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Do Different Types of Adhesive Agents Effect Enamel Demineralization for Orthodontic Bonding? An In Vitro Study

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Abstract: (1) Objective: The aim of this study was to compare the demineralization around brackets bonded with different types of adhesive agents in a cariogenic suspension environment. (2) Methods: In the study, 60 extracted upper first premolar teeth were divided into three groups with 20 teeth in each group. In Group 1, Transbond XT Primer + Transbond XT Light Cure Adhesive (3M Unitek, Monrovia, CA, USA), in Group 2, GC Ortho Connect Light Cure Adhesive (GC Crop, Tokyo, Japan) and in Group 3, Transbond™ Plus Self Etching Primer + Transbond XT Light Cure Adhesive (3M Unitek, Monrovia, CA, USA) adhesive agents were used. In Group 1 and 2, buccal enamel surfaces were etched for 30 s, washed for 15 s and dried for 15 s. All groups were bonded with Gemini metal (3M Unitek, Monrovia, CA, USA) brackets. Gingival, occlusal and proximal enamel surfaces of the brackets were measured with a DIAGNOdent pen (KaVo, Biberach, Germany), and demineralization values were recorded. Measurements were performed after bracketing (T0) and after 28 days in a cariogenic environment (T1), which was renewed every 48 h. The Kolmogorov–Smirnov test was used to determine whether or not the data were homogeneously distributed, the Wilcoxon test was used for comparisons within groups, and the Mann–Whitney U and Kruskal–Wallis tests were used for comparisons between groups. (3) Results: In all groups, demineralization values on all enamel surfaces of the brackets were found to be statistically significantly higher in the T1 period than in the T0 period ($p < 0.05$). In the T1 period, demineralization values of occlusal enamel surfaces in Groups 1 and 2 were found to be significantly higher than in Group 3 ($p < 0.05$). The amount of increase in occlusal enamel surface demineralization value between T0 and T1 periods in Groups 1 and 2 was significantly higher than in Group 3 ($p < 0.05$). There was no statistically significant difference in demineralization values of proximal and gingival enamel surfaces between the groups in the T1 period ($p > 0.05$). (4) Conclusion: Significantly less occlusal enamel surface demineralization was observed in teeth in which the Transbond™ Plus Self Etching Primer adhesive agent was not applied with acid etching.

Keywords: orthodontics; bracket; adhesive; bond; artificial saliva; *Streptococcus mutans*; cariogenic environment; demineralization; DIAGNOdent

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1. Introduction

In fixed appliances, the bands and brackets bonded to the teeth create retention areas for dental plaque, bacteria and food on the tooth surfaces [1].

For tooth caries to occur, there must be cariogenic bacteria, a sensitive tooth surface, time for the lesion to develop and nutrients for the bacteria. *Streptococcus mutans* creates strong biofilms on tooth surfaces, quickly metabolizes a wide range of carbohydrates from the host diet and endures numerous (and frequent) environmental challenges encountered in oral biofilms. *Streptococcus mutans* is a cariogenic organism. Cariogenic bacteria are the primary agents of initial caries; they adhere to the enamel, produce and tolerate acid and thrive in a sucrose-rich environment [2].

Excessive and frequent consumption of refined carbohydrates, along with the failure to remove plaque from retentive areas, accelerates the demineralization of tooth enamel. This situation disrupts the balance of remineralization and demineralization. Orthodontic bands and brackets placed on the teeth used in orthodontic treatment cause new retentive areas for plaque on the flat surfaces of the teeth with low caries prevalence. No matter how much patients pay attention to their oral hygiene during orthodontic treatment, auxiliary attachments such as fixed functional appliances, orthodontic arch wires, springs, loops, auxiliary arches and ligatures used during treatment create areas that are difficult to reach and clean [1]. It prevents the oral hygiene of the patients from remaining at the healthy level. Cariogenic activity increases with orthodontic treatment [3].

