The effect of additional etching on the marginal adaptation of self etching adhesives; evaluation through thermo-mechanical loading

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This certifies that the master's thesis of Wan Jung is approved.

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감사의 글

본 논문을 끝으로 저에게 아주 소중했던 대학원 2 년의 과정을 마치려 합니다. 2 년 동안 저에게 가르침과 도움을 주신 많은 분들께 이 자리를 빌어 감사의 마음을 전합니다.

2 년 넘게 많은 지도와 관심을 가져주신 보존과 모든 교수님들께 진심으로 감사드립니다. 특히 부족한 저의 논문을 처음부터 끝까지 함께 해주신 박성호 교수님과 보다 좋은 논문이 될 수 있도록 많은 도움을 주신 노병덕 교수님, 치과 생체 재료학 교실 김광만 교수님께 감사의 마음을 전해드리고 싶습니다.

대학원 생활이 힘들지 않도록 언제나 나와 함께해준 소중한 친구 혜영이와 보존과 의국의 동기들에게 고맙다는 말을 하고 싶습니다. 그리고 항상 저를 응원해주었던 지은이 언니에게도 정말로 고맙다는 말을 전하고 싶습니다.

2 년의 대학원 과정을 무사히 마칠 수 있도록 많은 배려와 관심을 주신 아름다운 치과 병원의 서원장님과 백원장님께도 이 자리를 빌어 감사의 마음을 전해드립니다. 수련생활의 시작을 함께한 아경이 언니와 언제나 옆에서 길잡이가 되어주신 승은이 언니와 유미언니께도 감사드립니다.

특히 힘든 상황에서도 언제나 나의 곁에서 든든한 힘이 되어준 진우에게 그때 그때 다 전하지 못했던 마음을 전하고 싶습니다.

아울러 힘든 수련과정에서도 동생을 챙겨주는 오빠 정걸과 언니 정지안, 그리고 귀여운 조카 정건에게도 사랑한다는 말을 전하고 싶습니다. 마지막으로 저에게 끝없는 정성과 사랑을 담아 길러주신 사랑하는 부모님께 감사의 마음을 전해드립니다.

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Abstract

The effect of additional etching on the marginal adaptation of
self etching adhesives;
evaluation through thermo-mechanical loading

The purpose of this study was to compare the marginal adaptation of composite resin restorations bonded with self etching adhesives, to those pretreated with 35 % phosphoric acid prior to bonding with self etching adhesives. The experiment was carried out in class II MOD cavities prepared in 28 extracted human lower molars. The teeth were divided into 4 groups, group 1 was bonded with Clearfil SE Bond, group 2 was pretreated with 35 % phosphoric acid before bonding with Clearfil SE Bond, group 3 was bonded with Tyrian SPE & One Step Plus and group 4 was pretreated with 35 % phosphoric acid before bonding with Tyrian SPE & One Step Plus. All cavities were filled with Heliomolar HB. Each specimen went through thermo-mechanical loading (TML) which consists of mechanical loading (720,000 cycles, 5.0kg) with the speed of 120rpm for 100hours and thermocycling (6000 thermocycles of 5 ℃ and 55 ℃). The continuous margin (CM) (%) of the total margin and regional margins (occlusal enamel(OE), vertical enamel(VE), cervical enamel(CE), and cervical dentin(CD)) were measured before and after TML under a x200 digital light microscope. Paired *t* test was used to assess the CM (%) before and after TML. 3 way ANOVA and Duncan's Multiple Range Test was performed to

assess the effect of 3 variables, pretreatment conditions (with or without pretreatment), type of bonding agents (Clearfil SE Bond, Tyran SPE & One Step Plus) and tooth regions (OE, VE, CE, CD) on the CM (%).Within the group 1 and 3, 2-way ANOVA and Duncan's Multiple Range Test was used to test the effect of bonding agents and regions (OE, VE, CE, CD) on CM (%). All statistical tests were carried out at the 95 % level of confidence. There was no statistical significance between the pretreated and non-pretreated groups, neither between Clearfil SE Bond and Tyrian SPE & One Step Plus, in any tooth region. Before TML, no statistical difference was found between groups within the same region, except the VE region between group 2and 4, which showed higher CM (%) in group 4 than in group 2. In group 3, the CD region showed higher CM (%) than the OE region and the VE region (Fig. 7, Table 4). After TML, vertical enamel regions showed lower CM (%) and cervical dentin regions showed higher CM (%) compared to other tooth regions.

