Eur. J. Prosthodont. Rest. Dent., Vol.20, No.1, pp 26-30
Printed in Great Britain

doi:10.1922/EJPRD_1024Ameri05

Correlation between Dental arch location and Clinical Success Rate of Total etch and Self-Etch Adhesives in Class V Composite Restorations

M. Ghavamnasiri*, H. Ameri*, J.E. Chasteen*, A.H.M. Mofrad† and B. Hashemi*

Abstract - *Flexure at the tooth cervix might render the restored Class V lesions to degradation. In this clinical trial a total of 76 carious cervical lesions in both arch were restored using Prime & Bond NT™ and Clearfil SE Bond™ adhesives, along with Clearfil APX™ composite resin. Retention of restoration, marginal discoloration and postoperative sensitivity were evaluated during a one year period. The overall clinical success rate was 89.5%, while no significant difference (p>0.05) was found regarding postoperative sensitivity or marginal discoloration between two adhesives. Retention loss was associated only with self-etch adhesives. No association was found between clinical success and dental arch location.*

KEYWORDS: Clinical trial, Adhesives, Class V Composite restoration, Dental arch

INTRODUCTION

Improved retention of adhesive restorations has been achieved with the introduction of the "etch and rinse" technique and there is trend in the development of dental adhesives to provide a simplified, more user friendly, and application procedure [1].

Studies have shown that the newly developed one-step self-etch systems offer a bond strength comparable to those of the two-step self-etch systems[2-4]. Even though the newer one-step self-etch systems have produced a favorable clinical performance either in carious or in non carious lesions[5], a systematic review of current clinical trials revealed that these systems are not as effective as conventional three-step total-etch systems [6]. Regarding bonding durability, a bond produced by self-etch adhesives appears to be more vulnerable to degradation due to the presence of areas of increased permeability at the hybridized adhesive-dentin interface [7].

Flexure at the tooth cervix has been advanced as one of the three principal factors causing cervical lesions. Hydroxyapatite crystals in the cervical region are susceptible to disruption under repetitive tensile and compressive stresses. This phenomenon renders the tooth more susceptible to mechanical and chemical degradation [8]. It is reasonable to hypothesize that similar stress is imposed on restored Class V lesions in the promotion of marginal degradation, or even dislodgment of the restoration[9, 10]. Therefore more flexible restorative materials may be required to absorb forces generated by tooth flexure rather than be dislodged [9].

Since masticatory and parafunctional stresses vary with different clinical situations, mechanical properties required of restorative materials vary considerably from case to case. This means stronger restorative materials are required where greater stresses are anticipated [11]. However it has been recognized that non-carious cervical lesions such as abfraction mostly occur in the maxilla [12]. It should be noted that Kubo *et al* found no correlation between marginal staining in composite restorations and the dental arch in which the restoration is located [13].

Therefore the aim of this study was to evaluate the role that arch location plays in the success rate of teeth restored with Class V composite restorations when two adhesive systems were used.

This study examined two null hypotheses regarding the retention, marginal staining and post-operative sensitivity of Class V composite restorations:

The adhesive systems used (etch and rinse, self-etch adhesive) have no effect on the clinical success rate of these restorations.

Dental arch location (mandible, maxilla) has no effect on the clinical success rate of these restorations.

MATERIALS AND METHODS

Patient Selection

Twenty three subjects with ages ranging between 25 and 55years who needed dental treatment of cervical carious lesions participated in this clinical trial. The participants were chosen from the patient pool of the Department of Operative Dentistry at the Mashhad University of Medical Science, School of Dentistry. A total number of 76 Class V carious lesions located in maxillary and mandibular premolars with incisal margins located in enamel and gingival margins in cementum.

* DDS, MS
† DDS

The number of the cavities in each arch was identical, so each participant had at least two restorations fabricated using two different adhesive techniques as shown in Table1.

Inclusion and exclusion criteria used for patient selection were included the following:

- Each patient required the restoration of two carious cervical lesions located in two different arches
- The teeth to be restored had no other restorations, endodontic treatment or dental defects.
- The teeth to be restored had no pre-operative sensitivity.
- The patients had no compromised medical history, severe or chronic periodontitis, extreme caries, and abnormal occlusion

Approval for the study was granted by the Commission for Medical Ethics of the Mashhad University of Medical Science. Participants were informed about the nature of the study and written consent was obtained prior to the onset of any treatment.