Increased demineralization causes the development of clinically visible white spot lesions on teeth. The clinical appearance of white spot lesions has a chalky white opacity and is defined as subsurface enamel pores resulting from demineralization [4]. Decalcified and porous enamel's changes in light scattering give it a white appearance [5]. When using fixed appliances for orthodontic treatment, white spot lesions are a frequent and unpleasant side effect. Within four weeks, or the time between two appointments for orthodontic treatment, these initial carious lesions can start developing [6]. The literature has shown that between 2% and 97% of patients undergoing fixed orthodontic treatment have white spot lesions [7–9]. The use of contemporary detection methods indicates a higher prevalence of white spot lesions than with the naked eye (97%) [8].

White spot lesions must be diagnosed as soon as possible in order to apply preventative measures and detect tooth integrity before it is compromised [4]. Without early detection and preventative measures, white spot lesions can advance rapidly and result in irreversible material loss on the teeth. The need for restoration arises in teeth with material loss [4]. In patients undergoing orthodontic treatment, fluoride varnishes are frequently used to increase mineralization and prevent demineralization before and after bonding. However, there are studies showing that the use of fluoride varnish before bonding reduces shear bonding strength (SBS) [10].

During the traditional acid etching method, the enamel preparation steps (acid etching, rinsing, drying and application of bonding agent) should be done properly. Loss of surface enamel and weakening of subsurface enamel can be seen in total-etch systems [11]. It can cause the enamel surface to split or break during debonding due to strong acidic conditioning liquid or prolonged etching [11]. It is quite often repeated that the use of self-etch primers produces a milder etching pattern than 37% phosphoric acid does [12,13]. The application of self-etch primers reduces the amount of adhesive remaining after debonding, thus reducing the invasive procedures required to clean the enamel surface [14].

This study was aimed at evaluating and comparing the enamel demineralization around the brackets bonded to the extracted human maxillary first premolars by using three different types of orthodontic adhesive agents and measuring with a laser fluorescence method, DIAGNOdent pen, in an artificial cariogenic suspension environment.

The null hypothesis was that no difference exists between demineralization around brackets bonded with different adhesive agents in the cariogenic suspension.

2. Materials and Methods

2.1. Preparation of Samples and Bonding

The study was carried out using 60 upper first premolars extracted for orthodontic treatment from patients referred to Zonguldak Bulent Ecevit University, Department of Orthodontics. Ethics committee approval was obtained prior the study, dated 9 February 2022 and numbered 2022/03, from Non-Invasive Clinical Research Ethics Committee of Zonguldak Bulent Ecevit University.

The teeth included in the study had no fluorosis on the enamel, caries, fillings, restorations, cracks or fractures [15–17]. The evaluation of the freshly extracted teeth was done with the naked eye. The patient's age, gender and the quadrant in which the teeth were extracted were neglected.

The teeth were stored in a 0.1% thymol solution until study [18]. The storage period of the teeth did not exceed six months [19]. The sample size of the study, in which the effect size was calculated using the mean and standard deviation of the groups, was performed by the G*Power 3.1.9.7 program. α error probability was set at 0.05. The power of the study (1 – α error prob) was set at 0.95. According to these data, the actual power of the study was calculated as 96%, and total sample size should have been 54. Sixty maxillary first premolars were divided into three groups, each group consisting of 20 teeth. Before bonding, roots of teeth were removed from the crowns with the use of a separator disc under water cooling along the enamel–cementum border of the teeth. The pulp chambers exposed after the incision were cleaned with a probe, and the pulp chambers were filled with a flowable composite [20]. A 3M ESPE Elipar S10 curing light (1200 Mw/cm^2 and a wavelength of 430–480 nm) was used for 20 s for the polymerization of the flowable composite. The flowable composite was polished with polishing discs to prevent a microbial retention area. The buccal surfaces of the teeth were cleaned with a rubber band and pumice before bonding (see Figure 1a). A 4 × 4 mm windowed acetate sheet was used to seal off the area where the bracket would be bonded to the buccal enamel surfaces. Using an acetate sheet limited the enamel surface that could be etched and adhered. Thus, the potential retentive enamel surface area caused by acid etching was reduced.