Keywords : Marginal adaptation , Continuous Margin, Thermo-mechanical loading, Self etching adhesives, Additional etching,

The effect of additional etching on the marginal adaptation of self etching adhesives;
evaluation through thermo-mechanical loading

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I. Introduction

Composite resin has made an eye-opening progress since it was first introduced in the mid-`60s. It has outpaced amalgam in toxicological and esthetic aspects, and is even showing enough advantages to be used as an alternative to amalgam in the posterior parts of the dentition[1]. We are truly entering the post-amalgam age.

But compared with amalgam, composite restorations are still much more technique sensitive and involves many steps of application[1]. The selective etching technique, which consists of a strong acid to etch the enamel, a weak acid to etch the dentin, a primer and an adhesive, involves a complicated, time-consuming and technique sensitive application procedure, due to separate conditioning of the enamel and dentin. But since the advent of the total-etch technique in the early 90's, universal enamel-dentin conditioners have been simultaneously applied to enamel and dentin,

thereby reducing the bonding process. Therefore studies are focused on simplifying the application procedures and reducing its technical sensitivity[2,3].

The current self etching adhesives using non-rinse acidic monomers, which simultaneously conditions and primes both enamel and dentin, was introduced to overcome the inconvenience and technical sensitivity of the total-etch adhesive system[4]. Nevertheless there are some concerns about the bonding effectiveness of these adhesives on enamel[4,5,6,7,8]. The enamel etching ability of the self etching primers is often suspected to fall short compared to phosphoric acid etching due to the higher pH and different etch patterns analyzed with SEM[5]. Miguez *et al.* [6] showed that additional enamel etching prior to application of self etching primers produce higher bond strengths to enamel than self etching priming only. On the contrary, Hannig *et al.*[7] compared the marginal adaptation of three self etching priming agents to conventional phosphoric acid etching and bonding application, and indicated that use of self etching primers may be an alternative to conventional phosphoric acid pretreatment in composite-to-enamel bonding restorative techniques.

Today, due to lacking significant controlled long term clinical trials, no clearly revealing conclusions could be made about the bonding effectiveness of self etched enamel. Because of this uncertainty, Van Meerbeek *et al.*[4] suggest that, until then, it remains clinically advisable to employ this simplified application first, only on enamel than has been previously coarsened by bur, second, by applying the self etching primer during a sufficiently long time of at least 15 seconds and third, by

actively applying it through rubbing the enamel surface with repeated applications of fresh material, or alternatively pretreating the tooth with phosphoric acid prior to the application of the self etching primer. And Miyazaki *et al.*[8] stated that, active application of self etching primer may help to ensure the creation of roughened enamel surface and enhance the penetration of primer into subsurface demineralized enamel. In spite of these uncertainties and interest in the bonding effectiveness of self etching adhesives on enamel, there are not many studies focused on the marginal adaptation of self etching adhesives pretreated with phosphoric acid.

The purpose of this study was to establish a basis for clinical usage of self-etch bonding systems, by evaluating the effectiveness of the self-etch primer on marginal adaptation. The evaluation was made by comparing the continuous margin (CM) (%) of composite resin restorations conditioned solely with self etching primers to those conditioned with 35 % phosphoric acid in advance (pretreatment), before and after thermo-mechanical loading (TML).

II. Materials and Methods

1. Materials

Two types of self etching adhesive systems were used to compare the effect of adhesive type, one being Clearfil SE Bond (Kuraray co., Ltd, Osaka, Japan) and the other being Tyrian SPE with One Step Plus (Bisco, Inc, Schaumburg, U.S.A.). According to the manufacturer, the pH of Clearfil SE Bond and Tyrian SPE were 2 and 0.4 respectively.

Heliomolar HB (Ivoclar Vitadent, Schaan, Liechtenstein) was used as the filling material in all specimens. 35 % phosphoric acid (Ultra-Etch, Ultradent Products, Inc, Utah, U.S.A.) was used for pretreatment.

2. Methods

a) Tooth preparation

28 extracted human lower molars without dental caries, fracture or preexisting restorations were used for this study. The teeth were freed from debris and stored in saline.

Class 2 MOD cavities were prepared without bevel. The cervical margin was put on enamel (1 mm above the cementoenamel junction) on one side and dentin (1 mm below the cementoenamel junction) on the other. The length of the gingival

margins, width of the gingival wall and depth of the cavity were designed to be 4.5 mm, 2 mm and 2.5 mm deep[9] , respectively (Fig.1, Fig.2).

