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Effects of 6 self-etching primers on shear bond strength of orthodontic brackets

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Introduction: This study was conducted to compare the effects of 6 self-etching primers (SEPs) on the shear bond strength (SBS) of orthodontic brackets bonded with the same orthodontic composite resin.

Methods: One hundred forty extracted premolars were randomly divided into 7 groups (20 per group). In group I (control), the enamel was etched with 37% phosphoric acid. In the other groups, it was conditioned with SEPs according to each manufacturer's instructions: group II, Transbond Plus SEP (3M Unitek, Monrovia, Calif); group III, AdheSE (Ivoclar Vivadent AG, Schaan, Liechtenstein); group IV, Primers A and B (Shofu, Kyoto, Japan); group V, Clearfil Mega Bond FA (Kuraray Medical, Tokyo, Japan); group VI, Peak SE and Peak LC Bond (Ultradent Products, South Jordan, Utah); and group VII, Bond Force (Tokuyama, Osaka, Japan). All brackets were bonded with Transbond XT (3M Unitek), and the teeth were then stored (37°C, 24 hours), tested, and statistically analyzed (Scheffé, ANOVA [$P < 0.05$], and Weibull analyses). The adhesive remnant index (ARI) was also recorded.

Results: Group I (26.5 ± 8.1 MPa) had a significantly higher SBS value than the other groups except group II (21.1 ± 6.2 MPa). There were no significant differences among groups II, V (19.0 ± 4.3 MPa), VI (19.6 ± 5.1 MPa), and VII (18.3 ± 4.4 MPa). The values for groups I, II, and VI were significantly higher than for group III (13.4 ± 4.1 MPa), and the value for group IV (8.8 ± 2.6 MPa) was significantly lower than the values for groups I, II, V, VI, and VII. Significant differences were found in the ARI scores.

Conclusions: The SBS values of all groups might be clinically acceptable, and orthodontic brackets can be successfully bonded with Transbond XT after enamel conditioning with any of these SEPs. However, since the SEPs used in groups III and IV significantly affected the bond strength negatively, further studies are warranted to evaluate their effectiveness.

The full text of this article can be found at: www.ajodo.org.

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EDITOR'S SUMMARY

Theodore Eliades

Orthodontists' desire for the most efficient bonding technique has given rise to various advances, including self-etching primers (SEPs). Derived from operative dentistry, SEPs eliminate 1 step in orthodontic bonding because they involve concurrent application of etchant and primer. The actual time-saving feature of this method has been disputed, because it is a technique-sensitive approach and does not tolerate a nonpumiced enamel surface; however, the potential for an overall limited invasive character, because of the reduced penetration depth of the enamel, might be a favorable effect. The authors of this study evaluated the bond strength of a light-cured adhesive used with 6 SEPs and a control material. Bond strength and adhesive remnant index (ARI) values were then evaluated to identify the best combination and most favorable pair.

Overall, the control material and the SEP from the adhesive manufacturer had higher bond strengths than the other 5 SEPs, which showed various rankings and values in the order of 19 MPa, with 1 as low as 8 MPa. However, the authors hypothesized that even the lowest bond strength value might be clinically acceptable, based on a proposal that has not been validated in the literature. The ARI scores of the SEPs demonstrated few adhesive remnants on enamel (<25%); this might presumably facilitate easier debonding.

Take-home points

1. Some combinations of SEPs and light-cured adhesive might have lower bond strength than others; in choosing a SEP, the clinician must consider its potential compatibility with adhesives from various manufacturers.
2. SEPs might result in less adhesive remaining on the enamel.

