhesion is multifactorial. Indeed, in a study by van Dijken,[53] there were an equal number of restoration failures in sclerotic and non-sclerotic lesions; hence, the negative interaction between dentin sclerosis and the clinical retention of adhesives has yet to be confirmed. However, in the present study, no relationship between age and loss of restorations was found.

In the present study, after 24 months, a total of ten restorations from the ER group (17.9% out of 59) and two restorations from the SE group (3.6% out of 58) failed as a result of debonding, which highlights poorer bonding efficacy of ADH when applied in ER mode compared to SE mode. These results are in agreement with those of a sys-



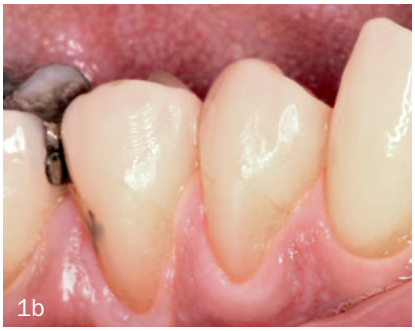
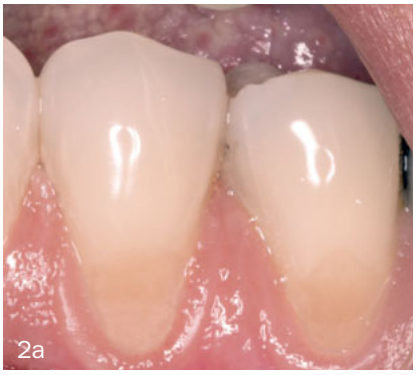


Fig 1a Photograph at baseline of restorations in teeth 44 and 45 using the etch-and-rinse technique.

Fig 1b Photograph after 24 months of restorations in teeth 44 and 45 using the etch-and-rinse technique.



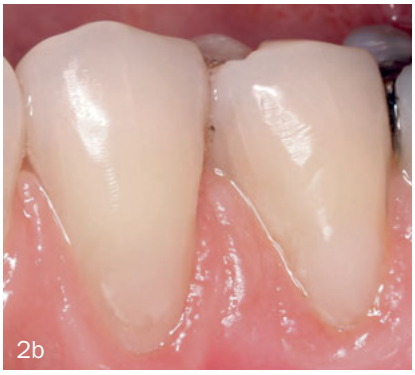
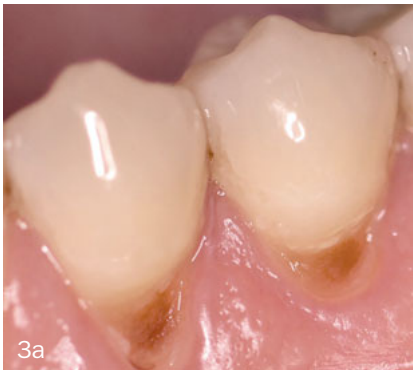


Fig 2a Preoperative photograph of the NCCLs in teeth 34 and 35.

Fig 2b Photograph after 24 months of the restoration in tooth 34 using the self-etch technique and that of tooth 35 using the etch-and-rinse technique.



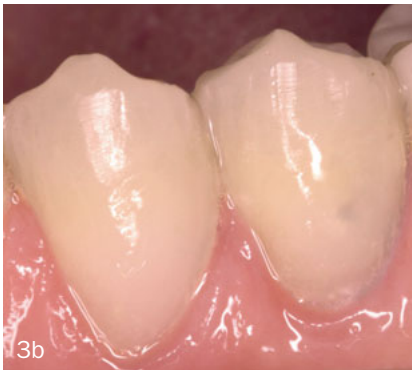


Fig 3a Preoperative photograph of the NCCLs in teeth 34 and 35.

Fig 3b Photograph after 24 months of the restoration in tooth 34 using the etch-and-rinse technique and that of tooth 35 using the self-etch technique.

tematic review[40] of clinical studies in NCCLs, which found that mild SE adhesives containing functional monomers with chemical adhesion potential can yield restorations with higher durability and quality in cervical lesions. Lawson et al[21] and Loguercio et al[22] showed that after two and three years, respectively, of clinical service, retention rates as high as 89% to 93% were observed.

Beveling can prevent adhesive materials from showing their performance, and for that reason, beveling is not performed in most clinical studies. However, a reason for failures due to lack of retention with the etch-and-rinse technique could be the omission of beveling.[2] In fact, some studies have shown that beveling can improve marginal adaptation[20] or reduce marginal microleakage[9] and result in better adhesion, because it increases the bonding area for enamel adhesion, which is known to be stronger and more durable than dentin adhesion. However, Perdigão et al[35] evaluated – separately and together – the effects on adhesion of enamel beveling and enamel etching for a self-etching adhesive and found that the 18-month survival rate did not improve. Moreover, in a 3-year clinical study, Baratieri et al[3] found that enamel beveling did not improve retention.