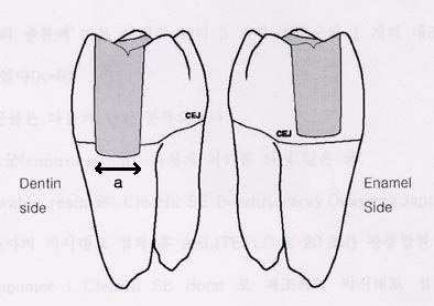


Fig. 1. Class II MOD cavity
Dentin side: Gingival margin 1 mm below CEJ,
Enamel side: Gingival margin 1 mm above CEJ
a) length of gingival margin: 4.5 mm

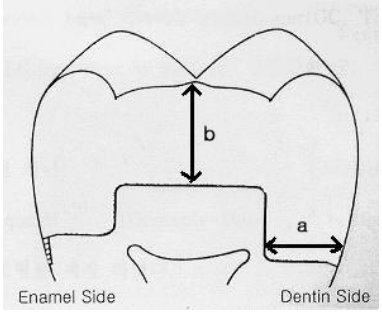


Fig. 2. Mesio-distal section of the cavity
Butt joint margin
a) width of gingival wall: 2 mm
b) depth of cavity: 2.5 mm

b) Priming and Bonding

The prepared teeth were divided into 4 groups (Table 1); each group consisted of 7 teeth.

Table 1. Groups classified by bonding agent and additional etching

	without additional etching	with additional etching
Clearfil SE Bond system	group 1	group 2
Tyrian SPE & One Step Plus	group 3	group 4

Group 1) The primer of Clearfil SE Bond was applied on the tooth with a rubbing motion for 20 seconds. The bond was applied following the primer. The surplus adhesive was gently blown away with dry air and cured with a light curing unit for 10 seconds.

Group 2) Enamel was pretreated with a 35% phosphoric acid gel for 30 seconds, followed by thorough rinsing and drying. The rest of the procedure is identical to Group 1.

Group 3) Tyrian SPE was applied on the tooth with a rubbing motion for 20 seconds. One Step Plus was applied following Tyrian SPE. The surplus adhesive was gently blown away with dry air and cured with a light curing unit for 10 seconds.

Group 4) Enamel was pretreated with a 35% phosphoric acid gel for 30 seconds, followed by thorough rinsing and drying. The rest of the procedure is identical to Group 3.

All cervical dentin regions of group 2 and 4 were excluded from phosphoric acid pretreatment.

c) Composite filling and Polishing

Heliomolar HB was inserted incrementally in all cavities (Fig. 3, Fig. 4). Each increment was light cured for 20 seconds.

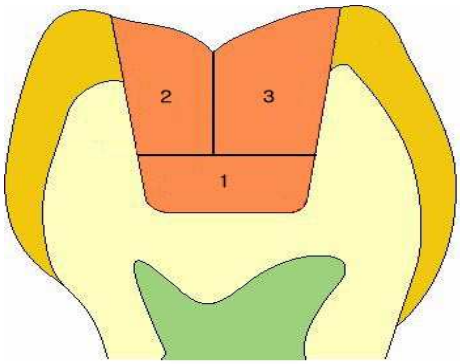


Fig. 3. Occlusal incremental filling.

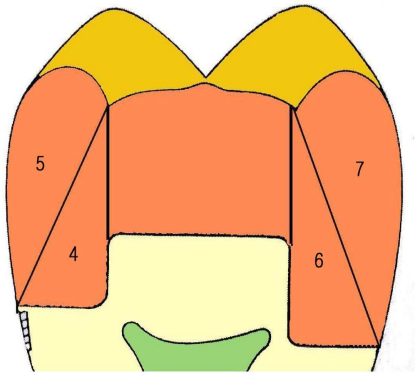


Fig. 4. Proximal incremental filling.

All specimens were polished immediately after curing[10], with a highspeed superfine diamond finishing bur, under a x30 microscope. After polishing the specimens were embedded in the metal mount (R&D Inc., Daejeon, Korea) with self curing acrylic resin.

d) Measuring the CM (%) before TML

The margins were measured under a x200 microscope (Hirox, Tokyo, Japan) with Image Pro Plus (Media Cybernetics, Inc., Silver Spring, MD, USA).