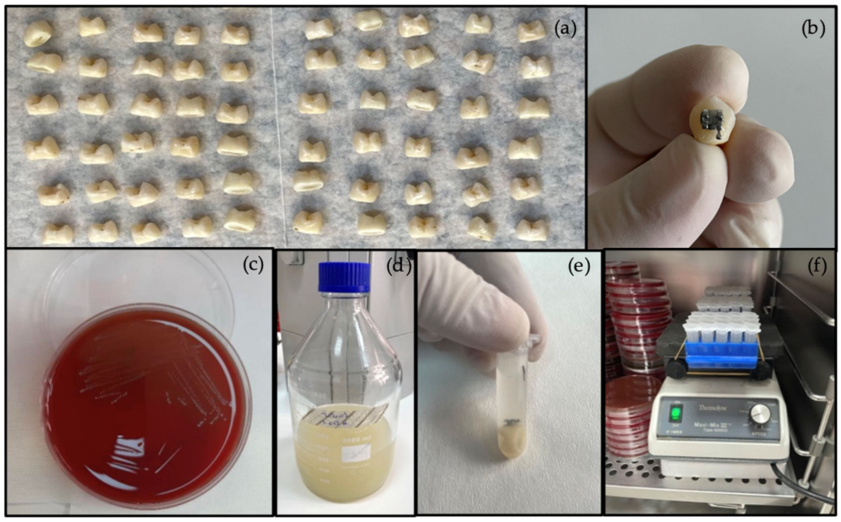

Figure 1. (**a**) Teeth whose roots were removed with a separator disc before bonding; (**b**) bonded tooth sample; (**c**) *Streptococcus mutans* medium; (**d**) artificial saliva solution; (**e**) specimen ready to be placed in the incubator; (**f**) specimens placed in an incubator on a Thermolyne Maxi-Mix III Type 65800 Rotary Shaker (Thermo Scientific, Iowa, IA, USA).

In Group 1, 37% orthophosphoric acid gel for acid etching was applied to the buccal enamel surfaces encircled by the acetate sheet for 30 s. After acid etching, the enamel surface was washed for 15 s and dried for 15 s. Transbond XT Primer (3M Unitek, Monrovia, CA, USA) was applied in a thin layer to the etched enamel surface. Then, brackets loaded with Transbond XT Light Cure Adhesive Paste (3M Unitek, Monrovia, CA, USA) were carefully placed on the teeth in the correct position.

In Group 2, 37% orthophosphoric acid gel for acid etching was applied to the buccal enamel surfaces encircled by the acetate sheet for 30 s. After acid etching, the enamel surface was washed for 15 s and dried for 15 s. Then, brackets loaded with GC Ortho Connect Light Cure Adhesive Paste (GC Crop, Tokyo, Japan) were carefully placed in the correct position.

In Group 3, a thin layer of Transbond Plus Self Etching Primer (3M Unitek, Monrovia, CA, USA) was applied to clean plaque-free enamel surfaces on which acetate-sheet-bounded brackets would be located. Air was applied lightly to the surface with an air

syringe. Then, brackets loaded with Transbond XT Light Cure Adhesive Paste (3M Unitek, Monrovia, CA, USA) were carefully placed on the teeth in the correct position.

All samples were bonded with Gemini metal (3M Unitek, Monrovia, CA, USA) brackets (see Figure 1b). Adhesive flashes during bracket placement were removed with a probe and a 3M ESPE Elipar S10 (3M ESPE Dental Products) curing light source with a light intensity of 1200 Mw/cm^2 and wavelength of 430–480 nm used for adhesive paste polymerization. During the polymerization, a total of 20 s of light was applied from the mesial and distal sides of brackets for 10 s. The ingredients of the adhesive agents used in the study are given in Table 1.

Table 1. Composition on ingredients of adhesives.