Regardless of the bonding strategy used, the present study observed deterioration of marginal adaptation. These

results are similar to those of other studies[22,27,38] which compared universal adhesives using SE and ER techniques. Although different clinical trials have shown that marginal discrepancies of a composite restoration usually develop quickly,[21,22,27,38] most of the marginal defects were clinically acceptable.[40] For the remaining restorations, in terms of marginal adaptation, the ER technique yielded poorer results (FDI score 1: 78.3%; score 2: 13.0%; score 3: 8.7%) than did the self-etch technique (score 1: 88.7%; score 2: 3.8%; score 3: 7.5%). Good performance of the restorations using the SE technique could be explained by the presence of an acidic functional monomer, 10-MDP, because calcium ions (released upon the partial dissolution of hydroxyapatite) diffuse within the hybrid layer and assemble the MDP molecules into nanolayers.[60] This chemical interaction between hydroxyapatite and MDP creates a stable nanolayer which can form a stronger area at the adhesive interface for both enamel and dentin, as both contain hydroxyapatite.[16,57,59] Results obtained with the etch-and-rinse technique may be due to the incomplete infiltration of the deeply demineralized collagen network by the bonding resin, which occurs because phosphoric acid can decalcify dentin more deeply than the adhesive can infiltrate.[34,35] Thus, given incomplete impregnation of the demineralized substrate, the adhesive interface is not impermeable; consequently, water and dentinal fluid can move easily through the adhesive interface, thus preventing full hybridization.[37,49,50]

Marginal discoloration was observed with both techniques, but statistically significant differences were not found. Using the ER technique, two restorations exhibited deep marginal staining, three restorations presented pronounced marginal staining, one restoration showed moderate marginal staining, and three exhibited minor marginal staining. Discolorations were observed at the gingival margins, where there is less likelihood of finding enamel margins and a greater likelihood of finding cementum or dentin.[29] Using the SE technique, four restorations showed deep marginal staining, three restorations exhibited moderate marginal staining, and three restorations presented minor marginal staining (esthetically acceptable). The discoloration was located at the enamel margin, which may suggest the importance of including selective conditioning of enamel with phosphoric acid to obtain the best marginal seal of restorations.[28] ADH is considered a mild self-etch adhesive like other commercially available universal adhesives, because it has a pH of 2.5. Due to the moderately high pH, these adhesives have limited interaction with enamel as they cannot condition enamel as effectively as the ER technique, resulting in increased marginal changes.[57] In fact, the authors of some studies[41,42] concluded that additional etching of the enamel cavity margins resulted in improved marginal adaptation on the enamel side. However, this was not critical and did not affect the overall clinical success of the restorations.[41,42]

Marginal discoloration may be a clinical sign of future restoration failure. However, it does not imply the imminent need for replacement, because these discolorations, if superficial, can be removed by polishing and routine finishing.[13,40,58] In this study, no restoration had secondary caries. In previous studies,[2,22,36] none of the restorations showed secondary caries or post-operative sensitivity at any recall. This may be due to the fact that the participants selected for this study had good oral hygiene habits.[58]

In this study, there was a significant difference in postoperative sensitivity between the SE and ER techniques at baseline. Postoperative sensitivity was higher using the ER technique. This can occur because phosphoric acid removes the peritubular dentin and fully opens the dentin tubules,[45] which the adhesive may not be able to seal completely afterward. In contrast, when the SE technique is applied, the dentin surface is smear-layer sealed and the tubule openings are smaller.[32] Nevertheless, at 24 months, there was no difference in postoperative sensitivity between the ER and SE modes. One explanation is that the pulp has the ability to recover in cases of reversible pulpitis.[14] Results from the literature indicate that a decrease or absence of hypersensitivity may occur over time in those with NCCL restorations.[5,51,58]

For this study, FDI criteria were used as opposed to the United States Public Health Service (USPHS)-modified criteria, because some studies comparing the clinical performance of adhesion strategies using USPHS-modified criteria and FDI criteria concluded that the latter are more sensitive to small variations in clinical outcomes.[22,25,27]

One of the limitations of this clinical study may be the evaluation time. A longer evaluation time could allow the appearance of substantial differences in clinical performance between the two adhesion strategies studied.

In future investigations, it would also be important to evaluate the behavior of this adhesive using the selective-etch technique, comparing it with the self-etch and etch-and-rinse techniques.

CONCLUSION

For this universal adhesive, the self-etch technique performed better than the etch-and-rinse technique, leading to the rejection of the null hypothesis. The 24-month clinical performance of Adhese Universal depends on the bonding strategy used.

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Clinical relevance: The clinical behavior of Adhese Universal is not as reliable when used with the etch-and-rinse technique as it is with the self-etch technique.