The total margin was divided into 4 regions, occlusal enamel (OE), proximal vertical enamel (VE), proximal cervical enamel (CE), and proximal cervical dentin (CD). Afterward, gaps, fractures and cracks between the restoration and tooth

were regarded as uncontinuous margin. The length of CM was calculated by subtracting the length of uncontinuous margin from the marginal length[11]. Total and regional CM were calculated as follows;

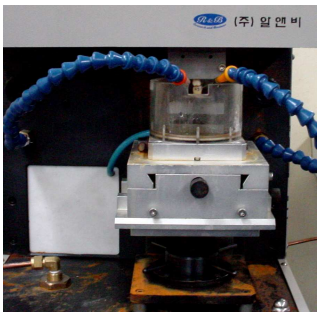
$$\text{Continuous Margin (\%)} = \frac{\text{Continuous Margin (um)} \times 100}{\text{whole margin (um)}}$$

Continuous Margin (um) = whole margin (um) – uncontinuous margin (um)

e) Thermo-mechanical loading (TML)

After measuring, the mounted specimens went through thermo-mechanical loading (TML) using the Dental Chewing Simulator (R&D Inc., Daejeon, Korea) (Fig. 5), which was designed based on the chewing simulator mentioned by Krejci[12]. The Dental Chewing Simulator reproduces the mastication by controlling the mastication sequence, rpm, load and temperature. Extracted human upper molars were used as the opposing tooth for the specimens. The central fossa of the specimen occluded with the palatal cusp of the maxillary tooth. Each specimen was put through TML which consists of mechanical loading (720,000 cycles, 5.0 kg) with the speed of 120 rpm for 100 hours[12,13] and thermocycling (6000 thermocycles of 5 ℃ and 55 ℃).

a



b

c

Fig. 5. Dental Chewing Simulator

a) Controller: controls temperature, load, rpm, sequence

b) Acrylic mount: tooth specimen undergoing thermo-mechanical loading

c) Body of the chewing simulator

f) Measuring the CM (%) after TML

After TML, the tooth specimens were measured and the CM (%) calculated with the identical method used for the specimens before TML.

g) Statistical analysis

Paired *t* test was used to compare the CM (%) before and after TML. 3-way ANOVA and Duncan's Multiple Range Test was performed before and after TML, to test the effect of 3 variables, pretreatment conditions, type of bonding agents (Clearfil SE, Tyrian SPE & One Step Plus) and tooth regions (OE, VE, CE) on CM (%). Within the groups without phosphoric acid pretreatment (group 1 & 3), 2 way ANOVA and Duncan's Multiple Range Test was used to test the effect of type of bonding agents and regions (OE, VE, CE, CD) on CM (%). All statistical tests were carried out at the 95% level of confidence.

III. Results

The result of 3-way ANOVA revealed no significant difference in the pretreatment conditions (before TML : p=0.1521, after TML : p=0.1255) and bonding agents (before TML : p=0.1058, after TML : p=0,4811) on CM, but there was significant difference in the regions after TML (before TML : p=0,2897, after TML : p=0.0018) (Table 2).

Table 2. Three way ANOVA for 3 variables before and after TML

Source	*df*	Sum of squares		Mean square		F		*P* value	
		before	after	before	after	before	after	before	after
Additional etching	1	6.937	50.549	6.937	50.549	1.98	2.38	0.1621	0.1255
Type of adhesive	1	9.311	10.596	9.311	10.596	2.66	0.50	0.1058	0.4811
Region	3	13.297	340.214	4.432	113.404	1.27	5.35	0.2897	0.0018
Error	106	370.943	2247.046	3.499	21.198				

The results of 2-way ANOVA indicated that there was significant difference in the regions (before TML : p=0.0004, after TML : p<0.0001), but not in the bonding agents (before TML : p=0.1591, after TML : p=0.4655) (Table 3).

Table 3. 2 way ANOVA for 2 variables before and after TML

Source	*df*	Sum of squares		Mean square		F		*P* value	
		before	after	before	After	before	after	before	after
Type of adhesive	1	6.489	9.556	6.489	9.556	2.01	0.54	0.1591	0.4655
Region	4	71.051	1740.670	17.763	435.167	5.49	24.39	0.0004	<0.0001
Error	134	433.602	2390.020	3.235	17.842				

Mean CM (%) and standard deviation of each tooth region is presented in Table 4. Paired *t* test revealed significant difference between the CM before and after TML in all regions except the cervical dentin region in group 1 (Table 4).

Before TML, no statistical difference was found between groups within the same region, except the VE region between group 2and 4, which showed higher CM (%) in group 4 than in group 2 (Fig. 6.) Within group 1,2 and 4, there was no statistical difference between the tooth regions. In group 3, the CD region showed higher CM (%) than the OE region and the VE region (Fig. 7, Table 4).