Cavity Preparation

All restorative procedures were carried out by single operator under rubber dam isolation using an Ivory #212 gingival retraction clamp and local anesthesia using 2% lidocaine with 1:80.000 epinephrine.

Hemispherically shaped Class V cavities were prepared on the buccal surfaces of each tooth using a 2.9 mm round diamond bur at the cementoenamel junction. No bevel was placed [14,15]. An attempt was made to prepare cavities of comparable size with dimensions of 3-4 mm occlusogingivally, 2-3 mm mesiodistally and 1 mm deep into the dentin. Cavities that exceeded these dimensions, or were difficult to isolate properly, were subsequently excluded from the study. Cervical and occlusal margins were not beveled and carious dentine was removed with a # 4 round bur at low speed.

Restorative Procedure

This study attempted to use same number of the two adhesive systems (etch and rinse, self-etch adhesive) in each arch that were randomized to include each one of adhesive systems

The teeth were first cleaned with a non-fluoridated prophylaxis paste using a rubber cup polisher and subsequently rinsed with water. The adhesives included in the study were used according to the manufacturers' instructions as shown in Table 2.

After placement of appropriate adhesives, all cavities were restored with a hybrid resin composite using the incremental insertion technique. Each increment (thickness < 2mm) was light cured for 60s using an Astralis7 light curing unit at an intensity of 750 mw/cm^2. Sof- Lex™ flexible polishing discs were used in a decreasing sequence of grit size for removing excess material, contouring and polishing the composite restorations.

Evaluation Procedures

Each restoration was blindly evaluated on days 2, 7, 14, 30 and after 3, 6 and 12 months of clinical service for postoperative sensitivity and after 3, 6 and 12 months for marginal discoloration as well as for the retention of the restoration in accordance with a slightly modified US Public Health Service (USPHS) criteria[16] (Table3) .

Table 1. *Distribution of adhesives and restored tooth location.*

Adhesives	*Max. Incisor*	*Mand. Incisor*	*Max. Canine*	*Mand. Canine*	*Max. Premolar*	*Mand. Premolar*	*Total*
Total Etch	8	4	6	6	4	10	38
Self Etch	7	5	7	6	6	7	38
Total	15	9	13	12	10	17	76

Table 2. *Adhesives used in the study.*

Adhesives	*Composition*	*Treatment*	*Manufacturer*
Prime&Bond NT	Etchant: 35% H3PO4	a(15s),b(15s),c,d,e,h	Dentsply/Caulk
	Adhesive: PENTA, UDMA, resin R5-62-1, resinT,resinD, silica nanoparticles , photoinitiator, cetilamine hydrofluoride and acetone		Milford, DE, USA
Clearfil SE Bond	Primer: MDP, HEMA, hydrophilic dimethacrylate dl-canphorquinone, N,N-diethanol p-toluidine water, dimethacrylate	f (20 s), e, g, h	Kuraray Dental
	Bond: MDP,bis-GMA,HEMA ,hydrophobic dimethacrylate,dl-canphorquinone,N,N-diethanol p-toluidine, silanated colloidal Silica		Kuraray, Japan

Application Technique: (a) acid etch; (b) rinse surface; (c) remove excess moisture; (d) apply one-bottle adhesive; (e) gently air dry; (f) apply self-etching primer; (g) apply adhesive; (h) light cure 20s

Post-operative sensitivity was measured by blowing a stream of compressed air for 3s at a distance of 2-3 mm from the cervical restoration while shielding the adjacent teeth with fingers and by moving a probe over the restored tooth surface.

Statistical Analysis

The Mann Whitney test was used to compare the-rating of, marginal discoloration, post-operative sensitivity and retention between the restorations fabricated with the experimental adhesives. The overall clinical success between the initial and final evaluation intervals was determined using the McNemar test while the Cochran Q test was used to compare the changes at the different evaluation intervals.

Differences in marginal discoloration, post-operative sensitivity and retention between mandibular and maxillary restorations were analyzed using the Chi square test. A significance level was set at ≤0.05 for all statistical analyses using SPSS, version 16.0 software (SPSS, Inc., Chicago, IL, USA).

