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Original research

Effects of application mode of self-etching primer on shear bond strength of orthodontic brackets

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ABSTRACT

Objectives: To compare the effects of application mode of one self-etching adhesive on the shear bond strength of metallic orthodontic brackets.
Methods: Seventy-five healthy bovine incisors were divided into 5 groups ($n = 15$). The self-etching primer (Transbond Plus, 3M Unitek) was applied on the enamel actively and passive for 0 (control), 5 and 10 s, followed by air jet application and light cured for 10 s (600 mW/cm^2). The metal brackets were bonded with adhesive (Transbond XT) and light cured for 20 s each proximal surface (mesial and distal). The shear bond strength was determined after water storage at 37 °C for 24 h. The specimens were tested using a universal testing machine (Instron 3342). Once debonded, each specimen was examined to identify the failure mode. The bond strength data were subjected to One-way Anova and Tukey tests ($\alpha = 0.05$) and failure mode data were analyzed by Kruskal–Wallis test ($\alpha = 0.05$).
Results: No significant difference in bond strength was found between 5 groups. Increasing the application time and applying agitation of self-etching primers did not affect the shear bond strength ($p = 0.487$). There were no differences between failure mode values in all tested groups ($p = 0.88$) and score 1 was predominant.
Conclusions: The shear bond strength of the self-etching adhesive is not influenced by the application mode.

Efeitos do modo de aplicação de primer auto-condicionante na resistência ao cisalhamento de *brackets* ortodônticos

Palavras-chave:
Brackets ortodônticos
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RESUMO

Objetivos: Comparar os efeitos do modo de aplicação de um adesivo autocondicionante, na resistência ao cisalhamento de brackets metálicos em esmalte bovino.
Métodos: Setenta e cinco dentes bovinos hígidos foram divididos em 5 grupos (n = 15). O sistema adesivo autocondicionante (Transbond Plus, 3M Unitek) foi aplicado no esmalte

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de forma ativa e passiva por 0 (controle), 5 e 10 segundos, seguido de aplicação de jato de ar e fotoativação por 10 s (600 mW/cm^2). Os brackets metálicos foram colados com resina fotopolimerizavel (Transbond XT, 3M Unitek) e fotoativado por 20 s em cada face proximal (mesial e distal). A resistência ao cisalhamento foi determinada após armazenamento em água a 37 °C por 24 horas. Os espécimes foram testados usando uma máquina de ensaio universal (Instron 3342). Uma vez descolados, cada espécime foi examinado para identificar o modo de fratura. Os dados da resistência ao cisalhamento foram submetidos aos testes One-way Anova e Tukey (α=0,05), enquanto que o modo de fratura foi examinado com o teste de Kruskal–Wallis (α=0,05).

Resultados: Não foram encontradas diferenças de resistência de união significantes entre os 5 grupos. O aumento do tempo de aplicação e agitação do primer auto-condicionante não afetou a resistência ao cisalhamento ($p = 0,487$). Não foi observado diferença do modo de fratura nos grupos testados ($p = 0,88$), o score 1 foi predominante em todos os grupos.

Conclusões: A resistência ao cisalhamento do adesivo auto-condicionante não é influenciada pelo modo de aplicação.

Introduction

The adhesive systems used for orthodontic bracket bonding may be presented in different forms. The etch-and-rinse adhesive are those in which phosphoric acid is used to etch the substrate surface, and with the self-etching types acidic primers are used to demineralize the enamel.[1–3] Orthodontic bracket bonding performed with adhesive systems with the use of phosphoric acid show high shear bond strength values. However, the innumerable clinical steps involve may prolong the time when the orthodontic appliance is being assembled, and cause iatrogenic damage to the enamel.[4–7] Etching with phosphoric acid may demineralize approximately 10–30 μm of enamel.[8] Moreover, phosphoric acid may cause a reduction in the mechanical properties of the etched enamel, due to demineralization and thus lead to fracture of this substrate.[9]

The use of self-etching adhesive systems has the advantage of reducing the number of steps and minimizing risk of eventual errors occurring during the adhesive technique.[10–12] These adhesive systems generally contain methacrylated phosphoric acid esters (derived from phosphoric acid) that demineralize the tooth surface by the removal of calcium ions.[13]

The SEP (self-etching) used in orthodontics have the advantage of simultaneously demineralizing and infiltrating into the tooth surface, and this mechanism is only possible due to the low pH of this material ($pH < 1$)[14] In addition to pH, there are innumerable other factors that may potentially contribute to the bond strength between enamel and the orthodontic bracket, including the type of enamel, adhesive composition, bracket base design, bracket material, oral medium, clinician's skills, acid concentration, and duration of etching time.[15–17]

The use of SEP is efficient in bracket bonding, but the bond strength results and clinical behavior are still below the standard obtained with etch-and-rinse adhesives. However, their behavior may change according to the application mode of these adhesive systems to enamel. Little is known about the application time and mode of application of these adhesive systems, or a combination of these factors on the bond strength of orthodontic brackets.

Therefore, the aim of this study was to evaluate the shear bond strength of a self-etching system applied in different modes (active and passive) and times (0, 5 and 10 s). The null hypothesis was that the application mode could not interfere in the shear bond strength of self-adhesive.

Material and methods

A total of 75 healthy bovine incisors were selected. The teeth were embedded in PVC tubes with acrylic resin, so that only the coronal portion remained visible. After this, the vestibular surfaces were treated with pumice stone and a rubber cup for 10 s, then washed and dried. The teeth were divided into 5 groups ($n = 15$) according to time and application mode of the adhesive system Transbond Plus Self Etching Primer (3M/Unitek, Monrovia, CA, USA) (Table 1). Light activation of adhesive system was performed with an Optilux 501 for 10 s (600 mW/cm^2, Kerr, Orange, CA, USA):

- Group SEP0 (control): The adhesive was applied only on the surface, a light jet of air was applied for 1–2 s, and then light activated;
- Group SEPNR5 (no rubbing): The adhesive was applied on the surface, waiting for 5 s, a light jet of air applied for 1–2 s, and then light activated;
- Group SEPR5 (active): The adhesive was applied on the surface with agitation for 5 s, a light jet of air applied for 1–2 s, and then light activated;
- Group SEPNR10 (no rubbing): In this group, the adhesive was applied on the surface, waiting for 10 s, a light jet of air applied for 1–2 s, and then light activated;
- Group SEPR10 (active): The adhesive was applied on the surface with agitation for 10 s, a light jet of air applied for 1–2 s and then light activated.