	Ingredients	wt%	Manufacturer
3M™ Unitek™ Transbond™ XT Primer	Bisphenol A Diglycidyl Ether Dimethacrylate (BISGMA) Triethylene Glycol Dimethacrylate (TEGDMA) 4-(Dimethylamino)-Benzeneethanol	45–55 45–55 <0.5	3M Unitek, Monrovia, CA, USA
3M Unitek Transbond XT Light Cure Adhesive	Silane Treated Quartz Bisphenol A Diglycidyl Ether Dimethacrylate (BISGMA) Bisphenol A *Bis* (2-Hydroxyethyl Ether) Dimethacrylate Silane Treated Silica Diphenyliodonium Hexafluorophosphate	70–80 10–20 5–10 <2 <0.2	3M Unitek, Monrovia, CA, USA
3M™ Unitek™ Transbond™ Plus Self Etch Primer Part A	2-Propenoic acid, 2-methyl-, 2-hydroxyethyl ester, reaction products with phosphorus oxide (P_2O_5) DL-Camphorquinone *N*,*N*-Dimethylbenzocaine 4-Methoxyphenol Hydroquinone	>95 <2 <2 <0.2 <0.1	3M Unitek, Monrovia, CA, USA
3M™ Unitek™ Transbond™ Plus Self Etch Primer Part B	Water Dipotassium Hexafluorotitanate	>98 <2	3M Unitek, Monrovia, CA, USA
GC Ortho Connect Light Cure Adhesive	Esterification products of 4,4′-isopropylidenediphenol, ethoxylated and 2-methylprop-2-enoic acid Urethane Dimethacrylate (UDMA) methacryloyloxydecyl dihydrogen phosphate 6-*tert*-butyl-2,4-xylenol diphenyl(2,4,6-trimethylbenzoyl)phosphine oxide	25–50 25–50 2.5–5 0.25–0.5 0.2–0.5	GC Crop, Tokyo, Japan

2.2. Measurements of T0 with DIAGNOdent Pen

The DIAGNOdent pen (KaVo, Biberach, Germany) device used in the study was calibrated for each tooth before measurement according to manufacturer's instructions.

Measurements were performed on the occlusal, gingival and proximal enamel surfaces around the brackets by holding the B tip perpendicular to these surfaces. After moving the B tip of the DIAGNOdent pen 3–4 times on the occlusal and gingival surfaces, up and down on the proximal surfaces, the value read on the screen of the device was recorded as T0 [21]. The DIAGNOdent pen device recognizes its readings as fluorescence arbitrary units (a.u.) and generates a score. A single proximal demineralization value was recorded for each tooth by averaging the measurements performed on the mesial and distal proximal surfaces. Measurements were repeated twice, and all measurements were made by the same researcher (R.M.D.). The measurement room was illuminated with a 6400 K white artificial light.

2.3. Preparation of Artificial Saliva and Cariogenic Suspension

Artificial saliva was prepared with the same formula as Toz Ertop et al. did [19]. Artificial saliva was prepared with 0.4 g of sodium chloride (NaCl), 0.4 g of potassium chloride (KCl), 0.8 g of calcium chloride ($CaCl_2 \cdot 2H_2O$), 0.78 g of sodium dihydrogen phosphate ($NaH_2PO_4 \cdot 2H_2O$), 0.005 g of sodium sulfate ($NaS \cdot 9H_2O$) and 1 g urea of in

1000 mL of deionized water [19,22] (see Figure 1c). After the prepared artificial saliva solution was sterilized in an autoclave, 140 mg of mucin (Mucin Type II; SigmaAldrich Chemie GmbH, Deisenhofen, Germany) was added per 100 mL of artificial saliva solution. Adding mucin was aimed at accelerating the development of pellicle formation [19,23].