RESULTS

The overall clinical success rate of the restorations was 89.5% at one year of clinical service. The data for the clinical parameters evaluated are summarized in Table 4.

At the second day post-operative recall, 26 of the 76 restored teeth demonstrated post-operative sensitivity. Of these 26 cases 15 (38.5%) and 11 (29.7%) were respectively associated with Prime&Bond NT and Cleaefil SE Bond.

As shown in Table 5, post-operative sensitivity increased at 7 and 14 day recall intervals in teeth restored with Prime&Bond NT, while it decreased in the Clearfil SE Bond. However, there was no significant difference (Mann Whitney $p>0.05$) between the two adhesives at these two intervals.

At the one month recall, the post-operative sensitivity in Clearfil SE Bond showed no decrease (27%), but Prime&Bond NT showed a greater frequency of post-operative sensitivity (48.7%). This finding could lead to a statistically significant difference ($p<0.05$) between two groups regarding post-operative sensitivity. Even though at the one year recall, 12 teeth showed post-operative sensitivity, but there was no significant difference (Mann Whitney $p>0.05$) between two adhesives regarding post-operative sensitivity at 3, 6 and 12 months recall. Post- operative sensitivity was associated with the post-operative time interval and it could significantly diminish over time. (Cochran $p=0.00<0.05$)

With regard to marginal discoloration, the percentage of restorations showing no discoloration remained quite stable over time in Prime&Bond NT, but increased in Clearfil SE Bond (Table 4 The observed difference between the two groups was not statistically different (Mann Whitney $p>0.05$), but Clearfil SE Bond was associated with the increase in marginal discoloration over time (Cochran $p<0.05$).

As for retention loss, two of the 76 restorations were lost after three months and two more were lost at the 6-month follow up time, while three more of the remaining 72 restoration were lost by the 12-month recall examination. All of the restorations that were lost within one year were associated with Clearfil SE Bond. As for the retention of restoration, a statistically significant difference between groups was observed only at 12-month recall (Mann Whitney $p<0.05$). In addition there was association between this clinical criteria with the passage of the time (Cochran $p<0.05$).

The Chi square test showed that there was no association between the loss of retention, marginal staining and post-operative sensitivity with regard to dental arch and tooth location. ($p>0.05$)

DISCUSSION

This clinical trial was randomized and the examiners were blinded for the adhesive technique used in the restorative procedures utilized in both dental arches. All restorations were placed using either total-etch or self-etch adhesives. The overall clinical success rate was estimated to be 89.5% while two other studies reported an overall clinical success

Table 3. *Modified USPHS criteria for direct clinical evaluation.*

Category	*Rating Scale*		*Criteria*
	Acceptable	*Unacceptable*	
Retention	A		Retained
	B		Partially retained
		C	Missing
Marginal staining	A		None
	B		Superficial staining(removable, localized)
		C	Deep staining(irremovable, generalized)
Recurrent caries	A		None
		C	Present
Marginal adaptation	A		Undetectable margin or slight detectable step(catches explorer going one way)
	B		Detectable crevice(catches explorer going one way)
		C	Obvious crevice or fracture
Gingival response	A		Absence of inflammation
	B		Mild inflammation
		C	Moderate or severe inflammation
Post-operative sensitivity	A		None
		C	Present

Table 4. *Clinical results for retention, marginal discoloration and post-operative sensitivity expressed in percentages.*

Recall	*Recall Rate*	*Experimental Group*	*Retention Rate*	*Absence of Marginal Discoloration*	*Absence of Sensitivity*	*Overall Clinical Success*
2 days	100	Prime&Bond NT	-	-	61.5	
		Clearfil SE Bond	-	-	70.3	
7 days	100	Prime&Bond NT	-	-	56.4	
		Clearfil SE Bond	-	-	73.0	
14 days	100	Prime&Bond NT	-	-	56.4	
		Clearfil SE Bond	-	-	75.7	
30 days	100	Prime&Bond NT	-	-	51.3	
		Clearfil SE Bond	-	-	73.0	
3 months	97.3	Prime&Bond NT	100	100	69.2	89.7
		Clearfil SE Bond	94.6	97.1	80.0	88.1
6months	94.7	Prime&Bond NT	100	100	79.5	93.1
		Clearfil SE Bond	94.3	100	81.8	92.0
12months	90.7	Prime&Bond NT	100	94.9	84.6	93.1
		Clearfil SE Bond	90.9	83.3	80.0	84.9