After TML, no statistical difference was found between groups within the same region (Fig. 8). Within group 2 and 4, there was no statistical difference between the tooth regions. In group 1, the CD region showed the highest CM (%). In group 3, the VE region showed the lowest CM (%) and the CD region the highest CM (%) (Fig. 9, Table 4).

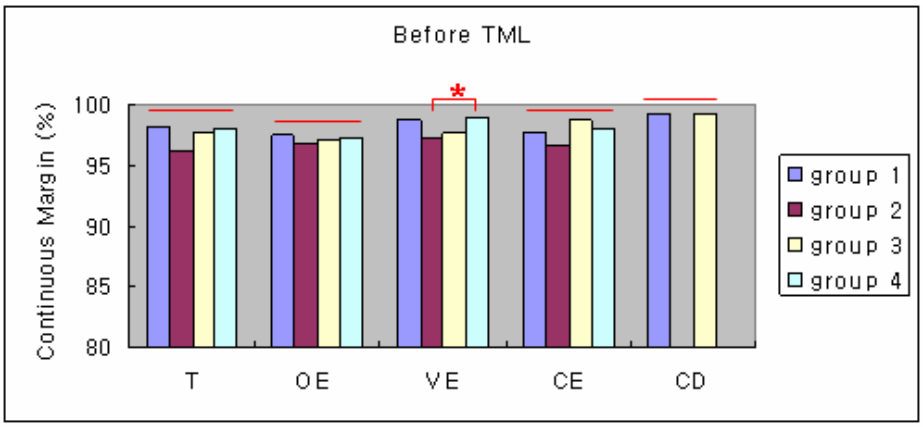


Fig. 6. CM (%) of each tooth region before TML

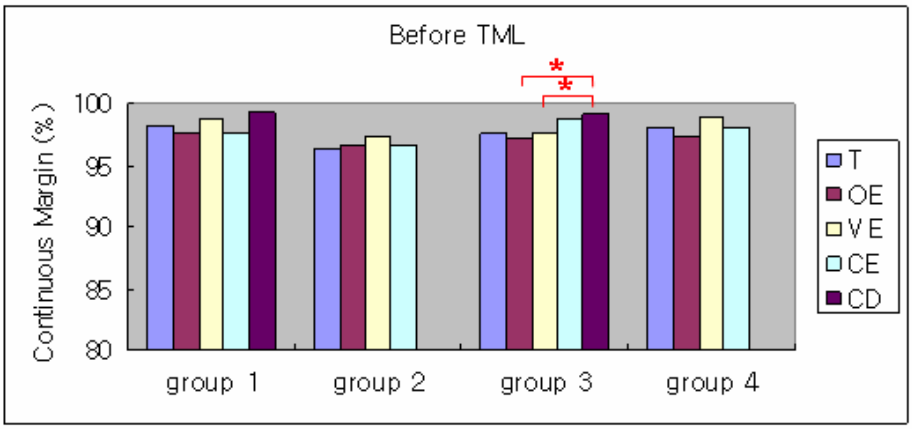


Fig. 7. CM (%) of each group before TML

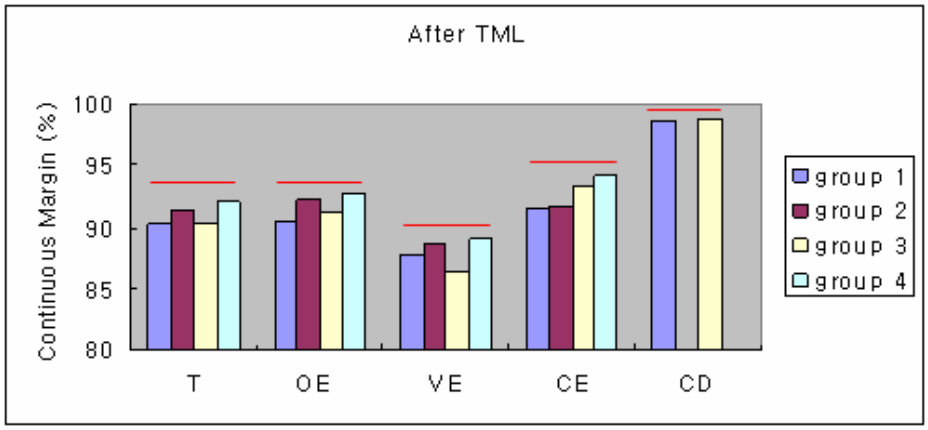


Fig. 8. CM (%) of each tooth region after TML

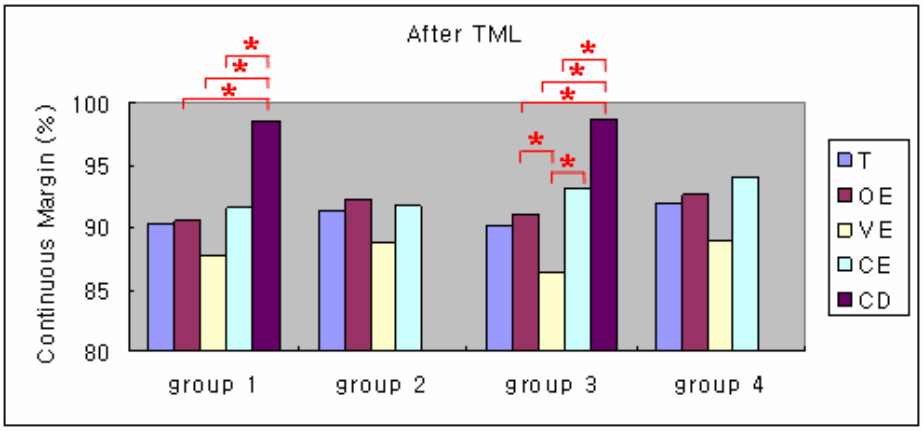


Fig. 9. CM (%) of each group after TML

Table 4. Mean CM (%) of tooth regions and DMR Grouping

Group	Tooth region	Mean CM (%) before TML			Mean CM (%) after TML			
		Mean	(Std Dev)	DMR[a)]	Mean	(Std Dev)	DMR	
group 1	T	98.211	(1.4168)		90.336	(2.7143)		*
	OE	97.546	(1.9669)	A[b)]	90.512	(2.8118)	B	*
	VE	98.740	(1.011)	A	87.698	(6.5581)	B	*
	CE	97.611	(4.0378)	A	91.507	(8.143)	B	*
	CD	99.336	(1.4767)	A	98.638	(2.0703)	A	
group 2	T	96.257	(2.6852)		91.429	(4.7766)		*
	OE	96.685	(2.9818)	A	92.218	(4.9604)	A	*
	VE	97.318	(1.5108)	A	88.654	(7.0979)	A	*
	CE	96.554	(1.7978)	A	91.654	(5.6159)	A	*
group 3	T	97.637	(1.1227)		90.248	(2.6897)		*
	OE	97.172	(1.5895)	B	91.125	(2.5901)	B	*
	VE	97,561	(1.5263)	B	86.427	(5.0131)	C	*