Bacteria stock culture were taken from Zonguldak Bulent Ecevıt University, Faculty of Medicine, Department of Medical Microbiology. *Streptococcus mutans* culture incubated on blood agar from a stock culture was used to prepare the cariogenic suspension (see Figure 1d). A bacterial suspension equivalent to 0.5 McFarland (10^8 cfu/mL) turbidity was prepared in brain–heart infusion broth with bacteria taken from the medium. The sucrose solution was prepared as 1 g/10 mL distilled water and passed through a sterile 0.22 µm syringe filter. An artificial cariogenic suspension with a turbidity of 10^6 cfu/mL was obtained by adding 0.5 mL of sucrose solution and 0.5 mL of bacterial suspension for each 49 mL of artificial saliva solution [19].

2.4. Cariogenic Suspension Environment

Bonded tooth samples and U-bottom centrifuge tubes to be used were sterilized in an autoclave to prevent contamination. Each tooth sample was placed in a tube. Two milliliters of artificial cariogenic suspension was added to the tubes (see Figure 1e). The tubes were placed in a Thermolyne Maxi-Mix III Type 65800 Rotary Shaker (Thermo Scientific, Iowa, IA, USA) on a tray. The rotation speed was set to 20 rpm. The homogeneous interaction of the artificial cariogenic suspension with all the teeth was done with the use of a rotary shaker. The prepared samples were incubated for 28 days at 37 °C in a 10% CO_2 atmosphere on a rotary shaker placed in incubator (see Figure 1f). During the incubation period, the artificial cariogenic suspension and the used U-bottom centrifuge tubes were renewed every 48 h. After 28 days, the teeth were removed from the cariogenic suspension and washed with distilled water.

2.5. T1 Measurements with DIAGNOdent Pen

After 28 days, enamel demineralization on the occlusal, gingival and proximal enamel surfaces around the brackets was remeasured with the DIAGNOdent pen. Measurement results were recorded as T1. The measurements were made with the same method and environment as for T0 measurements.

2.6. Statistical Analysis

SPSS (Statistical Package for Social Sciences) 28.0 (SPSS Inc., Chicago, IL, USA) was used for statistical analysis. The Kolmogorov–Smirnov test was used to determine whether or not the data were homogeneously distributed, the Wilcoxon test was used for comparisons within groups, the Mann–Whitney U and Kruskal–Wallis tests were used for comparisons between groups. The level of significance chosen for all statistical tests was $p < 0.05$.

3. Results

In the T0 period, all enamel surface demineralization values adjacent to the bracket in all groups did not differ significantly between the groups ($p > 0.05$). In all groups, all enamel surface demineralization values adjacent to the bracket in the T1 period increased significantly compared to those of the T0 period ($p < 0.05$). In all groups, the gingival and proximal enamel surface demineralization values adjacent to the bracket in the T1 period did not show a statistically significant difference between the groups ($p > 0.05$). The change in the demineralization values of the gingival and proximal enamel surface adjacent to the bracket in the T0/T1 period did not show a statistically significantly difference in all groups ($p > 0.05$). The increase in the demineralization values of the gingival enamel surfaces adjacent to the bracket was seen the most in Group 1 and the least in Group 3, but these differences were not statistically significant ($p > 0.05$). The increase in proximal enamel surface demineralization values adjacent to the bracket was seen the most in Group 2 and the least in Group 3, but these changes were not statistically significant ($p > 0.05$).

Occlusal enamel demineralization values adjacent to the bracket in Group 1 and Group 2 in the T1 period showed a statistically significant increase compared to that of Group 3 ($p < 0.05$). No statistically significant difference was found between the demineralization values measured on the occlusal surface adjacent to the bracket in Group 1 and Group 2 in the T1 period ($p > 0.05$). In Group 1 and Group 2, the amount of increase in the demineralization value of the occlusal surface adjacent to the bracket in the T0/T1 period was significantly higher than in Group 3 ($p < 0.05$). In Groups 1 and 2, the amount of increase in the demineralization value of the occlusal surface adjacent to the bracket in the T0/T1 period did not show a statistically significant difference between the groups ($p > 0.05$). Statistical analysis results of demineralization values in T0, T1 and T0/T1 periods are given in Table 2.