Table 5. *Results of the Mann Whitney U-test for the two experimental adhesives.*

	Post-operative Sensitivity							*Marginal Discoloration*			*Retention*		
	2nd Day	*7th Day*	*14th Day*	*30th Day*	*3rd Mo.*	*6th Mo.*	*S 12th Mo.*	*3rd Mo.*	*6th Mo.*	*12th Mo.*	*3rd Mo.*	*6th Mo.*	*12th Mo.*
Asymptomatic (2-tailed)	.426	.134	.079	.049	.293	.805	.619	.291	1.000	.118	.144	.133	.049

rate of 100% during a recall evaluation after one year of clinical service [17, 18].

This prospective study revealed a mild post-operative sensitivity that diminished over time, but persisted after one year of clinical service. There was no statistically difference between two adhesives regarding post-operative sensitivity. The frequencies of post-operative sensitivity were 15.4% and 20% respectively for Prime & Bond NT and Clearfil SE Bond. In a previous study reported by Abdalla *et al*[19], total-etch systems failed to offer any improvement in the quality of Class V resin composite restorations and at a one year recall evaluation, 7% of restorations had post-operative sensitivity which is less than that found in the present study. Variable results have been observed after using total-etch adhesives with regard to the frequency of the post-operative sensitivity [20, 21].

Post- operative sensitivity associated with removal of the smear layer and smear plugs is reduced when non-rinsing adhesives are used [22]. The present study showed significantly higher degree of post-operative sensitivity when a total-etch adhesive was applied but only at the one month recall evaluation. The increased sensitivity at base-line probably is due to the etching effect, gingival retraction and root exposure resulting from restoration placement and the finishing procedure [23]. Perdigao *et al*. found a significant reduction in post-operative sensitivity to air during the first 6 months when a self-etch adhesive was applied in combination with etching of the unbeveled enamel margins of Class V cavity preparations [24].

In the present study seven restorations in the self-etch group were debonded after one year of clinical service. Clearfil SE Bond is a two step self-etch adhesive that can create a micromechanical interlocking with tooth structure as a result of partial demineralization, allowing monomers to flow into a shallow submicron hybrid layer and hybridized smear plugs [25].

The mild self-etch adhesives create a hybrid layer with a thickness of 0.5 µm in which hydroxyl apatite crystals can still be found [26]. Some clinical and laboratory studies have confirmed the dentin bonding quality of Clearfil SE Bond [27, 28]. However, the present study found a retention rate of only 95% at one year of service which is nearly the same as the finding of 93% in a previous clinical trial [28].

In the present study, the enamel margin was not included in the etching procedure as a separate step. It may explain some of the differences despite the rather mild enamel etching effect of Clearfil SE Bond as compared with that of resulted from phosphoric acid etching, which could create a stronger bond to enamel [19, 22, 29]. The current study showed that the loss of retention increased over time. Early loss of retention is no longer the main cause of clinical failure when reliable adhesives are used [30].

Most of the cases with marginal discoloration were detected in the self-etch group (16.7 %) while one previous clinical trial showed almost no marginal discoloration[31]. Although marginal staining is thought to be one of the first clinical signs that a resin composite restoration is prone to failure [26] patient habits, diets and tooth brushing play an important role in the development of marginal staining. Browning and Dennison claimed that marginal discoloration is a prominent reason for replacement of restorations [15]. In the present study the incidence of marginal discoloration was correlated well with time of service that is in agreement with the finding of one previous study reported by Kubo *et al.* [13]. However, in this study, no difference was found between the two test adhesives regarding marginal staining at the end of one year recall evaluation.

No correlation was found between the three independent variables (post-operative sensitivity, marginal discoloration and retention) with the dental arch and tooth location in which the restorations were placed. Kubo *et al*. also found no correlation between marginal staining and the arch in which restorations were placed [13].