	CE	98.739	(1.5831)	AB	93.227	(3.9676)	B	*
	CD	99.182	(1.3696)	A	98.790	(1.6704)	A	*
group 4	T	98.125	(0.5632)		92.034	(1.5968)		*
	OE	97.280	(0.8325)	A	92.664	(1.8018)	AB	*
	VE	98.876	(0.9282)	A	89.054	(4.2175)	B	*
	CE	98.141	(2.3731)	A	94.136	(5.9894)	A	*

T: total margin, **OE**: occlusal enamel, **VE**: vertical enamel, **CE**: cervical enamel, **CD:** cervical dentin

*****: statistically significant difference between before and after TML, observed with paired t-test

a) Duncan's Multiple Range Test b) means with the same letter in the same group are not significantly different

IV. Discussion

In the present study, there was no significant difference in the pretreatment conditions and bonding agents on CM (%), before and after TML. Although the etched enamel surfaces of self etching primers with higher pH differ from that of self etching primers with lower pH and phosphoric acid[4], the microscopic morphologic difference may not be an essential factor that influences the CM (%). According to the present study, self etching primers alone may be capable enough to etch the enamel sufficiently as phosphoric acid. But it must be taken into consideration, that incremental curing, agitation of the self etching primer[4,8] and using Heliomolar HB as the filling material, which is a composite with relatively low polymerization shrinkage[14], may have reduced the influence of the two variables.

