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Original article

The effect of light curing and self-etching primer after saliva contamination on shear bond strength of orthodontic brackets: An in vitro experimental study

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ABSTRACT

Aim: The aim of this study was to evaluate the effect of saliva contamination and curing and reusing self-etching primer (SEP) on shear bond strength of orthodontic brackets.
Methods: Eighty sound extracted human premolars were collected and divided equally into 8 groups of 10 teeth in. Orthodontic metal brackets were bonded with self-etching primer adhesive under the following enamel surface conditions: (1) (control): SEP/XT(bonding)/Light Curing(LC), (2) SEP/LC/XT/LC (3) SEP/saliva/XT/LC, (4) SEP/saliva/LC/XT/LC, (5) SEP/saliva/SEP/XT/LC, (6) SEP/saliva/SEP/LC/XT/LC, (7) SEP/saliva/LC/SEP/XT/LC, (8) SEP/saliva/LC/SEP/LC/XT/LC. Samples were stored for 24h in distilled water at 37°C, then thermocycled for 1000 times (5–55°C). Shear bond strength of each sample was examined with a universal testing machine. The load was recorded at bond failure. Data were analyzed statistically.
Results: Clinically acceptable bond strength was found for all groups. There were significant differences between groups 1 and 4, also groups 3 and 4.
Conclusions: Saliva contamination has no significant effect on the shear bond strength of SEP. Light curing of SEP increased the bond strength. SEP has more value than the conventional primer in reaching to good bond strength results so that it may diminish the bad effect of saliva contamination on shear bond strength.

1. Introduction

The first step in fixed orthodontic treatment is placement of attachments on the teeth surfaces, so orthodontists can apply the forces to the teeth and move them. Introduction of bonding technique in orthodontics was a great jump facilitated this important step of treatment [1]. Bonding the brackets directly on the buccal aspect of the teeth has great advantages over banding them such as time saving, improvement of esthetic,

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reducing the risk of teeth decalcification and periodontal problems [2,3]. Nowadays, bonding materials and techniques have been improved and the story is going on [4].

The conventional technique for orthodontic bracket bonding requires multiple clinical steps (such as prophylaxis, surface etching, primer application, adhesive application at bracket base, complete isolation from blood and saliva during procedure) [5].

It seems difficult to maintain ideal isolation during clinical steps of orthodontic bracket bonding. In the oral cavity, there is always a great risk for contamination of conditioned tooth surface, which has adverse effects on bracket bond strength. It has been reported that saliva is the most frequently encountered contamination in clinic [6,7]. Previous studies have shown a significant reduction in bond strength value of brackets after saliva contamination, bonded with conventional techniques [8]. After saliva contamination, a biofilm forms over the etched enamel causes reduction in surface energy. Thus, penetration of resin in enamel surface porosity impairs and insufficient resin tags with respect to length and number causes inadequate micromechanical retention [9]. Failure of orthodontic bracket bonding can cause considerable increase in treatment period and decreased quality of treatment [10].

One approach to overcome this problem is simplifying clinical bonding procedure, so decreasing technique sensitivity of bonding materials. New materials have been introduced and improved over years as self-etching primers (SEPs) [11]. These materials combine the etching and priming steps as a single procedure and therefore reduce the risk of surface contamination. Generally, active agent of self-etching primers is methacrylated phosphoric acid ester, one two-purpose acidic functional molecule can etches and primes simultaneously [12]. Additionally, other advantages of SEPs include: time saving, fewer clinical steps leading to fewer procedural errors, reduction of enamel loss because of decreased depth of etching [13]. It has been reported that SEPs can be used in either dry or wet environments with minimal effect on bond strength, in contrast to conventional bonding systems. To the best of our knowledge, there are few studies which evaluated the effect of light curing and application of SEPs once more after moisture contamination on shear bond strength of orthodontic brackets [14–16]. Moreover, there are controversial results about shear bond strength of SEPs in different clinical conditions obtained from different studies [17,18]. So the aim of present study was to evaluate the effect of light curing and application of SEPs once more on shear bond strength of brackets bonded with SEPs after saliva contamination. The null hypothesis of research was that there is no significant difference in shear bond strength values among groups.

2. Materials and methods

A total of 80 sound human premolars extracted for orthodontic purposes over the past six months were collected. In the conduction of the study, the principles outlined in the declaration of Helsinki on experimentation involving human subjects (October 2000) were adhered to. The study was approved by the local Research Ethics Committee (approved number: 21008). The inclusion criteria for teeth selected were: no caries, no restoration, no crack, and absence of congenital anomalies. The teeth were cleansed of soft tissue and calculus using hand scalers and surgical scalpel blade No. 12. Then, they were placed in 0.5% chloramine for one week in order to disinfection. After disinfection, the teeth were stored in distilled water which was exchanged periodically.

Each species was embedded in self-cure and fast-setting acrylic (Acropars, Marlic Co. Tehran, Iran) up to 2 mm below CEJ and mounted in cubic metal frames (1.5 × 1.5 × 4.5 cm) and placed in water in order to control temperature of species during acrylic polymerization. The labial contour of the teeth were in contact with surveyor blade and tooth long axis was perpendicular to horizontal plane. Later, the surface of teeth were cleaned with low-speed prophylactic brushes (Perfection Plus Ltd, UK) for 10 s. Finally, the teeth were randomly assigned into 8 groups, each of whom consisted of 10 teeth.

Group 1: priming the surfaces with SEP/drying with air spray (5 s)/bonding of brackets by composite.

Group 2: priming the surfaces with SEP as group 1/drying with air spray (5 s)/light curing (10 s)/bonding of brackets by composite as group 1.

Group 3: priming the surfaces with SEP as group 1/saliva contamination/drying with air spray (5 s)/bonding of brackets by composite as group 1.

Group 4: priming the surfaces with SEP as group 1/saliva contamination/drying with air spray (5 s)/light curing (10 s)/bonding of brackets by composite as group 1.

Group 5: priming the surfaces with SEP as group 1/saliva contamination/drying with air spray (5 s)/application of SEP once more/bonding of brackets by composite as group 1.

Group 6: priming the surfaces with SEP as group 1/saliva contamination/drying with air spray (5 s)/application of SEP once more/light curing (10 s)/bonding of brackets by composite as group 1.

Group 7: priming the surfaces with SEP as group 1/saliva contamination/drying with air spray (5 s)/light curing (10 s)/application of SEP once more/bonding of brackets by composite as group 1.

Group 8: priming the surfaces with SEP as group 1/saliva contamination/drying with air spray (5 s)/light curing (10 s)/application of SEP once more/light curing (10 s)/bonding of brackets by composite as group 1.

Standard bonding procedure was performed on dried buccal enamel surface and brackets were placed on the center of buccal tooth surface. Transbond plus self-etching primer (TPSEP, 3M Unitek, Monrovia, USA) was applied on the buccal surface of teeth for 3 s. After that, the gentle dry air spray was used for 5 s. Stainless steel premolar brackets with 0.018 in. slot (American Orthodontic, Sheboygon, USA) were used in this study. The mean area of each bracket base was 10.5 mm^2. After application of Transbond XT composite (3M Unitek, Monrovia, USA) on the base of brackets, they were positioned on the center of buccal surface and compressive force of 300 gr, measured by a gage (Dentaurum, Ispringen, Germany) was applied for bracket adaptation to tooth surface. The visible light with intensity of 500 mw/cm produced by LED (Coltolux LED; Coltene/Whaledent Inc., OH, USA) for 40 s was used to cure the composite from mesial and distal surface. For each group, light intensity was checked using a radiometer

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