A long-term clinical study is needed to be conducted to reach a conclusive determination of the effectiveness of using dental adhesives in Class V composite restorations

CONCLUSION

The clinical performance of both adhesives was acceptable during one year of clinical service and no association was found between the three evaluated parameters with either the dental arch or the tooth location of the restorations.

MANUFACTURER DETAILS

- Ivory clamp, Columbus Dental, St louis, MO, USA
- Lidocaine ,Lignospan 2%, Septodont, St-Maur, France
- Round diamond bur, Catalog No. 801314029, Brasseler -Komet , Lemgo, Germany
- Prophylaxis paste, Prophy Jet, Septodont, St-Maur, France
- Resin composite, Clearfil AP-X, Kuraray Medical, Tokyo, Japan
- Astralis7 Light curing unit, Ivoclar Vivadent AG, Schaan, Liechtenstein
- Sof- Lex discs, 3M ESPE, St Paul, MN, USA

ADRESS FOR CORESPONDANCE

Dr H Ameri, Vakil Abad Blvd, Mashhad University of Medical Science, School of Dentistry, Department of Operative Dentistry, Mashhad ,Iran. Email: Amerih@mums.ac.ir

REFERENCES

1. Mandras RS, Thurmond JW, Latta MA, Matranga LF, Kildee JM, Barkmeier WW. Three-year clinical evaluation of the Clearfil Liner Bond system. *Oper. Dent*., 1997; **22**:266-70.
2. Hashimoto M, Ohno H, Yoshida E, Hori M, Sano H, Kaga M, Oguchi H. Resin-enamel bonds made with self-etching primers on ground enamel. *Eur. J. Oral. Sci*., 2003; **111**:447-53.
3. Lopes GC, Marson FC, Vieira LC, de Caldeira AM, Baratieri LN. Composite bond strength to enamel with self-etching primers. *Oper. Dent.,* 2004; **29**:424-9.
4. Torii Y, Itou K, Nishitani Y, Ishikawa K, Suzuki K. Effect of phosphoric acid etching prior to self-etching primer application on adhesion of resin composite to enamel and dentin. *Am. J. Dent*., 2002; **15**:305-8.
5. Kurokawa H, Miyazaki M, Takamizawa T, Rikuta A, Tsubota K, Uekusa S. One-year clinical evaluation of five single-step self-etch adhesive systems in non-carious cervical lesions. *Dent. Mater. J*., 2007; **26**:14-20.
6. Peumans M, Kanumilli P, De Munck J, Van Landuyt K, Lambrechts P, Van Meerbeek B. Clinical effectiveness of contemporary adhesives: a systematic review of current clinical trials. *Dent. Mater*., 2005; **21**:864-81.
7. Tay FR, King NM, Chan KM, Pashley DH. How can nanoleakage occur in self-etching adhesive systems that demineralize and infiltrate simultaneously? *J. Adhes. Dent*., 2002; **4**:255-69.
8. Braem M, Lambrechts P, Vanherle G. Stress induced cervical lesion. *J. Prosthet. Dent*., 1992;**67**:718-22
9. Heymann HO, Sturdevant JR, Bayne S, Wilder AD, Sluder TB, Brunson WD. Examining tooth flexure effects on cervical restorations: a two-year clinical study. *J. Am. Dent. Assoc*., 1991; **122**:41-7.
10. Van Meerbeek B, Braem M, Lambrechts P, Vanherle G. Evaluation of two dentin adhesives in cervical lesions. *J. Prosthet. Dent*., 1993; **70**:308-14.
11. Peutzfeldt A, Asmussen E. Determinants of in vitro gap formation of resin composites. *J. Dent.,* 2004; **32**:109-15.
12. Ferrari M, Cagidiaco MC, Goracci C, Vichi A, Mason PN, Radovic I& Tay FLong-term retrospective study of the clinical performance of fiber posts. *Am. J. Dent*., 2007; **20**: 287-291.
13. Kubo S, Yokota H, Yokota H, Hayashi Y. Two-year clinical evaluation of one-step self-etch systems in non-carious cervical lesion. *J. Dent*., 2009; **37**: 149-155.