This result may differ with that of Miguez *et al.*[6], which states that acid etching prior to application of the self-etching primer produced higher bond strengths to enamel than self-etching priming only. The efficiency was accessed by the microtensile bond test and SEM, using 16 bovine teeth. However, Hannig *et al.*[7] indicated that use of self etching primers may be an alternative to conventional phosphoric acid pretreatment in composite-to-enamel bonding restorative techniques, by comparing the marginal adaptation of three self etching priming agents to conventional phosphoric acid etching and bonding application. The marginal adaptation was accessed by using quantitative SEM analysis on class II cavities with all margins placed on enamel. But because the present study evaluated the bonding

efficiency by assessing the marginal adaptation of restorations in class II cavities having both enamel and dentin margins, and analyzing it under a light microscope before and after dental TML, the results cannot be directly compared to the study mentioned above.

In the present study, there was statistical difference within the regions before and after TML. The vertical enamel region showed the lowest CM (%) in group 3 after TML. Bott and Hannig[21] also found that load-induced marginal disintegration takes place especially in cervicoproximal areas of class II composite restorations. Krejci *et al.*[22] also found that approximal regions, which are not totally surrounded by enamel margins, showed lower CM (%) than occlusal regions. Moreover, Shimada and Tagami[23] reported a study investigating the effects of the region of enamel and the direction of enamel sectioning on the bonding ability of a self-etching primer system and a total-etch bonding system. They concluded that the self-etching primer system showed higher bond strength, and that the anisotropic structure of enamel influenced the bond strengths of the two adhesive systems. They also explained the lower bonding strength of parallel prismatic enamel etched with phosphoric acid is due to the over-etched enamel surface.

Longitudinally cut etched enamel are reported to have lower tensile bond strengths that for crosscut enamel[24]. And their prisms are described to be prone to microfractures[25,26]. Based on these reports, the butt-joint finishing line in the vertical enamel region, which runs parallel to the enamel rods, may be an explanation of the

low CM (%) of the vertical enamel region compared to other regions after TML in the present study. If so, beveling of the proximal margins might have lead to a higher CM (%).

The intriguing fact of this study is that the cervical dentin region showed the highest CM (%) after TML. Since there are not many reports regarding the marginal adaptation of dentin in composite resin restorations using self etching adhesive systems, no direct comparisons could be made. But although they are not studies concerning self etching adhesive systems, there are studies reporting poor marginal adaptation in the cervical dentin region than in other regions[21,22]. Therefore it was difficult to interpret this outcome of the present study. But the lower modulus of elasticity in dentin might have contributed in the higher CM (%) of the cervical dentin region than the regions located on enamel, by absorbing the occlusal load rather than delivering the load directly to the tooth. The reduction of occlusal load while reaching the cervical dentin, and the fact that the cervical dentin lies perpendicular to the axis of occlusal load, and also the fact that the bond strength of self-etching adhesive systems has improved enough to be equal or even higher than that of total etch systems[27], might have also contributed to the higher CM (%).

Unlike mild self etching adhesives (self etching adhesives with a pH around 2), strong self etching adhesives (self etching adhesives with pH<1) are documented to have a resemblance in interfacial ultra-morphology at dentin to that of the total etch adhesives[6]. Therefore, in this present study, two types of self etching adhesive

systems were used to compare the effect of adhesive type, one being Clearfil SE Bond (Kuraray co., Ltd, Osaka, Japan) and the other being Tyrian SPE with One Step Plus (Bisco, Inc, Schaumburg, U.S.A.). According to the manufacturer, the pH of Clearfil SE Bond and Tyrian SPE were 2 and 0.4 respectively. The type of adhesive did not influence the CM (%) of the restoratives. However, it is dangerous to conclude that the pH of self etching adhesive systems has no effect on the integrity of the restoration, because the two adhesive systems which were used in this study differ in many more physical properties than pH. Further investigations concerning about the effect of pH of self etching adhesives on marginal adaptation is needed.

Leakage between the restoration and tooth may result in serious consequences such as hypersensitivity, marginal staining, discoloration, secondary caries, and pulp pathosis[15,16,17,18,19], which indicates that marginal adaptation is directly connected with the longevity of the restoration. Therefore evaluating the marginal adaptation is a common method used to assess the restoration[2,5,6,9,11,15,16].

There are many ways of quantifying the marginal adaptation between a tooth and composite. SEM views, dye penetration, isotope immersion and light microscopes are the frequently used methods. Although there is no completely accurate and objective method for evaluation, the light microscope can provide the relative marginal adaptation of restorations. Kyung-Mo Cho[28] reported that microscopic assessment of marginal leakage can closely represent the actual marginal leakage. Furthermore, because sectioning of the specimen is not required for

evaluation, it is possible to compare the marginal adaptation of the restoration before and after TML, which is the main reason, why the light microscope was used in this study.