Table 2. Demineralization values on the enamel surface adjacent to the brackets at T0, T1 and T0/T1 periods.

		Group 1	Group 2	Group 3	*p*
Occlusal					
T0	Median	3.00	3.00	2.50	NS
T1	Median	6.00 [3]	7.00 [3]	5.00 [1,2]	0.003 [K]
T0/T1 difference	Median	4.00 [3]	4.00 [3]	3.00 [1,2]	0.003 [K]
Intra-Group difference	*p*	0.000 [W]	0.000 [W]	0.000 [W]	
Proximal					
T0	Median	3.00	2.50	2.75	NS
T1	Median	7.00	7.00	7.00	NS
T0/T1 difference	Median	4.50	4.25	4.00	NS
Intra-Group difference	*p*	0.000 [W]	0.000 [W]	0.000 [W]	
Gingival					
T0	Median	3.00	3.00	3.00	NS
T1	Median	10.00	10.00	10.00	NS
T0/T1 difference	Median	7.50	7.00	7.00	NS
Intra-Group difference	*p*	0.000 [W]	0.000 [W]	0.000 [W]	

[K]: Kruskal–Wallis (Mann–Whitney U test); [W]: Wilcoxon test; T0: before placement in cariogenic environment; T1: 28 days after placement in cariogenic environment; $p < 0.05$: level of significance considered; [1] difference with Transbond XT primer + Transbond XT adhesive group $p < 0.05$; [2] difference with GC Ortho Connect group $p < 0.05$; [3] difference with Transbond Plus primer + Transbond XT adhesive $p < 0.05$; NS: not significant.

4. Discussion

The areas where the appliances used in fixed orthodontic treatment are placed are not generally caries-prone areas [24,25]. Toz Ertop et al. kept the bracketed teeth in a cariogenic suspension that they renewed every 2 days for 28 days and observed demineralization in all teeth [19]. In this study, statistically significant increases in demineralization values were found on all enamel surfaces adjacent to the bracket 28 days after all groups were placed in the cariogenic environment. There is a study showing that the use of biomimetic hydroxyapatite is appropriate to treat demineralization around the bracket and to increase enamel mineralization [26].

Visel et al. compared the effects of a self-etch adhesive system (Transbond Plus) and a conventional total-etch adhesive system (Transbond XT) on demineralization around the bracket in vivo and observed that the enamel samples which were conditioned with the self-etching fluoride-releasing primer (Transbond Plus) displayed the highest degree of remineralization [27]. Montaseer et al. in their study examining the potential protection effect of different treatments against demineralization around orthodontic brackets reported that applying the Transbond Plus Self Etching primer to the enamel surface before demineral-

ization showed significantly less demineralization and more resistance to demineralization than the enamel surfaces that did not undergo any treatment in vitro did [28]. These studies support the fact that less demineralization was observed on the occlusal surfaces adjacent to the enamel in the group in which the self-etch primer was used in our study. We could suggest that time spans for remineralizations were produced as a result of the artificial saliva solution in a cariogenic suspension medium, which was replaced every 48 h.

Kohda et al. stated in their study that the reason why self-etch primer application shows statistically significantly less demineralization than phosphoric acid does could be a result of the higher pH level of self-etch primers and shorter application time in vitro [29]. Narendran and Raghunath reported that the conventional total-etch (Transbond XT) group causes a significantly more irregular structure on the enamel surface and found a deeper penetration of 86.7% compared to that of the self-etch (Transbond Plus) group in their study where they compared the demineralization around orthodontic brackets in vitro. In addition, they stated that the Transbond Plus group underwent less demineralization than the Transbond XT group did [30]. Ghandi et al. performed bracket bonding with a self-etch adhesive system (Transbond Plus) and a conventional total-etch adhesive system (Transbond XT). By decalcifying the bracketed teeth, the resin replicas remaining at the base of the brackets were examined under a scanning electron microscope for micromorphological observation of adhesive penetration in the enamel in vitro. They stated that there was significantly less enamel demineralization and resin infiltration in the self-etch group, and that self-etch adhesive systems were more conservative than conventional total-etch adhesive systems [31]. In our study, lower demineralization values were found in the group in which the self-etch primer was used, and statistically significantly less demineralization was observed on the occlusal surface of the enamel adjacent to the bracket in the same group. This result can be explained by the fact that self-etch primers caused more superficial changes on the enamel surface and had a higher pH level.