14. Bagheri M, Ghavamnasiri M. Effect of cavosurface margin configuration of Class V cavity preparations on microleakage of composite resin restorations. *J. Contemp. Dent. Pract*., 2008;9:122-9.
15. Browning WD, Denison WD. A survey of failure modes in composite resin restorations. Oper. Dent., 1996; **21**: 160-6.
16. Van Dijken JW. A clinical evaluation of anterior conventional, microfiller and hybrid composite resin fillings. A six year follows up study. *Acta. Odont. Scan*., 1986; **44**: 357-67.
17. Peumas M, De Munck J, Van Landuyt K, Lambrechts P, Van Meerbeek B. Three-year clinical effectiveness of a two-step self-etch adhesive in cervical lesions. *Eur. J. Oral Sci*., 2005; **113**: 512-518.
18. Peumas M, De Munck J, Van Landuyt K, Kanumilli P, Yoshida Y, Inoue S, Lambrechts P, Van Meerbeek B. Restoring cervical lesions with flexible composites. *Dent. Mat*., 2007; **23**: 749- 754.
19. Abdalla A I, Garcia- Godoy F. Clinical performance of self-etch adhesive in class V restorations made with and without acid etching. *J. Dent*., 2007; **35**: 558-563.
20. Akpata ES, Behbehani J. Effect of bonding systems on post-operative sensitivity from posterior composite. *Am. J. Dent.,* 2006; **19**: 151-4.
21. Manchorova NA, Vladimirov SB, Donencheva ZK, Drashkovich IS, Kozhuharov PZh, Manolov SK, Todorov RG. A study of post-operative sensitivity in class I and class II restorations with self-etching adhesive and nanofilled composite. *Folia. Med*. (Plovdiv), 2006; **48**: 63-9.
22. Pashley DH, Tay FR. Aggressiveness of contemporary self-etching adhesives Part II: etching effects on unground enamel. *Dent. Mater*., 2001; **17**: 430-44.
23. Perdigao J, Anauate- Netto C, Carmo AR, Lewgoy HR, Coreiro HJ, Dutra-Correa M, Castilhos N, Amore R. Influence of acid etching and enamel beveling on 6-month clinical performance of a self-etch dentin adhesive. *Compend. Contin. Educ. Dent*., 2004; **25**: 33-44.
24. Tay FR, King NM, Chan KM, Pashley DH. How can nanoleakage occur in self-etching adhesive systems that demineralize and infiltrate simultaneously? *J. Adhes. Dent*., 2002; **4**: 255-69.
25. Van Meerbeek B, Kanumilli P, De Munck J, Van Landuyt K, Lambrechts P, Peumans M. A randomized controlled study evaluating the effectiveness of a two-step self-etch adhesive with and without selective phosphoric acid etching of enamel. *Dent. Mater*., 2005; **21**: 375-83.
26. Van Dijken JW. Clinical evaluation of three adhesive systems in class V non-carious lesions. *Dent Mater* 2000; **16**: 285-91.
27. Brackett WW, Covey DA, St Germain Jr HA. One-year clinical performance of a self-etching adhesive in class V resin composites cured by two methods. *Opr. Dent.,* 2002; **27**: 218-22.
28. Perdigao J, Carmo ARP, Anaute-Netto C, Amore R, Lewgoy HR, Cordeiro HJD, Dutra- Correa M, Castilhos N. Clinical performance of a self-etching adhesive at 18 months. *Am. J. Dent*., 2005; **18**: 135-140.
29. Peumans M, De Munck J, Van Landuyt K, Lambrechts P, Van Meerbeek B. Five-year clinical effectiveness of a two-step self-etching adhesive. *J. Esthet. Restor. Dent*., 2010; **22**:200-5.
30. Kurokawa H, Miyazaki M, Takamizawa T, Rikuta A, Tsubota K, Uekusa S. One- year clinical evaluation of five single-step self-etch adhesive systems in non-carious cervical lesions. *Dent. Mater. J*., 2007; **26**: 14-20.
31. Kubo S, Yokota H, Watanabe T, Ohsawa M, Matsumoto H. Adhesive properties of Liner Bond II (KB-110) system Part 1. Relationship between marginal seal and tensile bond strength. *Jap. J. Cons. Dent*., 1994; **37**: 1216-23.