Occlusal load, mastication velocity and thermal change are components of important factors which represent the actual mastication environment of the oral cavity. The chewing simulator used in this study is designed to control all three components. And compared to machines used in other studies, this chewing simulator performs thermocycling and mechanical loading concurrently[12]. The physical load, velocity and thermal change which was used in this study, represent the general mastication environment of the oral cavity for 3 years, which is a period long enough to discuss the quality of the composite.

Even though the chewing simulator resembles the actual oral environment in many aspects, it can only deliver constant load to the composite and the biochemical environment of the oral cavity cannot be applied. Therefore, it may not be appropriate to directly apply the results of the present in vitro study to in vivo situations.

Within the limitations of this study, the present in vitro study indicate that phosphoric acid pretreatment prior to application of self etching adhesives as to ensure the enamel bonding effectiveness, can be omitted.

V. Conclusion

The purpose of this study was to compare the marginal adaptation of composite resin restorations conditioned only with self-etching primers in comparison to those pretreated with 35% phosphoric acid. MOD cavities of human teeth were restored with Heliomolar HB, and put through thermocycling and mechanical loading. The CM (%) of the restorations before and after TML was evaluated under a light microscope with Image Pro Plus in occlusal, vertical, cervical enamel and cervical dentin. Within the limitations of this study, the conclusions were as follows:

1. Phosphoric acid pretreatment did not influence the CM (%) before and after TML.
2. There was no statistical difference between Clearfil SE Bond and Tyrian SPE & One Step Plus in CM (%) before or after TML.
3. Vertical enamel regions showed lower CM (%) after TML than other tooth regions.
4. Cervical dentin regions showed higher CM (%) after TML than other tooth regions.

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국문요약

부가적인 산부식이 자가부식형 접착제의 변연접합성에 미치는 영향;
구강저작재현장치를 이용한 분석

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정 완

이 실험의 목적은 추가적인 법랑질 부식이 자가 부식 접착제를 사용한 2 급 MOD 와동의 복합 레진 수복물의 변연접합에 미치는 영향을 알아보는 것이었다. 발거된 치아에 Clearfil SE Bond 또는 Tyrian SPE & One Step Plus 를 사용하여 Heliomolar HB 를 충전하였으며, 사용한 접착제와 부가적인 산부식의 유무에 따라 4 가지 군(군 1: Clearfil SE Bond 를 사용한 군, 군 2: 법랑질을 35 % 인산으로 부가적인 산부식을 한 후 Clearfil SE Bond 를 사용한 군, 군 3: Tyrian SPE & One Step Plus 를 사용한 군, 군 4: 법랑질을 35 % 인산으로 부가적인 산부식을 한 후 Tyrian SPE & One Step Plus 를 사용한 군)으로 나누었다. 구강저작재현장치를 이용하여 5.0g 의 하중을 720000 회 (분당 120 회) 주었고, 동시에 5℃와 55℃의 물을 교대로 치아에 총 6000 회 주사하였다. 실험 전, 후 변연접합도를 전체와 부위별 변연으로 나누어서 x200 배율의 디지털 광학 현미경으로 측정하였다. 부위별 변연은 교합부 (OE), 법랑질의 수직 변연부 (VE), 법랑질 치경부

변연부 (CE)와 상아질의 치경부 변연부 (CD), 네부위로 나누어서 측정하였다. 전체 변연접합도에서와 부위별 변연접합도에서의 저작재현장치 적용 전후의 분석은 paired t-test 로 하였고, 추가적 산부식 유무의 차이, 재료별 차이(Clearfil SE Bond, Tyran SPE & One Step Plus)와 부위별 차이(OE, VE, CE, CD)는 3 way ANOVA 로 분석 후 Ducan's Multiple Range Test 로 다중비교 하였다. 상아질의 치경부 변연부와 다른 부위와의 비교를 위하여 1 군과 3 군에서 2-way ANOVA 를 분석하였다. 모든 통계는 95%의 신뢰성을 가지고 분석하였다. 전체와 부위별 변연 모두에서 재료나 추가적 산부식 유무에 따른 변연접합도의 차이를 보이지 않았다. 모든 군에서 저작재현장치 적용후 법랑질 수직변연부는 다른 부위보다 낮은 변연접합성을 보였고, 상아질 치경부위는 다른 부위보다 높은 변연접합성을 나타냈다.

핵심되는 말: 변연접합성, 연속변연, 구강저작재현장치, 자가 부식형 접착제, 부가적 산부식