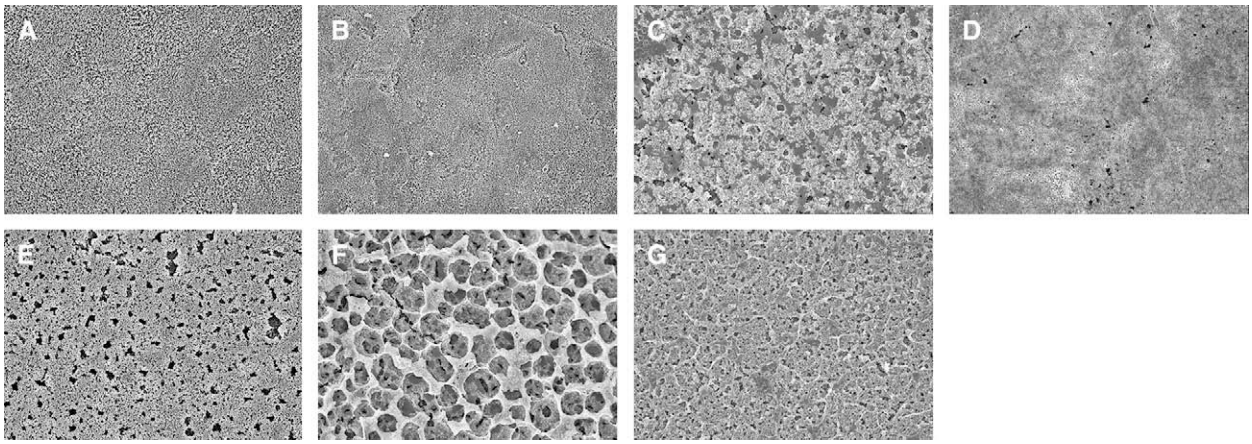

Fig 2. Representative SEM images of enamel surface morphology after conditioning: **A,** etched with 37% phosphoric acid for 15 seconds (group I). Conditioned with SEPs: **B,** Transbond Plus SEP for 5 seconds (group II); **C,** AdheSE, primer applied for 30 seconds and bond component light-cured for 10 seconds (group III); **D,** Primers A and B for 3 seconds (group IV); **E,** Clearfil Mega Bond FA, primer applied for 20 seconds, and bond component light-cured for 10 seconds (group V); **F,** Peak SE Primer applied for 20 seconds and Peak LC Bond Resin rubbed for 10 seconds and light-cured for 10 seconds (group VI); **G,** Bond Force, applied for 20 seconds and light-cured for 10 seconds (group VI). Original magnification 3000 times.

Q & A

Eliades: Your study confirmed previous evidence suggesting that there might be some compatibility of adhesives with SEPs from various manufacturers. To what would you assign this phenomenon?

Scougall-Vilchis: The adhesion mechanism between the enamel surface and a composite resin is basically derived from the microretention produced by the enamel conditioner and the chemical reactions of primers and bonds. The bonding procedure in orthodontics is influenced by several factors, including the effect of enamel conditioners; nevertheless, etchants, primers, and bonding agents can be generally combined with any resin-based material (although there is great diversity of filler content, level, size, and shapes). Our previous research showed that Transbond Plus SEP did not significantly influence the bond strength of stainless steel brackets; however, this conditioner was unavailable in Japan temporarily, and we decided to evaluate the bond strength of Transbond XT combined with other SEPs because the greater advantages of these conditioners are evident.

Eliades: Please comment on the "clinically acceptable" value reported in the literature. How was this derived, under what conditions (in vitro or clinically) and can it stand 30 years after its introduction, considering the new materials and knowledge on aging of materials in vivo?

Scougall-Vilchis: It was reported in the literature that 6 to 8 MPa is the necessary force to accomplish orthodontic tooth movement. However, the difference between in-vitro and in-vivo bond strengths has also been reported, and the bonding of orthodontic brackets is easily affected by numerous factors. Therefore, readers should interpret the results of these studies cautiously, paying particular attention to the materials and methods. Despite advances in orthodontics materials, there is not yet an ideal adhesive system, and we continue to look for the best combination of products and methods, because even recently developed and improved materials have some contraindications. For example, an adhesive that produces lower bond strength with stainless steel brackets could be suitable for bonding ceramic brackets; nevertheless, adhesives with higher bond strengths should be avoided with ceramic brackets. Fluoride-releasing adhesives might be helpful in preventing white spot lesions but contraindicated in patients with fluorosis or those exposed to high concentrations of fluoride. After all, the bonding of brackets is still routine in daily orthodontic practice, and better understanding of the mechanisms and materials is essential in our specialty.