Hung et al. found significantly high fluoride release in the teeth they bonded with Transbond Plus SEP and Transbond Plus adhesive, especially in the first 14 days in their in vitro study [32]. Zrinski et al. also supported this finding in vitro and stated that Transbond Plus SEP can release fluorine, but its capacity to store fluorine again is inadequate [33]. Krasniqi et al. compared the antimicrobial effects of different types of adhesive agents on *Streptococcus mutans* and *Lactobacillus acidophilus* bacteria; they found that Transbond Plus SEP was the agent with the largest inhibition area (antibacterial effect) against *Streptococcus mutans* and *Lactobacillus acidophilus* among all groups. In the same in vitro study, they found that the Transbond XT primer and adhesive did not show an antibacterial effect. They thought that this result was related to fluorine release [34].

In this study, statistically significantly less demineralization observed in Group 3 on the occlusal surface adjacent to the bracket and less demineralization in Group 3 on all surfaces adjacent to the bracket is supported by studies indicating that the self-etch adhesive system causes less demineralization [14,27,28]. In this situation, it was thought that the use of a self-etch adhesive system caused a more superficial change in the enamel. Additionally, it may result in less irregular surfaces to which bacteria can adhere, and these outcomes were influenced by fluorine's antibacterial properties and its capacity to release fluorine in Transbond SEP [14,32–34].

Turğut clinically evaluated the white spot lesion formation and bond failure of the self-priming total-etch adhesive system for bonding orthodontic metal brackets in vivo [35]. In that study, 51 patients were bonded with a split-mouth study protocol using a self-priming total-etch adhesive system (GC Ortho Connect) and a conventional total-ecth adhesive system (Transbond XT). As a result of the study, it was stated that there was no significantly difference between the GC Ortho Connect and Transbond XT groups in terms of demineralization formation and bond failure [35]. In our study, enamel demineralization on the gingival, occlusal and proximal enamel surfaces adjacent to the bracket measured at T0, T1 and T0/T1 periods did not show a statistically significant difference between Group

1 and Group 2. However, a statistically significant difference was observed in the occlusal surface of Group 3; based on these findings, the null hypothesis was rejected.

Regarding the limitations of the study, in addition to the composite materials to which bacteria can easily adhere, the patient's diet may also be effective in the demineralization of the hard tissues of the teeth. However, using an artificial cariogenic suspension environment simulated an intact surface layer and a subsurface lesion pattern [36,37]. Considering the inadequacies of the artificial cariogenic suspension environment created in the in vitro environment to fully simulate the oral flora, it is thought that further studies planned under in vivo conditions are needed.

5. Conclusions

1. Significant increases in demineralization occurred on all enamel surfaces adjacent to the bracket 28 days after placement in an artificial cariogenic suspension in all groups.
2. There was no statistically significant difference between Group 1 and Group 2 in the demineralization values of enamel surfaces adjacent to the bracket after 28 days.
3. The null hypothesis was rejected. Demineralization values on the occlusal surfaces of the brackets bonded using a Transbond™ Plus Self Etching Primer adhesive agent were found to be significantly lower than those with other adhesive agents. Since the use of a self-etch primer does not require etching on the enamel surface, it can be assumed that the result was less enamel surface changes. It is possible that self-etching teeth had enamel surfaces that were more resistant to plaque formation. The use of a self-etch primer may have made remineralization more effective. The use of a self-etch primer in bracketing may cause less demineralization on the occlusal surfaces of the teeth in cariogenic attacks.

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